

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

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

CELRH-EC-WM

20 January 2004  
Schray/5604

3/16/04  
elle

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



DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
502 EIGHTH STREET  
HUNTINGTON, WEST VIRGINIA 25701-2070

REPLY TO  
ATTENTION OF:

CELRH-EC-W (1110-2-1403a)

21 April 2004

MEMORANDUM FOR Commander, Great Lakes and Ohio River Division,  
ATTN: CELRD-MT-E

SUBJECT: Water Control Manual for Mohawk Dam

1. Enclosed herewith are two copies of the subject manual for your retention. There are no changes to the water control plan operating procedure. Changes include changing from the 11 chapter format to the 9 chapter format according to ER 1110-2-8156, modifying the Damtender Section to reflect changes in the reporting procedures and updated water quality information.
2. If you have any questions, please contract Mr. Charles Brown at [REDACTED]

Encl

A handwritten signature in black ink that reads "John J. Jaeger".

JOHN J. JAEGER, Ph.D., P.E.

Chief, Engineering & Construction Division

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

**MOHAWK DAM  
WALHONDING RIVER BASIN  
OHIO**

PROJECT MANUAL  
FOR WATER CONTROL MANAGEMENT  
MOHAWK DAM - WALHONDING RIVER

PREPARED BY  
CORPS OF ENGINEERS  
HUNTINGTON DISTRICT  
WATER RESOURCES ENGINEERING BRANCH

APRIL 2004



**MOHAWK DAM**

MUSKINGUM RIVER  
MOHAWK DAM  
DAM AND SPILLWAY  
PLAN AND SECTIONS  
HUNTINGTON DISTRICT, HUNTINGTON, W. VA.  
Revised: 30 SEPTEMBER 1988

## 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  
Muskingum Area Office,  
Dover, Ohio  
[REDACTED], Area Manager

Normal Work Hours, [REDACTED]  
Night, weekend, Holiday, NWS observers [REDACTED]  
[REDACTED] -Home [REDACTED]

**KEY EMERGENCY CONTACTS**

**Huntington District Office, Water Resources Engineering Branch**  
Normal Work Hours, Nights, [REDACTED]  
Weekends, and Holidays [REDACTED]

<u>DISTRICT PERSONNEL</u>	<u>Office</u>	<u>Telephone</u>	<u>Residence</u>
<b>Water Resources Engineering Branch</b>			
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
Chief, Water Management Section	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
Chief, Hydrology and Hydraulic Section	[REDACTED]	[REDACTED]	[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 [REDACTED]  
[REDACTED] [REDACTED]

National Weather Service  
Cleveland, Ohio [REDACTED]

U.S.ARMY, CORPS OF ENGINEERS  
HUNTINGTON DISTRICT

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BY  
WATER RESOURCES ENGINEERING BRANCH

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

**Daily** --- Computer report 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 forecast at Ohio River tributary gage points.

**Weekly** -- Reservoir effects at Ohio River tributary gage points.

**Monthly** - Record 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 map 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.  
Snow-melt runoff and flood potential letter report to OCE.

Narrative summaries of major drought or lowflow conditions likely to call for regulations 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.

**PERTINENT DATA**

**MOHAWK DAM  
MUSKINGUM RIVER LAKES, OHIO**

**LOCATION OF DAM:** In Coshocton County, Ohio. On Walhonding River, a tributary of the Muskingum River: 129.8 miles above the mouth of the Muskingum.

**PURPOSES SERVED:** Flood control.

**DAM:** Type - Rolled earth, gravel and rock fill with impervious core.

Maximum height, feet	118.5
Crest length, feet	2,330
Crest width, feet	35
Base width, feet	780

**SPILLWAY:** Type - Uncontrolled saddle spillway beyond left (east) abutment.

Crest length, feet	620
Crest elevation, feet above msl	890
Design discharge, cubic feet per second	151,000
Surcharge, feet	18

**OUTLET WORKS:**

Type - Intake structure, tunnel and stilling basin

**INTAKE STRUCTURE:** - Reinforced concrete with two horseshoe tunnels and control gates

Number of control gates	6
Size of control gates, feet	8x17
Invert elevation of control gates, msl	799.2
Maximum outlet discharge, cfs	43,200
at spillway elevation - all gates open	

**TUNNEL:**

Type - Horseshoe, concrete lined	
Number of tunnels	2
Size - Diameter, feet	20
Length, east tunnel, feet	361
west tunnel, feet	198.5

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

MUSKINGUM RIVER BASIN  
OHIO  
PROJECT MANUAL  
FOR  
WATER CONTROL MANAGEMENT  
MOHAWK DAM-WALHONDING RIVER

SECTION I - INTRODUCTION

1-01. AUTHORIZATION

This manual is prepared in accordance with Engineer Regulation 1110-2-8156, Preparation of Water Control Manuals, dated 31 August 1995; Engineer Regulation 1110-2-240, Water Control Management, dated 30 April 1982; Engineer Manual 1110-2-3600, Management of Water Control Systems, dated 30 November 1987; and ETL 1110-2-251, dated 14 March 1980, 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 water control management of Mohawk Dam, on the Walhonding River in the Muskingum River Basin. The manual will function as documentation of the plan for water control and as a reference source for higher authority and office and field personnel responsible for water control management throughout the life of the project. The manual also 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 Mohawk Dam or the Muskingum River projects have been previously completed.

<u>TITLE</u>	<u>DATE</u>
1. Report on main river (Navigation) near mouth .....	1879
2. Report on main river (Navigation) .....	1884
3. Report on main river (Navigation) .....	1886
4. Report on main river Zanesville to Dresden (Navigation) .....	1889
5. Report on main river Zanesville to Dresden (Navigation).....	1895

	<u>TITLE</u>	<u>DATE</u>
6.	Report on main river from Zanesville to Coshocton (Navigation).....	1902
7.	Report on main river in vicinity of the mouth (Navigation)....	1905
8.	Report on main river and all tributaries (flood control).....	1916
9.	Report on Mohican River and tributaries (flood control).....	1931
10.	Comprehensive report on reservoirs in Mississippi River Basin.....	August 1935
11.	Ohio River 308 Report.....	August 1935
12.	Major Dams and Hydro-Projects in the Huntington, West Virginia and Zanesville, Ohio Engineer Districts.....	November 1937
12.	Comprehensive flood control plan for Ohio and lower Mississippi Rivers	
13.	Official Plan for the Muskingum.....	October 1934
	Watershed Conservancy District,.....	Amended April 1935
	Volumes I and II.....	Revised June 1935
14.	Muskingum River 308 Report.....	December 1934 Revised Jan. 1942
16.	Analysis of Design - Mohawk Dam.....	Revised 1938
17.	Analysis of Design - Mohawk Dam - Addenda.....	1938
18.	History and Development of the.....	March 1938
	Muskingum Watershed Conservancy.....	Revised March 1939
	District Project.....	Revised July 1952
19.	Analysis of Hydrologic Data for Index Areas - Muskingum River Basin, Ohio.....	April 1942
20.	Flood Control Operation - Flood of December 1942-January 1943 - Muskingum River Reservoirs, Ohio.....	February 1943
21.	Channel Capacity Investigation Muskingum River, Ohio.....	May 1944
22.	An Experience History of the Muskingum River Reservoir System.....	October 1951

<u>TITLE</u>	<u>DATE</u>
23. Instructions to Damtender, Mohawk Dam.....	November 1953
24. Water Inventory of the Muskingum River Basin and Adjacent Ohio River Tributary Area.....	1968
25. Muskingum Area, Emergency Operation Plan.....	March 1970
26. Periodic Inspection, Mohawk Dam	
Report No. 1.....	April 1970
Report No. 2.....	August 1975
Report No. 3.....	August 1980
Report No. 4.....	May 1985
Report No. 5.....	August 1990
Report No. 6.....	August 1995
Report No. 7.....	August 2000
27. Post-Flood Report, Muskingum River Basin, Ohio - Flood of July 1969.....	April 1970
28. Muskingum River Basin, Ohio - Basin Report.....	September 1973
29. Muskingum River Dams, Spillway Adequacy Study.....	April 1975
30. Muskingum River Basin, Ohio - Interim.....	November 1975
Feasibility Report for Water.....	Revised March 1976
Resources Development.....	Revised Feb. 1977
31. Muskingum River Reservoirs General.....	October 1976
Plan of Reservoir Regulation.....	Revised Oct. 1984
32. A Valley Renewed - The History of The Muskingum Watershed Conservancy District.....	1976
33. Operations and Maintenance Manual - Mohawk Dam.....	November 1977
34. Southeast Ohio Water Plan.....	September 1978
34. Dam Safety Training Program Manual, Mohawk Dam.....	April 1983

1-04. PROJECT OWNER

The Muskingum Watershed Conservancy District originally had full title, ownership, and fee control of all Muskingum Reservoirs lands, including Mohawk Dam. The United States Government reimbursed the Muskingum Water Conservancy District for most of the surrounding land and now owns the dam and operating structures.

1-05. OPERATING AGENCY AND RESPONSIBILITIES

The Huntington District, Operations and Readiness Division is responsible for the operation of Mohawk Dam.

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

The mailing address is:  
Mohawk Dam  
36007 State Route 715  
Warsaw, Ohio 43844

Telephone:  
[REDACTED]  
Office Number [REDACTED]

1-06. REGULATING AGENCY

Mohawk Dam is staffed, attended, and operated continuously by the Huntington District, Corps of Engineers.

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 District projects, technical evaluations of performance of these projects, and developing plans and manuals for the reservoir systems within the District, such as the Mohawk Dam Project. The locations of the reservoirs within the District are 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.

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, 24 April 1970, Subject: Reservoir Control Centers.

(3) ER 1110-2-240, DAEN-CWE-Y, 8 October 1982, Subject: Reservoir Control Centers.

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

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

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

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

## SECTION II - DESCRIPTION OF PROJECT

### 2-01. LOCATION

Mohawk Dam is located in Coshocton County, Ohio, on the Walhonding River, a tributary of the Muskingum River. The dam is located at Nellie, Ohio, 6.1 miles below the forks of the Walhonding River; 17.4 miles above the junction of the Walhonding and Tuscarawas Rivers at Coshocton, and approximately 129.8 miles above the mouth of the Muskingum River. The nearest village is Nellie, Ohio, which is shown with the general location of the dam on **Plate No. 2-1**.

### 2-02. PROJECT PURPOSES

The Mohawk Dam project was authorized basically for flood control and certain allied purposes in a comprehensive plan for the Walhonding, Muskingum, and Ohio River Basins. The principal flood control benefits of Mohawk Dam are general benefits to agricultural areas and urban communities downstream along the Walhonding, Muskingum and Ohio Rivers through the coordinated operation of Mohawk Dam and the other Muskingum Basin reservoirs. Along the Ohio River, much industrial development is outside the flood walls and levees. The Muskingum System provides protection for this flood prone development from floods of all stages.

### 2-03. PHYSICAL COMPONENTS

a. Embankment. The embankment is a rolled earthfill structure with a central core flanked by pervious zones and outer rockfill shells. The embankment has a maximum structural height of 111 feet, a crest length of 2300 feet, and a crest width of 35 feet. It is founded on sand and gravel. Relief wells and a filter blanket were installed at the downstream toe from 1975 to 1981 to control seepage. **Plate No. 2-2** shows an overview photograph of the dam and outlet works, and **Plate No. 2-3** shows a plan view and typical sections of the dam and outlet works. **Plate Nos. 2-4** thru **2-10** shows embankment details.

The original design of Mohawk Dam was developed in 1934 using the accepted criteria of that day. By 1984, a new more comprehensive, design code had been developed for the Corps of Engineers. Accordingly, Mohawk Dam was reviewed on an after the fact basis, under the Spillway Adequacy Program, for possible earlier design and safety deficiencies. In order to comply with certain deficiencies, revealed by the new hydraulic design code, a 4.5 foot earth addition was made to the crest of the dam. And a pre-cast 3.0 foot concrete parapet wall was placed on top of the new crest of the dam, effectively raising the top of dam to elevation 917.5 feet NGVD, all during 1988.

b. Spillway. The spillway is an uncontrolled saddle located beyond the left (east) abutment. The spillway is an open cut trapezoidal section with a curved concrete weir at the crest. The spillway crest length was 640 feet at elevation 890.0 feet (NGVD). As a part of the dam safety and spillway adequacy program of 1988 the emergency spillway was widened from 640 feet to 657 feet. This removed weathered material from the sides of the crest in an effort to anchor the new concrete side-walls to stable rock. This required the installation of two additional monoliths (M-1 and M-24) to the curved concrete weir that protects the spillway crest in the event of spillway flow. All work associated with the construction of Mohawk Dam was

completed in 1988.

A plan view, profile and sections of the spillway are shown on **Plate No. 2-11** and structural details of the weir are given on **Plate No. 2-12**, plate section. The enlarged spillway is shown in **Plate No. 2-13**. The modifications to the weir are shown in **Plate No. 2-14**.

c. Outlet Works. The outlet works consist of an approach channel, intake tower, horseshoe tunnels, stilling basin and outlet channel. The intake structure consists of a reinforced concrete substructure and a brick and stone superstructure to house the gate operating machinery for the six 8'x17' sluiceway gates and the auxiliary power unit. Access to the structure is by a service bridge extending from the left abutment. Details of the structure are given on **Plate Nos. 2-15** through **2-18**.

The tunnels consist of two 20-foot-diameter concrete-lined horseshoe tunnels which extend through the left abutment from a transition section near the gates to the stilling basin. A profile, sections, and extra details of the tunnel are on **Plate Nos. 2-19** to **2-22**.

The stilling basin is a shallow pool confined between concrete side walls. Below the tunnels, the channels are flared to reduce the depth of flow at the entrance of the stilling basin. The embankment side is protected by a gravity section retaining wall and the abutment side by a slab poured against and anchored to the rock face. The bottom is paved with a concrete slab anchored into the rock. Two rows of baffle piers and an end sill were constructed into the bottom slab to aid in energy dissipation. The outlet channel extends from the stilling basin approximately 2,400 feet downstream to the Walhonding River. Stilling basin details are given on **Plate Nos. 2-23** and **2-24** and outlet channel details are shown on **Plate No. 2-25**.

d. Operating Machinery.

(1) Slide Gates. The six standard caterpillar-type gates are appropriately sized for the 8'x17' sluiceways. Each gate is raised or lowered by means of an electrically driven mechanical hoist mounted at the operating floor level in the gate house. Each gate is also equipped for manual operation. One emergency caterpillar-type gate is provided to be inserted in front of any outlet gate. It is placed into position by an electric crane in the operating house. A floor plan of the operating house and a section of the intake structure appear on **Plate No. 2-16**.

(2) Auxiliary Power Unit. The standby power unit consists of a 39 KVA alternating current generator driven by a six-cylinder gasoline engine. The generator is electrically started.

## 2-04. RELATED CONTROL FACILITIES

Mohawk Dam is closely linked for control purposes with four upstream tributary reservoirs. The three larger ones are located on the major forks of the Mohican River, while the smaller one is located on a fork of the Kokosing River. Charles Mill Lake is on the Black Fork of Mohican River, Pleasant Hill Lake is on Clear Fork of Mohican River, and Mohicanville Dam is on Lake Fork of Mohican River; and North Branch of Kokosing Lake is on the North Fork of Kokosing River. During flood conditions all four upstream reservoirs maintain close contact with each other in order to achieve better water control management for the

Walhonding, Muskingum, and Ohio Rivers. For better control purposes all of the Walhonding River flood control projects are usually assigned to the same Water Management Section forecaster as the other Muskingum River Basin projects.

#### 2-05. RESERVOIR DESCRIPTION

The Official Plan for Mohawk Dam did not provide for a permanent lake to be maintained behind the dam, and this policy has always remained in effect. However, since the sluice intake elevation at the dam is approximately 5 feet higher than the original stream bed, a small 30 acre backwater pool extends upstream about 1.5 miles but is contained within the stream banks.

The reservoir is located at the southeastern corner of a somewhat rectangular-shaped drainage basin which lies in a generally north-south direction, as shown on **Plate No. 2-1**. At the maximum flood control pool level (elevation 890 NGVD), the reservoir has a surface area of 7,950 acres and a flood control capacity of 285,000 acre-feet. At this elevation the pool extends approximately 27.9 miles from the dam up the Walhonding and Mohican Rivers above Greer, Ohio, and approximately 11.7 miles up the Kokosing River to Howard, Ohio.

The reservoir is situated near the glacial boundary in a well-dissected section of the Allegheny Plateau Physiographic Province. The area in and surrounding the reservoir is characterized by rolling hills and broad valleys.

#### 2-06. REAL ESTATE ACQUISITION

In the acquisition of interest in the reservoir lands for the Muskingum Basin structures, several guiding principles were established by the Muskingum Watershed Conservancy District. Fee simple title was to be acquired for all reservoir lands up to a line measured horizontally from the conservation pool, if a conservation pool was planned. Flowage easements were then to be acquired from the fee title line up to reservoir spillway level (elevation 890.0 feet NGVD for Mohawk Reservoir). No properties were set up for easements unless some part of the property was located below spillway level. Fee simple title was to be obtained in all cases whenever the cost of a flowage easement would approach the cost of fee title. In the actual taking of these lands, however, these criteria were modified somewhat according to local conditions at individual properties. In the Mohawk Reservoir area, 251.28 acres at the dam site were acquired in fee title and flowage easements were acquired for 13,773.27 acres in the reservoir.

#### 2-07. RECREATION AND PUBLIC USE FACILITIES

Mohawk is basically for flood control, camping areas and canoe liveries are in the area upstream of the dam. The site locations of the various facilities are shown on **Plate No. 2-1**.

## SECTION III - GENERAL HISTORY OF PROJECT

### 3-01. AUTHORIZATION

Mohawk Dam is one of a system of 14 original reservoir projects in the Muskingum River Basin which were constructed in cooperation with the Muskingum Water Conservancy District in the 1930's. The U.S. Government, Public Works Administration approved a general project plan developed by the Conservancy District and allocated funds to the Corps of Engineers to aid in financing the construction of the project. Pertinent data for the original 14 reservoirs plus two additional projects is shown on **Table No. 3-1**, Table Section.

The Flood Control Act of 1939 contained a provision that the Muskingum River Basin dams and reservoirs, then owned by the Muskingum Water Conservancy District, be included in the comprehensive flood control plan for the Ohio River Basin. The operation and maintenance of the dam and appurtenances at Mohawk Dam have been the responsibility of the Corps of Engineers since that date. The Muskingum Water Conservancy District owns the waters of Mohawk Dam, and leases the waters to the State of Ohio for hunting, fishing, and wildlife enhancement.

### 3-02. PLANNING AND DESIGN

The Muskingum River Basin was divided into four large tributaries and each tributary had a large reservoir near the mouth. The Walhonding River, Tuscarawas River, Licking River, and Wills Creek Basins were each to have a large reservoir. Mohawk Dam was designed to be the key reservoir in the Walhonding River Basin with consideration originally given to have it provide the entire control of the Walhonding River. As the plans and budget for this giant dam developed, the flowage costs grew astronomically. Because of these high flowage costs an alternate plan of three smaller upstream reservoirs to reduce inflows into a downsized Mohawk Dam was next considered.

Mohicanville Dam on Lake Fork, Pleasant Hill Lake on Clear Fork, and Charles Mill Lake on Black Fork were selected as tributary reservoirs. The combination of Pleasant Hill Lake, Charles Mill Lake, Mohicanville Dam, and North Branch of Kokosing Lake, finished in 1972, control approximately 728 square miles, or about 48% of the drainage area above Mohawk Dam. Mohawk Dam alone controls 776 square miles, or approximately 51.6% of the remaining drainage area above Mohawk Dam. These four upstream reservoirs reduce the flood flows into Mohawk Reservoir as well as provide local flood protection along the tributary streams. The final plan for the new redesigned Mohawk Dam required the allocation of all the available storage for flood control. Therefore, Mohawk Dam is basically a dry dam, used for flood control only; all normal inflow is passed on, with no conservation, recreation, or water supply pool.

All of the related Walhonding Reservoirs are reasonably close to Mohawk Dam, with all the tributary projects being about 25 to 35 air miles distance; and all are operated in conjunction with the much larger Mohawk Dam at Nellie.

Each of the original reservoirs in the Walhonding system was designed to be constructed and operated such that the reservoirs would be filled to spillway level, but not beyond, by the runoff from the design storm, which is approximately 36% greater than the 1913 storm for the Mohawk drainage area. To this end, Mohawk Dam was designed to have a flood

control pool of 285,000 acre-feet which is equivalent to 6.5 inches of runoff from the 776 square mile drainage area that is not controlled by upstream reservoirs.

Two sites were originally considered for Mohawk Dam. The upper site was located about 5 miles upstream from Warsaw and the lower site about 0.5 mile above Warsaw. Studies and estimates from preliminary surveys indicated the upper site was more advantageous due to lower anticipated costs and better rock conditions.

Studies of site surveys, foundation explorations and available construction materials indicated that the most feasible structure would consist of a rolled earthfill dam across the valley, with the outlet works and a saddle spillway in the left abutment. Sufficient borrow materials for the embankment were available adjacent to the site, and firm rock suitable for the foundation of the outlet works and spillway existed in the left abutment.

### 3-03. CONSTRUCTION

The contract for the construction of the dam was awarded to George M. Brewster and Son, Inc. of Bogata, New Jersey, with a notice to proceed given on 27 April 1935. The original completion date was set at 5 July 1937, but subsequent change orders resulted in extending the final completion date to 23 September 1937.

Foundation materials in the old stream channel, left abutment and spillway saddle were found to be significantly worse than contemplated during design. In the stream channel, quick granular materials were encountered at a depth of 2 feet in the toe trench excavation. Rock in both the left abutment and saddle was generally described as highly jointed, frequently shattered and more weathered than anticipated.

Because of these adverse foundation conditions, the upstream embankment slope was flattened and the foundation treatment was revised. Under the impervious section of the dam the foundation was stripped to the quick materials and alternating 3-inch layers of clay and gravel were placed until no water soaked into the fill from below. Normal embankment placement began at that point. The rock toe and cutoff trenches were eliminated and replaced with a steel sheet piling keywall.

Wider benches were established in the stilling basin excavation, due to the numerous joints and weathering found in that area. The rock at the proposed location of the service bridge center pier was so badly fractured and weathered that the pier was eliminated and deck trusses were substituted for structural steel beams. A suitable foundation was not found at the proposed location of the spillway weir, so the weir was moved 75 feet downstream and slightly curved to keep within the limits of the original design.

Numerous problems were also encountered during construction of both tunnels. The shale in the roofs of both tunnels were so jointed and weathered that ring timbers and solid logging were used throughout. Approximately 162 feet of the right tunnel near the intake structure was replaced with a conduit section in an open cut. The left tunnel roof settled in this same general area a maximum of 1.6 feet, which required lowering the invert grade in that area to give room for sufficient thickness of concrete in the crown of the arch. During construction of the outlet works, the Walhonding River was diverted through a new channel in the right side of the main valley.

Final diversion and closure of the main valley was effected by upstream and downstream cofferdams. About this time another disastrous record summer flood occurred in August 1935 which devastated most of the agriculture in central Ohio. The vast damage from this flood caused more people to support any possible method for flood control.

The work began at Mohawk Dam and concurrently on all 14 dams, plus ten railroad relocations and forty-one utility gas line relocations. Private contractors, who performed construction under the Corps supervision were required to employ as many laborers as possible from relief rolls, because an important project purpose was to aid in recovery from the National Depression. About 58 percent of the funds on this project were paid to site labor, not including the labor necessary to produce the cement, steel and other purchased materials. The Federal Government, through the Corps of Engineers, was directly responsible for the construction of the 14 reservoirs and relocations of railroads and other public utilities. The Ohio Highway Department, financially aided by the Federal Bureau of Public Roads, was responsible for the relocations of highways, roads and streets. The Conservancy District purchased lands, easements and rights-of-way needed for the reservoirs, and was subsequently reimbursed for these expenditures by the Federal Government. The original 14 reservoirs were completed by 1938, dedicated, and the structures and facilities were deeded to the Corps of Engineers for operation on 11 August 1939 at a cost of about 34 million dollars. The Flood Control Act, approved 11 August 1939, contained a provision that the dams and reservoirs be included in the comprehensive flood control plan for the Ohio River Basin. Total project cost was well over the original estimate. Final settlement of cost distribution was not resolved until October 1955, although construction of the original project was completed in 1938.

### 3-04. RELATED PROJECTS

Mohawk Dam originally had three upstream related flood control projects; Charles Mill Lake on the Black Fork of Mohican River; Pleasant Hill Lake on the Clear Fork of Mohican River; Mohicanville Dam on Lake Fork of Mohican River. Later, North Branch of Kokosing River was built near Fredricktown. All four upstream projects are operated in conjunction with Mohawk Dam, especially during a flood.

Operation and maintenance of the entire reservoir system have been the responsibility of the Corps of Engineers since 1938. The Conservancy District, assisted by the National Park Service, prepared a master plan for comprehensive development of the areas surrounding the pools for recreation and conservation. Fee title to the lands required specifically for construction of the 14 dams and appurtenant structures was conveyed to the United States. The United States acquired flowage easements over the remaining reservoir land from the Conservancy District and directly from property owners. The Conservancy District retains fee title to the remainder of the project land. The Muskingum Water Conservancy District sector was about 36,190 acres of land adjoining the projects and a financial obligation of only about \$1.5 million because of changes in Federal law regarding requirements for local participation in flood control projects. The Ohio Highway Department, financially aided by the Federal Bureau of Public Roads, was responsible for the relocations of highways, roads and streets. The State of Ohio contributed about 7 million dollars in highway relocations and cash. Two reservoirs have been added to the Muskingum Basin system since the 1930's. Dillon Lake was completed in 1961 and North Branch of Kokosing Lake was completed in 1972.

The original design of Mohawk Dam was developed in 1934 with an open cut trapezoidal section with a curved concrete weir at the crest. The spillway crest length was 640 feet at elevation 890.0 feet (NGVD). By 1984, a new more comprehensive, design code had been developed for the Corps of Engineers. Accordingly, Mohawk Dam was reviewed, on an after the fact basis, for possible earlier design and safety deficiencies. In order to comply with certain deficiencies, revealed by the new design code, the emergency spillway was widened from 640 feet to 657 feet. This removed weathered material from the sides of the crest in an effort to anchor the new concrete side-walls to stable rock. This required the installation of two additional monoliths (M-1 and M-24) to the curved concrete weir that protects the spillway crest in the event of spillway flow. As a part of the dam safety program of 1988 a 4.5 foot earth addition was made to the crest of Mohawk Dam. And a pre-cast 3.0 foot concrete parapet wall was placed on top of the new crest of the dam, effectively raising the top of dam to elevation 917.5 feet NGVD, All work associated with the remodeling construction of Mohawk Dam was completed in 1988.

The Muskingum Reservoir system now has sixteen reservoirs and five local protection projects with a total of 1,604,000 acre-feet of storage and 5,020 square miles of controlled drainage area or 62.5 percent of the total basin. Mohawk Dam has a year-round flood control storage area of 285,000 acre-feet. The partially completed dams were used for the first time in the great Ohio valley flood of 1937 and in the next 61 years the system prevented or were credited with about 2.07 Billion Flood Control Benefit Dollars. This is a accumulated figure and the process of benefit allocations to individual reservoirs is often vague and misleading. However, based on storage allocations of 21.5 percent for Mohawk Dam the reservoir accumulated benefit total would be about 445 million dollars.

During the five years of 1994 to 1998 the combined 14 reservoir system accumulated damages prevented was 630 million dollars. This would mean 126 million benefit dollars per year for the system, and with a 21.5 percent allocation for Mohawk Dam the annual benefits for the last five years would be about 27.4 million dollars per year.

The final post war phase of development in the Walhonding River Basin was the solid growth of recreation and vacation resorts at the lakes and rivers in the area. When the original Muskingum Reservoirs were built this function was only lightly considered, but the Muskingum Water Conservancy District later built and developed elaborate facilities that draw enormous crowds at the nearby Pleasant Hill and Charles Mill Lakes during the summer. This has produced a new industry for the basin called tourism and recreation. This led to the creation of the Ohio Department of Natural Resources in 1949 and they have coordinated with the Corps of Engineers on many water projects in this final phase of water resources and recreation development.

Before the recreational phase of the Muskingum River Basin was initiated, the National Park Service assisted the Muskingum Water Conservancy District in the 1940's in estimating the recreational value of the Muskingum River Basin projects. The value was estimated to be \$807,000 per year. Thirty years later, in 1975, conservative estimates placed the annual value in excess of 5 million dollars. The present day value of these recreation benefits would be about 26 million dollars per year. Mohawk Dam having no conservation pool does not draw very many visitors.

The summary and final phase of the Walhonding River Basin water resources development is that many public and private groups now depend on the multi-purpose water projects that were developed by the Corps of Engineers. The vital personal water supply of several villages, towns, and many homes within the Walhonding-Mohican Basin now come from both underground and surface streams and lakes. The city of Mansfield has built Clear Fork Lake and Dorothy lake. Surface waters are also used by railroad, coal, mining, manufacturing, and lumbering industries for producing steam, processing material, and washing coal. In addition, several villages in the Walhonding River Basin also have a municipal sewerage treatment plant; and there is still a strong need for additional water supply each summer for optimum crop growth in the watershed. This very basic need for steady reliable water supply is expected to more than triple by the year 2020. Due to the lack of a conservation pool at Mohawk Dam, little consideration was given for any water supply plans for the Walhonding River. This initial consideration may be modified by these future needs because the underground water sources of the Lake Fork, Black Fork, Clear Fork, and Killbuck Creek Basins are very good.

### 3-05. MODIFICATIONS TO REGULATIONS

The overall operating regulations for Mohawk Dam have been slightly modified due to the building encroachment on downstream floodplains.

### 3-06. PRINCIPAL REGULATION PROBLEMS

Mohawk Dam is located in the north central section of Ohio, well above Columbus, therefore, the winter weather is a little more severe than that found at the projects below the Ohio River. Problems that have arisen from the severe winter is the freezing of ice on the spillway below Mohawk Dam and ice forming on the water surface near the gates. During the condition with ice on the gates, S1 and S6 are closed and S2 thru S5 are opened 7.5 feet.

## SECTION IV - WATERSHED CHARACTERISTICS

### 4-01. GENERAL CHARACTERISTICS

The Walhonding River Basin upstream of Mohawk Dam covers portions of Ashland, Coshocton, Holmes, Knox, Morrow, Richland, and Wayne Counties. The full Walhonding Basin is shaped as a rough irregular pear or diamond with a maximum length of approximately 55 miles and a maximum width of the same distance. The total drainage area of the Walhonding River is 2,222 square miles; 1,504 square miles of this area is fully controlled by four upstream reservoirs. Charles Mill, Mohicanville, Pleasant Hill, and North Branch of the Kokosing Reservoirs all control 728 square miles, leaving 776 square miles controlled by Mohawk Dam. The downstream uncontrolled area covers 718 square miles; Killbuck Creek has 613 square miles, and the remaining 105 square miles is uncontrolled local area.

The Walhonding River is formed by the confluence of the Kokosing and Mohican Rivers at Walhonding, Ohio, about 6 miles above the dam site. The Kokosing River rises near the center of the west edge of the Walhonding watershed and flows easterly through a wide valley bordered by rolling hills. The Mohican River and its principal tributaries rise from the extreme northwestern portion of the watershed and flow southerly to southeasterly through generally narrow valleys bordered by steep hill slopes. The Walhonding River flows generally easterly from Walhonding, through Mohawk Dam, joins Killbuck Creek, and flows to Coshocton, where it joins with the Tuscarawas River to form the Muskingum River. The drainage areas and stream flows of the Walhonding River and tributaries within the influence of Mohawk Dam are listed in **Table No. 4-1**, next page. A drainage area map is shown as **Plate No. 4-1** and a stream profile is shown as **Plate No. 4-2**, plate section.

The longest source stream of the Walhonding River is the 58.4 mile Black Fork of the Mohican River, which flows southward from above Mansfield in the northwest corner of the basin. The Black Fork of the Mohican River rises near the eastern edge of Crawford county near West Liberty and Tiro, in the northwest corner of the Muskingum basin and flows easterly through Richland Counties to Ashland County. Then it turns and flows through Charles Mill Lake southerly through Ashland County to unite with Clear Fork below Perryville, to form the 37 mile Mohican River. About nine miles downstream is the mouth of Lake Fork of the Mohican River at Spellacy Junction. The Mohican River then flows southerly across Holmes County into Knox County for another 28 miles to unite with the Kokosing River in Coshocton County near Walhonding to form the Walhonding River. This short 23.4 mile river then flows through Mohawk Dam, unites with Killbuck Creek and flows eastward 16 miles to Coshocton, Ohio, to unite with the Tuscarawas River.

This confluence forms the Muskingum River and combining with Wills Creek from the east and Licking River from the west flows generally southward through Muskingum, Morgan, and Washington Counties 112 miles emptying into the great Ohio River at Marietta.

The Black Fork of the Mohican River flows from its source at elevation 1240 to its mouth with a total fall of 317 feet or 5.4 feet per mile. Most of the fall is above Charles Mill Dam with a fall of 260 feet in 40 miles or 6.5 feet per mile. Big Run, a tributary of Black Fork has a rate of fall of 56.3 feet per mile. Singer Run, a tributary of Kokosing River has a rate of fall of 205 feet per mile. The Mohican River flows from its source at elevation 923 feet, NGVD, to the mouth at Walhonding with a fall of 104 feet in 37.6 miles or 2.8 feet per mile. The

Walhonding River flows from its source at elevation 819 feet, NGVD, to the mouth at Coshocton with a fall of 81 feet in 23.5 miles or 3.4 feet per mile. The fall from Coshocton at elevation 738 feet NGVD, to Marietta at elevation 585 feet, NGVD, is 153 feet in 112 miles or 1.4 feet per mile. The highest point in the basin is at elevation 1500 feet, NGVD, and the lowest is about 580 feet NGVD. The general characteristics and data for the Muskingum River Basin are shown below on **Table No. 4-1**.

**TABLE NO. 4-1  
STREAM CHARACTERISTICS OF MUSKINGUM - WALHONDING RIVER  
AND PRINCIPAL TRIBUTARIES**

Gaging Station or Tributary	Drainage Area (sq mi)	Elevation at Source (ft / NGVD)	Length of Stream (miles)	Slope (ft/ mi)
Clear Fork of Mohican River	218.5	1,326	36.6	11.0
Black Fork of Mohican River	350.9	1,240	58.4	5.4
Lake Fork of Mohican River	344.3	936	14.7	2.5
Mohican River at Greer	942.0	* 1,326	* 36.3	* 10.6
Mohican River at mouth	998.7	* 1,326	* 64.2	* 7.9
Kokosing River at mouth	482.0	1,308	57.2	8.5
Walhonding River below Mohawk Dam	1505.0	* 1,326	* 71.7	* 7.5
Killbuck Creek at mouth	612.9	1,202	81.7	5.5
Walhonding River at Coshocton	2,252.0	* 1,326	* 87.7	* 6.7
Tuscarawas River at Coshocton	2,589.7	1,140	129.9	3.1
Muskingum River near Coshocton	4,847.0	738	2.0	6.5
Wills Creek at mouth	853.2	1039	92.2	3.5
Watatomika Creek at mouth	233.9	1105	42.6	9.3
Muskingum River at Dresden	5,982.0	738	24.0	1.9
Licking River at Dillon	754.0	1292	64.0	9.5
Licking River at mouth	780.5	1292	67.5	9.1
Muskingum River at Zanesville	6,844.0	738	44.6	1.6
Moxahala Creek at mouth	300.7	999	29.2	11.0
Salt Creek at mouth	145.6	1020	27.1	13.1
Meigs Creek at mouth	141.9	843	21.2	10.7
Muskingum River at McConnelsville	7,411.0	738	61.9	1.4
Wolf Creek at mouth	230.8	1017	47.4	8.5
Muskingum River at Marietta junction with Ohio River	8,037.6	738	111.9	1.3

\* Walhonding River data includes Mohican River and Clear Fork.

\*\* Data based on published U.S.G.S. Compilation, U.S.G.S. Water Supply Paper, and Gazetteer of Ohio Streams.

#### 4-02. TOPOGRAPHY

The Walhonding River Basin watershed lies in the Appalachian Plateau physiographic province in the east central portion of the State Of Ohio. The northern and westerly portion of the basin lies in the glaciated plateau section while the southeastern portion lies in the unglaciated plateau section. The topography of the glaciated and unglaciated sections exhibit marked differences, though the transition from one to

the other is rather gradual. The narrow Mohican River valley from just below Pleasant Hill Dam and down below Lake Fork and the Walhonding River valley lie within the unglaciated portions of the Plateau. Terminal and lateral moraines are inconspicuous, and in many places it is not easy to establish the boundary from surface evidence.

During Pleistocene time, a series of ice sheets advanced southward over the northern portion of the state of Ohio, with the furthest advance occurring about 18,000 years ago. These great ice invasions into Ohio probably were the most important factors in changing the drainage patterns and surface features in the Muskingum-Walhonding Basin. The glacial border extended across the northeastern to the southcentral portion of the state along a line extending from just south of Canton, Ohio, through Millersburg to Loudonville, and then south to just west of Zanesville and on west to Newark and Chillicothe.

The effects of glaciation on the topography and drainage of Central Ohio are very obvious, with two very distinct belts or zones with a gradual transition from one belt to the other as a result. The surface effects of glaciation in the northern and westerly part of the state are not presently very visible, but the already near flat ground or terrain was flattened much more and all the streams in the northern glaciated belt drain north to the Great Lakes. The lower portion, or nonglaciated zone was not shaped by the glacier itself, but was heavily shaped by the glacier outwash. Pre-glacier streams such as the Haydensville and Massillon River generally flowed northward and were blocked by the ice and outwash of the Illinoian Ice Sheet, Scioto Lobe, creating temporary reservoirs into which large quantities of glacial and waste land materials were deposited from the melting ice. Drainage along the main valleys was reversed, now flowing towards the Southeast, and in some places new valleys were cut into old rock divides. The Walhonding River follows the course of the old Warsaw Creek and the Tuscarawas River occupies the channel of the old Massillon River, but flow is reversed. The Licking River, now flows eastward from Newark, formerly followed the present course of Wills Creek to West Lafayette where it entered the Tuscarawas Valley and followed this valley to Conesville, where it left the present drainage channel and continued westward past Hanover to Newark.

The unglaciated area is comprised of a very well dissected typical Appalachian terrain with rugged hill country and broad flat bottomed valleys in which flood plains and terraces are prominent along the main stream. It is apparent that many of the valleys are too wide to be the work of the streams that occupy them at the present time, and that they were cut by pre-glacial streams of far greater magnitude. The surface of the old plateau in this section, as indicated by the summits of the main ridge, stands approximately 1100 to 1200 feet NGVD. The highest ridges in the watershed are at approximately 1150 feet NGVD, with a total relief of approximately 560 feet. Since the stream has a low gradient along its lower course with little entrenching and does its cutting mainly at the headwaters, the stream shows maturity in the cycle of erosion.

The topography of the glaciated portion of the water shed is fairly well dissected near its border, and is made up of rolling hills and broad valleys. The relief is low to moderate due to the glacial erosion of the hills and the glacial deposits in the valley.

At the Mohawk Dam site, the left (east) abutment wall is formed by a steep-sided, narrow ridge, which joins the upland through a narrow saddle. The spillway for Mohawk Dam is located in this saddle. On the

right abutment, a terrace, which stands approximately 50 feet above the present flood plain, rises abruptly on the right bank 600 feet from the water's edge. The right abutment wall rises on moderately steep slopes from this terrace to an upland whose general elevation ranges from 1100 to 1200 feet. The total relief in the watershed is approximately 500 feet. The Kokosing River has an average fall of 8.5 feet per mile and the Mohican River has an average fall of 7.9 feet per mile.

Approximately 45 percent of the Basin falls in the maturely dissected section of the western Allegheny Plateau Physiographic Province. About three-fourths of the area is in farms. Hay and feed grains for livestock are the principal crops. The dissected-sandstone plateau has a narrow level valley floor, rolling ridge tops, and hilly to steep ridge slopes. Local relief ranges from one to several hundred feet.

Another 27 percent of the Muskingum Basin lies in the Eastern Ohio Till Plains. Approximately three-fourths of this area is in farms with urbanized areas occupying another 20 percent. The gently to strongly rolling dissected plateau is underlain by limestone and sandstone. Stream valleys are narrow and not deeply incised. Local relief ranges from a few feet to over a hundred feet.

The southeast 20 percent of the Basin falls within the Central Allegheny Plateau. Farms occupy ninety percent of the area. The dissected plateau is underlain by sandstones and shales and some layers of calcareous rocks. Level narrow valleys and narrow rolling ridges tops are separated by long steep ridge slopes. Local relief is in hundreds of feet.

The remaining eight percent of the western portion of the basin is in the Ohio and Indiana Till plains section. More than ninety percent of the area is in farms and eighty percent is in cropland. The surface area is gently sloping glacial till which is broken in places by hilly moraines, kames, and outwash terraces. Relief varies from a few feet to as much as 100 feet.

The width between banks of the Tuscarawas, Mohican, Kokosing, Walhonding, and Muskingum River varies from less than 100 feet to over 600 feet, and the width including the flood plain may be 1800 feet in the lower Muskingum. The banks are generally quite low, ranging in height from 2 to 3 feet to over 20 feet averaging about 7 feet.

The topography of the Muskingum Basin is generally steep in the upper perimeter section, with moderately steep slopes in the upper portion, from there it begins to decline to medium in the middle portion, and becomes rather flat in the lower section.

#### 4-03. GEOLOGY AND SOILS

The entire Muskingum River drainage area is in the great Allegheny Plateau and has a varying degree of relief. Although all but one of the damsites in the Tuscarawas River Basin are situated below the glacial boundary, the old drainage patterns of the entire area have been altered by glaciation. Four of the damsites in the Walhonding Basin; Charles Mill, Pleasant Hill, Mohicanville, and North Branch of Kokosing, are above the line of glaciation. The consolidated rocks now appearing at the surface in the Muskingum Basin are of sedimentary origin and belong to the Mississippian and Pennsylvanian geologic system. As the area lies along the western limb of the structural trough, the strata have a gentle dip to the southeast at the rate of about 20 feet to the mile however, the rate is not constant due to localized minor folding. No

indication of major faulting has been found in the area, although joint faulting fractures, which have resulted from stresses induced by uplift, are very numerous.

The Mississippian formations, the oldest rocks outcropping in area, occur in the western portion of the watershed. They consist essentially of sandstone and interstratified sandstone and shale. The strata dip in a southeasterly direction with the result that the overlying deposits of Pennsylvanian coal measures, sandstones, limestones, and shales together with Permian shales, sandstones, and coal outcrops successively in a southeasterly direction across the basin. Mohawk Dam is underlain by Mississippian rock formations.

The Pennsylvanian formations, overlie the Mississippian formations and occupy the eastern portion of the watershed. They include and are made up of sandstone, shale, indurated clay, and coal, with a few thin beds of limestone. Except for isolated outliers of Monongahela beds found in the tops of high hills, the surface rocks of the area belong to the Conemaugh series. Allegheny formations underlie the rocks of the Conemaugh series. It consists of essentially horizontal beds of shale, sandstone, limestone, and coal. In the vicinity south of Marietta, the top member of the Allegheny formation, Upper Freeport or No. 7 coal is about 40 feet below the valley floor. One of the most persistent and easily recognized stratum in the region is the fossiliferous limestone outcrops at many locations throughout the basin. Ordinarily less than two feet thick, here they range from 30 to 50 feet above the valley floor.

The Allegheny series of rock, lie below the present flood plain and consist of shale and sandstone. In the lower basin area the alluvial valley fill ranges from about 15 feet to about 35 feet and is comprised of silt with varying amounts of clay, sand, and gravel. Flood plain alluvium occurs in two fairly distinct bands. A relatively impervious stratum, ranging from 12 to 20 feet in depth, composed of silt, sand and clay is underlain by a relatively pervious sand and gravel stratum ranging from 5 to 25 feet in depth. The residual soil on the valley walls ranges in depth from about 15 feet to about 20 feet and is comprised mostly of silt and clay with varying amounts of sand and fragments of shale and sandstone.

The lower basin area is underlain by Conemaugh and Monongahela series of the Pennsylvanian system. The hard, well cemented, medium to coarse grained Mahoning Sandstone, basal member of the Conemaugh series, is prominent. Bedrock immediately beneath the alluvial fill in the valley bottoms are a succession of shales and sandstones belonging to the Allegheny series and of the Conemaugh series. The rock types exposed in the highway and spillway cuts are interbedded sandstones and shales of the Lower Conemaugh formation.

The unconsolidated materials in the watershed consist of glacial drift and till, outwash sands, gravel, and cobbles derived from glacial deposits; river deposited silts, clays, and fine sands; and residual materials formed by disintegration of the bedrocks. In the glacial area the valleys are deeply filled with glacial drift and poorly sorted glacio-fluvial sand, gravel, and cobbles, over which is spread a thin blanket of flood plain silt and clay. The valley walls and saddle at the Mohawk Dam site are underlain by inter-stratified, thinly bedded sandstones and shale whose bedding planes are approximately horizontal.

The uplands in the glacial area are blanketed for the most part with a variable thickness of till. In the unglaciated areas the valley fill

materials are generally fine and consist of river deposited silt, clay, and sand. The unglaciated uplands are blanketed with residual sandy clay which generally pass into bedrock at shallow depths.

Soils in the glaciated area are generally developed from the late Wisconsin drift. Permeability of these soils range from fair to poor on the uplands. In the valleys, more permeable soils are to be found. Southeast of the glacial boundary there are some alluvial soils in the valleys and residual sandstone and shale soils in the uplands. Low permeability is a characteristic of this area also. Soils in the Walhonding-Mohican watershed generally fall into the following associations: Hanover-Muskingum-Loudonville, Bennington-Cardington, Bennington-Cardington-Pewamo, and Canfield-Wooster-Ravenna. All of these soils were formed in a glacial drift of Wisconsin age which were derived mainly from sandstone, shale, and low amounts of limestone. They are generally low in fertility and organic matter and are acid. The Hanover-Muskingum-Loudonville association occupies hilly uplands and the soils are well drained. The Canfield-Wooster-Ravenna occupies nearly level to rolling uplands; the Canfield and Wooster soils are well drained, while the Ravenna soils are somewhat poorly drained. The Bennington-Cardington and Bennington-Cardington-Pewamo associations occupy low knolls and ridges and nearly level to gently sloping areas. The Bennington and Pewamo soils are generally poorly drained and occupy the less sloping areas, while the Cardington soils are moderately well drained and occupy the more sloping areas.

Soils in the unglaciated areas of the Mohawk Dam watershed are generally of the Muskingum - Berks association. The Muskingum-Berks association consists of well-drained, moderately deep Muskingum soils and well drained, shallow Berks soils which are also sloping to rather steep. Shallowness to bedrock is a problem on Berks soils, which are usually all forested.

#### 4-04. EROSION AND SEDIMENT YIELD

Soil erosion, particularly sheet erosion, and steepness of slope are the major management problems associated with most soil associations. Most of the rural Muskingum River Basin land is fully committed to farming, however, some of the land within the watershed is a little too steep for cultivation. This steep land has been retained as forest or used for pasture. About 63 percent of the Muskingum River Basin's soils are characterized as being for cultivation crops. As such, much of the area is in forest cover which partially accounts for the low erosion and sediment rates. When the soil is bare, however, soil loss on the sloping soils in Southeast Ohio can be as high as 10 or 20 tons per acre per year. General farm crops are grown on the more gentle slopes and the remaining areas are used for pasture and woodlands.

The amount of sediment generated by a watershed depends on a number of factors including land use, physiography, 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 is an indicator of the amount of bottom land available for sediment deposition before it reaches the reservoir.

In general, the largest amounts of sediment are delivered by streams during the three-month period of February, March, and April. About one-half of the total sediment is delivered during this three-month period. This coincides with the period of highest runoff and the period when the agriculture land would be expected to be bare, and the period when the leaves are dormant and deciduous plants are barren of leaves. Records indicate, however, that the highest concentrations of sediment occur in July. This is likely due to a combination of high intensity rainfalls occurring in July with the ground being bared for construction and agricultural lands in row crops. Southeastern Ohio precipitation records indicate that the 24-hour intensity in July is nearly twice the intensity of storms in the early and later parts of the year.

Fluvial sediment is recognized as a pollutant of surface waters. Erosion, transport, and deposition of sediment present significant economic and environmental problems. These erosion problems are caused by a number of factors, including highly porous soils, wave action, lack of vegetation, pool drawdowns, and surface water runoff. Surface water erosion has been caused by inadequate storm water drainage facilities and lack of vegetation. Drawdown erosion has been caused by lake drawdowns, normally on slopes of 0-7 percent. And severe shoreline erosion with significant soil loss has been caused by wave action, drawdowns and lack of vegetation on steep slopes of over 7 percent.

Only a small fraction of total eroded soil is transported to the streams where it is measured. The average annual gross erosion is estimated to be about 4.6 tons per acre in the Muskingum River Basin, but the sediment discharge on the Muskingum River as measured at Dresden averages only approximately 0.17 tons per acre per year. That portion that is not measured is trapped by upstream reservoirs, settles out in various stream reaches or is re-deposited on other land. This annual gross erosion estimate is below the national estimated average of nine tons per year on cropland alone, and is below the five tons per acre which is considered the maximum tolerable level at which the soil is still capable of producing food on a sustained basis.

Most of the sediment transported by the Muskingum River Basin streams is in suspension. Mean annual bedload discharge, in percentage of mean annual suspended-sediment discharge, is estimated to be less than 10 percent. Duration analysis shows that about 90 percent of the suspended sediment is discharged during 10 percent of the time. Concentration of suspended sediment averages less than 100 milligrams per liter 50 percent of the time.

Suspended sediment in the Muskingum River basin streams is composed mostly of silt and clay. Sand particles content ranges from 1 to 2 percent in the northern region to 15 percent in the southern. Sediment yields range from 100 to 500 tons per square mile per year. Several of the lakes have been surveyed for sedimentation and the results are reasonable. The only project to cause alarm in the first years to after World War II in the Walhonding Basin was Charles Mill Lake.

Surface mining has also caused some slight difficulty at certain lakes, however, as a result of the combination of strip-mining reclamation measures and the Muskingum Watershed Conservancy District's reforestation program, soils in the Muskingum Basin are being conserved and restored; and erosion of slopes and siltation in the basin have been reduced as a result.

The Mohawk Dam watershed is highly agricultural in nature. There are periods during the year when large portions of the basin's soils are devoid of vegetation, thus creating the potential for serious erosion and sedimentation. This is especially true during the winter and early spring months, a time period which has produced several historical floods. In non-agricultural areas, erosion and siltation has been reduced as a result of the Muskingum Watershed Conservancy District's reforestation program. More than 12 million trees have been planted to date in the Muskingum River Basin by the Conservancy District, and more are planted every year.

Several sedimentation surveys have been conducted at most of the Muskingum reservoirs. None of the adjacent lakes have ever indicated an excessive sedimentation rate. Because of the tiny 20 acre minimum pool at Mohawk Dam there has never been a sedimentation network established or any sediment survey. Based on the sedimentation rates at the adjacent Pleasant Hill and Charles Mill Lake there is no basis for any concern that any excess sedimentation rate would occur at Mohawk Dam.

#### 4-05. CLIMATE

a. General. The climate of the Walhonding River Basin is typical of a central temperature zone and is characterized by moderate extremes of heat, cold, wetness, and dryness. Frequent and rapid changes in weather occur due to the passage of fronts associated with general low-pressure areas. The average conditions for the Walhonding River Basin are represented by the climatological data obtained at Wooster, Fredericktown, and Mansfield Airport stations. Temperatures, precipitation and snowfall data for these stations are listed in **Table No. 4-2**, Table Section.

b. Temperature. The mean annual temperature is about 49.5°F which is close to the state average. The highest temperature of record for Wooster is 105°F and the lowest is -24°F. Maximum temperatures usually occur during July or August and minimum temperatures usually occur in January or February. Based on the station at Wooster, the growing season, defined as the period where the minimum daily temperature is 32°F or above, is approximately 156 days and extends from the middle of May to the beginning of October.

c. Precipitation. The average annual precipitation over the Mohawk Dam watershed averages approximately 37.3 inches. Precipitation varies from year to year but is normally abundant and well distributed throughout the year and over the watershed. Extreme amounts of precipitation and long periods of drought are relatively uncommon. During the growing season, precipitation occurs predominantly in showers and thunderstorms, which occur mostly in the period of May through August. Approximately 60 to 65 percent of the annual precipitation occurs in the six-month period from March through August. Due to the influence of the Great Lakes and the region's variable topography, the average annual snowfall varies somewhat across the watershed, ranging normally between 30 and 40 inches. Of the approximately 38 inches of mean annual precipitation falling over southeastern Ohio, about 12 inches runs off into streams, and about 26 inches per year is lost to evaporation, transpiration, infiltration, and other natural extractions.

d. Evaporation and Wind. For most Muskingum 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 lake evaporation over the Walhonding River Basin is 32 inches, based on data from U.S. Weather Bureau Technical Paper No. 37. Comparison of the water surface evaporation with the water loss shows that the average increase in loss, or augmented evaporation due to a reservoir such as Charles Mill or Pleasant Hill Lake is about seven or eight inches per year. However, Mohawk Dam is essentially a dry dam, especially in summer, with a very small tiny 10 acre minimum pool. And since most evaporation occurs during the warm summer months, any extra evaporation would be very small compared to the pre construction amount. Therefore, the estimated evaporation loss from Mohawk Dam would be very minute, near zero.

Prevailing winds in the area are from the south and southwest for most of the year; in February and March prevailing winds are from the northwest. The mean annual wind speed, based on data from the Akron-Canton Airport, is 9.9 miles per hour. The maximum mean monthly wind speeds average between 11 and 12 miles per hour during the period November through April; the minimum mean monthly wind speed is 7.4 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 occurs most frequently during January to March and rarely occurs during August to October.

The flooding characteristics of the Walhonding River Basin as a non-regulated basin and as regulated and controlled by the 5 flood control reservoirs (North Branch Kokosing, Pleasant Hill, Charles Mill, Mohawk and Mohicanville) can be partially described by comparing the highest annual historical floods above 7,500 cfs. These are shown in **Table No. 4-3**, page 4-12, for the water years 1922 through 1996. The non-regulated period is from 1922 through 1935, when construction of the Walhonding River Basin dams began. Construction of all 14 dams was virtually complete in 1938 so the regulated period extends from 1939 to the present. Prior to water year 1938, the gaging station was located at Pomerene, approximately 2 miles upstream of Mohawk Dam. Since water year 1938, the gage has been located at Nellie, which is approximately 1.75 miles downstream of Mohawk Dam. The gage datum was 805.53 feet National Geodetic Vertical Datum (NGVD) prior to water year 1938, 792.09 feet NGVD during water year 1938, and 790.00 feet NGVD from water year 1939 to date. All flows and gage heights are as actually occurred, and the water year has been changed to the calendar year where appropriate. Flooding characteristics of the Walhonding - Muskingum River Basin can also be described by flow-frequency curves. Such curves for the Walhonding River at Mohawk Dam and at Reference Point No. 1, and the Muskingum River at the Coshocton, Dresden, Zanesville, McConnelville and Marietta gaging stations are given in **Plate Nos. 4-3** thru **4-6**. Discharge rating curves for each of these stations except Marietta are also given in **Plate Nos. 7-3** and **7-4**, Flow duration curves for the Walhonding-Muskingum Basin below Mohawk Dam are shown on **Plate Nos. 4-3** thru **4-5**, respectively, all in plate section. Regulated hydrographs at

Mohawk Dam from 1937 to 1995 are now stored in the Water Management computers. A stream profile for the Walhonding River and its major tributaries to the upstream reservoirs is shown on **Plate No. 4-2**.

b. Storm and Flood of March 1913. The flood of March 1913 is the greatest flood of record for the Walhonding River. The flood was caused by excessive precipitation over a comparatively large area. Due to the mild winter, the ground was without snow cover, not frozen and already saturated from previous rains. In the Muskingum River Basin, the main storm began just before noon on 23 March. The rainfall became increasingly heavy the next two days and continued on the 26th and in some portions of the Basin on the 27th. The total rainfall during the five-day period, most of which fell in a period of 96 hours or less at individual points, averaged 6.94 inches over the entire Muskingum River Basin and 9.17 inches over the Walhonding River Basin. The resulting flood crested at about 26.9 feet at Mohawk. The estimated high water profile resulting from this flood along the Walhonding River is shown in **Plate No. 4-6**, plate section.

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. Tributary streams in the Muskingum River Basin experienced successions of flood rises which moved out of the smaller rivers to accumulate in the larger rivers resulting in increasingly higher stages and discharges after each storm. The heavy general rainfall continued for almost an entire month and concluded with the heaviest storm from 14 to 25 January in which 7.93 inches fell over the Muskingum Basin. The partially completed flood control reservoirs helped decrease the peak stages and discharges by acting as retarding basins. The maximum recorded stage at Pomerene, two miles upstream of Mohawk Dam, was 18.8 feet with a corresponding peak discharge of 43,800 cfs.

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 Walhonding 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 ranging from 6 to 18 inches. In addition a storm occurring between 14-17 January deposited an average of approximately one inch of precipitation over the Basin. 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 between midnight on 20 January and noon on the 21st. Mohawk Dam reached the highest pool level in its history, elevation 873.94 feet NGVD, on 25 January 1959.

e. Storm and Flood of July 1969. On the evening of 4 July 1969, severe thunderstorms with intense rainfall moved across northern Ohio. The storm centered along a line beginning just east of Toledo and extended through Ashland and Wooster to Uhrichsville. The average rainfall over the Muskingum River Basin upstream of Coshocton for the 18-hour period ending at 1:30 PM, 5 July was 6.6 inches. Unofficial measurements ranged from 10-14 inches for the same period in the Wooster area. Precipitation at Mohawk Dam was only 1.77 inches, but upstream at Pleasant Hill, Charles Mill, and Mohicanville Dams, rainfall amounts were 5.86 inches, 6.67 inches, and 9.67 inches, respectively. The

intense rainfall and runoff resulted in the rapid and severe inundation of much of the upper Muskingum River Basin. Many headwater and tributary streams overflowed with flood stages approaching or exceeding those recorded in previous major floods. The storm pattern was such that flooding was severe in areas upstream from existing reservoirs; however, the reservoirs were utilized efficiently to minimize flooding in downstream reaches. The maximum pool level observed at Mohawk Dam during this flood was elevation 868.5 feet NGVD on 14 July 1969.

f. Storm and Flood of February 1979. Antecedent conditions prior to moderate rainfalls near the end of February 1979 were mainly responsible for flooding conditions in the Basin. Soils were frozen and snow cover persisted over most of the Muskingum Basin from early January to the onset of the major rainfall on 25-26 February. Snow cover on the Basin ranged from approximately 6 inches in the northern part of the Basin to 20 inches at McConnelsville. Temperatures rose to above freezing for the first time in nearly 4 weeks on 20 February and, combined with rainfalls of less than 0.5 inch on 21-22 February, created rapid melting of snow and runoff and rising stages along the Basin's streams. Continued thawing combined with heavier rainfalls of approximately 1.5 inches over the Basin on 25-26 February produced heavy runoff and considerable flooding in the Muskingum River Basin. The Basin reservoirs were utilized efficiently to reduce downstream flows and stages.

g. Storm and Flood of August 1980. Heavy rainfalls falling on saturated ground were mainly responsible for the flooding conditions experienced in many portions of the Muskingum River Basin in August 1980. The Basin experienced average rainfalls approximately 150% of normal during June and July 1980. Widespread, intense thunderstorms produced the bulk of the Basin's precipitation in August, with a large portion of the Basin receiving more than 10 inches of rain during the month. The most notable storm occurred on 10-11 August in Guernsey, Belmont, Licking and Muskingum Counties. The Cambridge area received 7.5 to 8.0 inches of rain in about 18 hours, and most stations in these counties received at least 3.5 inches of rain from the storm. Wills Creek at Cambridge reached its highest peak since 1935, with property damage exceeding that of the 1913 flood due to economic development of the area. Heavy rainfalls exceeding 1-2 inches were common throughout most of the Walhonding Basin during storms of 2-6 August, 9-12 August, 17-19 August, and 21-22 August. Operation of the Muskingum Basin dams reduced flood stages significantly during the month, especially downstream of Wills Creek Dam and Dillon Dam.

**TABLE NO. 4-3  
WALHONDING RIVER NEAR MOHAWK DAM, OHIO  
HIGH WATER DATA**

Date	Gage Height (feet NGVD)	Discharge (cfs)
Mar 1913 Pre Construction.....	26.9 <sup>1/</sup>	102,000 <sup>1/</sup>
25 Jan 1937 Historic Flows.....	18.8	43,800
26 Feb 1929.....	15.5	27,400
7 Aug 1935.....	15.97	27,100
1 Dec 1927.....	14.0	23,400
9 Jan 1930.....	13.7	23,200

22 Mar 1927.....	13.8.....	22,900
14 May 1933.....	13.25.....	22,000
27 Feb 1936.....	13.56.....	21,100
11 Jan 1924.....	12.5.....	21,700
13 May 1923.....	12.2.....	20,900
15 Apr 1922.....	11.6.....	19,400
26 Feb 1926.....	11.4.....	17,200
18 Jan 1932.....	11.43.....	17,100
2 Feb 1925.....	7.2.....	8,530
3 Mar 1934.....	7.30.....	8,470
23 Apr 1931.....	6.71.....	7,260
14 Mar 1939 Regulated Flows.....	15.66.....	15,800
9 Mar 1940.....	15.53.....	15,400
9 Apr 1938.....	12.64.....	13,600
11 Apr 1942.....	14.39.....	13,000
20 Mar 1945.....	14.23.....	12,600
31 Jan 1947.....	14.19.....	12,600
7 Dec 1983.....	14.06.....	12,500
11 Feb 1966.....	14.05.....	12,500
11 Feb 1968.....	14.05.....	12,500
5,7 Jan 1943.....	14.02.....	12,200
27 Feb 1946.....	13.74.....	11,600
5 Mar 1963.....	13.54.....	11,300
14 Feb 1950.....	13.20.....	10,600
12 Apr 1948.....	13.07.....	10,400
13 Feb 1952.....	13.07.....	10,400
6 Feb 1959.....	12.78.....	9,760
24 Mar 1964.....	12.50.....	9,650
14 Dec 1977.....	12.56.....	9,560
18 Jan 1996.....	12.47.....	9,390
7 Mar 1944.....	12.47.....	9,230
13 Feb 1951.....	12.33.....	8,850
2 Feb 1949.....	12.27.....	8,850
10,17 Mar 1979.....	12.15.....	8,800
27 Jan 1962.....	12.22.....	8,710
12 Mar 1967.....	12.17.....	8,700
18 Feb 1976.....	11.80.....	8,190
30 Dec 1968.....	11.88.....	8,150
29 Mar 1955.....	11.88.....	8,110
17,18,20 Mar 1956.....	11.88.....	8,110
5 Feb 1970.....	11.68.....	7,970
12 Feb 1960.....	11.80.....	7,960
20 Jan 1974.....	11.59.....	7,810
2,3 Mar 1971.....	11.66.....	7,730
25 Feb 1977.....	11.52.....	7,690
3 Mar 1981.....	11.50.....	7,650
4 Feb 1982.....	11.48.....	7,620
5 Mar 1975.....	11.45.....	7,560
30 Dec 1940.....	11.53.....	7,550

<sup>1/</sup> Present site and datum - estimated.

#### 4-07. RUNOFF CHARACTERISTICS

Mohawk Dam is located on the Walhonding River which is a tributary of the Muskingum River. The Mohican and Kokosing Rivers form the Walhonding River approximately 2.5 miles upstream of Mohawk Dam. Water is only impounded behind the dam during flood conditions. Therefore, the Walhonding River is free flowing most of the year at Mohawk Dam.

Geological considerations are important because rock type in the drainage area determine, to a great extent, the inorganic composition

of the inflow waters. At the dam site the Walhonding Valley is filled with Pleistocene Epoch glaciofluvial sediments to a depth of 150 feet. The fill consists chiefly of sand and gravel with lesser quantities of silt and clay. This fill is overlain by a blanket of alluvial silt and clay that is 5 to 9 feet in thickness.

Most of the Basin is used for agriculture purposes and wooded areas cover only a small percent of the basin. Oil and gas are the only known minerals in the area, which are considered to have commercial value. For the most part the watershed is in good condition, although the state has listed 25 streams within the basin as impaired. Most of the problems fall into the categories of organic enrichment and habitat alteration. Thirty-four percent of the streams within the basin have problems with organic enrichment.

**Table No. 4-4** below, presents the average , normal, maximum monthly runoff from the watershed just below the Mohawk damsite based on 63 years of record at the USGS gage.

<b>TABLE NO. 4-4</b>			
<b>MONTHLY AND ANNUAL RUNOFF</b>			
<b>WALHONDING RIVER BELOW MOHAWK DAM</b>			
<u>Month</u>	<u>Normal Average</u> <u>Flow (cfs)</u>	<u>Maximum Average</u> <u>Flow (cfs)</u>	<u>Minimum Average</u> <u>Flow (cfs)</u>
January	2032	6384	583
February	2446	6563	749
March	3174	7281	997
April	2710	6048	982
May	1864	4651	748
June	1320	3805	483
July	878	2732	354
August	620	2062	273
September	480	1307	240
October	451	1119	265
November	843	2349	355
December	1470	4417	537
Annual	1519	2370	511

#### 4-08. WATER QUALITY

The Walhonding River is formed by the junction of the Mohican and Kokosing Rivers about 5.7 miles upstream of Mohawk Dam near Walhonding, Ohio. Mohawk Dam is located on the very short Walhonding River that flows about 17 miles on down stream to unite with the Tuscarawas River to form the Muskingum River at Coshocton. Water is only impounded behind the dam during flood conditions. Therefore, the Walhonding River is free flowing most of the year at Mohawk Dam.

Geological considerations are important because rock types in the drainage area determines, to a great extent, the inorganic composition of the inflow and outflow waters of most reservoirs. Land use patterns, including some strip mining of coal and agriculture, also exert strong influences on the chemical characteristics of basin waters.

The Walhonding valley is filled with Pleistocene Epoch glacio-fluvial

sediments to a depth of 150 feet. Before the Pleistocene glacial epoch, the regional drainage direction was generally to the northwest, as a part of the Haydensville River. This drainage was reversed by the Illinoian Ice Sheet, Scioto Lobe and the drainage direction is now to the southeast. Although waterlain, the sediments were deposited so near the source that only a minor amount of sorting occurred. The fill consists chiefly of sand and gravel with lesser qualities of silt and clay. This fill is overlain by a blanket of alluvial silt and clay that is 5 to 9 feet in thickness.

A prominent sand-gravel terrace, standing approximately 50 feet above the present flood plain, occupies the western area of the 2,000 foot wide valley. Bedrock in the valley area and at the abutments, consists of essentially horizontal sandstones and shales of the Mississippian Period, Logan formation of the Waverly group.

Inflow water on both main tributaries is characteristic of the calcareous nature of the watershed. Ionic concentrations and buffering capacity (alkalities) are high. Nutrient levels are also high for both tributaries. Also, sulfate concentrations are relatively high, as are total salt concentrations and buffering capacity (alkalinity). Iron and manganese, possibly because of the calcareous nature of the basin and neutralization of acid drainage, are not present at problematic concentrations. The Kokosing River receives some domestic sewerage pollution from two waste water treatment plants and the Mohican River has some upstream industrial pollution, but it improves before it reaches the river's mouth.

Most of the Basin is used for agriculture purposes and wooded areas cover only a small percent of the basin. Oil and gas are the only known minerals in the area, which are considered to have commercial value. For the most part the watershed is in good condition, although the state has listed 25 streams within the basin as impaired. Most of the problems fall into the categories of organic enrichment and habitat alteration. Thirty-four percent of the streams within the basin have problems with organic enrichment.

The Walhonding River is one the best water quality streams in Ohio. The water quality data collected by the Corps of Engineers from 1974 to 1975 is limited, but indicates that water quality in the basin reflects watershed conditions.

#### 4-09. CHANNEL AND FLOODWAY CHARACTERISTICS

The regulation channel capacity or control flow in the Walhonding River below Mohawk Dam is 7,140 cfs in the summer and 10,400 cfs in the winter. The control flow in the Walhonding River is less in the summer than in the winter to accommodate farming in the flood plain. Ratings are checked frequently by the USGS so that regulations personnel always have up-to-date ratings. Flood time of travel of Mohawk Dam discharge to the confluence with the Tuscarawas River at Coshocton is 9 hours and to the Ohio River at Marietta is an additional 55 hours.

The Mohican and Kokosing Rivers form the Walhonding River in terrain which is typified by low banks and broad flood plains. The flood plain of the Walhonding River averages about three-fourths of a mile in width and the width between the banks varies from about 200 feet to 600 feet. The banks are low and range in height from a few feet to about 20 feet and average about 7 to 8 feet. At the dam site, the river has a width of 200 feet and a water surface elevation of 795 feet NGVD.

From its head at elevation 818 feet NGVD to its mouth at elevation 733.5 feet NGVD, the Walhonding River has a total fall of 84.5 feet or an average slope of 3.6 feet per mile.

4-10. UPSTREAM STRUCTURES - N.A.

4-11. DOWNSTREAM STRUCTURES - N.A.

4-12. ECONOMIC DATA

a. General. The Muskingum-Walhonding River Basin is accessible from the large metropolitan areas within Ohio and surrounding states by rail, air, and a well developed and maintained network of Federal and State highways. Bus travel is good between the large cities and air service is available to Akron-Canton, Columbus-Newark, and Parkersburg-Marietta. The completion of superhighways I-70 (east-west) and I-77 (north-south) have provided an excellent source of transportation and access for the basin.

b. Population. The Mohawk Dam watershed covers large portions of Knox, Richland, and Ashland Counties, and smaller portions of Coshocton, Holmes, Wayne, Morrow, Medina, and Crawford Counties. Portions of certain counties are outside the basin perimeter. The main population centers in the Basin are Mansfield, Shelby, Ashland, and Mount Vernon.

The basin population is about 30 percent urbanized, with about 70 percent of the people living in the rural or unincorporated areas. The towns and cities of the basin vary from very small to medium size with many tiny villages of less than 100 people to the major city of Mansfield. The highly urban area is concentrated along the northwest perimeter of the basin in Richland County with the largest city in the basin at Mansfield, which lies on the Rocky Fork of Clear Fork River. The most sparsely populated county is Morgan County with an average of 34 persons per square mile. **Table No. 4-5** next page, shows the population of the Walhonding River Basin counties as determined by the 1960, 1970, 1980, 1990. and 2000 population censuses.

**TABLE NO. 4-5  
POPULATION OF WALHONDING RIVER BASIN**

County	Population				Percent Increase	
	2000	1990	1980	1970	1960	1960 to 2000
* Ashland	52,523	47,507	46,180	43,300	38,770	35.47
Coshocton	36,655	35,427	36,020	33,490	32,220	13.76
Holmes	38,943	32,849	29,420	23,020	21,590	80.38
* Knox	54,500	47,473	46,300	41,800	38,810	40.43
* Morrow	31,628	14,194	14,240	12,380	12,750	148.06
Muskingum	84,585	82,068	83,340	77,830	79,160	6.85
* Perry	34,078	31,557	30,130	27,430	27,860	22.32
* Richland	128,852	126,137	131,210	130,000	117,760	9.42

Wayne	111,564	101,461	97,410	87,120	75,500	47.77
-----						
Total	573,328	519,670	514,250	476,370	444,420	29.01
*Entire county is not within Walhonding River Basin, also eight counties not listed with only a few people.						

It should be noted that the populations shown are the entire population of the counties and several counties do not lie entirely within the basin. Also, the table does not include the populations of eight counties which contain very small portions of the basins population. Most of the population increase has occurred in the northern portion of the basin. The counties in the southern portion of the basin and especially the southeastern portion have experienced the least growth and in some southeastern counties there was a net loss of people in past few years.

c. Industry and Agriculture. Manufacturing is the chief source of economic activity in the basin accounting for nearly 40 percent of the labor force in 1960. Agriculture, dominant at one time and now on the decline, accounts for less than six percent of the total basin employment. The industries in the Walhonding River Basin include the manufacturing of rubber, plastic, wood, glass, clay, and metal products; the extraction or mining of gas and oil, coal, clay, sandstone, limestone, dolomite, shale, and salt; farming; and timbering.

The Muskingum-Walhonding River Basin is rich in mineral resources. Coal is the most importune mineral resource and deposits are located in the eastern and southeastern portions of the basin. Crushed sandstone is quarried in six counties, and limestone and dolomite are quarried extensively in many areas of the eastern counties of the basin. About one-fourth of the states sand and gravel is produced in the basin. Salt brines rich in bromine, calcium, chlorine, magnesium, potassium and sodium are mined in the northern portion of the basin.

The most important manufacturing center in the basin is in the city of Mansfield in Richland county. Fabricated metals, machinery, and rubber and plastic products account for the major portion of manufacturing in the area. Other importune manufacturing centers in the Walhonding Basin include Newark, and Zanesville.

Approximately three-fourths of the land in the western and northwestern counties of the Muskingum River Basin, particularly in the Walhonding Basin, and about one-half of all the land in the basin is utilized for agriculture purposes, mainly cropland and pasture. More than 75% of the land in the Walhonding Basin is devoted to agriculture, and dairy products are the main agriculture items produced in the Basin. In recent years there has been a steady conversion of agriculture lands to forests and industrial-urban development, but agriculture development is still occurring, primarily in the glaciated areas and the wide stream valleys.

A great percentage of the land centered along the Muskingum River (Coshocton, Muskingum, Morgan, and Washington Counties) consists of woodland and extensive forest cover. A very small portion of these lands is controlled by government agencies. About one-third of the states commercial forest land is in the basin.

d. Flood Damages. Areas subject to flooding downstream of Mohawk Dam in the Walhonding River Basin consist of small farms, rural residences, cities, and many small communities. The various cities include Nellie, Warsaw, Coshocton, Dresden, Zanesville, Philo,

McConnelsville, and Marietta.

Since the construction in the early 1930's, the original 14 reservoirs in the Muskingum River Basin 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 reservoirs, the original system has helped prevent an estimated 2.53 billion dollars in total damages prevented from 1936 through 2003, or, about 37.8 million dollars per year. However, this is an accumulated amount with no adjustment for inflation, new construction, or depreciation, therefore, accurate damage estimates are rather vague. Allocation of benefits to individual reservoirs is usually a GLD function often based on storage volume. Based on ratio and proportion of storage Mohawk Dam would have about 21.5 percent of the total Muskingum Basin benefits. This procedure would allocate about 445 million dollars accumulated raw dollars for Mohawk Dam. For the 67 years of operation this would be about 7 million dollars per each year.

Studies have been undertaken in the past to determine the relative percentage of flooding benefits afforded by each of the individual Ohio River Basin projects. These studies analyzed the contribution of each project for a number of selected Hocking, Muskingum, and Ohio River floods. Based on these studies, it was determined that the Muskingum River Basin Projects alone are responsible for approximately 2.1 percent of the total Ohio River benefits afforded by all of the Ohio River Basin projects.

## SECTION V - DATA COLLECTION AND COMMUNICATION NETWORKS

### 5-01. HYDROMETEOROLOGICAL STATIONS

a. Streamflow Stations. Several stream gaging stations, designed for the collection of hydrologic data, are located at strategic sites in and around the Walhonding River Basin. Data from these stations are necessary for execution of the water control plan.

(1) Stream Cooperative Program. The Corps of Engineers participates in the U.S. Geological Survey Federal-State Cooperative Water Resources Program under which the Survey installs, rates and maintains the gages at locations desired by the cooperating entity, except at Corps' projects where the lake and outflow gages are originally installed by the Corps. Under this program, the Survey maintains the following stream gaging stations in the Muskingum River Basin pertinent to Mohawk Dam: Charles Mill Reservoir outflow gage, Black Fork of the Mohican River at Melco and Loudonville, Pleasant Hill Reservoir outflow gage, Mohicanville Reservoir outflow gage, Mohawk Reservoir outflow gage, Muskingum River at Coshocton, Dresden, Zanesville, and McConnelsville, and Ohio River at Marietta.

The Corps of Engineers also maintains several gages in the Muskingum River Basin independent of the stream cooperative program. Those pertinent to Mohawk Dam include the lake gages at Charles Mill, Mohicanville, Pleasant Hill, North Branch of Kokosing and Mohawk Reservoirs and the stream gage on the Walhonding River at Reference Point No. 1.

The National Weather Service maintains gaging stations at some locations providing data from those on the Weather Wire; however, none of these is in the Mohawk watershed. The Corps of Engineers and the Weather Service cooperatively exchange stage information along with weather information as delineated in sub-section 5-02b.

(2) Collecting and Reporting Facilities. Early 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. The platforms store stage and precipitation data and every four hours transmit to the LRD computer downlink via the Geostationary Operational and Environmental Satellite. The District Water Control System receives data automatically from the LRD water control system on an hourly basis. If necessary, the District can also access the data at other times by operator control.

A new type of data collection platform is now available which has the capability of reporting in response to a telephone query by computer, terminal or human. The query can be initiated at any time from the water control system, project office or the home of a selected individual during off-duty hours. In response to a human caller, the platform will respond with current information such as stage with a synthesized voice. These DCP's can also dump several readings to a computer terminal over a period of hours. These DCP's are being installed at critical locations such as inflow, lake, outflow, and some control point stations.

(3) Reports. Currently, morning reports from the Mohawk

watershed projects, containing stage, precipitation, operational and temperature data, are received in the Water Management Section as computer printouts from the water control system. They are received in the same format in which they are input at the project office. Stage data are converted to flow and the values are used in the forecasting process. Frequency of reporting, and thus data collection, is dependent on the degree of urgency of weather and/or flooding conditions as specified in Exhibit B, Instructions to Damtender. The frequency ranges from daily (5 days per week) at about 0730 hours under Normal Conditions to hourly under Major Flood Conditions when the lake level approaches or threatens spillway elevation.

b. Precipitation Stations.

(1) ORN Program. The Ohio River Reporting Network, a division-wide cooperative program with the National Weather Service, involves interchanges of information between the Weather Service and the Corps of Engineers which utilizes the respective installations and experience of the two agencies. The Weather Service recruits, trains, equips, and pays observers at Corps' requested locations and receives and records data from them. 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 incurred on the Corps' behalf, Huntington District provides NWS with all precipitation, snow cover, and stage information received in the Water Management Section from reservoir and other reports, three day pool and outflow forecasts, and depth reports from the Corps of Engineers' Snow Cover Reconnaissance.

Precipitation stations in and near the Mohawk Dam watershed are Ashland, Centerburg, Charles Mill Lake, Cooperdale, Fredericktown, Mansfield Airport, Millersburg, Mohawk Dam, Mohicanville Dam, North Branch of Kokosing Lake, Pleasant Hill Lake, and Wooster.

(2) Collecting and Reporting Facilities. Normal equipment is the 8-inch Standard Rain Gage with a metal support. All the above named stations have this standard gage except Centerburg, Charles Mill Lake, Mohawk Dam, Mohicanville Dam, North Branch of Kokosing Lake and Pleasant Hill Lake, which use a tipping bucket gage. At ORN weather stations the measuring instrument, the standard 8-inch rain gage, is read and reported manually by telephone landline to the Muskingum Area Office. At the unattended stations, the "tipping bucket" measuring gage is interfaced to a data collection platform. The platform receives the signal electrically and transmits to the computer downlink via the satellite. Station locations are shown on the Basin Drainage Map, **Plate No. 2-1**, Plate Section.

(3) Reports. Weather service observers at Centerburg, Cooperdale, and Millersburg report by telephone to the Muskingum Area Office. The Muskingum Area Office in turn transmits the data to the District Water Control System and also relays the data to the NWS in Cleveland. Usage of data from these reports and data exchanged with the NWS is as described below.

While primary dependence is on morning report information, the Water Management Section uses Weather Service data, available between 0900 and 0930 hours, in forecasting and computing average precipitation over the Basin, area, and District. The data are used to fill in, by implication, for missing data and confirmation or refutation of doubtful readings. Weather Service coverage of areas lacking Corps' projects, when plotted on the District Isohyetal Map, provides a basis for better

understanding of storm movement and areal intensity, which contributes to improved water management decisions. Radar images on the NWS screen at Cleveland 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.

A large portion of the total precipitation information received by NWS comes through the cooperative ORN program. Complete District morning-report data accessed from the District computer (water control system) are reorganized by NWS personnel into downstream format and inserted into the NWS Eastern data bank. The data are widely used by NWS elements such as those producing infiltration indices and short, medium and long range forecasts, and by the River Forecast Center in Wilmington which produces Ohio River and tributary stage and flow forecasts. The Cleveland Office utilizes the data early in their mid-morning weather report including any updating of forecasts which may be indicated.

Data from the unattended, tipping-bucket precipitation stations are collected and processed in the water control system along with stage data from the platform reported stream gages.

The platform-satellite system described earlier in sub-sections 5-02, a(2) and 5-02, b(2) is the primary source of lake and outflow stage data at the Muskingum River Basin projects as well as stage data at the downstream control gages. Secondary sources of data are the morning and other reports from the Muskingum Area Office which are transmitted over telephone lines directly to the water control system via computer terminals. Backup for these reports is via Cell Phone to the communication section operator-typist in the District Office.

Cell Phones are now the primary mode of emergency backup communication between the District Office and the Area Office or projects; standard procedures require Cell Phone to be turned on at all times during working hours. During military emergency or national disaster, protected commercial telephone lines with Muskingum River Basin projects or special radio frequencies may be assigned by the Emergency Operations Manager.

## 5-02. WATER QUALITY STATIONS

a. Facilities. There is one water quality station established at Mohawk Dam. It is located on the Walhonding River about 1.5 miles below the dam. See **Plate No. 5-1.**

b. Reporting. There has been no program design for water quality sampling at Mohawk Dam. The outlet works were not designed with water quality as one of its purposes; therefore, the discharge of water is not regulated for downstream quality. Samples collected within the watershed are for long-term applications.

Parameters measured, frequency of collection, and number of data collection stations at any one time are determined by specific project conditions. The water quality program design for Mohawk Dam/Lake was structured to describe the various factors affecting water quality on an as-needed basis. 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. 5-1**, next page.

c. Maintenance. During emergency or under adverse conditions, water quality samples are collected on an as-need 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.

5-03. SEDIMENT STATIONS - N.A.

TABLE NO. 5-1

Standard Physical/Chemical Tests

<u>Type of Test</u>	<u>Reason for Testing</u>
Calcium (Ca) Magnesium (Mg) Sodium (Na) Potassium (K)	Major Cations - Ionic Balance, ratios and relationships
Sulfate (SO <sub>4</sub> ) 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	<u>insitu</u> parameters used to evaluate conditions for project operation

5-04. RECORDING HYDROLOGIC DATA

Data collection and communications within the Corps of Engineers have been accomplished largely by manual methods in the past. Precipitation data from the reservoir projects or the National Weather Service (NWS) have been reported by telephone, and stream gage readings have been obtained manually and daily reports verbally submitted over the district radio network. During the past few years, however, several changes in data collection and communications have been made. The current hydrologic network and system is shown on **Plate No. 5-2**.

Recently, the Water Resources Engineering Branch acquired a mini-computer to be used as a District Water Control System. Since that time, numerous changes in data collection have been effected with anticipated future improvements to take places as to data collection, analysis, and use.

All daily reservoir reports are now received through the water control system. Each Muskingum Basin project reports directly to the Muskingum Area office at Dover, Ohio, via computer. The project report is then entered into the terminal offline and transmitted directly over telephone lines to the district computer by INTRANET.

Cell Phones are used as a back-up. Data from the NWS are now received by the water control system via network connection. Reservoir project data are also disseminated back to the NWS from the water control system.

All data entered into the water control system are stored in a database and used by water control software programs, allowing more timely and efficient water management decisions and generation of required reports. Stream and precipitation data is stored in one hour increments. Project information, along with that data now being stored in one hour increments is also processed in one day average values and stored. The data is stored in water year files and in period of record files for each basin. As the data is useful for historic studies it is to be maintained indefinitely, or until a specific time limit for storage is published.

#### 5-05. COMMUNICATION NETWORK

Communications between Mohawk Dam, the Muskingum Area Office, the District Office, etc., is carried out primarily by telephone. Cell Phones provide a backup when telephone service is interrupted. Data collection platforms (DCP's) are installed at stream gaging stations and precipitation stations for collection of hydrometeorological data. The DCP's can be accessed by phone and data retrieved by computer terminal at the Area Office or by synthesized voice.

#### 5-06. COMMUNICATION WITH PROJECTS

Telephone is the primary mode for most communication between the Water Management Section and the multipurpose projects and area offices and between projects and respective area offices. Cell Phones are now used for secondary backup communication, while mobile radio, State Police, courier, etc, are utilized during an emergency when neither the telephone nor Cell Phones are operational. Inter-project communication is mostly by Cell Phone with some telephone use for privacy. The Water Management Section personnel use the telephone to request and receive additional operations information and weather information and to give operational guidance and directives. The U.S. Postal Service is utilized for letter reports, 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.

#### 5-07. PROJECT REPORTING INSTRUCTIONS

Project personnel will report hydrometeorologic 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 and Readiness Division.

#### 5-08. WARNINGS

A RV park is affected downstream at the original channel capacity stages, 11.3 and above. 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 markedly increased.

Mohawk Dam personnel coordinate in person and by telephone with Ohio Division of Natural Resources personnel concerning the forest fire protection agreement with the Forestry Division. Project personnel cooperate with the Environmental Health Services Department by sampling all drinking water for biological safety factors, mailing to Columbus for analysis and receiving results by mail. In addition, a copy of the monthly water plant report on chemicals and water use is submitted for informational purposes.

County offices with which project personnel communicate are the Sheriff's and Health Departments, the first in conjunction with the patrol and law enforcement contract, and the second concerning periodic inspections of the Marina in compliance with provisions of the Corps of Engineers lease.

## SECTION VI - HYDROLOGIC FORECASTS

### 6-01. GENERAL

Hydrologic forecasts of lake elevations and stream flows in the Walhonding 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. Role of Other Agencies.

(1) National Weather Service. The National Weather Service (NWS) has the official responsibility for preparing forecasts of Ohio River 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 FORECASTS

a. Requirements. 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 Walhonding Basin has been sub-divided 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 hour to complete the forecast of the Walhonding 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 control stages and flows for the Walhonding River Basin are

summarized in **Table No. 6-2**, next page. The detailed drainage areas for the Walhonding-Muskingum River Basin are listed in **Table No. 6-3**, page 6-4, and are shown on **Plate No. 6-3**.

<b>TABLE NO. 6-1</b> <b>RESERVOIR POOL DATA</b> <b>MOHAWK DAM</b> <b>WALHONDING-RIVER</b>							
Pool	Area (acres)	Main Stream (miles)	Surface Acre-Feet (Thousands)		Surface Runoff Inches		
			Net	Gross	Net	Gross	
All Year							
Minimum	799.2	33	0.1	0.1	0.1	0.0	0.0
Flood Control	890.0	7,950	27.9	285	285	6.5	6.5
Total							
Capacity	890.0	7,950	27.9	285	285	6.5	6.5

b. Methods. In order to achieve the most efficient water control management possible, a real-time computer model, developed for Water Resources Engineering Branch by the Hydrologic Engineering Center (HEC), Davis, California, was adapted and calibrated for use in water management of the Walhonding 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.
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 can be 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.
5. Step 3 is repeated to obtain subsequent forecasts that

consider any additional precipitation (QPF), special regulation or other hypothetical analyses that may be required.

**TABLE NO. 6-2  
MOHAWK DAM  
CONTROL STAGES AND TRAVEL TIMES**

Station	Stream	MIANO** (16 Apr-30 Nov)		DEMIA** (1 Dec-15 Apr)		Time of Travel Hours
		Stage Feet	Flow cfs	Stage Feet	Flow cfs	
<b><u>WITH A SPECIAL DIRECTIVE from WATER MANAGEMENT SECTION</u></b>						
Mohawk Outflow*	Walhonding River	11.2	7,140	13.0	12,100*	0
<b><u>WITHOUT A SPECIAL DIRECTIVE</u></b>						
Mohawk Outflow*	Walhonding River	8.8	3,520	10.0	5,240*	0
Walhonding RP1	Walhonding River	10.0	9,300	11.5	12,100	4
Coshocton	Muskingum	15.5	21,810	18.0	30,660	9
Dresden	Muskingum	16.0	23,420	18.5	32,000	20
Zanesville	Muskingum	19.5	38,200	21.5	48,000	24
McConnelsville	Muskingum	10.0	35,600	11.0	41,600	30
Marietta	Ohio	35.0	260,000	35.0	260,000	66@

\* Slope station rating

# Flood stage

@ Operational time prior to Ohio River crest stage of 35 feet

NOTE: \*\*Value as specified by stage/flow rating at time of publication. It is subject to change as rating tables are revised.

Water Management will provide rating table updates to the Manuals it holds and to the Project. All other Manual holders should verify if flow values are outdated.

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 Mohawk Dam. With this computer program and practical experience the Water Management Section is able to produce a reliable forecast for the Walhonding River Basin. **Table No. 6-3**, next page is an example of the various small areas above and below Mohawk Dam which small-area unit hydrographs are developed.

The small area 6-hour adopted unit-hydrographs for the various Mohawk Dam uncontrolled forecast areas are shown on **Table No. 6-4**, page 6-5 and the Discharge Rating Tables for the key points in the Walhonding River Basin are shown on **Plate Nos. 7-3** and **7-4**, plate section. 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 Walhonding 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.

TABLE NO. 6-3

**STREAM CHARACTERISTICS OF MUSKINGUM - WALHONDING RIVER  
AND PRINCIPAL TRIBUTARIES**

Gaging Station or Tributary	Drainage Area (sq mi)	Elevation at Source (ft/NGVD)	Length of Stream (miles)	Slope (ft/mi)
Clear Fork of Mohican River	218.5	1,326	36.6	11.0
Black Fork of Mohican River	350.9	1,240	58.4	5.4
Lake Fork of Mohican River	344.3	936	14.7	2.5
Mohican River at Greer	942.0	* 1,326	* 36.3	* 10.6
Mohican River at mouth	998.7	* 1,326	* 64.2	* 7.9
Kokosing River at mouth	482.0	1,308	57.2	8.5
**Mohawk Dam uncontrolled area	777.0	-	-	-
Walhonding River below Mohawk Dam	1504.0	* 1,326	* 71.7	* 7.5
Killbuck Creek at mouth	612.9	1,202	81.7	5.5
Walhonding River at Coshocton	2,252.0	* 1,326	* 87.7	* 6.7
Tuscarawas River at Coshocton	2,589.7	1,140	129.9	3.1
Muskingum River near Coshocton	4,847.0	738	2.0	6.5
Wills Creek at mouth	853.2	1039	92.2	3.5
Muskingum River at Dresden	5,982.0	738	24.0	1.9
Licking River at Dillon	754.0	1292	64.0	9.5
Licking River at mouth	780.5	1292	67.5	9.1
Muskingum River at Zanesville	6,844.0	738	44.6	1.6
Muskingum River at McConnelsville	7,411.0	738	61.9	1.4
Muskingum River at Marietta junction with Ohio River	8,037.6	738	111.9	1.3

\* Walhonding River data includes Mohican River and Clear Fork.

\*\* Data based on published U.S.G.S. Compilation, U.S.G.S Water Supply Paper, and Gazetteer of Ohio Streams.

TABLE NO. 6-4

**ADOPTED SIX - HOUR UNIT-HDROGRAPHS FOR  
UNCONTROLLED AREA ABOVE MOHAWK DAM**

Time Hours	Natural Unit Graph	Inflow Unit Graph	1-A Pool Head	#2 Around Pool	#3 Pool Area
6-hours	777.0	777.0	661.2	103.4	12.4
0	0	0	0	0	0
6	1080	2000	1620	400	1340
12	2610	4020	3980	980	0
18	4830	7800	9400	2030	
24	10,350	16,400	19,650	4030	
30	18,000	21,000	15,500	1700	
36	16,360	12,000	7200	880	
42	9510	8000	4270	550	
48	6230	5640	2800	330	
54	4490	3620	1920	180	
60	3190	2710	1350	80	
66	2190	1810	900	30	
72	1420	1200	590	0	
78	890	790	350		
84	560	550	210		
90	350	340	140		
96	170	165	70		
102	80	75	20		
108	40	35	0		
114	0	10			
120					

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 Walhonding 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 Walhonding 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 Management Section 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 timely and efficient water management decisions and generation of required reports.

While primary dependence is on morning report information, Water Management Section personnel use Weather Service data, available between 0900 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 on Wednesdays for the next 30 days. As mentioned previously Mohawk Dam is operated as a 'DRY' dam; all storage is used for flood control only. The normal run of the Walhonding River is passed on each day, therefore no additional storage is available for downstream drought requests. The daily outflow data of Mohawk Dam is interfaced with data from the Tuscarawas River Basin reservoirs to produce a Muskingum 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 Walhonding River Basin. As mentioned previously Mohawk Dam is operated as a 'DRY' dam; all storage is used for flood control only. The normal run of the Walhonding River is passed on each day, therefore no additional storage is available for long range downstream requests. The daily outflow data of Mohawk Dam is interfaced with data from the other Mohawk River Basin reservoirs to produce a long range Muskingum 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 Branch (WMB) as they utilize it to inform the Mississippi Valley Division (MVD) of probable future conditions and to suggest specific items of water control management to the districts.

b. Methods. The Water Management Section produces 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 Nation 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 Walhonding 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. 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 Walhonding 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 apprised of the condition. Marina operators and other affected parties are in turn notified of the changing situation by the Damtender.

## SECTION VII - WATER CONTROL PLAN

### 7-01. GENERAL OBJECTIVES

In accordance with ER 1110-2-8156 "Preparation of Water Control Manuals" dated 31 August 1995, ER 1110-2-240, "Water Control Management," dated 8 October 1982, and ORDR 1110-2-27, "Water Control Management Activities," dated 12 January 1976, the plan of water control management and regulation as discussed in the subsequent paragraphs reflects optimal consideration of the primary project purpose, namely flood control. In developing the plan of regulation, the following general requirements were considered and evaluated in relation to the overall effective water control plan for the five projects in the Walhonding River Basin and the Ohio River Basin:

a. Prevention or reduction of serious damages to the communities, crops and properties below the dam along the Walhonding River to the greatest extent consistent with safe operation of the project.

b. Maximum retention of flows which would add to flood crests on the Muskingum River and the Ohio River at Marietta, Ohio.

c. Establish maximum allowable discharge to avoid downstream damage during flood releases.

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

e. Sensitivity to reasonable requests for operational changes from the Ohio Department of Natural Resources.

f. Concern for safety and well-being of humans, fish and wildlife, manmade structures and stream banks downstream of dam, which can be affected by discharge control.

g. 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 Mohawk Dam must be within the confines or constraints of the Mohawk Dam - Walhonding 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 below the dam area, or the inability to discharge storage as quickly as planned because of floodplain encroachment or downstream construction. There is no summer recreation function or recreation pool to be maintained, therefore, there is very little concern for low inflow due to lack of upstream rainfall. Operational limitations concerning flood control functions have been modified and extended to accommodate the structural improvements facilitated by the Corps of Engineers Dam Safety Assurance structural remodeling program. **Table No. 7-1**, next page, shows the Mohawk Dam Operational Restraints.

TABLE NO. 7-1
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**MOHAWK DAM OPERATIONAL RESTRAINTS**

Pool Level Elevation NGVD	-	Streambed	795.0	zero storage
Minimum Pool			799.2	55 acre-feet 33 acres area
Maximum Flood Control Pool			890.0	285,000 acre-feet - Gross
Maximum Surcharge Level			908.0	475,940 acre-feet - Gross
Original Top of Dam	910.0 NGVD;	rose to 917.5 NGVD in 1988.		
Gate Change Maximum Rate	-	1.0 feet per hour	on Outflow gage	
Sluiceway maximum flow	-	890.0 NGVD	Outflow	- 21,600cfs
Spillway Maximum Flow	-	908.0 NGVD	Outflow	- 150,000cfs
Max. Summer flow with <u>SPECIAL DIRECTIVE</u>	-	7,145 cfs,	11.20ft @	"O"gage
Max. Winter flow with <u>SPECIAL DIRECTIVE</u>	-	12,100 cfs,	13.00ft @	"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. With Mohawk Dam the principal problems encountered since regulation began were gradual encroachment of the flood plain and winter ice jams on the Walhonding River below the dam.

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 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 the Walhonding River soon began to gradually build and move a little closer to the stream. Soon the new property was within the maximum channel limits. The recommended solution is that once a year, if possible, the maximum channel capacity should be used to remind everyone of the location of the maximum channel capacity flood plain.

The only other local problem hindering the operation of Mohawk Dam is during the very cold winter ice jams often are formed on the Walhonding River below the dam near the RP1 Gage. These ice jams may partially block the river and cause back water that is damaging to lower level farm land.

7-03. OVERALL WATER CONTROL PLAN

Mohawk Dam is part of the flood control system of the entire Ohio River Basin as well as of the Muskingum and Walhonding River Basin projects. Mohawk Dam has four upstream tributary lakes that modify the inflow into the dam, therefore, operation of Mohawk Dam requires close coordination among all the Walhonding and Muskingum flood control projects. Coordination of the 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 Walhonding and Muskingum Basin and along the Ohio River below Marietta.

As mentioned previously the Walhonding River joins the Tuscarawas just below Coshocton to form the Muskingum River. Coshocton at the junction has always been subject to flooding from one or both of the two main stems, the Walhonding and Tuscarawas Rivers. Flood damages occurring along the Walhonding and Muskingum River to Marietta primarily involve residences, utilities, highways, and commercial; with lesser amounts to agriculture and extractive industries. The most valuable agricultural products are from livestock, which sustain only slight damage from flooding. Greatest flood damages in the past have occurred to residences in the communities of Coshocton, Dresden, Zanesville, McConnelville, Beverly, and Marietta; as well as individual residences along the river and to small villages of less than 200 people.

Mohawk Dam drains 1,504 square miles and this constitutes 67 percent of the 2,252 square mile Walhonding River Basin. The optimal method of regulation coordinates operation on the basis of comparative storage utilization and, to the fullest extent possible, with regulation of flood control projects on other tributaries of the Ohio River. The combined controlled drainage area above Coshocton covers about 3,435 square miles, leaving an uncontrolled area of about 1410 square miles. The uncontrolled drainage area above the Coshocton gage is composed of about 663 square miles on the lower Tuscarawas River and about 747 square miles on the lower Walhonding River between Mohawk Dam and the mouth of the river at Coshocton. The Walhonding local area is composed of 613 square mile from Killbuck Creek, and the remaining area is divided with 55 SM above the Walhonding RP1 gage at the mouth of Killbuck Creek and 80 SM of local area between the gage and Coshocton.

The record flood of March 1913 was created by a combination of very heavy rainfall and snowmelt, and the Coshocton gage had a record crest stage of 29.6 feet. This flood occurred before construction of the Muskingum River flood control system, but, the record flood has been reconstituted and the reservoirs have been operated on a theoretical after-the-event basis. Based on these calculations the present Muskingum system would reduce the flood crest at Coshocton by about 10 feet. This reduced flood stage would now be about one foot above the winter flood control stage of 18.0 feet, and the flood damage, compared to the huge damage in 1913, would be near minimum. Accordingly, due to the effects of the upstream flood control reservoirs flooding has been greatly reduced, but, Coshocton is still subject to localized flooding from the uncontrolled areas of Killbuck Creek and the lower Tuscarawas River Basin.

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 between storage volume at maximum flood control pool elevation, 890.0 feet NGVD, and the minimum gate sill pool at 799.2 feet NGVD is 285,000 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 flood storage capacity. Accordingly, there is a very tiny minimum pool at Mohawk Dam and there is no provision for sediment storage space and winter habitat. Since all of the storage is allocated for flood control, all of the normal daily inflow is passed on through the gates. Furthermore, since the storage behind the dam is only used during

flood periods, the sedimentation rate would be very low, near zero.

Constraints to regulation that are of special concern 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 or by inability to discharge storage as quickly as planned, because of floodplain encroachment. Compliance with a requested deviation as outlined above in sub-section 7-03b may become a constraint to regulation if some assumed factor, such as weather, developed differently from the way assumed.

#### 7-04. STANDING INSTRUCTIONS TO DAMTENDER

The Mohawk Dam Damtender (Resource Manager) and staff operate the project in accordance with general instructions and Special Directives issued by the Water Management Section.

a. General Instructions. The general instructions apply at all times except when instructed by Special Directives which will be applicable for a specific operation or period of time. General instructions provide for routine reservoir regulation including the discharge limit at project initiative, details of gate operation technique, collection and transmission of hydrologic and streamflow data, reservoir regulation at the start of a flood before contact can be made with the District Office, and emergency regulation in the event all communications fail during a flood. These instructions are contained in Exhibit B, "Instructions to Damtender". These instructions also establish the minimum number of observations to be made and are designed to insure that any necessary gate operation will be promptly executed and that special reports will be initiated by the Damtender (Resource Manager) before reservoir and stream conditions reach critical proportions. 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.

b. Special Directives. Special Directives are issued by telephone and confirmed by mail to record all substantive guidance given 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 Muskingum Basin streams or Ohio River control.

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

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

(2) Special regulation 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) Stocking tailwaters-stable flow 24-48 hours.
  - (g) Complete closure for inspection on emergency or periodic basis.
- (3) Change in general instructions.
  - (4) Any and all other key operations as deemed necessary by Water Management Section.

c. Regulations. The above mentioned general instructions and Special Directives are written in accordance with the following regulations:

- (1) EM 1110-2-3600, 25 May 1959, Subject: Reservoir Regulation.
- (2) ER 1110-2-1400, DAEN-CWE-Y, 24 April 1970, Subject: Reservoir Control Centers.
- (3) ER 1110-2-240, DAEN-CWE-Y, 8 October 1982, Subject: Reservoir Control Centers.
- (4) ORDR 1110-2-27, 12 January 1976, Subject: Water Control Management Activities.
- (5) ER 1130-2-415, DAEN-CWE-Y, 28 October 1976, Subject: Water Quality Data Collection, Interpretation and Application Activities.
- (6) ORDR 1110-2-26, 5 February 1979, ORDED-W, Subject: Water Quality Investigations and Control Activities.
- (7) ER 1110-2-208, DAEN-CWE-Y, 30 July 1979, Subject: Water Control Management.

#### 7-05. FLOOD CONTROL

The Walhonding River, a major tributary of the Muskingum River, is controlled by Mohawk Dam near the mouth, and four upstream tributary reservoirs, Mohicanville Dam, Charles Mill Lake, Pleasant Hill Lake, and North Branch of Kokosing Lake. These reservoirs were designed to most economically meet basin needs for flood protection. The greatest flood damages in the past have occurred to farm lands, crops, buildings and urban communities located in the valleys. The optimal method of regulation coordinates operations between the various projects on the basis of comparative storage utilization and, to the fullest extent possible, with regulation of flood control projects on other tributaries.

a. Requirements. Summer-type storms featuring intense rainfall of relatively small areal extent can be destructive and result in local flooding despite the prevalence of conditions for water retention. Due to their proximity, Mohawk Dam and each of the upstream reservoirs may be operated for these storms, although it is possible to have a heavy thunderstorm affect only one of them. Winter-type storms occur when the vegetation and soil conditions are such that a high percentage of runoff results. They are frequently of wide extent, necessitating operation of reservoirs on several Muskingum or Ohio River tributaries.

Flood protection below Mohawk Dam requires vigilance on the part of project personnel due to rapidly discharging water from the lake during moderate rainfall. Damage to crops and buildings occurs around the confluences with both Killbuck Creek and the Tuscarawas River if high flows from Mohawk combine with high flows in these two streams.

b. Normal Plan. Mohawk Dam is part of the flood control system for the Muskingum River Basin, as well as the Ohio River Basin. It is one of 16 reservoirs in the Muskingum River Basin and regulation procedures are therefore very closely coordinated with the other Basin projects, particularly those located upstream in the Mohawk watershed. Coordination of regulation is toward maintenance of a 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 Muskingum Basin and along the Ohio River.

The reservoirs are operated so that the capacities up to flood stages of the downstream channels may be utilized as far as possible during periods of storm runoff and until the flood waters stored in the reservoirs have been emptied. In general, storage commences when the limits of channel capacity at any of the damage points below the dam sites are attained, and continues until the stages at all control points fall below the danger point, taking into consideration the time of water travel.

During flood events, the following operational procedures will provide for effective management of the project to meet downstream and reservoir area flood control objectives.

(1) All inflow is to be released up to that causing a stage at the outflow gage not to exceed 11.2 feet (7,140 cfs) in the summer and 13.0 feet (12,100 cfs) in the winter except when critical flood conditions prevail or are predicted at downstream control points, or when Water Management Section has directed special operations.

(2) All inflow will be stored which would contribute to stages in excess of the designated control stages at key downstream stations as listed in **Table No. 6-2**, page 6-3.

(3) All inflow will be stored from 66 hours in advance of the predicted time of reaching a forecast crest stage in excess of 35 feet on the Ohio River at Marietta gage. When the stage at Marietta has crested and fallen one foot and continued recession is indicated, the outflow from Mohawk Dam will be gradually increased to channel capacity as permitted by conditions downstream from the dam.

(4) If the river stage at Marietta is not indicative of flooding conditions further downstream along the Ohio River, guidance from LRD Reservoir Control Center may suggest the storage of inflow in order to provide some benefit to these downstream areas. In such special cases, the Water Management Section will make a complete assessment of all current and anticipated hydrologic conditions in the

Muskingum River Basin to devise an operational scheme which will benefit the downstream Ohio River areas and not prove detrimental to Muskingum River flood control objectives.

(5) Release of accumulated flood storage is based on determinations by the Water Management Section after a complete evaluation of all hydrologic conditions which impact effective management of the project for optimal flood control benefits. The Branch will evaluate each individual flood event, including consideration of percentage utilization of storage between the Muskingum Basin reservoirs and issue Special Directives for release of stored flood waters.

(6) The normal operation procedures for flood control will also be followed in the regulation of major floods. If the reservoir inflow is such that the spillway level of the dam is exceeded, the outflow will be limited to the uncontrolled flow over the spillway until stages at all downstream control points will permit the sluice gates to be gradually opened so as to maintain the downstream channel capacities.

The plan of operation is based on having adequate flood forecasting and flood warning systems in effect. Streamflow data are obtained from the Muskingum Basin projects' morning reports, from the National Weather Service (NWS) office in Cleveland and from the platform-satellite system. Precipitation amounts in and near the Muskingum Basin on the morning report come from the project gages and from observers in the Ohio River Network. Additional precipitation data are received through the platform-satellite system and from NWS in Cleveland. Water Management Section personnel use current and previous rainfall, soil and foliage conditions, and stream stage data to forecast lake and downstream stages.

Following the utilization of the reservoir for flood control, it is desirable to empty the reservoir as quickly as possible, considering any special operations, in view of the possibility of a major flood occurring at a time when the reservoir is partly filled.

Area and capacity tables are given in **Plate No. 7-1** and percent storage Utilization Tables are given in **Plate No. 7-2**. The Mohawk Spillway Rating curve and the Outflow Rating Tables at the Nellie gage are given in **Plate Nos. 7-3** and **7-4**, respectively. Discharge Rating Tables and Low-flow-Seasonal Pool are shown on **Plates Nos. 7-5** and **7-6** respectively.

c. Emergency Plan. In the event that all communication is disrupted either between the Huntington District Office and the Muskingum Area Office or between the Area Office and the Mohawk Dam Project Office, the District Office will try to establish communication directly with the Project Office. If the District Office cannot communicate with either the Project or Area Offices, the Water Resources Engineering Branch will utilize all available data, e.g. satellite platform data, to keep informed of project conditions and be prepared to resume regulation instructions when communication is restored. The Area Office Manager or Facility Manager of Walhonding will then assume regulation in the interim if communication exists between the Area and Project Offices. Otherwise, the Damtender will assume regulation of the reservoir, following the measures listed below. In addition, the Damtender will immediately make every effort to re-establish communications with the District Office. If a Special Directive was not in effect prior to the failure of communications, project personnel shall operate the reservoir in accordance with the operating

instructions for either summer or winter storms as contained in Exhibit B, Instructions to Damtender. If the reservoir was being operated in accordance with a Special Directive when communications failed, the instructions of the Special Directive should be followed until the specific operation given in the Directive has been executed, twenty-four hours have elapsed since the last contact with the District Office, or additional heavy rainfall occurs. Whenever any of these conditions occur, project personnel shall operate the reservoir in accordance with the operating instructions for either summer or winter storms as contained in Exhibit B, Instructions to Damtender.

#### 7-06. RECREATION

Mohawk Dam was originally designed and built for maximum flood control protection, therefore, it is operated as a dry dam. The only time the dam stores water is during a large flood. Accordingly, the usual conservation functions usually associated with other multi-purpose dams are not applicable at Mohawk Dam.

#### 7-07. WATER QUALITY

Mohawk Dam is located in Coshocton County, Ohio, on the Walhonding River, a tributary of the Muskingum River. It was authorized for flood control as a part of a comprehensive plan for the Muskingum and Ohio River Basins. The dam is a rolled earth-fill structure located 17.4 miles above the mouth of the Walhonding River. An uncontrolled saddled spillway at crest elevation 890.0 feet NGVD was built to protect the dam from overtopping. Drainage area above the dam is 1540 square miles.

The outlet works were not designed with water quality as one of its purposes; therefore, the discharge of water is not regulated for downstream quality.

#### 7-08. FISH AND WILDLIFE - N.A.

#### 7-09. WATER SUPPLY - N.A.

#### 7-10. HYDROELECTRIC POWER - N.A.

#### 7-11. NAVIGATION - N.A.

#### 7-12. DROUGHT CONTINGENCY PLAN - N.A.

#### 7-13. FLOOD EMERGENCY ACTION PLANS

a. Introduction. Conditions affecting operation of Mohawk Dam could result in a hazard to life and/or property due to high lake levels and/or sudden release of large volumes of water. Early identification of the existence or potential for occurrence of such conditions is essential as a basis for initiating emergency operations and/or repairs and for issuing appropriate notifications to higher authority and

potentially affected parties.

b. Definitions.

(1) Pre-Emergency. A "Pre-Emergency" condition is one in which some impending or existing threat to the safe operation of the dam is identified but no significant hazard to life or property is expected to occur. Declaration of a Pre-Emergency condition is internal to the Corps of Engineers and does not require notification of other parties or warnings to evacuate.

(2) Emergency. An "Emergency" condition is one in which the occurrence of a significant hazard to life and/or property is possible or certain to occur. Conditions justifying declaration of an Emergency condition may be imminent or longer term. Declaration of an Emergency condition requires notification to others and issuance of warnings to evacuate potentially hazardous areas.

c. Declaration of Pre-Emergency and Emergency Conditions.

(1) Responsibility. The District is responsible for the declaration of "Pre-Emergency" or "Emergency" conditions in all but extreme cases where the loss of communications or the speed of onset of a situation prevents the Damtender from conferring with the District.

Pre-Emergency and Emergency declarations will be made by the Commander/District Engineer. The Chief of Engineering Division, Chief of Water Resources Engineering Branch, Geotechnical Branch, Design Branch, Operations Division and the Emergency Management Division will provide input in the decision making process.

(2) Conditions Warranting Declaration. Not every situation requiring declaration of a Pre-Emergency or an Emergency condition can be specified. Initiative must be exercised by all involved personnel and each situation judged individually on the basis of all relevant factors.

d. Pre-Emergency. Examples of circumstances warranting declaration of a Pre-Emergency condition include:

(1) Malfunction of flood control gate system during flood operations which impedes release of water and creates potential for spillway flow.

(2) Minor seepage problems including: unusual increases or decreases in amount, cloudy appearances of seepage or presence of fines, development of new seepage areas as indicated by soft boggy areas or new or lush vegetation, and substantial unexplained fluctuation in piezometer readings.

(3) Minor slope failures including: tension cracks at crest or in slopes of embankment, small bulges in slopes or in foundation near toe of slope, small depressions or sags in crest or slopes, changes in horizontal crest alignment, and gullies forming in or near embankment or junction of the embankment and abutments.

(4) Threats of sabotage or occurrence of sabotage of non-critical project features.

e. Emergency. Examples of conditions warranting declaration of an Emergency condition include:

(1) Emergency Drawdown. Extremely high flood storage levels and/or sudden releases of large volumes of water or any emergency condition affecting operation of Mohawk Dam could result in a serious hazard to life and/or nearby property. Early identification of the existence or the potential for occurrence of such conditions is essential for initiating emergency drawdown operations and/or repairs and for issuing appropriate notifications to higher authority and potentially affected parties. The emergency drawdown schedule for Mohawk Dam is shown on **Plate No. 7-9**, plate section.

(2) Major seepage problems including: large increases in piezometer readings, movement of large amounts of material in existing or new seep wells, pipes in embankment or foundation materials, seepage at higher elevations on downstream face of dam or in abutment areas, and substantial increases in normal seepage amounts (especially when associated with movement of material from embankment of foundation).

(3) Major slope failures including: appreciable depressions or sloughs in the crest or slopes of the dam or bulges in the slopes or foundation, large gullies developing and continuing to erode in the embankment or at the junction of the embankment and abutments, displacement of structures of instrumentation on the dam and continuing expansion of tension cracks after their appearance on the dam crest or slope.

(4) Threats of sabotage or occurrence of sabotage to critical project features.

f. Action Upon Declaration.

(1) Damtender (Resource Manager).

(a) Monitor telephones on 24-hour basis.

(b) Notify key personnel at Muskingum Area Office and Facility Manager of Walhonding.

(c) Notify District Dam Safety Officer (Chief, Engineering Division).

(d) Maintain steady 24-hour surveillance of situation responsible for declaration.

(e) Perform non-routine observations and tasks as directed by District.

(f) If Area Office personnel cannot be contacted, notify key District personnel listed in **Table No. 7-2**, page 7-12.

(2) Muskingum Area Office (Area Manager).

(a) Monitor telephones on 24-hour basis.

(b) Notify key personnel-See **Table No. 7-2**, page 7-13.

(c) Place all personnel on standby for emergency duty.

(3) District.

- (a) Activate Emergency Operations Center.
- (b) Monitor telephones on 24-hour basis.
- (c) Test Cell Phone communications.
- (d) Place key staff on emergency duty.
- (e) Provide detailed instructions to Damtender for any needed non-routine observations and tests.
- (f) Dispatch personnel to dam site as required to provide expert evaluation of situation and to assist the Damtender as needed.
- (g) Make any necessary notifications concerning declared situation.

g. Communications.

(1) Normal. Communications between the District, Damtender (Resource Manager) and Muskingum Area Office will normally be by telephone. Telephones at the Project Office, Muskingum Area Office and District Emergency Operations Center will be manned on a 24-hour basis whenever a Pre-Emergency or Emergency condition is in effect at Mohawk Dam or at another site that can be affected by operation of Mohawk Dam. Office and home phone numbers of key District, Mohawk Dam, Muskingum Area Office and other personnel are listed in **Table No. 7-2**, next page.

(2) Back-up. Cell Phones are now used as a backup communications network between the District Office, Project Office and Muskingum Area office. Cell Phones at the Project Office, Muskingum Area Office and District Emergency Operations Center should be kept turned on at all times whenever telephone service is disrupted, or, while a Pre-Emergency or Emergency condition is in effect at Mohawk Dam or at another site that can be affected by operation of Mohawk Dam.

(3) Emergency. During a situation when both Cell Phone and telephone communications between the District Office and Muskingum Area Office or Project Office is lost, others agencies or people equipped with amateur or citizens band radio or telephone facilities will be called on for assistance. Those to whom application for assistance may be made are listed in **Table No. 7-2**, next page, along with information for telephone contacts.

7-14. OTHER PLANS

The Water Resources Engineering Branch has prepared Inundation Maps for Mohawk Dam that delineate the areas both upstream and downstream of the dam that have potential for flooding in the highly unlikely event of an enormous flood of the Spillway Design Flood category or a large release of water. The maps were prepared in accordance with ER 1130-2-419, with the possibility of dam failure and dam retention. The maps also show the time factors associated with the movement of the hypothetical flood waves downstream of the dam.

TABLE NO. 7-2

**KEY EMERGENCY PERSONNEL**  
**Huntington District Office - Water Resources Engineering Branch**

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

**Water Resources Engineering Branch Personnel**                      **Home Telephone Number**

[REDACTED] ..... [REDACTED]  
 Chief, Water Management Section  
 [REDACTED] ..... [REDACTED]  
 Water Management Section  
 [REDACTED] ..... [REDACTED]  
 Chief, Hydrology and Hydraulic Section

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

**Muskingum Area Office**

[REDACTED] ..... [REDACTED]  
 [REDACTED] ..... [REDACTED]

**Mohawk Lake Project Office**

[REDACTED] (Damtender)  
 [REDACTED] (Facility Manager of Walhonding)  
 [REDACTED]

**Gate Operating Personnel**    **Telephone No.**

[REDACTED] .....Commercial..... [REDACTED]  
 [REDACTED] .....Commercial..... [REDACTED]  
 [REDACTED] .....Commercial..... [REDACTED]

**Other Agencies**

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

The effects of dam failure while the pool is being maintained at maximum flood control elevation were also modeled as part of the inundation studies but were not delineated on the maps. Flood profiles for all three conditions have been prepared as part of a Study Summary Report and are on file in the Water Resources Engineering Branch. Computation efforts were accomplished using the dam break computer program programs developed by the National Weather Service. U.S. Geological Survey Quadrangle maps were used as a base in preparing the inundation plates.

The Mohawk Dam inundation maps have been provided to the district Emergency Management Branch for use in developing an Emergency Plan for Mohawk Dam and for contact with State and local authorities. The State and local authorities are provided the maps for their use in developing evacuation plans for the affected areas.

#### 7-15. DEVIATION FROM NORMAL REGULATION

The Huntington District Engineer is occasionally requested to deviate from the normal regulation of Mohawk Dam. Approval and notification procedures are required when deviations from the normal water control plan are necessary. Prior approval for major deviations is required from the Division Engineer except as noted below. Deviation requests normally fall into the following categories.

##### a. Definitions.

Major Deviation: Changes the normal operation of the project for a period of time greater than 5 days and elevation changes greater than two feet. A Major Deviation requires approval of both the Branch and Division levels.

Minor Deviation: A change in the normal operation that is less than the Major Deviation criteria. A Minor Deviation may be approved at the Branch level with the concurrence at division level.

A letter example for the above is shown as **Plate 7-1a.**

1. Emergencies. Emergencies may fall under Major or Minor Deviations. Normally they begin as minor deviations and if necessary are elevated to Major Deviations. The most common emergency that can be expected to occur at a project is a downstream drowning; decreased flow may be needed while searching for the victim or increased flow may be needed to dislodge the body. Other common accidents occurring at the project are failure of the operation facilities, chemical spills, treatment plan failures and other temporary pollution problems. Water control actions necessary to abate the problem are taken immediately unless such action would create equal or worse conditions.

2. Minor Deviations. There are instances that create a temporary need for minor deviations from the normal regulation plan, although they are not considered emergencies. The following list contains most of the types of special regulations commonly requested: Construction work, major or minor, including pipeline changes or repair, boat dock work, or testing of a finished facility may have various and changing flow requirements.

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

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

and Ohio River Division office or Huntington Water Resources Engineering Branch Chief, along with recommendations for review and approval. Except in case of emergency, confirmation is necessary before the Water Management Section may grant a request.

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

7-16. RATE OF RELEASE CHANGE - N.A.

## SECTION VIII - RESULTS OF WATER CONTROL PLAN

### 8-01. GENERAL

The results of regulation for the authorized purpose of flood control are presented in the following paragraphs and in the plates referenced therein. Flood control benefits are discussed in sub-section 8-03 and stage and flow reductions are listed in the table section at the back. Reservoir operations for various hypothetical design floods and for representative actual floods were used to 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. 8-1** shows that the lake is likely to be filled to spillway elevation 890.0 once in 195 years. The Water Resources Engineering Branch recently completed a district-wide study involving simulation of post-project operation. Included in this study was the simulation of the Mohawk Dam project from the beginning of its operation in 1937 to 1992. The Mohawk Dam regulated outflow hydrographs derived from this study are stored in the Water Management Section computer system.

### 8-02. FLOOD CONTROL

The Mohawk Dam and the four tributary reservoirs in its watershed control 1,504 square miles or nearly 51.6 of the drainage area of the Walhonding River above the Nellie gage. Regulation of the project has been effective for control of flood damages downstream of Nellie and subsequent waterways. The application of the adopted water control plan to three hypothetical floods, two historical floods and four recent floods as they occurred are discussed in the following paragraphs.

#### a. Hypothetical Floods.

(1) Official Plan Flood. Mohawk Dam was designed by the standard prevailing criteria for the 1930's. At that time the modern concept in the 1930's of a Spillway Design Flood(SDF) or a Standard Project Flood (SPF) had not yet been developed. Therefore, the original criteria utilized for the design and construction of Mohawk Dam was named the Official Plan Flood, the Reservoir Design Flood, and the Project Design Flood. The Official Plan Flood was assumed to be the largest general flood that could occur in the Muskingum River Basin. The record 1913 storm from the Miami River Basin was adjusted with a proportional isohyetal rainfall pattern and converted to the Official Plan Flood for Mohawk Dam. This storm had a runoff factor of 90 percent over a period of 3 days, which is equivalent to about 10 inches of runoff.

The Official Plan Flood for Mohawk Dam used was based on three criteria adopted by the Board of Consulting Engineers. The spillway was considered adequate if all three criteria produced sufficient freeboard below the top of the dam. The assumptions made for each of the criteria are given in **Table No. 8-1** next page, and the resulting hydrographs are on **Plate No. 8-3**, plate section.

Criterion II is the ruling criterion. The natural flow, no dam, was about 200,000 cfs; and the inflow peaked on a full spillway pool of 890 feet NGVD at about 219,000 cfs, with a crest of about 908.0 feet NGVD with two feet of freeboard, with a spillway flow of 151,000 cfs, the sluices were closed. The dam was designed to accommodate this

condition. Criteria I and III are less severe and would raise the reservoir level to elevations 901.6 feet NGVD and 903.6 feet NGVD, respectively.

Criterion	Initial Pool Elevation	Operation of Mohawk Dam	Flood Volume Inches of Runoff	Ac-ft.
I	799.2	All outlets closed for flood	10.0	801,500
II	890.0	All outlets closed for flood	10.0	801,500
III	799.2	Outlets operated according to the Official Plan until spillway crest elevation is reached, then outlets fully opened	14.0	1,122,000

The adequacy of the outlets for passing flood flows without overtopping the spillway crest was further investigated by their ability to handle the maximum flows resulting from three other hypothetical floods:

(a) A 5-day Storm Flood. This was a flood resulting from a 5-day storm which was proportional to the Official Plan Flood. The natural duration of the flood at the dam site was about 8 days, with a total runoff of 10.8 inches.

(b) A 3-day Storm Flood. This was a flood resulting from a 3-day storm, with a rainfall distribution of 25 percent the first day, 52.5 percent the second day, and 22.5 percent the third day. The natural duration of the flood at the dam site was about 6 days, with a total runoff of 9.2 inches.

(c) A 3-day Inflow Flood. This was an inflow flood with a duration arbitrarily set at 3 days and with a hydrograph that was roughly triangular. The total runoff was 9.2 inches.

(2) Reservoir Design Flood. As previously stated at the time of design of Mohawk Dam in the 1930's the concept of a (SDF) or a Standard Project Flood (SPF) had not yet been developed. For the 1930's the equivalent or similar flood for the current Standard Project Flood was named the Project or Reservoir Design Flood. The Project Design Storm was defined as the greatest storm for a given duration that is, excluding very rare possibilities, within the realm of being reasonably probable over a particular drainage area. This flood peaked at Mohawk Dam at about 91,500 cfs, and the sluice system was designed for this flood.

(3) Spillway Design Flood. As mentioned above, at the time of construction in the 1930's the present concept of a Spillway Design Flood (SDF) or a Standard Project Flood (SPF) had not yet been developed. Several years later, the Corps of Engineers and the National Weather Service developed the program or concept of the Spillway Design

Storm (SDS) as the theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage area at a certain time of year. Accordingly, the new SDS criteria was informally applied, on an after the fact basis, to Mohawk Dam, and the spillway was somewhat inadequate.

The Mohawk Dam spillway was originally designed for a storm equal to 10.0 inches of runoff, with a peak inflow of 218,000 cfs on a full spillway pool of 890 NGVD. The pool crest was about 908.0 feet NGVD with two feet of freeboard. About 40 years later, the contract for an evaluation and study of the entire Muskingum System for Spillway Adequacy and Replacement was awarded to the Dodson-Lindbloom Co. of Columbus, Ohio. This detailed study was undertaken in 1975 with the overall plan of evaluating and comparing the original Muskingum System of 14 reservoirs, plus 2 added, by current 1975 criteria. The 1975 study was based on Hydromet Bulletin No. 33, defined as the theoretically greatest depth of precipitation or probable maximum 48 hour storm or SDS over a particular drainage area at a certain time of year in the eastern United States. Detailed unit hydrographs were developed from individual storms and the SDS rainfall was applied, with the storm centered over the uncontrolled area above Mohawk Dam. The pool routings were natural conditions, no dam; followed by a full pool elevation 890 NGVD routing, and the third routing on a 50% half pool for all lakes. The natural SDF crest at the damsite was 352,000 cfs. The Spillway Design Storm had 19.99 inches of rain, with 17.15 inches of runoff, with an "A" inflow hydrograph peak of 385,000 cfs with all upstream reservoirs full. The pool crest for the full pool was 912.8 feet NGVD with a peak outflow of 266,800 cfs, while the half pool crest was 911.5 feet NGVD with a peak outflow of 242,500 cfs. Since the existing top of dam was elevation 910.0 feet NGVD, the dam was theoretically overtopped by 2.8 and 1.5 feet during the two floods. Based on this study the original Mohawk Dam and spillway was only capable of safely passing, with proper freeboard, about 84.9 percent of the Hydromet No. 33 (SDF) on a full pool, and about 86.9 percent of the SDF on a half-pool. Therefore, the 1975 Dodson-Lindbloom study recommended the top of the dam be raised a minimum of 7.0 feet in order to safely pass the SDF on a full pool with a 3.9 foot freeboard. This flood operation is shown on **Plate No. 8-4**, plate section.

Because of this obvious design deficiency, a report titled "Design Memorandum for Correction of Spillway Deficiency" was prepared in July 1981 by Tippetts, Abbett, McCarthy, and Stratton of New York. This report was prepared in compliance with the Huntington District letter ORHPB, dated 25 November 1977 "Muskingum River Dam Safety Program". This report utilized a SDS or PMP flood compiled by the Huntington District, Corps of Engineers, based on 1978 criteria of Hydromet Bulletin 51, had 21.28 inches of rainfall, 17.22 inches of runoff, a natural hydrograph peak of 355,000 cfs, a "A" inflow hydrograph peak of 380,000 cfs, a peak outflow of 278,600 cfs, and a pool crest of 913.2 NGVD. The next year the Corps prepared Supplement No. 1 "Design Memorandum for Correction of Spillway Deficiency" with approximately the same storm, now with a Hopbrook reduction, applied to a sharper peaking unit hydrograph. This Spillway Design Storm with 20.12 inches of runoff, a natural hydrograph peak of 381,000 cfs, a "B" inflow hydrograph peak of 410,700 cfs, a peak outflow of 257,260 cfs, and a pool crest of 918.7 feet NGVD was adopted for the 1982 design memorandum and was submitted under the Dam Safety Assurance Program for approval of funds to correct the deficiency. This 1982 SDF is shown on **Plate No. 8-5**, plate section. The Chief of Engineers then directed that a parapet wall be added to the top of the dam, raising the top of dam to elevation 916.7 feet NGVD to correct the deficiency. The additional 3.1 foot parapet wall for Mohawk Dam was

completed by 1984, and the additional improvements and revamping for both Dike No. 1 and Dike No. 2 were completed in 1985.

Later in 1982, the same Dodson-Lindbloom Associates of Columbus performed a dam break study for Mohawk Dam. Flood waves were determined for failure of the dam during the 1975 Spillway Design Flood (SDF) and with the reservoir level at elevation 890 feet NGVD. Flood waves were also determined for the SDF without failure. The study provided estimated wave heights and arrival times at several locations downstream of Mohawk Dam as well as maps of the areas inundated during the SDF with and without failure.

Current Corps criteria specify that the Spillway Design Flood (SDF) be based on the runoff from the Probable Maximum Precipitation (PMP), as indicated in Hydromet Reports 51 and 52. The CELRD further requires that this PMP be used with an antecedent storm of 39%(PMP) for 72 hours followed by a 120 hour dry period. Mohawk Dam has never been computer operated for this storm, as a result there is no plate to be shown. When this operation is completed the operational hydrograph will be forwarded to all concerned parties.

(4) Standard Project Flood. As previously stated at the time of design of Mohawk Dam the concept of a Spillway Design Flood (SDF) or a Standard Project Flood (SPF) had not yet been developed. The equivalent flood for the 1930's was named the Project or Reservoir Design Flood. The Standard Project Flood concept was developed for Corps use as an overall comparison and evaluation for all projects and areas. The Standard Project Storm is defined as the theoretically greatest depth of precipitation for a given duration that is, excluding very rare possibilities, within the realm of being reasonably probable over a particular drainage area at a certain time of year in the eastern United States. When the SDF concept was developed, the new SDF criteria was informally applied, on an after the fact basis, to Mohawk Dam. The SDF was based on generalized rainfall for small drainage areas up to 1000 square miles east of 105 degrees longitude as presented in EM 1110-2-1411, or Standard Project Flood. Later still, the Corps of Engineers made a detailed study of the maximum probable storm and flood SPF for all areas in the Muskingum Basin of less than 1,000 square miles drainage area. This detailed study was undertaken in 1966 with the plan of overall evaluating and comparing the original Muskingum System of 14 reservoirs, by current criteria. Detailed unit hydrographs were developed from individual storms and the SPF storm runoff of about 9.33 inches was applied. The SPF routings for Mohawk Dam were on a normal year-round pool of elevation 799.2 feet NGVD, which produced a natural crest of about 190,000 cfs, and a pool crest of 901.7 feet NGVD with a peak outflow of 121,000 cfs. Therefore, the original Mohawk Dam is capable of safely passing, within the required freeboard and with the concrete sluiceway, the Standard Project Flood on a normal year-round pool of elevation 799.2 feet NGVD.

Peak flood stage and discharge reductions due to the Muskingum River Basin flood control structures are given in the Muskingum Basin Master Manual for the representative floods at various locations downstream of Mohawk Dam. For a detailed compilation of all recorded annual natural flood crests at Mohawk Dam above 5,000 cfs see **Table No. 4-4** page 4-12, in this report.

b. Representative Floods.

(1) General. The historical floods which were selected for illustration of the water control plan are the floods of March 1913,

August 1935, and January 1937. Also selected were the floods of January 1959, July 1969, February 1979, August 1980, and February 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 Walhonding River. The flood of August 1935 was caused by widespread heavy rains falling on saturated ground, and resulted in record peaks for a summer storm on many streams. The flood of January 1937, which occurred when the Muskingum River Basin reservoir system was under construction, stemmed from a series of severe storms and resulted in record stages along the Ohio River. The flood of January 1959 resulted from generalized rains with high runoff due to the saturated, frozen and snow-covered ground. The flood of July 1969 resulted from intense rainfalls associated with a series of heavy thunderstorms which passed through north-central Ohio during a 6-hour period. The flood of February 1979 was caused by antecedent snowmelt and moderate rainfall falling on snow-covered and frozen ground. The flood of February 1985 resulted from a combination of rainfall and a general thaw.

(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 Walhonding 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 Walhonding River Basin, the main storm began just before noon 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 9.17 inches over the Walhonding River Basin. No rainfall information is available within the Mohawk Dam Basin for the storm, but at Wooster, located east of the basin, total rainfall was 10.15 inches, while at Bangorville located near the southern drainage boundary of Pleasant Hill Lake total 5-day period of 10.56 inches was reported. The mass rainfall over Pleasant Hill Lake was the highest of the Muskingum Reservoirs and Mohawk Dam was slightly less.

Neither Mohawk Dam nor any of the flood control dams in the Muskingum River Basin was built at the time, but the flood has been reconstituted. The computed natural crest at the dam would be about 102,000 cfs, while the modified inflow crest at Mohawk Dam due to the upstream reservoirs was approximately 86,000 cfs in the early morning hours of 26 March. In the reconstituted operation of Mohawk Dam, outflow was gradually increased at the onset of the storm on 22 March from approximately 1,030 cfs to about 9,800 cfs on 24 March, when the outlets would have been fully closed. The outlets would remain closed until the pool elevation reached the spillway elevation of 890 feet NGVD, on 26 March. The pool reached a maximum elevation of 896.2 feet NGVD on 27 March and stayed above the spillway crest with a fairly steady outflow of 10,200 cfs until 3 April. The pool continued to slowly drop to below elevation 822 feet NGVD with the same outflow of 10,200 cfs until about 3 May. Results of the regulation of this flood at Mohawk Dam, Walhonding Reference Point No. 1 gage by the fully functioning Muskingum River Control System are shown on **Plate Nos. 8-4 and 8-5**, plate section, respectively. The hydrographs shown in this and subsequent plates labeled "natural" represent the flow conditions that would exist without the Mohawk Dam Project, and those labeled "modified" represent the inflow conditions that exist with the project. The outflow hydrograph represents the regulated outflow from Mohawk Dam. The hydrographs from the other

regulated floods are labeled the same way.

(3) Flood of August 1935. The flood of 6-7 August 1935 is one of the largest general summer floods to affect the Muskingum River Basin. A series of storms from the end of July through 4 August raised basin streams and decreased soil retention capacities. Heavy rainfalls on 6 and 7 August, averaging 4.1 inches in less than 12 hours in the Muskingum River Basin created large runoff volumes which produced the highest summer stages of record on the Tuscarawas River below Dover.

Mohawk Dam was under construction when the flood occurred, but the flood has been reconstituted. The major inflow peak to Mohawk Dam was 5,250 cfs on 8 August. In the reconstituted operation of Mohawk Dam, the gates were closed at the onset of the flood and stored all of the flood inflow. The gates were then opened gradually to channel capacity outflow on 13 August to draw down the flood pool. The maximum pool level calculated for this flood was elevation 951.48 feet NGVD on 13 August.

(4) 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 Walhonding Basin, which was situated to the north of the center of maximum precipitation, experienced less severe flooding. Tributary streams experienced successions of flood rises, which moved out of the smaller rivers to accumulate in the larger rivers and caused increasingly higher stages and discharges in them. The heavy general rainfall continued for almost one month and concluded with the heaviest rainfall of the period in the storm of 14 to 25 January in which 7.93 inches fell over the Muskingum Basin and produced damaging floods. The flood control reservoirs in the Muskingum System were partially completed and helped to decrease the peak stages and discharges downstream by acting as automatic retarding basins.

Mohawk Dam was under construction when the flood occurred but the flood was reconstituted. There was a series of peaks through the period from 15 January to 25 January, with the largest peak occurring on 25 January. The computed natural crest was 37,000 cfs and the modified crest due to the operation of upstream reservoirs was approximately 30,100 cfs. The outlets were closed at the onset of the last crest and were gradually opened to a maximum of 10,200 cfs on 2 February until the reservoir emptied. The flow on the Walhonding River at Reference Point No. 1 was reduced from 41,500 to 11,800 due to the regulation of the upstream reservoirs. Results of regulation of this flood similar to those given for the 1913 flood are given in **Plate Nos. 8-6** thru **8-7**, plate section.

(5) Flood of January 1959. The flood of January 1959 is generally regarded as one of the highest of record along most tributaries in the Walhonding 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 ranging from 6 to 18 inches. In addition, a storm occurring between 14-17 January deposited an average of approximately one inch of precipitation over the Basin. 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 between midnight on 20 January and noon on 21 January. Most stations in the Walhonding Basin received between 4.0 and

5.5 inches of rain during the period 19-23 January.

The flood was reconstituted, and peak flows for the natural and the modified natural inflows were 70,200 and 63,870 cfs, respectively. The outlets were closed at the onset of the storm on 21 January and then gradually opened beginning on 24 January. The maximum outflow from Mohawk Reservoir was 9,780 cfs, and the maximum pool level obtained for the flood was elevation 873.94 feet NGVD. Approximately 62% of the available flood storage below the spillway crest was utilized during the flood. It is estimated that regulation of the Walhonding River Basin dams reduced the flood stage at the Nellie gage by 15.5 feet. Results of regulation of this flood are given in **Plate Nos. 8-8 thru 8-9**, plate section.

(6) Flood of February 1979. Subfreezing temperatures and a major snow cover persisted over the Muskingum River Basin during most of January and February 1979. Rising temperatures and light rainfall on 21-22 February created thawing conditions which persisted until moderate rainfall on 25-26 February, combined with rapid snowmelt, created flooding conditions in the Muskingum River Basin. Rainfalls averaged only approximately 1.5 inches but combined with snowmelt from 6-20 inches of snow cover on the Basin. The computed inflow crest at Mohawk Dam was approximately 19,800 cfs; maximum outflow from the dam was approximately 6,300 cfs. It is estimated that operation of the Walhonding River Basin reservoirs reduced the flood peak at the Nellie gage downstream of Mohawk Dam by 6.8 feet. Results of regulation of this flood are given in **Plate Nos. 8-10 thru 8-11**, plate section.

(7) Flood of August 1980. Heavier than normal rainfall over the Muskingum River Basin during June and July 1980 created saturated soil conditions in many areas. Subsequent widespread and intense thunderstorm activity during several periods in August thus resulted in substantial runoff, causing major rises in water levels during the month. Rainfalls of 2" were common from storms occurring on 2-6 August, 9-12 August, 17-19 August, and 21-22 August. The most notable rainfall occurred on 10-11 August in Guernsey, Belmont, Licking, and Muskingum Counties, as the Cambridge area received approximately 8.0 inches in 18 hours, and most areas in the 4 counties received at least 3.5 inches.

Of the four major aforementioned storms in August, three of the storms created reconstituted natural inflow peaks of more than 4,500 cfs at Mohawk Dam. Of those three, the most significant storm was that of 9-12 August, which had a natural inflow crest of 12,200 cfs. The storms of 17-19 August and 21-22 August created natural inflow crests of approximately 4,800 cfs and 5,300 cfs, respectively. No significant reductions were experienced in flood heights due to the operation of the dams for the storms of 17-19 August and 21-22 August. However, for the storm of 9-12 August, the maximum outflow from Mohawk Dam was limited to 6250 cfs, and it is estimated that regulation of the Walhonding River Basin dams reduced the flood peak at the Nellie gage below Mohawk Dam by approximately 3.2 feet. Results of regulation of this flood are given in **Plate Nos. 8-12 thru 8-13**, plate section.

c. Benefits. Since their construction in the 1930's, the 14 original dams in the Muskingum River Basin reservoir system have continued to significantly reduce flood damages in the Basin. The total dollar amount of benefit creditable to the projects is estimated to be 2.53 billion through 2003. This constitutes damages that would have occurred in the Muskingum Basin if the projects were not operating.

8-03. RECREATION - N.A.

8-04. WATER QUALITY

a. Special Problems. The most significant water quality problems affecting the Walhonding River are related to agricultural activities within the watershed. Since water is not routinely impounded behind Mohawk Dam, problems with water quality, other than what already exist in the watershed, are not expected.

b. Data Interpretation and Results. An interdisciplinary approach is used to evaluate the physics, chemistry, and biology of inflow streams and the outflow. The following interpretations are based on limited data collected between 1974 and 1975.

(1) 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. Samples were only collected at one station downstream of the dam. No biological samples have been collected at the Mohawk Dam by the U.S. Army Corps of Engineers.

In terms of major ions and descriptive parameters, the Walhonding River is characteristic of the predominately calcareous nature of the watershed. The water was classified as a calcium carbonate type which represents a balanced condition. Specific conductance, chlorides, and sulfates were elevated. Water hardness was high, with the water classified as very hard (Durfor and Becker, 1964). The system had high alkalinity which indicated a good inherent capacity to resist shifts in pH. Dissolved oxygen was slightly above saturation which indicates a high quality stream.

Concentrations of nutrients are indicators of productivity. The Walhonding River showed moderate levels of all nutrients tested, including phosphorous and nitrate. All were within Ohio's Water Quality Standards. There is no recent data to evaluate trends or shifts in the system.

(2) Biological. No biological samples have been collected at the Mohawk Dam by the U.S. Army Corps of Engineers

8-05. FISH AND WILDLIFE - N.A.

8-06. WATER SUPPLY - N.A.

8-07. HYDROELECTRIC POWER - N.A.

8-08. NAVIGATION. - N.A.

8-09. DROUGHT CONTINGENCY PLAN - N/A

8-10. FLOOD EMERGENCY ACTION PLAN

Since the Mohawk Dam project has been operational, no emergency drawdown has occurred; and since it has always been operated as a dry dam, the possibility that it should become necessary to evacuate the dam is rather rare. However, drawdown from the maximum flood elevation to normal pool elevation can be accomplished in approximately 10 days. This estimate is based on several assumptions, including the outlets to be

fully open at Mohawk Dam, a natural inflow of one cfs per square mile, and additional inflow from outlet capacity discharge at Charles Mill, Mohicanville, and Pleasant Hill Reservoirs. The time required to empty the reservoir without overtopping the river banks below the dam would be approximately 20 days, based on the same assumptions. An emergency drawdown schedule for Mohawk Dam is shown on **Plate No. 7-9**, plate section.

8-11. FREQUENCIES AND DURATIONS

a. Natural Discharge-Outflow Gage Frequency. The natural discharge-frequency curve for the Walhonding River at the Mohawk Dam 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 Muskingum Basin. 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 certain exceedence intervals from 1 year to 1000 years are given on the next page as **Table No. 8-2**, below.

<b>TABLE NO. 8-2</b>	
<b>FREQUENCY SUMMARY</b>	
<b>WALHONDING RIVER AT MOHAWK DAM OUTFLOW GAGE</b>	
<b>ALL SEASONS - NATURAL</b>	
<u>Exceedence Interval (years)</u>	<u>Discharge (cfs)</u>
1000	94,500
500	83,400
200	70,500
100	61,600
50	53,200
20	43,500
10	35,600
5	29,200
2	21,900
1	16,900

Since 1937, flows in the Walhonding River have been regulated by Mohawk Dam. 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 1938 through 1978. 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 and for each month to produce the Annual and Monthly Flow Duration curves for the Walhonding River below Mohawk

Dam.

b. Pool Elevation Frequency and Duration. All significant flows for the period of record on the Walhonding River were tabulated and hydrographs reconstituted for the dam site or obtained by discharge-drainage area ratio. The hydrographs were routed through the lake following the approved plan of water control and the peak pool elevation noted. Using the graphical analysis method described in Beard's work mentioned in sub-section 8-13a above, the pool elevation frequency was estimated and is shown in Frequency of Filling, **Plate No. 8-1**, plate section. Deviation from the minimum elevation, 799.2 feet NGVD, was plotted as pool elevation probable of occurrence on the average once in a number of years, which is the exceedence interval, against the interval. Selected exceedence intervals with the respective maximum pool elevation expected to occur on the average once in that interval are listed below in **Table No. 8-3**.

Pool elevation hydrographs produced when the floods were routed through the lake were measured for amplitude (duration in days) at certain specified elevations and these were tabulated by elevation. The total number of days tallied for each elevation for all the floods of the period of record was divided by the number of years of record to obtain the average number of days per year at or above that elevation. The "Average" curve in Duration of Filling, **Plate No. 8-2**, plate section, was derived by plotting these values of the average number of days against the respective elevations. Amplitudes at specific elevations of the curve with the highest peak were plotted against the elevations to obtain the "Maximum Number of Days per Period of Record."

**TABLE NO. 8-3**

**FREQUENCY SUMMARY  
MOHAWK DAM POOL ELEVATION DEVIATION - ALL SEASONS**

<u>Exceedence Interval (years)</u>	<u>Elevation (feet NGVD)</u>
195.....	890.0
150.....	888.0
100.....	884.8
50.....	879.0
20.....	870.8
10.....	865.0
5.....	857.8
2.....	847.8
1.....	839.0

c. Control Stations. The natural frequency was estimated at several control locations along the Walhonding and Muskingum Rivers using similar methods and techniques of data handling and calculation as were used for the Walhonding River at the dam site. These control stations are located at Nellie, Reference Point No. 1, Coshocton, Dresden, Zanesville, McConnelsville, and Marietta.

Actual peaks occurring at each of the gaging stations since the

Muskingum Basin projects went into operation were increased by the routed lake reductions to produce natural flows. For each gage the 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 Flow Frequency Curves, All Seasons.

In order to estimate modified frequencies at each gage, representative floods from the record prior to beginning operation of the Muskingum Basin projects were routed through the reservoirs and reductions routed to the gaging stations. These were applied to the actual (natural) and the resulting modified peaks noted. Reductions of flows affected by the Muskingum Basin projects since they were placed in operation were routed to the gaging stations and added to the actual (modified) flows to produce the natural. At each gaging station the peak modified flow for each event was plotted against the peak natural flow for each event. The most representative smooth curve, to be known as the "Correlation Curve," was drawn among the points. Any point on the Correlation Curve gives, for the peak natural flow specified, the probable peak flow to be experienced at that gaging station because of the control of the Walhonding and Muskingum Rivers by the Muskingum Basin projects. The exceedence intervals of the modified flows are the same as those of the corresponding natural flows. Therefore, the intervals of selected natural flows were plotted against their corresponding modified flows to produce the "modified" curve.

Studies of the flow durations at the various gaging stations were performed using the U.S. Geological Survey records of flow at each 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 and for each month, to produce the annual and monthly flow duration curves.

## SECTION IX - WATER CONTROL MANAGEMENT

### 9-01. RESPONSIBILITIES AND ORGANIZATION

#### a. Corps of Engineers.

(1) General authorities for allocation and regulation of reservoir storage in projects owned and operated by the Corps of Engineers are contained in legislative authorization Acts and referenced project documents. These public laws and project documents usually contain provisions for development of water control plans, and appropriate revisions thereto, as shown on the Organization Chart **Plate No. 9-1**, plate section, under the discretionary authority of the Chief of Engineers. Some modifications in project operation are permitted under congressional enactments subsequent to original project authorization; regardless, Mohawk Dam is fully owned and operated by the U.S. Government. The Huntington District, Corps of Engineers is the operating agency under administrative control of the Muskingum Area office within Operations and Readiness Division.

An organizational chart is shown on **Plate No. 9-1**, plate section, for Water Control Management in the Muskingum River - Walhonding River Basin. As shown on the chart, the Recreation-Resource Management Branch and the Muskingum Area Office is responsible for supervision of the operation and maintenance of the dam and operations area at Mohawk Dam. The Damtender (Resource Manager) at Mohawk Dam regulates the project in accordance with general instructions and Special Directives issued by the Water Management Section. Special Directives are issued and signed by the Chief, Water Management Section, for dissemination to the Mohawk Dam, Damtender as necessary to efficiently regulate the project for optimal water control management for all project purposes.

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

(3) Great Lakes and Ohio River Division-LRD. The Division Engineer has primary responsibility and authority for direct action with respect to all phases of reservoir regulation, including: (a) basic policies, criteria, and concepts that determine operating plans; (b) technical evaluations; (c) field operation; and (d) review and approval of reservoir regulation plans and manuals and related activities. The Great Lakes and Ohio River Division Office(LRD) 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 Water Control Center is responsible for administration of the Division Engineer's policy for water control management.

(4) Huntington District. The District Engineer has 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 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) Navigation stage regulation;
- (d) Hydropower;
- (e) Recreation;
- (f) Fish and Wildlife enhancement;
- (g) 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 utilizing objectives and specific provisions of project authorizing legislation and applicable Corps of Engineers reports. They will include any applicable authorities established after project construction. All water control plans will be prepared with appropriate consideration to all applicable congressional acts relating to operation of Federal facilities. Included are the 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. is further 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-MT-E, is advised, as soon as possible, of any coordination activities which may require a study, public hearing, or revision in operating plans. Districts are required to alert the Division Engineer, ATTN: CELRD-EC-W, of any significant deviations from routine regulation plans. The communication mode for the advisory is commensurate with the urgency of the situation and is transmitted before the district implements a plan of action.

During normal operations, the Water Management Section of the Water Resources Engineering Branch is 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 Branch hydrologic data collection and water control management system, including computers and field equipment.

(f) Developing 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 a 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 meteorologic data.

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

(c) Providing liaison personnel to support Emergency Operations 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 the lines of communication between the various office elements are shown on **Plate No. 9-2**. Details and responsibilities of other elements are indicated in the overall

district plan in the Emergency Operations Center Plan and ER 500-1-1, ER 500-2-1 and all annexes to these two ER's.

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 Resources Engineering Branch personnel may be required to maintain effective water control management within the Huntington District. The area affected and magnitude of the flood determines 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 staffs are available from 18 to 24 hours daily, depending on the magnitude of a particular event. At each project, including Mohawk Dam, 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 and illustrated in **Plate No. 9-3**, plate section.

b. Other Federal Agencies. The National Weather Service and the U.S. Geological Survey cooperate and coordinate activity with the Water Management Section in regard to accumulation of rainfall and streamflow data, as well as river forecasts and discharge measurements. The Corps of Engineers is required by the Fish and Wildlife Coordination Act (48 Stat. as amended) to coordinate all plans affecting Fish and Wildlife with the U.S. Fish and Wildlife Service. The service is required to present the plans to the relevant State Agency, in this case, the 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.

c. State and County Agencies. No local or state agency has funding or operational responsibilities in the Huntington District multipurpose reservoirs except in leased recreational areas. 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 the responsibility for conservation of fish and wildlife and for boating safety at the project lakes. The Game Protection Division of the Department of Natural Resources enforces hunting regulations and licenses on the reservoir lands. The State has undertaken fish management at the project lakes and the Corps of Engineers cooperates in the lake level manipulation and maintenance of downstream flow requirements to enhance fisheries management.

d. Private Organizations. There are numerous private interests or businesses presently involved with Mohawk Dam.

#### 9-02. INTERAGENCY COORDINATION AND COOPERATION

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

The Public Affairs Office in the Huntington 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 Corps of Engineers. Both are unofficial monthly publications for Corps' employees and retirees of all ages.

b. National Weather Service. An agreement between the National Weather Service (NWS) and The Corps of Engineers provides for collection and dissemination of current precipitation data for the Ohio River Basin. By joint agreement, the NWS installs, maintains and operates all stations in the Ohio River Network, except those operated by the Corps of Engineer personnel at flood-control and navigation projects. Where there is a mutual need for the data, station costs are shared by both the NWS and the Corps of Engineers. Costs of stations required 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 described in paragraph 6-02b, NWS provides a range of 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 USGS in order that sufficient stream flow water would be available to meet special needs in connection with the Corps water resources responsibilities. This is in keeping with the Chief of Engineers policy of fully utilizing the facilities and services of other Federal Agencies in obtaining many

types of basic data. Accordingly, arrangements were made for the Geological Survey to operate specific stations for the Corps on an advance of funds basis. Although the Corps of Engineers requires the basic data, many other Federal, State, and private agencies and individuals interested use the water data. The data are published by the survey assuring maximum availability and use of all data.

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

The Geological Survey coordination and cooperation with the Corps, described in paragraph 6-20a, provides the Water Management Section with a system for obtaining reliable stage and flow information, which is necessary for efficient water control management.

d. Ohio Department of Natural Resources. The Huntington District Water Management Section cooperates fully with the Ohio Department of Natural Resources about fish and wildlife enhancement in the Ohio lakes and downstream areas, by making special efforts to maintain constant pool elevations during April, May, and June for spawning benefit. Additional coordination is used for proper timing of spring filling and fall drawdown, and probable height of both lake level manipulation during flooding and expected project outflow.

The Ohio Department of Natural Resources maintains an Office of Corps Liaison for the purpose of coordinating special releases from Corps Lakes for recreational or other purposes. This office receives all requests for special regulation and, after examining the request and appending to it any ODNR comments, sends the request to the District Office. Using the Corps based guidance policies and criteria a determination is then made, and this decision is then sent back to the ODNR to coordinate with the organization making the request.

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

The Ohio Division of Forestry, all project lake Corps Personnel, and project lake state park personnel cooperate in fire-fighting activities to suppress fires that threaten or are burning on project lands. Project personnel cooperate by taking training in fire suppression techniques, reporting such fires to the ODNR District

Forester, fighting the fires before State personnel arrive and by assisting their suppression efforts after arrival.

The Parks and Recreation Division will enforce the Boating safety and water regulations, while hunting and fishing licensure procedure enforcement is by the Division of Wildlife. There is frequent day-to-day contact between project personnel and Ohio Department of Natural Resources personnel through much of the year.

e. Other Federal, State, Local or Private Agencies. The Corps of Engineers receives requests for information, aid, or cooperation from many parties or groups. All legitimate responsible requests from Federal, State, local, or private organizations or from groups that coordinate with ODNR receive appropriate attention and consideration. Accuracy of information transmitted and the proper level or amount 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 concerns or emergency complications involving regulation of Mohawk Dam, the District Emergency Operations Manager coordinates with the Ohio Disaster Services Agency. An example of cooperation with a State entity is an occasion when the Corps studies damages and reconstruction costs due to a flood or other disaster for the office of the Governor to use in applying for Federal assistance.

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

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

### 9-03. INTERAGENCY AGREEMENTS, MEETINGS AND ORGANIZATIONS

Agreements among the Corps of Engineers, the U.S. Geological Survey, and the National Weather Service are mentioned and outlined in paragraphs 5-02a and b. An annual meeting is held with each of the State branches of the Geological Survey cooperating 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 the Division of Forestry. The understanding includes cooperative warning and suppression of fires on or threatening Corps owned lands, Ohio Department of Natural Resources maintenance of a standard cache of fire-fighting tools at the project, and payment by the Corps of extinguishment costs incurred by the Ohio Department of Natural Resources.

The Great Lakes and Ohio River Division Water Management Division holds a quarterly meeting of the Reservoir Operations Coordinating Group. The meeting is normally 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 meeting is to exchange information and views on regional water recourse concerns.

### 9-04. COMMISSIONS, RIVER AUTHORITIES, COMPACTS, and COMMITTEES

a. Ohio River Basin Commission(ORBC). This commission has an active interest in the operation of Mohawk Dam 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(PBFC). 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 Counsel; 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 and Construction 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 IIDMC is composed of local, state, and Federal agency directors that have the authority to represent all user water needs within the Muskingum 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. HUNTINGTON DISTRICT REPORTS

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

a. Periodic.

(1) Daily. Districts are required to report current hydrologic data daily as prescribed by the Division Office. A daily report is prepared seven days per week by the Water Management Section of the Water Resources Engineering Branch and on Saturdays, Sundays and holidays. It is prepared and inserted into a computer file. After review, the report is sent over a leased line to the Great Lakes and Ohio River Division water control system. The transmission includes morning lake elevation, rate of outflow, and 3-day forecast of lake and outflow for all reservoir projects. Ohio River morning stages and 24-hour rainfall, morning stage and flow and 5-day flow forecast for Ohio River tributary gage points complete the transmission and the report. The report items are prepared in accordance with ORDER 1110-2-20, CHORD-ED-W lt, 10 Jul 69, CHORD-ED-W lt, 23 Jan 67, and ORDER 1110-2-17.

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

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 are 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 LRD. 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. All of the key gage points are reported for the Muskingum and Ohio River Basins. The main stem point is located at McConnelville.

During any flood, drought or other emergency involving reservoirs, the Ohio River or other streams in the District, the Water Resources Engineering Branch provides all available information to the District Engineer, Chief of Engineers and interested elements as frequently as necessary.

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

(4) Quarterly Reservoir Operations. Each District provides a quarterly review of meteorological influences and water control management activities to each of the four yearly meetings of the Reservoir Operations Coordinating Group. Huntington District personnel of the Water 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 CEORD-ED-W Ltr, 30 September 1977 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 reports on major accomplishments concerning personnel, training, model application, ADP use, data reporting and analysis, and general improvements in reservoir regulation activities.

By Executive Order 12088, the President ordered 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. An annual Division Water Quality report is required by ORDR-2-26. The report is submitted in two parts. The first part addresses the divisions 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. The District report 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, aimed at identification or solution of problems and problems requiring special studies with schedules for executing the studies. The annual water quality report is submitted by 1 December of each year.

b. Special Reports.

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

(2) Post-Flood Report of Reservoir Effects. Information on the operation of the affected reservoirs is gathered in accordance with ER 500-1-1. This report provides details on antecedent meteorologic and hydrologic conditions, description of the performance of the dam and appurtenant works, detailed analysis of the operating procedures, and effects of reservoir operation on both Muskingum and the Ohio River. Reservoir effects include evaluation of the stage reductions at key stations, estimates of damages prevented by the projects, and precipitation maps will be included in the post-flood reports required by ER 500-1-1. Conclusions are discussed with regard to adequacy of operating technique, performance of structures, and benefits derived from operations during the flood. Tabular and graphic data are used to calculate stage reductions at the following gaging stations pertinent to Mohawk Dam: Walhonding River at RPl, Muskingum River at Coshocton and Zanesville, and Ohio River at Marietta. The outline of a typical post flood report is given below.

- I- Authority, Purpose And Scope
- II- Basin Description
  - Basin Flood Control works
  - Impact of Flood
- III- General Precipitation
  - Storms and Reservoirs
- IV- Damages and Flooding
- V- Antecedent Rainfall
  - Storm Rainfall and Runoff

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

VII- Computer Programs Utilized  
Special Flood Activity

(3) Fiscal year budget requests. Fiscal year budget requests for water control management activities are 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 reported. Information on the Water Control Data Systems and associated Communications Category of the Plant Replacement and Improvement Program is submitted with the annual budget. Reporting is in accordance with an Engineer Regulation and the annual Engineer Circular on Civil Works Operations and Maintenance, General Program.

(4) The Chief of Engineers. The Chief of Engineers and staff require information to respond to inquiries from members of Congress and others regarding runoff potentials. Therefore, the Division Engineer submits 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, if necessary. Dispatch of supplemental reports is determined by the urgencies of situations as they occur. The reports are 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) Major droughts. During major droughts or extreme 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 precipitate actions associated with Corps of Engineers reservoirs.

(6) Master Plans. Division water control managers will develop Master plans for water control data systems and significant revisions thereto. They are 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 are maintained current and are updated as necessary to meet needs.

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

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

TABLE NO. 9-1

HUNTINGTON DISTRICT REPORTS  
BY  
WATER RESOURCES ENGINEERING BRANCH

**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. 3-1

PERTINENT GAGE DATA  
WALHONDING RIVER

Gage	Location	Code Symbol	Equip	Reference Staff	Gages Other	Recorder	Datum of Gage
Lake, I	Gate House on Top of Dam	MKWD4-I	DCP	SL		RL	799.2
Outflow, H	Nellie, above US Rt. 36 HW Bridge, 1.7 mi Below dam	MKWD4-K	DCP,H	SO	TO	RO,PO	790.0
Inflow	Mohican River inflow is estimated by the combined outflow of three upstream lakes, Charles Mill, Pleasant Hill, and Mohicanville.						
Inflow	Mt. Vernon on Kokosing R.	MTVD4	DCP,V	SN	WN,TN		984.16
Walhonding Reference Point #1	Walhonding R. bridge, 4.7 mi above mouth	MKWD4-I	DCP	SL		RL	764.0
Coshocton	Muskingum R. 1 mi southwest of Coshocton						725.0
Killbuck	Killbuck Cr. at Killbuck, below Rt. 62 bridge						
SB	- Stilling Basin						
T	- Electric tape			W - Wire Weight			
DCP	- Data collection platform			S - Staff			
H	- Hydrologger, answers telephone by giving stage in synthesized voice						
R	- Strip chart recorder						
V	- Voice module with data collection platform to answer telephone as the Hydrologger above						
P	- ADR or Punch-tape type stage recorder						

TABLE NO. 4-2

## CLIMATIC SUMMARY - WALHONDING RIVER BASIN

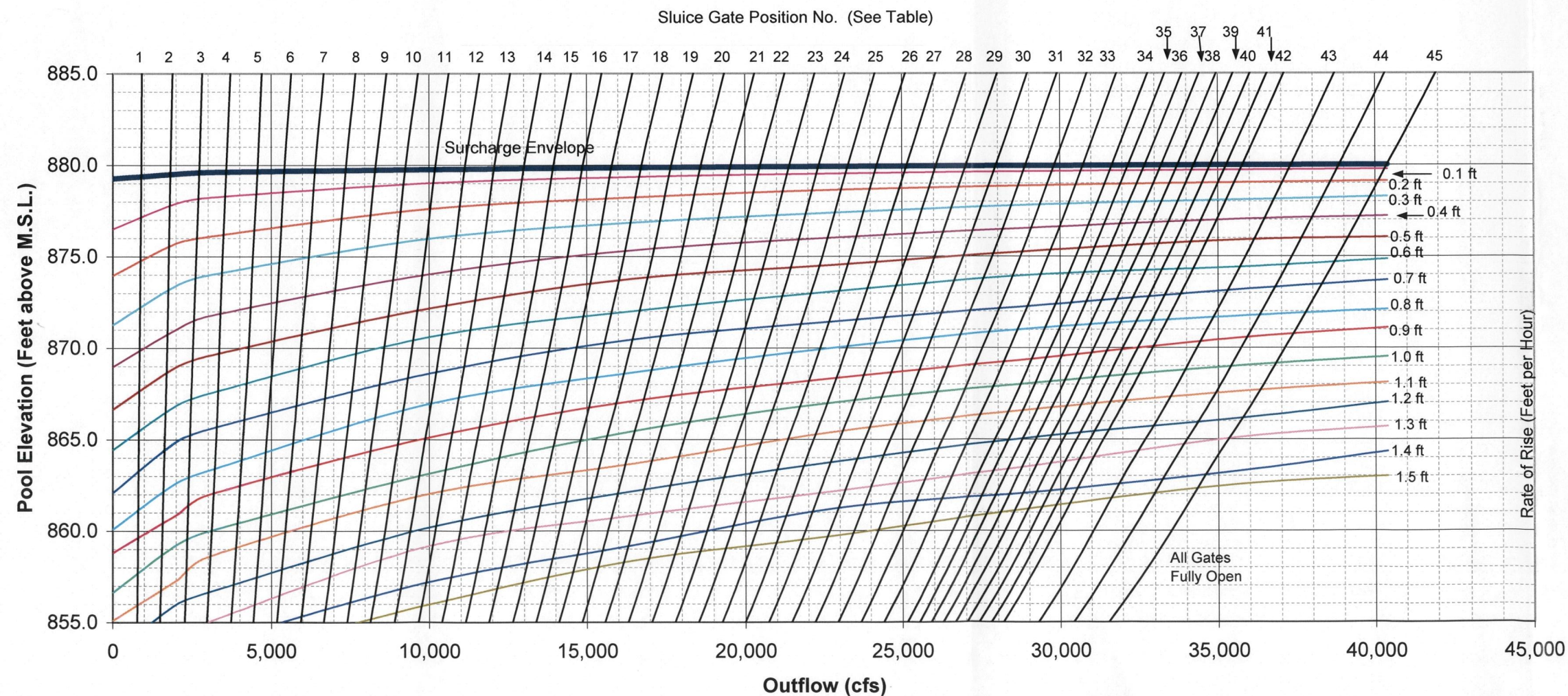
Condition	Station	Years of Record	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Normal Monthly and Annual Temperature (°F)	Wooster	86	26.9	28.5	37.0	48.1	58.4	67.7	71.6	69.7	63.6	52.1	40.2	30.0	49.5
	Mansfield Airport	18	26.5	29.1	35.9	48.1	58.4	68.3	71.9	70.1	63.5	53.7	40.1	29.0	49.6
	Fredericktown	25	26.2	27.9	37.5	48.7	59.4	68.5	71.9	70.3	63.6	52.5	40.1	28.6	49.6
Normal Monthly and Annual Precipitation (Inches)	Wooster	90	2.93	2.37	3.32	3.04	3.75	3.99	4.14	3.37	3.09	2.31	2.55	2.48	37.34
	Mansfield Airport	18	2.75	2.07	3.06	3.43	3.60	2.95	3.82	2.81	2.68	1.83	2.79	2.41	34.20
	Fredericktown	27	2.80	2.36	3.46	3.61	3.78	4.17	3.82	2.96	2.73	2.27	2.57	2.37	36.90
Normal Monthly and Annual Snowfall (Inches)	Wooster	79	8.4	7.2	5.3	1.7	0.1	---	---	---	---	0.3	2.7	6.5	32.2
	Mansfield Airport	19	8.4	8.5	7.7	1.3	0.1	---	---	---	---	0.1	3.0	7.9	37.0
	Fredericktown	25	7.6	7.1	4.9	0.6	0.1	---	---	---	---	0.1	2.0	5.9	28.3



Sluice Gate Position No.	Sluice Gate No. 1	Sluice Gate No. 2	Sluice Gate No. 3	Sluice Gate No. 4	Sluice Gate No. 5	Sluice Gate No. 6	Sluice Gate Position No.	Sluice Gate No. 1	Sluice Gate No. 2	Sluice Gate No. 3	Sluice Gate No. 4	Sluice Gate No. 5	Sluice Gate No. 6	Sluice Gate Position No.	Sluice Gate No. 1	Sluice Gate No. 2	Sluice Gate No. 3	Sluice Gate No. 4	Sluice Gate No. 5	Sluice Gate No. 6
1	0 FT	1 FT	0 FT	0 FT	1 FT	0 FT	16	5 FT	6 FT	5 FT	5 FT	6 FT	5 FT	31	10 FT	10 FT	11 FT	11 FT	10 FT	10 FT
2	0 FT	1 FT	1 FT	1 FT	1 FT	0 FT	17	5 FT	6 FT	6 FT	6 FT	6 FT	5 FT	32	10 FT	11 FT	11 FT	11 FT	11 FT	10 FT
3	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	18	6 FT	6 FT	6 FT	6 FT	6 FT	6 FT	33	11 FT	11 FT	11 FT	11 FT	11 FT	11 FT
4	1 FT	2 FT	1 FT	1 FT	2 FT	1 FT	19	6 FT	7 FT	6 FT	6 FT	7 FT	6 FT	34	11 FT	11 FT	12 FT	12 FT	11 FT	11 FT
5	1 FT	2 FT	2 FT	2 FT	2 FT	1 FT	20	6 FT	7 FT	7 FT	7 FT	7 FT	6 FT	35	11 FT	12 FT	12 FT	12 FT	12 FT	11 FT
6	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	21	7 FT	7 FT	7 FT	7 FT	7 FT	7 FT	36	12 FT	12 FT	12 FT	12 FT	12 FT	12 FT
7	2 FT	3 FT	2 FT	2 FT	3 FT	2 FT	22	7 FT	8 FT	7 FT	7 FT	8 FT	7 FT	37	12 FT	12 FT	13 FT	13 FT	12 FT	12 FT
8	2 FT	3 FT	3 FT	3 FT	3 FT	2 FT	23	7 FT	8 FT	8 FT	8 FT	8 FT	7 FT	38	12 FT	13 FT	13 FT	13 FT	13 FT	12 FT
9	3 FT	3 FT	3 FT	3 FT	3 FT	3 FT	24	8 FT	8 FT	8 FT	8 FT	8 FT	8 FT	39	13 FT	13 FT	13 FT	13 FT	13 FT	13 FT
10	3 FT	4 FT	3 FT	3 FT	4 FT	3 FT	25	8 FT	9 FT	8 FT	8 FT	9 FT	8 FT	40	13 FT	13 FT	14 FT	14 FT	13 FT	13 FT
11	3 FT	4 FT	4 FT	4 FT	4 FT	3 FT	26	8 FT	9 FT	9 FT	9 FT	9 FT	8 FT	41	13 FT	14 FT	14 FT	14 FT	14 FT	13 FT
12	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	27	9 FT	9 FT	9 FT	9 FT	9 FT	9 FT	42	14 FT	14 FT	14 FT	14 FT	14 FT	14 FT
13	4 FT	5 FT	4 FT	4 FT	5 FT	4 FT	28	9 FT	10 FT	9 FT	9 FT	10 FT	9 FT	43	14 FT	14 FT	Full Open	Full Open	14 FT	14 FT
14	4 FT	5 FT	5 FT	5 FT	5 FT	4 FT	29	9 FT	10 FT	10 FT	10 FT	10 FT	9 FT	44	14 FT	Full Open	Full Open	Full Open	Full Open	14 FT
15	5 FT	5 FT	5 FT	5 FT	5 FT	5 FT	30	10 FT	10 FT	10 FT	10 FT	10 FT	10 FT	45	Full Open	Full Open	Full Open	Full Open	Full Open	Full Open

**OPERATING INSTRUCTIONS**

- SEE SEPARATE INSTRUCTIONS AS TO WHEN RESERVOIR MAY BE OPERATED WITHOUT SPECIFIC INSTRUCTIONS MUSKINGUM AREA OFFICE.
- READ THE "LAKE" GAGE EVERY HOUR AND COMPUTE THE RISE IN POOL ELEVATION DURING THE PRECEDING HOUR.
- ADJUST THE GATE SETTINGS EACH HOUR AND OBTAIN THE SLUICE GATE POSITION FROM THE SET OF CURVES. OBTAIN THE SLUICE GATE OPENINGS FROM THE TABLE.
- WHEN THE RESERVOIR LEVEL EXCEEDS ELEVATION 880.0 AND THEN STARTS TO FALL, MAINTAIN THE CURRENT GATE SETTINGS UNTIL THE POOL RECEDES TO ELEVATION 880.0.
- HOLD THE POOL AT ELEVATION 880.0 OR AT MAXIMUM LEVEL ATTAINED, IF BELOW ELEVATION 880.0, UNTIL ORDERED BY SPECIAL DIRECTIVE TO BEGIN DRAWDOWN OPERATION.
- IF A SECOND RISE OCCURS WHILE THE POOL IS BEING HELD AT MAXIMUM LEVEL, RESUME OPERATION IN ACCORDANCE WITH RATE OF RISE CURVES AND ABOVE INSTRUCTIONS.



WALHONDING RIVER  
OHIO

MOHAWK RESERVOIR PROJECT

INTERIM EMERGENCY OPERATION  
SCHEDULE (MAX POOL 880.0 FT)

DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
HUNTINGTON, WV REDRAWN DECEMBER 2006

**PERTINENT DATA**

**MOHAWK DAM  
MUSKINGUM RIVER LAKES, OHIO**

**LOCATION OF DAM:** In Coshocton County, Ohio. On Walhonding River, a tributary of the Muskingum River: 129.8 miles above the mouth of the Muskingum.

**PURPOSES SERVED:** Flood control.

**DAM:** Type - Rolled earth, gravel and rock fill with impervious core.

Maximum height, feet	118.5
Crest length, feet	2,330
Crest width, feet	35
Base width, feet	780

**SPILLWAY:** Type - Uncontrolled saddle spillway beyond left (east) abutment.

Crest length, feet	620
Crest elevation, feet above msl	890
Design discharge, cubic feet per second	151,000
Surcharge, feet	18

**OUTLET WORKS:**

Type - Intake structure, tunnel and stilling basin

**INTAKE STRUCTURE:** - Reinforced concrete with two horseshoe tunnels and control gates

Number of control gates	6
Size of control gates, feet	8x17
Invert elevation of control gates, msl	799.2
Maximum outlet discharge, cfs	43,200
at spillway elevation - all gates open	

**TUNNEL:**

Type - Horseshoe, concrete lined	
Number of tunnels	2
Size - Diameter, feet	20
Length, east tunnel, feet	361
west tunnel, feet	198.5

**PERTINENT DATA**

**MOHAWK DAM  
MUSKINGUM RIVER LAKES, OHIO**

Cont'd

**DRAINAGE AREAS:** (Square Miles)

Black Fork at Charles Mill Lake	215
Black Fork at mouth	356
Clear Fork at Pleasant Hill Lake	197
Clear Fork at mouth	217
Mohican River at confluence of Black Fork and Clear Fork	573
Lake Fork at Mohicanville Dam	271
Lake Fork at mouth	347
Mohican River at mouth of Lake Fork	930
Mohican River at mouth	1,004
North Branch of Kokosing River at North Branch of Kokosing River Lake	44.5
Kokosing River at Mount Vernon	202
Kokosing River at Mouth	485
Walhonding River at confluence of Mohican River and Kokosing River	1,489
Walhonding River at Mohawk Dam	1,504
Walhonding River at mouth	2,256
Muskingum River at mouth	8,051

**STREAMFLOW DATA** (Cubic feet per second)

Average annual flow just below dam site	1,511
Maximum peak discharge at dam site (1913-computed	102,000
Minimum discharge just below dam site	19

**RESERVOIR DATA:**

Elevations (NGVD)

Streambed at dam site	795
Minimum pool	799.2
Flood control pool	890
Spillway design flood	914.3

**PERTINENT DATA**

**MOHAWK DAM  
MUSKINGUM RIVER LAKES, OHIO  
Cont'd**

<u>Capacities</u>	<u>Acre Feet</u>	<u>Inches Runoff</u>
Minimum pool	-----	-----
Flood control pool	285,000	6.5
Total Storage	285,000	6.5
 <u>Surface Areas (Acres)</u>		
Minimum pool		-----
Flood control pool		7,950
 <u>Backwater along Main Stream (Miles)</u>		
Minimum pool		-----
Flood control pool		27.9

**STILLING BASIN**

Type - Conventional jump type. Two sections, each with a stepped apron discharging onto 2 rows of baffles and an end sill.

Width (2 sections), feet	130
Length including outlet transition, feet	245

**STATUS:** All construction work is complete. The dam closure was completed in September 1936.

**COST:** Construction \$5,203,800 which includes portions of the cost of the Official Plan.

Estimated (code 711) recreation	\$60,800
Expended through 30 September 79	\$55,400

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

**MOHAWK DAM  
WALHONDING RIVER  
MUSKINGUM RIVER BASIN  
OHIO**

PROJECT MANUAL  
FOR  
WATER CONTROL MANAGEMENT

INSTRUCTIONS TO DAMTENDER  
MOHAWK DAM

APRIL 2004

EXHIBIT B

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INSTRUCTIONS TO DAMTENDER  
MOHAWK DAM

SECTION 1 - GENERAL OPERATION INSTRUCTIONS

1-01. GENERAL

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

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

1-02. GATE REGULATION FACILITIES

a. General. The outlet works is located in the left (south) abutment and consists of an approach channel, an intake structure consisting of a reinforced concrete sub-structure and a brick and stone superstructure to house the gate operating machinery for six 8'x17' sluice gates and the auxiliary power unit. Access to the structure is by a service bridge extending from the left abutment. Details of the outlet structure are two horseshoe tunnels, stilling basin, and outlet channel. Facilities provided for water control include six 8'x17' sluiceways with appropriately sized tractor gates with sill invert at 799.2 feet, NGVD, for passing routine flood flows. The gates are designated S01 through S06 numbering from the left facing downstream.

b. Outlet Works. The tunnels consist of two 20-foot-diameter concrete-lined horseshoe tunnels which extend through the left abutment from a transition section near the gates to the stilling basin. The stilling basin is a shallow pool confined between concrete side walls. Below the tunnels, the channels are flared to reduce the depth of flow at the entrance of the stilling basin. The embankment side is protected by a gravity section retaining wall and the abutment side by a slab poured against and anchored to the rock face.

c. Spillway. The bottom is paved with a concrete slab anchored into the rock. Two rows of baffle piers and an end sill were constructed into the bottom slab to aid in energy dissipation. The outlet channel extends from the stilling basin approximately 2,400 feet downstream to the Walhonding River.

An uncontrolled, saddle type spillway with an open cut trapezoidal section, is provided for passing extreme flood flows. The spillway crest originally was 640 feet long at elevation 890.0 feet (NGVD) with a curved concrete weir at the crest. Following the dam safety and spillway adequacy review program of 1988 the emergency spillway was widened or lengthened from 640 feet to 657 feet.

Sequence and method of operation where applicable, appear in subsequent paragraphs. The six gates are to remain opened during routine conditions, with gate settings of 5.5 feet during MIANO and 7.5 feet during DEMIA. These settings allow free flow of the river through the dam most of the time and prevent major damage downstream from flash flooding. If the gates were left fully open, and the project unattended, a large storm could create heavy downstream flooding before arrangements could be made to man the project.

When closing the gates, they should be closed in the following sequence: S06, S01, S04, S03, S05, and finally S02. When opening the gates the reverse sequence should be followed. In either opening or closing, operate in such a manner that the stage at the outflow "H" gage does not change more rapidly than 1.0 foot/hour unless specified in a Special Directive or conditions of 1-05 below.

**Plate No. 1-1** (back of section) is a tabulation of approximate stage and discharge to be reached on the Outflow "H" gage under various conditions of the lake level and openings of gates. Using these tables as a guide, the approximate gate openings required to attain a designated stage at the Outflow gage can be determined. When the flow at the outflow gage has stabilized after setting the gates as determined by the tables, only a minor adjustment of the gates should be necessary to attain the designated stage.

#### 1-03. ROUTINE REGULATION

Under normal conditions, the project is operated with gates preset as specified above to avoid damage downstream from a sudden storm.

Regulation under normal conditions(not under Special Directive) may be determined by the Muskingum Area Office staff or Facility Manager of Walhonding; however, releases shall not exceed a stage at the outflow "H" gage, of 10.0 feet (5,240 cfs) in DEMIA or 8.8 feet (3,520 cfs) in MIANO unless specifically directed by the Water Management Section. After rainfall or when there is a general stream rise, guidance presented in the following paragraphs shall be used to maintain proper project conditions.

#### 1-04. REGULATION FOR DOWNSTREAM CONTROL

During reservoir regulation activity, a maximum regulation activity, a maximum stage of 11.2 feet (7,140 cfs) during MIANO or 13.0 feet (10400 cfs) during DEMIA can be maintained on the outflow "H" gage at Nellie without causing any appreciable damage downstream along Walhonding River to Killbuck Creek and the Muskingum River when maximum stages of 10.0 feet (9300 cfs) and 11.5 feet (12,100 cfs) during MIANO and DEMIA seasons, respectively, are maintained on the Walhonding River, particularly Killbuck Creek, discharges through Mohawk Dam will be regulated so as not to add to or cause flooding along Walhonding or Muskingum River.

Operation for the Ohio River at Marietta, Ohio is based on stage forecasts and water travel time from the project to Marietta. Special Directives will be issued by Water Management Section for operation of Mohawk Dam for Ohio River control. Releases are timed so as not to add to the crest at Marietta or at other stations downstream along the Ohio River.

## 1-05. OPERATION DURING COMMUNICATION FAILURE

During flood periods, every effort must be made to maintain full communication with the Area Office and the Water Management Section. If telephone and cell phone facilities fail, solicit the cooperation of local radio and television stations, amateur and citizens band radio operators, other Walhonding River projects, or the State Police.

The emergency procedure outlined below shall be followed during periods when the Water Management Section cannot be contacted either through the Area Office or otherwise. In a Communications Emergency the Damtender will assume regulation of the reservoir. Project personnel will operate the reservoir in accordance with operating instructions until specific instructions are received.

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

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

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

(3) sufficient rainfall or snowmelt occurs which causes the lake or streams in the vicinity to raise rapidly.

Whenever any of the foregoing conditions, (1), (2) or (3) occurs or if not under Special Directive and either of conditions (2) or (3) applies, follow operating instructions contained in sub-sections 1-03, 1-04, or 1-05, whichever is applicable.

b. Close gates as necessary to avoid exceeding the maximum allowable stage 11.2 feet MIANO or 13.0 feet DEMIA on the outflow ("H") gage at Nellie. In order to prevent the Walhonding River discharge from causing flood damage below the forks of the Muskingum River near Coshocton, the Coshocton U.S.G.S. gage and local conditions are used as a reference. If the Coshocton stage is above 15.5 feet MIANO or 18.0 feet DEMIA, reduce the stage at Nellie approximately 0.2 feet for each 0.1 foot the stage at Coshocton is above the particular seasonal control stage as listed above. For example, to lower the Coshocton 0.5 feet for either seasonal control stage, reduce the stage at Nellie by 1.1 feet. For flood pool elevations not approaching emergency spillway elevation, **Table No. 7-9** main text, gives the travel time from Mohawk Dam to Coshocton as 9 hours.

If the pool crests below elevation 890 feet NGVD, gradually close gates as necessary to hold pool level at the highest elevation attained. If the pool crests at or above 890, maintain gate settings until pool level recedes to 890; then close gates as necessary to maintain the pool level at that elevation. Hold the pool at elevation 890, or at the highest elevation attained as above until ordered by Special Directive to begin drawdown operation.

#### 1-06. EMERGENCY RESPONSE

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. Detailed information concerning these emergency actions can be found in the Flood Emergency Plan for Mohawk Dam.

#### 1-07. PUBLIC NOTIFICATION OF UNUSUAL RELEASES

Operation of reservoir projects during major floods 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, Mohawk Dam Resource Manager(Damtender) must stay informed and inform Water Resources Engineering Branch of all points of potential flooding downstream along Walhonding River and Muskingum River to Coshocton.

If required by unusual release patterns, obtain directions through the Area Office from Water Resources Engineering Branch which will coordinate the release with Public Affairs Office for public notification procedures. Unusual release patterns of concern at the Mohawk Project are emergency, above channel capacity, discharges. Notification of large releases is to afford those likely to be affected an opportunity to take remedial measures in advance of the arrival of the release so as to prevent damage to or loss of their property.

DISCHARGE, OULOW GAGE ("H"), AND  
OPENING OF ONE SLUICE GATE AT LAKE ELEVATION

Gate Opening	2'		4'		6'		8'		10'		14'		Fully Open	
	Disch cfs	"H" Gage feet	Disch cfs	"H" Gage feet	Disch cfs	"H" Gage feet	Disch cfs	"H" Gage feet	Disch cfs	"H" Gage feet	Disch cfs	"H" Gage feet	Disch cfs	"H" Gage feet
799.2	0	4.0	0	4.4	0	4.4	0	4.4	0	4.4	0	4.4	0	4.4
800	20	4.6	20	4.6	20	4.6	20	4.6	20	4.6	20	4.6	20	4.6
802	110	5.1	130	5.2	130	5.2	130	5.2	130	5.2	130	5.2	130	5.2
804	180	5.3	280	5.6	290	5.6	290	5.6	290	5.6	290	5.6	290	5.6
806	220	5.4	400	5.8	470	5.9	470	5.9	470	5.9	470	5.9	470	5.9
808	280	5.6	500	6.0	610	6.1	680	6.1	680	6.1	680	6.1	680	6.1
810	310	5.6	580	6.1	760	6.3	900	6.5	930	6.5	930	6.5	930	6.5
812	330	5.7	640	6.2	880	6.5	1090	6.7	1190	6.8	1190	6.8	1190	6.8
814	370	5.7	710	6.2	970	6.5	1230	6.8	1400	7.0	1490	7.1	1490	7.1
816	390	5.7	760	6.3	1070	6.6	1350	6.9	1600	7.2	1820	7.4	1850	7.4
818	410	5.8	820	6.4	1150	6.7	1480	7.1	1780	7.3	2150	7.7	2230	7.7
820	430	5.8	860	6.4	1230	6.8	1590	7.2	1930	7.5	2380	7.9	2580	8.0
822	470	5.9	900	6.5	1310	6.9	1690	7.3	2070	7.6	2620	8.1	2890	8.3
824	490	5.9	930	6.5	1390	7.0	1800	7.4	2200	7.7	2840	8.2	3200	8.5
826	510	5.9	990	6.6	1460	7.0	1890	7.4	2320	7.8	3060	8.4	3470	8.7
828	530	6.0	1030	6.6	1530	7.1	1980	7.5	2440	7.9	3240	8.5	3720	8.9
830	550	6.0	1070	6.6	1590	7.2	2060	7.6	2550	8.0	3420	8.7	3960	9.0
832	570	6.0	1110	6.7	1650	7.2	2140	7.7	2650	8.1	3595	8.8	4200	9.2
834	590	6.1	1140	6.7	1710	7.3	2210	7.7	2760	8.2	3760	8.9	4420	9.4
836	600	6.1	1180	6.8	1770	7.3	2280	7.8	2860	8.3	3910	9.0	4630	9.5
838	610	6.1	1210	6.8	1820	7.4	2360	7.8	2960	8.3	4070	9.1	4830	9.7
840	630	6.1	1230	6.8	1870	7.4	2430	7.9	3060	8.4	4200	9.2	5030	9.8
842	650	6.1	1280	6.9	1920	7.5	2500	8.0	3140	8.5	4340	9.3	5210	9.9
844	670	6.2	1305	6.9	1980	7.5	2570	8.0	3220	8.5	4480	9.4	5390	10.1

DISCHARGE, ( LOW GAGE ("H"), AND  
OPENING OF ONE SLUICE GATE AT LAKE ELEVATION

Gate Opening	2'		4'		6'		8'		10'		14'		Fully Open	
	Disch cfs	"H" Gage feet	Disch cfs	"H" Gage feet	Disch cfs	"H" Gage feet	Disch cfs	"H" Gage feet	Disch cfs	"H" Gage feet	Disch cfs	"H" Gage feet	Disch cfs	"H" Gage feet
846	690	6.2	1335	6.9	2020	7.6	2635	8.1	3310	8.6	4600	9.5	5570	10.2
848	700	6.2	1370	7.0	2060	7.6	2710	8.1	3400	8.7	4730	9.6	5740	10.3
850	710	6.2	1400	7.0	2100	7.6	2770	8.2	3500	8.7	4860	9.7	5900	10.4
852	720	6.2	1420	7.0	2140	7.7	2830	8.2	3580	8.8	4960	9.8	6060	10.5
854	730	6.2	1460	7.0	2180	7.7	2890	8.3	3660	8.9	5100	9.9	6210	10.6
856	750	6.3	1500	7.1	2220	7.7	2950	8.3	3740	8.9	5200	9.9	6360	10.7
858	770	6.3	1520	7.1	2260	7.8	3015	8.4	3820	9.0	5320	10.0	6500	10.8
860	780	6.3	1550	7.1	2300	7.8	3080	8.4	3900	9.0	5430	10.1	6640	10.9
862	790	6.3	1580	7.2	2340	7.8	3120	8.5	3980	9.1	5530	10.1	6780	10.9
864	800	6.3	1605	7.2	2380	7.9	3170	8.5	4060	9.1	5640	10.2	6920	11.0
866	810	6.3	1635	7.2	2420	7.9	3220	8.5	4130	9.2	5750	10.3	7050	11.1
868	820	6.4	1665	7.2	2460	7.9	3270	8.6	4190	9.2	5850	10.4	7180	11.2
870	830	6.4	1685	7.3	2500	8.0	3310	8.6	4250	9.3	5950	10.4	7320	11.3
872	840	6.4	1705	7.3	2520	8.0	3350	8.6	4310	9.3	6050	10.5	7450	11.4
874	850	6.4	1730	7.3	2560	8.0	3400	8.7	4370	9.4	6150	10.5	7570	11.4
876	860	6.4	1750	7.4	2600	8.0	3460	8.7	4430	9.4	6250	10.6	7690	11.5
878	870	6.4	1770	7.4	2640	8.1	3500	8.7	4490	9.4	6340	10.7	7800	11.5
880	880	6.4	1790	7.4	2680	8.1	3540	8.8	4590	9.5	6430	10.7	7920	11.6
882	890	6.4	1810	7.4	2720	8.2	3580	8.8	4600	9.5	6530	10.8	8030	11.7
884	900	6.5	1830	7.4	2760	8.2	3630	8.8	4640	9.5	6620	10.8	8150	11.7
886	910	6.5	1850	7.4	2780	8.2	3675	8.9	4700	9.6	6700	10.9	8260	11.8
888	920	6.5	1870	7.4	2810	8.3	3720	8.9	4760	9.6	6780	10.9	8370	11.9
890	930	6.5	1890	7.4	2840	8.3	3760	8.9	4810	9.6	6880	11.0	8470	11.9

## SECTION II - COLLECTION OF HYDROMETEOROLOGIC DATA

### 2-01. PRECIPITATION AT MOHAWK DAM

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

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

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

d. Recording Precipitation Gage. Check the recording Precipitation gage about 0730 hours daily. Remove punched tape record monthly, marking record and unused portions with date and time and mail the record to National Weather Service, Wilmington in the envelope provided. Install new roll of tape as needed. Empty collector bucket as needed between 10 and 15 inches has been collected and all two quarts of antifreeze oil if between 1 October and 1 May.

e. Special and Extra Readings. Take special readings of the precipitation gage when requested by the Water Management Section or the Muskingum Area Office and extra readings whenever required by the Schedule for Reading Gages, **Plate No. 3-1**, next section. When taking these readings, do not empty the gage at any time except the regular time. Report the total rainfall that 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. Several precipitation stations at or near Mohawk Dam have tipping-bucket rain gages reported by data collection platforms, including Mohawk Dam, Pleasant Hill Lake, Centerburg, Mohicanville Dam, North Branch of Kokosing Dam, and Charles Mill Dam. The platforms transmit every four hours to the GOES satellite. The GOES satellite transmissions are received by DOMSAT downlinks at CELRH and CELRD, and by a GOES downlink at CELRD. The CELRH DOMSAT downlink passes data to the Water Management Section water control system (WCS) several times hourly. CELRD water control system (WCS) receives from the downlinks and disseminates hourly to the data base of Water Management Section as backup for the CELRH downlink. From the data base it is available for use in water control management and dissemination and is accessible by computer terminal as described in sub-section 3-04.

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

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

The water content of the sample can be measured by placing the outside container in a vessel of warm water, and then pouring the melted snow into the inside container of the gage for a reading with the measuring stick. The vessel containing the snow should never 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 as often as indicated below.

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

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

## 2-02. PRECIPITATION FOR THE NATIONAL WEATHER SERVICE

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

a. Ohio River Network Stations. The Ohio River Network, abbreviated ORN, includes precipitation stations and stations reporting both precipitation and stage.

b. Reporting Criteria. This precipitation network has been abolished, therefore there is no reporting criteria.

c. Method of Reporting. This precipitation network has been abolished, therefore there is no reporting method.

## SECTION III - COLLECTION OF STREAMFLOW DATA

### 3-01. GENERAL

Obtain lake and outflow gage readings by telephoning the Hydrologger at each station and recording the value in the log book. Add the zero of the lake gage, 799.2 feet NGVD, to lake readings, and 790.0 feet NGVD for the outflow gage to make stream elevations before recording. The necessary frequency for reading the gages at the project is set forth in the Schedule for Reading Gages, **Plate No. 3-1**, this section, which appears at the end of this section. Instructions regarding the transmission of regular, extra and special reports of gage readings are contained in Section IV.

During trips to the North Branch of Kokosing project for various purposes, take at least one (preferably two) weekly readings of the staff and bubbler gages at the lake station noting the time and date of readings. See 4-01c for the proper manner of reporting the data. The readings serve as a continuous check on the operation of the bubbler gage and on the platform reporting of the readings. Water Resource Engineering Branch may request special trips to the project for information on flood or drought effects such as are listed in 4-01c and 4-05b in the next section.

### 3-02. GAGES PERTINENT TO REGULATION OF MOHAWWK DAM

a. Gage Listing. Information about the various gages for operation of the project 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. Read inflow and outflow gage readings in terms of elevation above NGVD but record all other gages in feet above gage datum, or zero of the gage. Gage datum is listed in **Table No. 3-1** next page.

### 3-03. TELEPHONIC GAGES

In order to facilitate collection of stage information, a data collection platform was installed at the lake station to transmit water levels to CELRD downlink via satellite for dissemination to Water Management Section. A Hydrologger was installed at the outflow station and one is to be installed later at the lake station to allow personal or computer interrogation for stage information by telephone line. To obtain reports from a Hydrologger, call the station telephone number. After a few seconds of high pitched tone, the Hydrologger will repeat by synthesized voice the unit identification, the time and current reading of the gage. Elevation and stage are called "level." The message ends with a short pause and notification to "Enter command" which is to be ignored.

One should note that the time given by the Hydrologger is Greenwich Mean Time (GMT). To convert to Eastern Daylight or Eastern Standard Time, subtract four or five hours, respectively.

TABLE NO. 3-1

PERTINENT GAGE DATA

<u>Gage</u>	<u>Location</u>	<u>Code Symbol</u>	<u>Eqpt</u>	<u>Reference Staff</u>	<u>gages Other</u>	<u>Recorder</u>	<u>Datum of Gage</u>
Lake I	Gate house on top of house	I	-	SI	TI	RI	799.2
Outflow, "H"	Nellie, ab US. Rt. 36 highway Bridge 1.7 mi. below Dam	H	H	-	TH in WH	RH	790.0
Inflow	Mt. Vernon on Kokosing R.--.8 mi below N. Br.	MV	DCP	-	TMV WWMV	RMV	984.16
Walhonding Ref. Pt. 1	Bridge over Walhonding R. 4.7 miles above mouth	RP	V	-	WWRP	-	746.0
Coshocton	Muskingum R. 1 mile SW of Coshocton	C	V	SC	TC	RC	725.0
Killbuck	Killbuck River below US Rt. 62 Hwy Bridge	K	V	-	MnK	RK	

- 
- V - Voice platform
  - DCP - Standard Platform
  - S - Staff
  - T - Electric tape
  - H - Hydrologger
  - M - Manometer gage

When interrogated by computer, a Hydrologger will give any portion or all of the stored readings specified.

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 telephonic gages is set forth in "Schedule for Reading Gages", **Plate No. 3-1**, 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 lake and outflow gages appear below in **Table No. 3-2**, next page.

**TABLE NO. 3-2  
STREAM GAGE TELEPHONE NUMBERS**

Gage	Code* Symbol	Telephone Number	Type of Device
Mohawk outflow "H", Nellie	MKWOE	[REDACTED]	Telemark
Killbuck	KIKC5		Voice Platform
Walhonding Reference Point 1	WALD5		Voice Platform
Coshocton	COMD5		Voice Platform

\* Project abbreviation plus location on District Isohyetal Map

### 3-04. DATA COLLECTION

Project personnel will read at times specified in the Schedule for Reading Gages, and at other times requested, the beginning and ending times from the recording gage, the lake and outflow stations, the snow depth if relevant. Adding gage zero to the water level reading converts to elevation above NGVD. Record values in the daily log and report to the district INTRANET water control system when called for in morning and extra reports. Personnel telephone the outflow gage Hydrologger for the current outflow stage. Killbuck, Walhonding Reference Point No. 1, and Coshocton when needed, are obtained by telephoning the Voice Platform as described in 3-03 above. Gate settings and operations are noted in the log and on Form 14 and the settings are included in morning and extra reports to the Water Control System. Data is then reported each morning through INTRANET by the Water Control System to the Muskingum Area Office. Data are given by Mohawk Dam personnel as detailed in Section IV and as shown in **Plate No. 4-1**, this section.

Project precipitation is measured in the standard 8" rain gage. Stage and precipitation data as taken and gate operations as made are entered into the Project logbook. They are subsequently entered into the computer as part of reports to the Water Control System. Gate operations, lake and outflow readings are also entered in the Reservoir Weekly Report.

Standard data collection platforms (without voice modules) report stage at the outflow and precipitation. All the platforms relating to the project update readings each 60 minutes.

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

The data collection platforms mentioned in 3-03 above report outflow stage and lake elevation by transmitting to the CELRD downlink via satellite every four hours. The CELRD Water Control System retrieves from the downlink and disseminates hourly to Water Management Section data base. By use of the INTRANET with the portable terminal assigned, Area Office or Project personnel can access the most recent readings, or series of readings from area stations that are reported by platform.

SCHEDULE FOR READING GAGES  
MOHAWK DAM

The regular stream gages VL or SL and VO or SO 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.

CONDITIONS	SCHEDULE A(1) Normal Conditions		SCHEDULE B(1) Flood Threat		SCHEDULE C(1) Flood Condition		SCHEDULE D Major Flood Condition	
	MIANO*	DEMIA**	MIANO*	DEMIA**	MIANO*	DEMIA**	MIANO*	DEMIA**
	Lake elevation	Below 829	Below 829	829-856	829-856	856-883	856-883	Above 883(3)
Stage at 'O' gage	Below 8.8(5)	Below 10.0(5)	8.8-10(5)	10.0-11.6(5)	10.1-11.2(5)	11.6-13.0(5)	Above 11.2(5)	Above 13.0(5)
Precipitation								
Within 24 hours(6)	Less than 0.75	Less than 0.50	0.75-1.25	0.50-1.00	1.25-2.50	1.00-2.50	More than 2.50	More than 2.50
<u>READ GAGES</u>								
RI and HH (2)	At 0730 & 1330(2)		At 0730 & 1330		At 0730, 1330, 1930 & 0130		At 3 hour intervals (3)	
Telephone	Readings for 0730, 1330, 1930 & 0130(4)		Readings for 0730, 1330, 1930 & 0130(4)		Readings, for 0730, 1330, 1930 & 1330(4)		Readings for 0730, 1330, 1930 & 0130(4)	
Precipitation Gage	At 0730		At 0730 & 1330		At 0730, 1330, 1930 & 0130		At 3 hour intervals	
SI, TI, RI, WWH, TH, and RH	Monthly (as check)		Monthly (as check)		Monthly (as check)		Monthly (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) Take readings on work days regularly and on weekends and holidays by special arrangement.
- (3) Whenever the water level is between elevation 883 and 890 and rising or at elevation 890 or above, read the lake gage and outflow gage hourly.
- (4) The 1330, 1930, and 0130 readings on workdays and all readings for weekends and holidays may be obtained from telephone. Back readings may also be obtained.
- (5) All stages at the outflow gage above 8.8 feet in MIANO and above 10.0 feet in DEMIA must be authorized by Water Resources Engineering Branch.
- (6) 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 outflow, read the lake gage,, outflow gage, and rain gage at 1330 hours and transmit the information to the Muskingum Area Office.

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.

\* MIANO - 16 April through 30 November

\*\* DEMIA - 1 December through 15 April

## 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 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 readings which are utilized by project personnel for gate operation decision making.

To reduce the probability of error in transcribing data from other forms, enter gage readings through the week on a copy of Form 14. Lake and outflow gage readings will be obtained for every six hours (0130, 0730, 1330 and 1930) during periods when the project is attended and recorded on the form. This new reporting program was installed at the dam in May 1998, as a fully computerized three page, menu-driven master data sheet which is virtually self-explanatory, with a convenient auto-prompt feature easily completed by filling the empty data boxes.

The Schedule for Reading Gages, **Plate No. 3-1**, previous section, defines conditions for taking more frequent readings of gages. After entering each of the readings on the form, check the accuracy of the readings as recorded. If doubt arises, investigate to the extent necessary to be certain of the readings. During normal conditions, if the 1930 and 0130 readings have not been recorded on the form, take them from the recorder charts when taking the 0730 Project Report readings. On Monday morning, or Tuesday if the project was not attended on Monday, record any missed readings along with the 0730 readings. Check the accuracy of the data on the typed original compared to the handwritten form.

b. 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.

Use of ORH-13 is now discontinued. The regular morning readings at the project, including precipitation, readings of the lake "L" gage, outflow "O" gage, gate positions, river stages and gate operations shall be recorded each day. After recording, the data will be transmitted via the internet to the District INTRANET System for the Water Management Section(When requested by the Water Management Section) by approximately 0800 hours on each day in which the project is attended. The proper manner of reporting the data is shown in a printout of a Project Data Input Form found at the end of this section as **Plate No. 4-1**.

c. Gage 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.

All gate operations shall be reported by phone (only PES, CLB, TAL, ATI, TJE and BOS need to call) at the time it occurs or the next morning when all gage valve operations since the previous reports will be submitted. If several gate operations are performed within a short period of time, up to 6 (six) gate operations. Choose the Gate ID from a drop down menu. Transmit all gate valve operations since the previous report and transmit with each morning or extra report. List them in chronological order after project report data. Enter the data on the report in the following manner with the first entry for a new report. Use column one through six, successively for gate designation, initial gate opening, final gate opening, date, beginning time, and ending time. An unlimited field is also provided to make any additional comments.

The information will be entered into a permanent record. This record can be viewed at the Mohawk Dam web page on the Huntington District Intranet: (<http://cwms.lrh.usace.army.mil/MKW/gateop.htm>).

d. Water Quality Report. Not Applicable at Mohawk.

e. Weekly Precipitation Report. 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 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 days field and report the combined days precipitation in the next day when the project is staffed. Ie. If the Project does not staff the weekend, place a "NS" in Saturday and Sundays field and report the 72 hour precipitation record on Monday morning.

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,

Failing this attempt, telephone the report to one of the Water Resources Branch personnel in the order listed on the Key Personnel list shown in **Plate No. 4-2**, end 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 Management Section should have knowledge of or when requested by the Section.

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

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

(2) Gate positions and/or operations.

(3) Flooding upstream or downstream.

(4) Request for special operation.

(5) A catastrophe such as drowning.

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

(7) Moisture content of snow.

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

(9) Local weather forecast.

c. Transmission of Special 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 radio network.

When making telephone calls after hours or during weekends or holidays, unless advised that the Water Management Section will be on duty, to call one of the Water Management Section personnel, in the order listed on **Plate No. 4-2**, end of section.

#### 4-04. CELL PHONE AS BACKUP COMMUNICATION

Cell phones have now replaced radio as the emergency back-up communication system. Keep the Cell Phone turned on at all times when anyone is away from the project office, including overtime periods. The District Office operator is sometimes on duty outside of regular office hours. Also, messages may be relayed through other projects.

#### 4-05. LETTER REPORTS

a. General. All letter reports pertaining to water control management will be addressed to the District Engineer, Attention: Water Management Section.

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 Walhonding River from Walhonding to Coshocton, Ohio.

(2) Inspections will be made downstream to Coshocton, 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) 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. 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.

d. 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 water level reaches or exceeds the Alert Elevation, 855 feet NGVD for Mohawk Dam, daily observations are made and reported under provisions of the Dam Operations Management Policy in addition to the normal weekly observations made under the policy. At these or other times requested by Water Resources Engineering Branch for a particular use, forward a copy of such observations as soon as practicable to Water Resources Engineering Branch as a letter report.

e. 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.



Huntington District  
Water Control Section

Welcome to the

# MOHAWK LAKE

## WATER CONTROL INTRANET PAGE



### WEEKLY DATA ENTRY

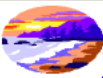


[WEEKLY PRECIP REPORT](#)



[Additional Comments \(including snow moisture content, gage problems etc\)](#)

### WATER QUALITY DATA ENTRY



[WATER QUALITY](#)

### AS NEEDED DATA ENTRY



[PROJECT DATA](#)



[GATE OPERATIONS](#)

### OTHER PLACES 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](#)

[Muskingum Basin Current Conditions](#)

[Project Report Archive](#)

The POC for this page:

 [CELRH-EC-WW](#)  
Huntington, WV  
[Send Email to Water Resources](#)



# MOHAWK LAKE

## Lake Quality Report



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

DATE	TIME	LAKE ELEV (FT)	WEATHER
<input type="text" value="5 Feb 2004"/>	<input type="text" value="0730"/>	<input type="text" value="885.00"/>	<input type="text" value="0 Unchanged"/>

DEPTH (M)	TEMP (C)	D.O.	COND	TURB	pH
<input type="text" value="OUTFLO"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

DEPTH (M)	TEMP (C)	D.O.	COND	TURB	pH
<input type="text" value="0.0"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="1.0"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="2.0"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="3.0"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="4.0"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="5.0"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="6.0"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="7.0"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="8.0"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="9.0"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="10.0"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="12.0"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="14.0"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>


## ADDITIONAL COMMENTS

PLEASE ENTER THE MOHAWK PASSWORD:

SUBMIT DATA

CLEAR FORM



[CLICK HERE TO RETURN TO MOHAWK 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 0510*

This file is a  submission.



PLEASE ENTER THE MOHAWK PASSWORD:


SUBMIT REPORT

CLEAR FORM



[CLICK HERE TO RETURN TO MOHAWK LAKE HOME PAGE \(WILL NOT SAVE DATA\)](#)

The POC for this page:

, *CELRH-EC-WW*  
*Huntington, WV*  
[Send Email to Water Resources](#)



*Date last modified: 16 Jan 2004 at 0610*

## MOHAWK LAKE GATE OPERATIONS



New ▾

GATE ID	VALUE		DATE	TIME	
	Start	End		Start	End
S01 ▾	0.0	0.0	5 Feb 200	0700	0705
▾					
▾					
▾					
▾					
▾					

**ADDITIONAL COMMENTS**


Text area for additional comments with scrollbars.

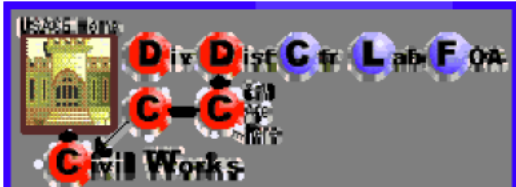
**PLEASE ENTER THE MOHAWK PASSWORD:**



[CLICK HERE TO RETURN TO MOHAWK LAKE HOME PAGE \(WILL NOT SAVE DATA\)](#)

The POC for this page:

, CELRH-EC-WW  
Huntington, WV



[Send E:mail to Water Resources](#)

*Date last modified: 16 Jan 2004 at 0510*

KEY PERSONNEL

Huntington District Office - Water Resources Engineering Branch

Normal Work Hours [REDACTED]  
0700 to 1600 hrs

Nights, Weekends, and Holidays Additional Extensions [REDACTED]

Water Resources Engineering Branch Personnel

Home Telephone Number

[REDACTED] Chief, Water Management Section [REDACTED]  
[REDACTED] Water Management Section [REDACTED]  
[REDACTED] Chief, Hydrology and Hydraulics Section [REDACTED]

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

Muskingum Area Office  
Personnel and Telephone Numbers

[REDACTED] [REDACTED]

Mohawk Lake Project Office  
[REDACTED] - Facilitator [REDACTED]

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

Other Agencies

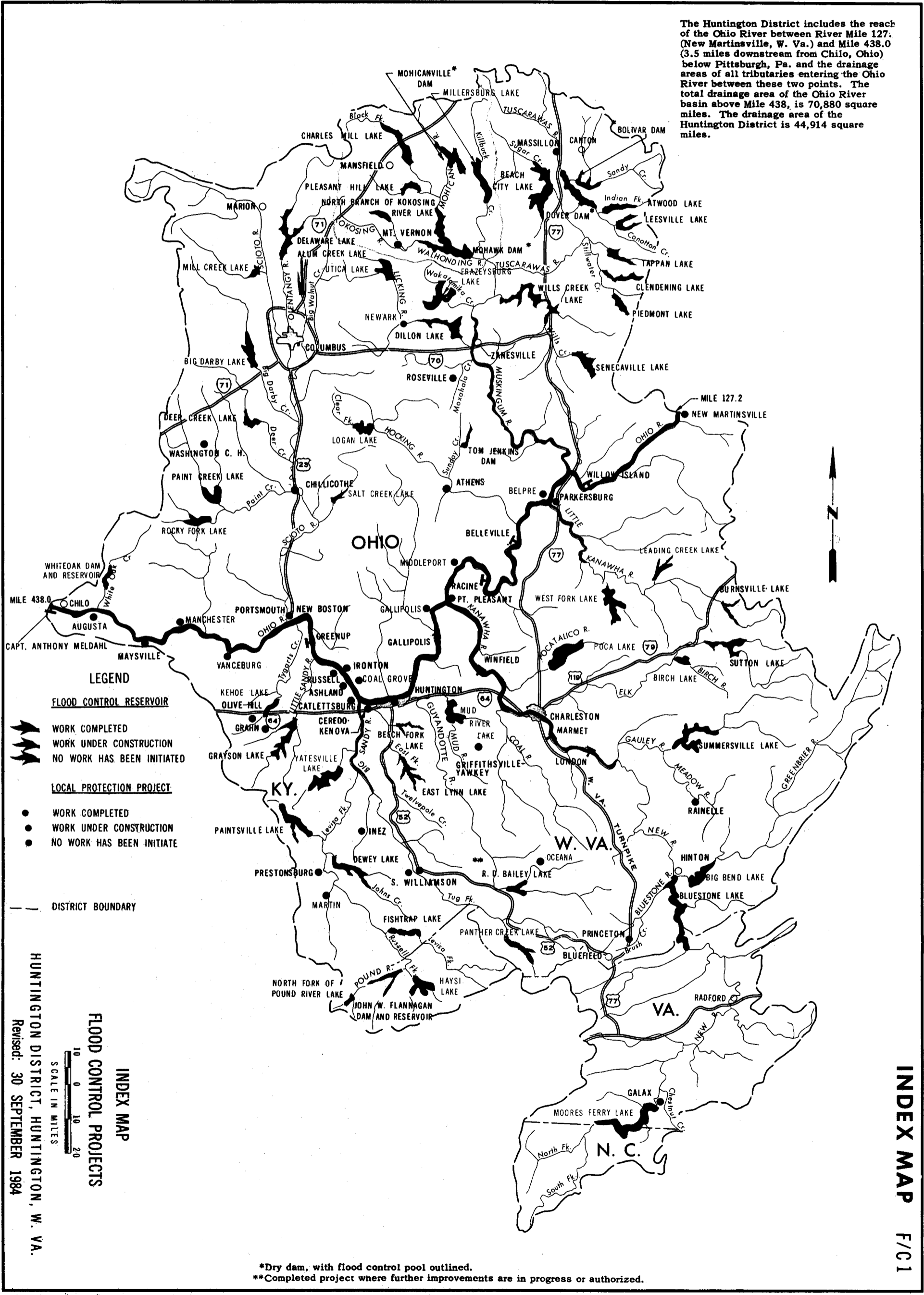
U. S. Geological Survey Commercial [REDACTED]  
New Philadelphia, Ohio

Nights, Weekends, Holidays Commercial [REDACTED]  
[REDACTED]

National Weather Service Commercial [REDACTED]  
Forecast Office, Commercial [REDACTED]  
Hydrology Section Commercial [REDACTED]  
Cleveland, Ohio Commercial from HDQ [REDACTED]

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

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.



- LEGEND**
- FLOOD CONTROL RESERVOIR**
- WORK COMPLETED
  - WORK UNDER CONSTRUCTION
  - NO WORK HAS BEEN INITIATED
- LOCAL PROTECTION PROJECT**
- WORK COMPLETED
  - WORK UNDER CONSTRUCTION
  - NO WORK HAS BEEN INITIATED
- DISTRICT BOUNDARY

**INDEX MAP**

**FLOOD CONTROL PROJECTS**

HUNTINGTON DISTRICT, HUNTINGTON, W. VA.

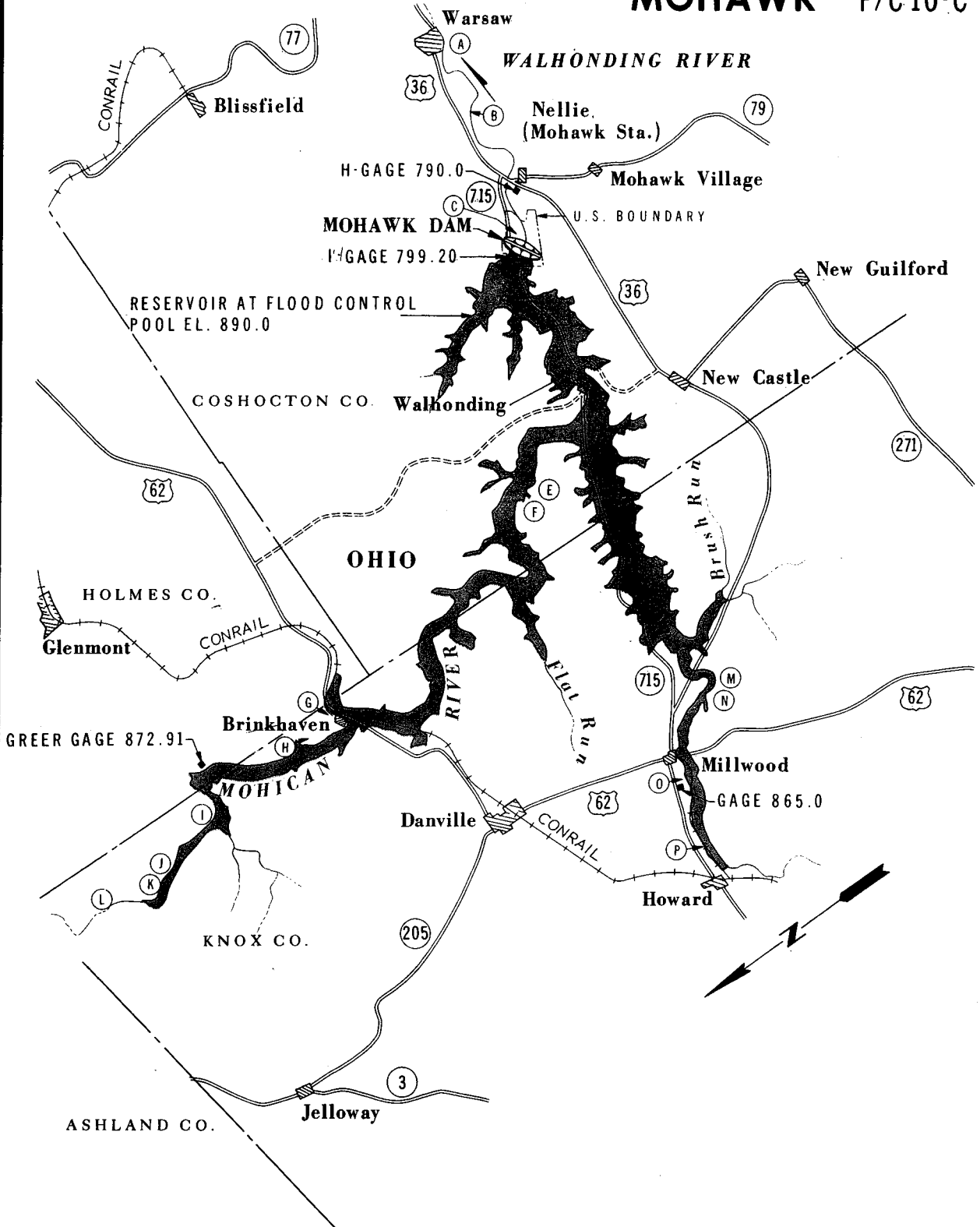
Revised: 30 SEPTEMBER 1984

SCALE IN MILES

0 10 20

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

# MOHAWK F/C10-C



**PUBLIC USE GUIDE**

- CAMPING AREA (A B F H K L M O)
- PARKING, REST ROOMS, CAMPING & PICNIC AREA - CORPS OF ENGINEERS (C)
- PUBLIC CANOE LIVERY (E G I J N P)

MUSKINGUM RIVER BASIN  
 WALHONDING RIVER  
**MOHAWK DAM**  
 Scale In Miles



HUNTINGTON DISTRICT, HUNTINGTON, W. VA.  
 Revised: 30 SEPTEMBER 1978

CORPS OF ENGINEERS

U. S. ARMY

MOHAWK F/C 10



MUSKINGUM RIVER  
MOHAWK DAM  
DAM AND SPILLWAY  
PLAN AND SECTIONS  
HUNTINGTON DISTRICT, HUNTINGTON, W. VA.  
Revised: 30 SEPTEMBER 1988

MUSKINGUM WATERSHED  
WALHONDING RIVER

MOHAWK DAM

**EMBANKMENT DETAILS**

DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
HUNTINGTON, W. VA. REDRAWN: OCT. 1999

Designed by  
*Michael J. Gault*  
Drawn by:

Checked by:  
MFE

Approved by:  
\_\_\_\_\_



MUSKINGUM RIVER BASIN  
WALHONDING RIVER, OHIO

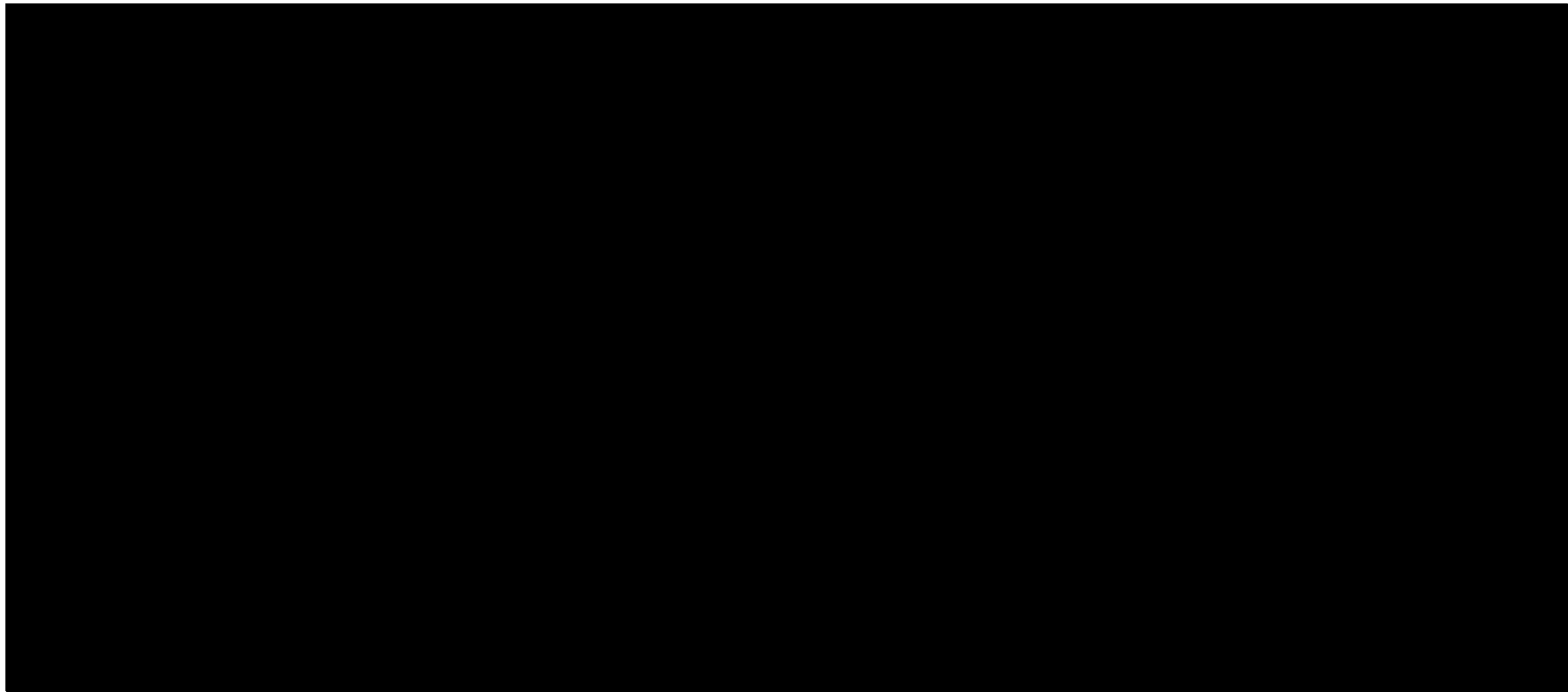
US Army Corps  
of Engineers  
Cincinnati, District

**MOHAWK DAM REMEDIAL WORK**  
EMBANKMENT CROSS SECTIONS  
STA. 10+00A THRU 19+00A

Date: \_\_\_\_\_ Sheet \_\_\_\_\_ of \_\_\_\_\_

Scale: 1" = 20' HORIZ.  
1" = 10' VERT. Drawing Number 027g-UM-6-87/7

Record Drawing as constructed dated \_\_\_\_\_




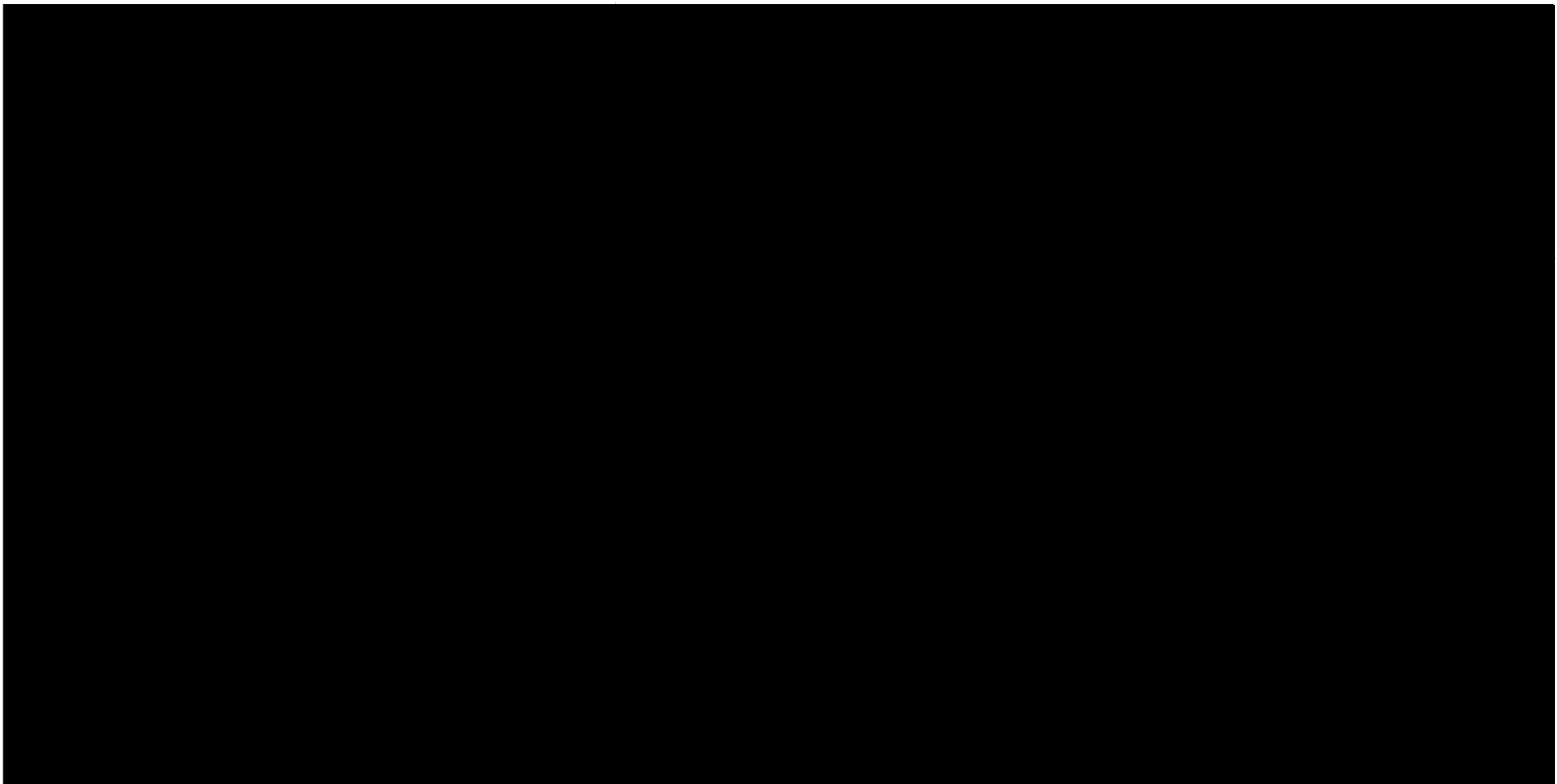

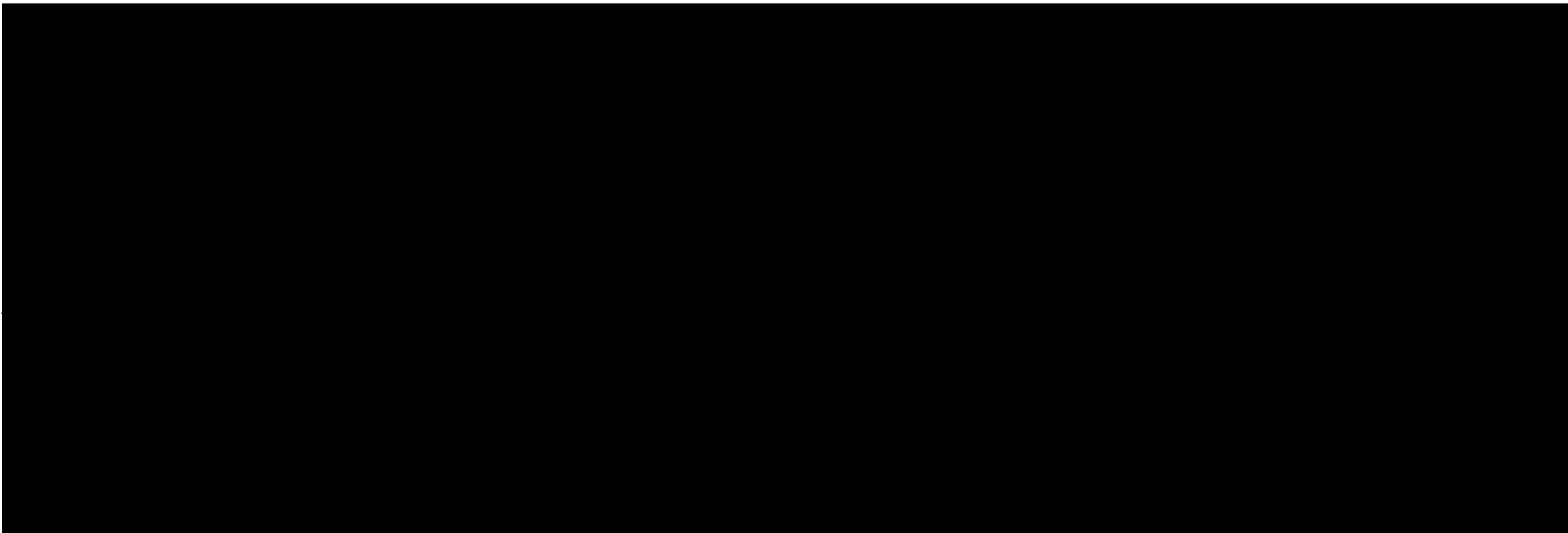
Designed by <i>Michael J. Gault</i> Drawn by	 MUSKINGUM RIVER BASIN WALHONDING RIVER, OHIO Burlington, District	MOHAWK DAM REMEDIAL WORK	
Checked by AFZ		EMBANKMENT CROSS SECTIONS STA. 20+00A THRU 21+00A	
Approved by	Date	Sheet	of
	Scale: 1" = 20' HORIZ. 1" = 10' VERT.	Drawing Number 027g-UM-6-87/8	
Record Drawing as constructed dated			

Plate No. 2-6

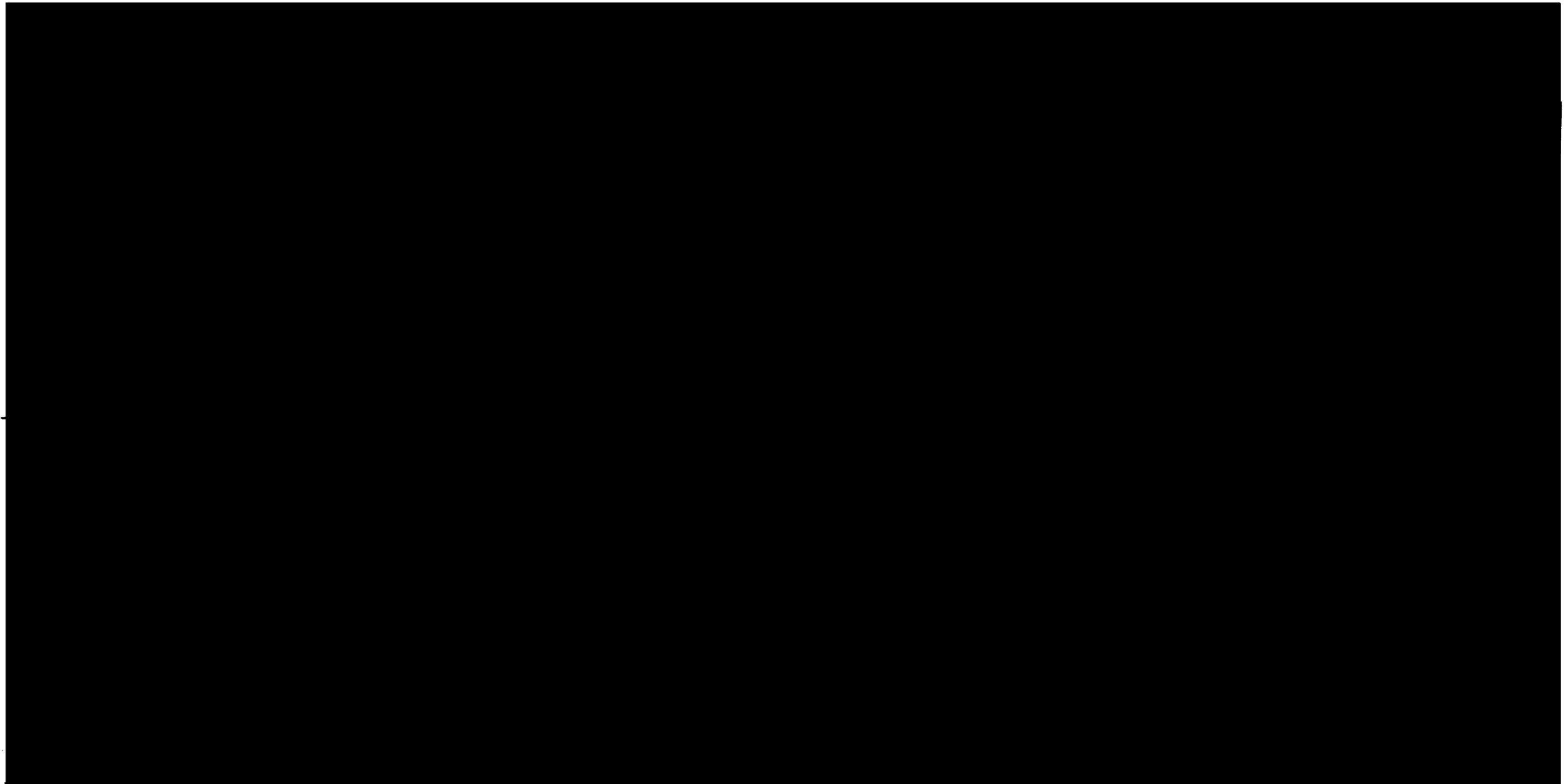



Designed by <i>Michael J. Jacobs</i>	 MUSKINGUM RIVER BASIN WALHONDING RIVER, OHIO District
Drawn by	
Checked by <i>MEZ</i>	<b>MOHAWK DAM REMEDIAL WORK</b> EMBANKMENT CROSS SECTIONS STA. 29+00A THRU 29+40A
Approved by	Date: _____ Sheet _____ of _____
	Scale: 1" = 20' HORIZ. 1" = 10' VERT. Drawing Number 027g-UM-6-87/9
	Record Drawing as constructed dated _____





Revisions	Date	Description	By	Checked
<b>Graphic Scale</b>				
PREPARED BY U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS NASHVILLE, TENNESSEE		U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS HUNTINGTON, W. VA.		
Designed by <i>Joseph J. Malachuk</i> Checked by <i>JMM</i>	MUSKINGUM RIVER BASIN WALHONDING RIVER, OHIO <b>MOHAWK DAM REMEDIAL WORK</b> SPILLWAY EXCAVATION CROSS SECTIONS 1+00B THRU 3+00B			
Approved by	Date	Sheet -- of --		
		Scale 1" = 20'	Drawing Number 027g-UM-6-87/31	
Record Drawing as constructed dated				



Designed by: <i>Joseph J. McLaughlin</i>	 US Army Corps of Engineers Hampton, 8-01101	MUSKINGUM RIVER BASIN WALHONDING RIVER, OHIO
Checked by: <i>JM</i>		<b>MOHAWK DAM REMEDIAL WORK</b> SPILLWAY EXCAVATION CROSS SECTIONS 4+00B THRU 5+00B
Approved by:	Date:	Sheet <u>    </u> of <u>    </u>
	Scale: 1"=20'	Drawing Number 027g-UM-6-87/32
Record Drawing as constructed dated		

MUSKINGUM WATERSHED  
WALHONDING RIVER

MOHAWK DAM

**SPELLWAY- PLAN & PROFILE**

DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
HUNTINGTON, W. VA. REDRAWN: OCT. 1999

MUSKINGUM WATERSHED  
WALHONDING RIVER

MOHAWK DAM

**SPILLWAY  
STRUCTURAL DETAILS NO.1**

DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
HUNTINGTON, W. VA.    REDRAWN: OCT. 1999

MUSKINGUM WATERSHED  
WALHONDING RIVER

MOHAWK DAM

SPILLWAY  
SECTION LIMITS &  
SLOPE LAYOUT DATA

DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
HUNTINGTON, W. VA. REDRAWN: OCT. 1999

WALHONDING RIVER  
OHIO

MOHAWK DAM

**INTAKE ELEVATIONS**

DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT CORPS OF ENGINEERS  
HUNTINGTON, W. VA. REDRAWN: OCT. 1999

MUSKINGUM WATERSHED  
WALHONDING RIVER

**MOHAWK DAM**

**INTAKE SECTIONS NO. 1**

DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
HUNTINGTON, W. VA. REDRAWN: OCT. 1999

WALHONDING RIVER  
OHIO

MOHAWK DAM

**INTAKE- SECTIONS- NO. 2**

DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT CORPS OF ENGINEERS  
HUNTINGTON, W. VA. REDRAWN: OCT. 1999

WASKINGUM WATERSHED  
WALHONDING RIVER

MOHAWK DAM

OPERATING HOUSE-  
ELEVATIONS & SECTIONS

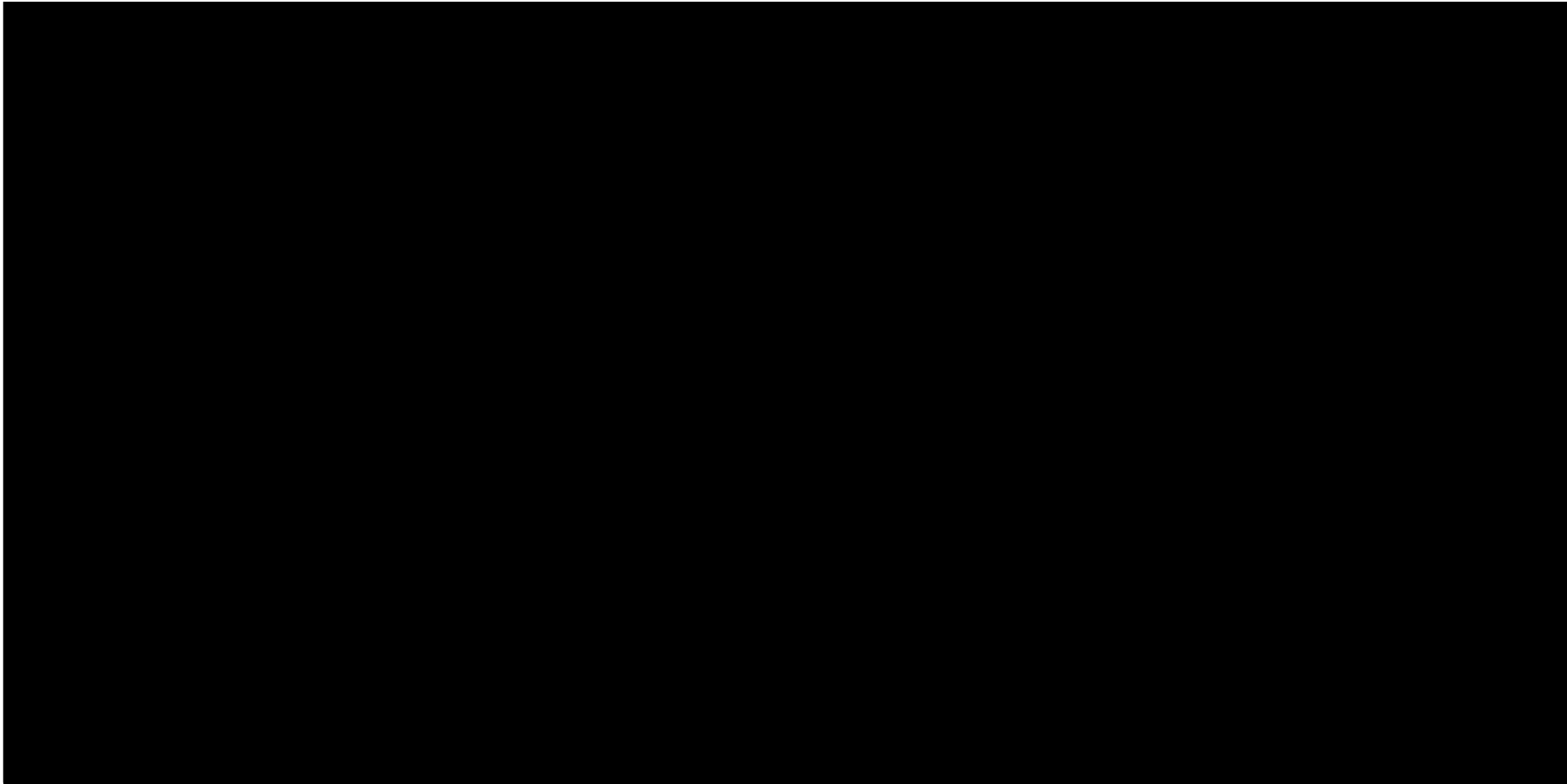
DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT CORPS OF ENGINEERS  
HUNTINGTON, W. VA. REDRAWN: OCT. 1999


MUSKINGUM WATERSHED  
WALHONDING RIVER

MOHAWK DAM

OUTLET WORKS-  
PLAN AND PROFILE

DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
HUNTINGTON, W. VA. REDRAWN: OCT. 1999



Designed by <i>Michael Zwick</i>	 MUSKINGUM RIVER BASIN WALHONDING RIVER, OHIO Huntington District
Drawn by	
Checked by <i>ACZ</i>	<b>MOHAWK DAM REMEDIAL WORK</b> EMBANKMENT CROSS SECTIONS STA. 31+48A ON RD. E TANGENT
Approved by	Date: _____ Sheet _____ of _____
	Scale: 1" = 20'H; 1" = 10'V Drawing Number: 027g-UM-6-87/11
	Record Drawing as constructed dated _____

MUSKINGUM WATERSHED  
WALHONDING RIVER

**MOHAWK DAM  
TUNNELS-  
PLAN PROFILE AND SECTIONS**

DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
HUNTINGTON, W. VA. REDRAWN: OCT. 1999

MUSKINGUM WATERSHED  
WALHONDING RIVER

MOHAWK DAM

**CONDUIT-PLAN, PROFILE  
AND SECTIONS**

DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
HUNTINGTON, W. VA. REDRAWN: SEPT. 1999

MUSKINGUM WATERSHED  
WALHONDING RIVER

MOHAWK DAM

STILLING BASIN- PLAN

DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
HUNTINGTON, W. VA. REDRAWN: OCT. 1999

MUSKINGUM WATERSHED  
WALHONDING RIVER

**MOHAWK DAM**

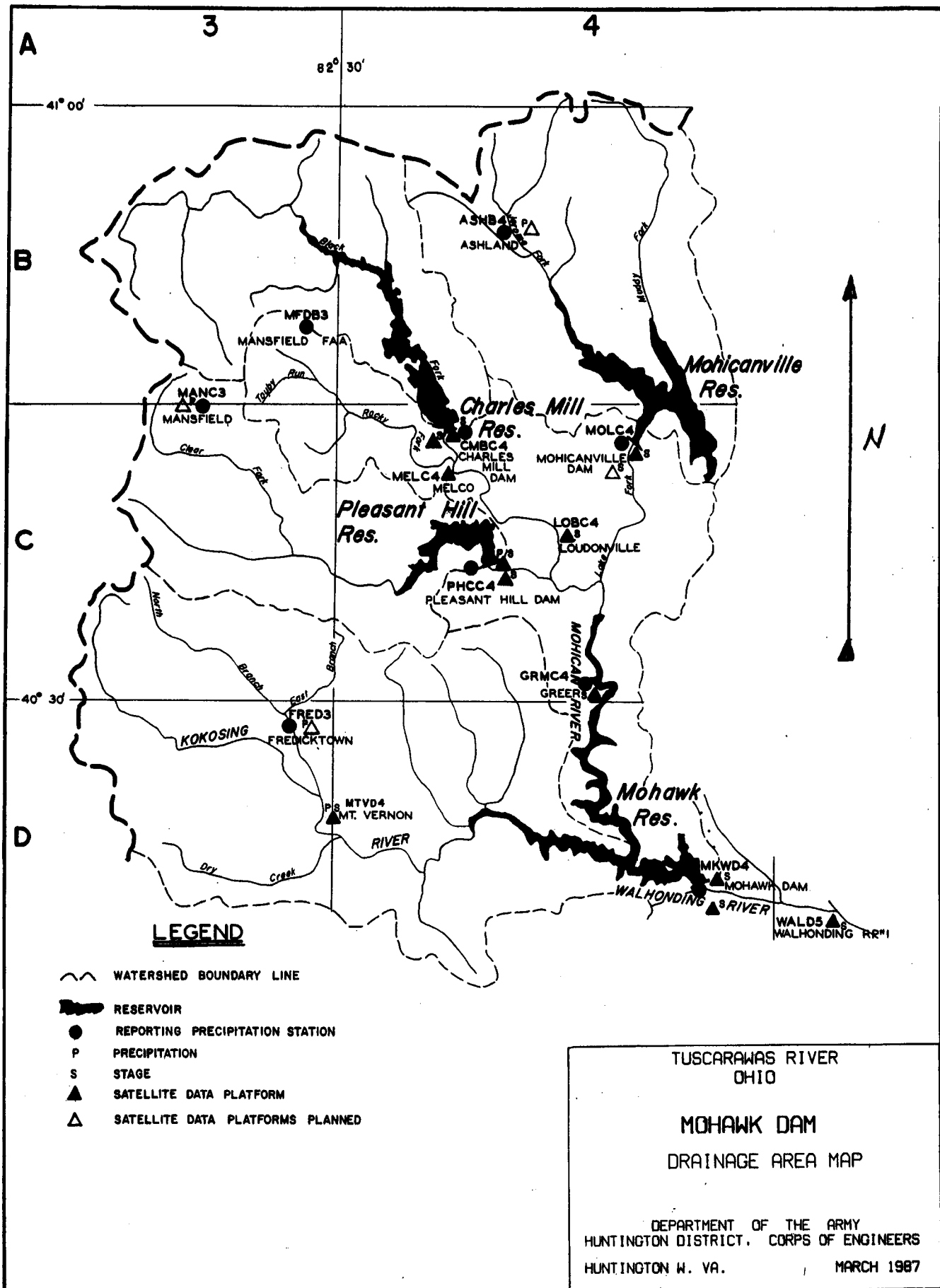
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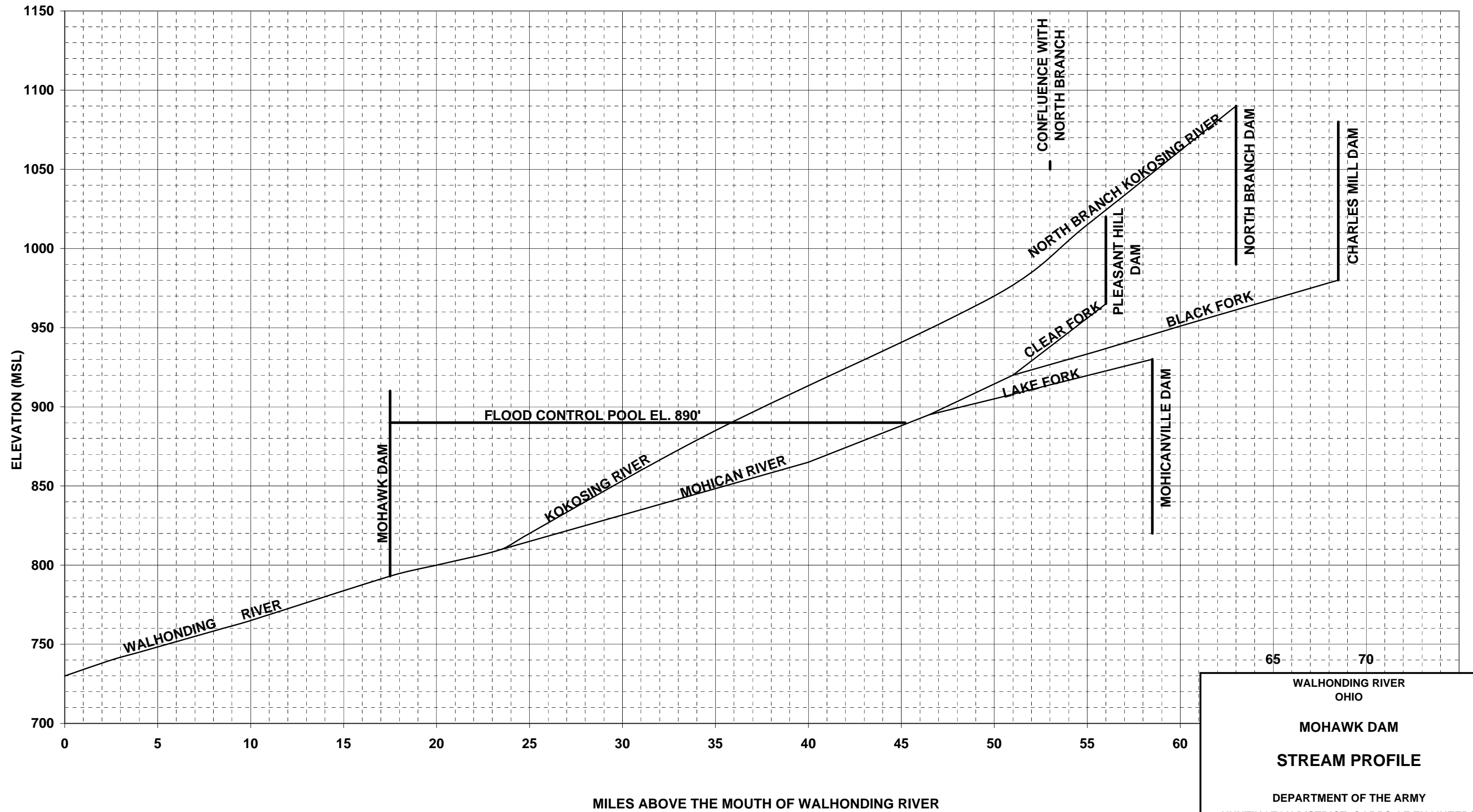
DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
HUNTINGTON, W. VA. REDRAWN: OCT. 1999

MUSKINGUM WATERSHED  
WALHONDING RIVER

MOHAWK DAM  
OUTLET CHANNEL

DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
HUNTINGTON, W. VA. REDRAWN: OCT. 1999





65 70

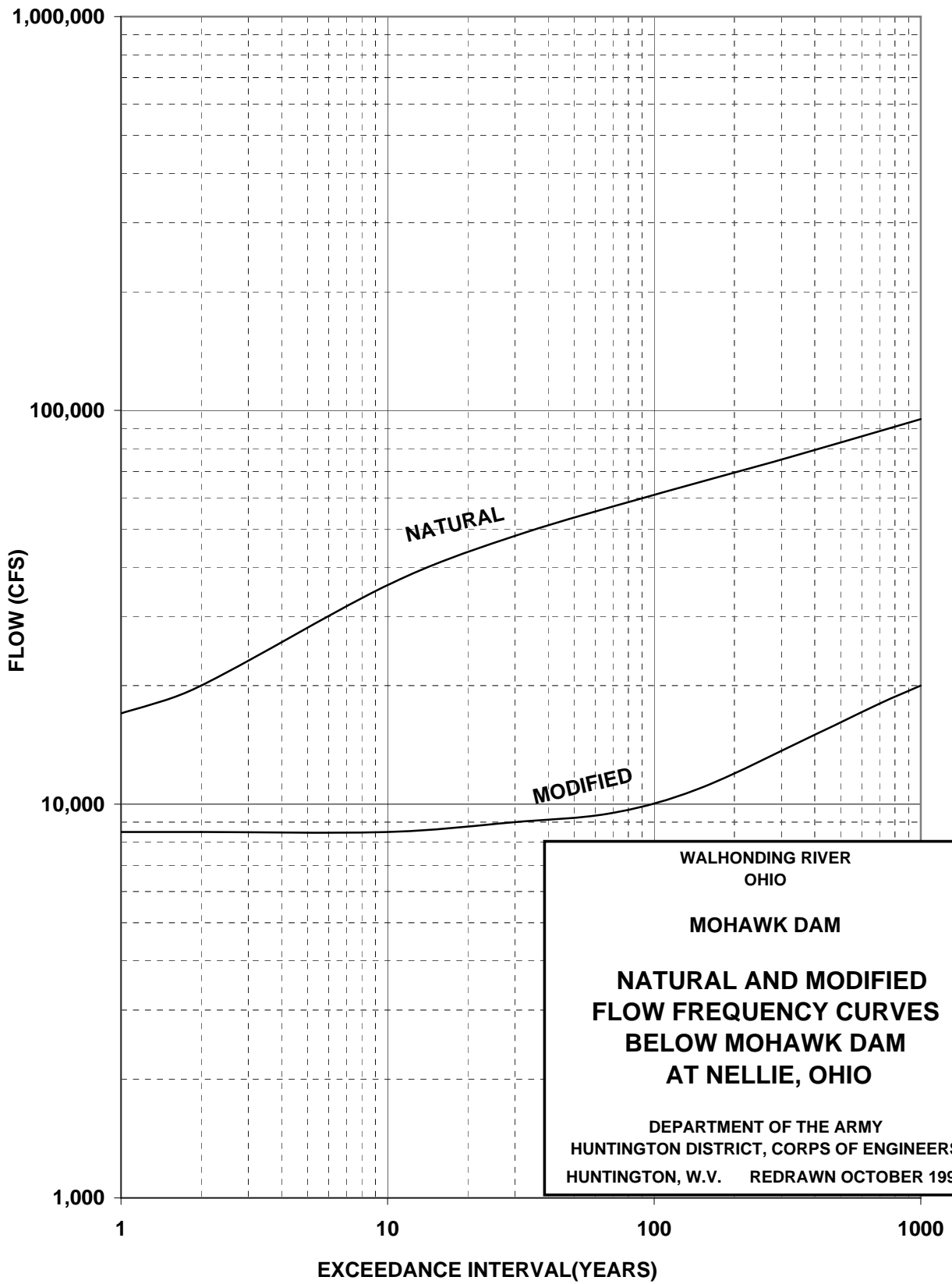
WALHONDING RIVER  
OHIO

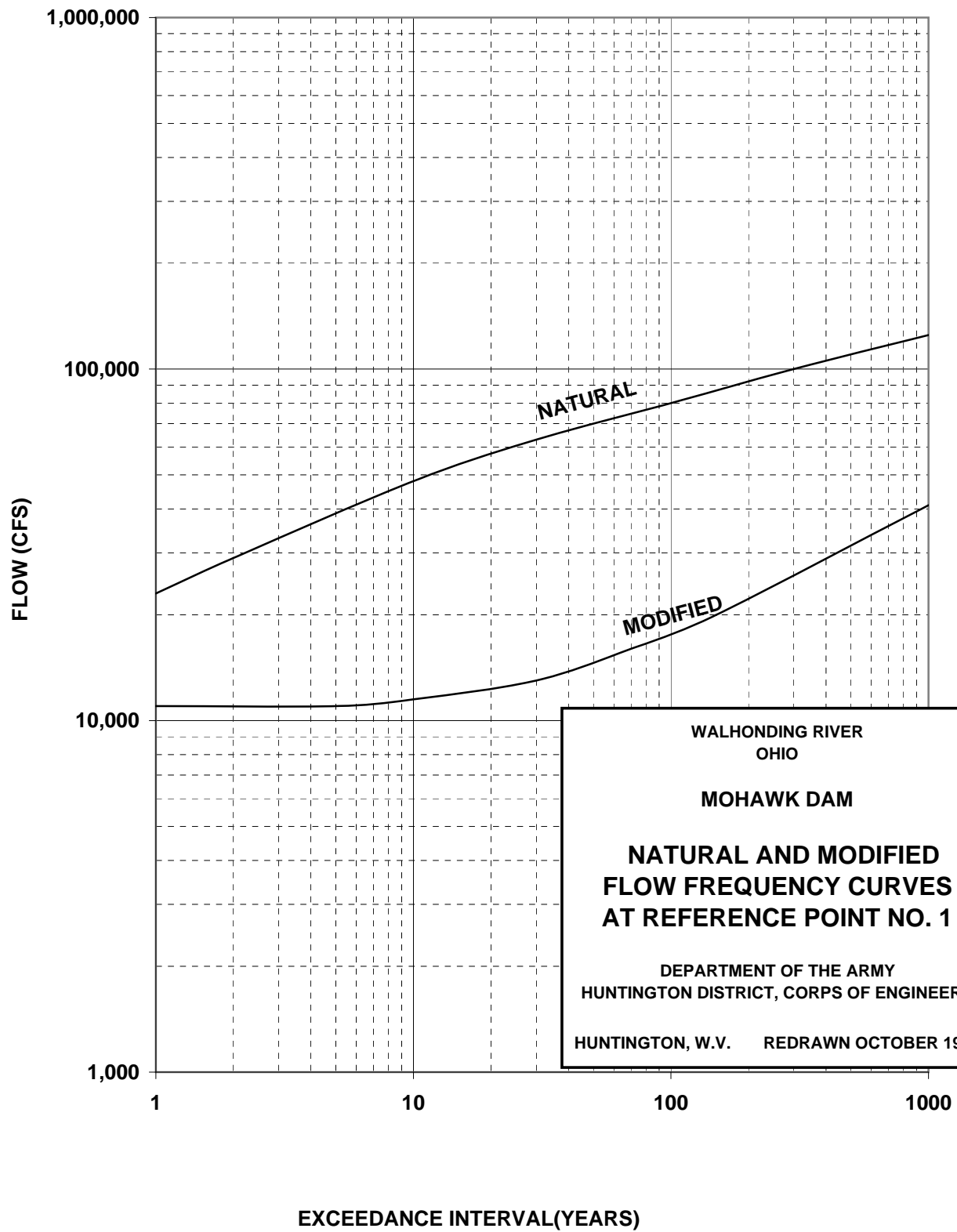
**MOHAWK DAM**

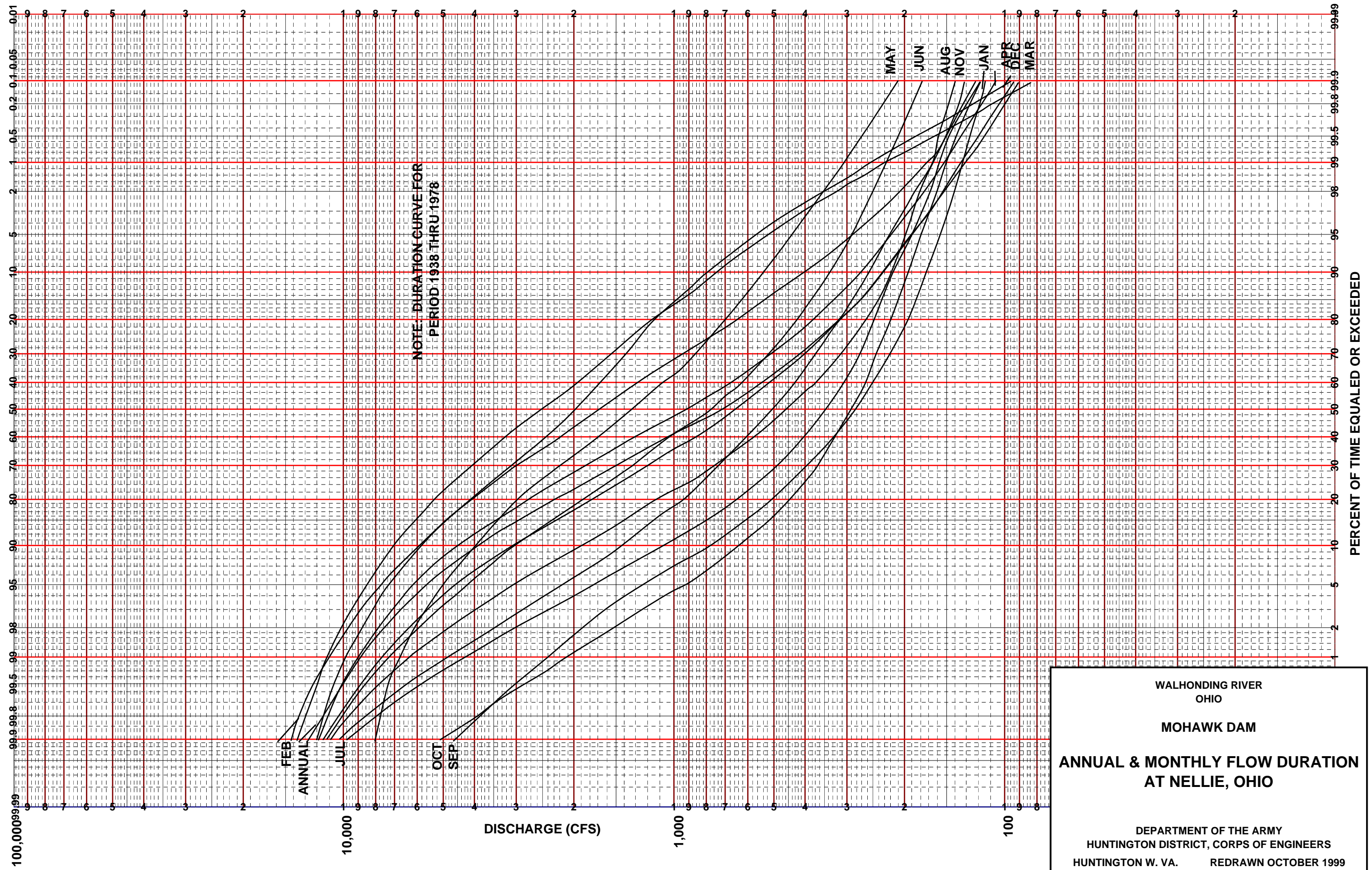
**STREAM PROFILE**

DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W.V. REDRAWN OCTOBER 1999





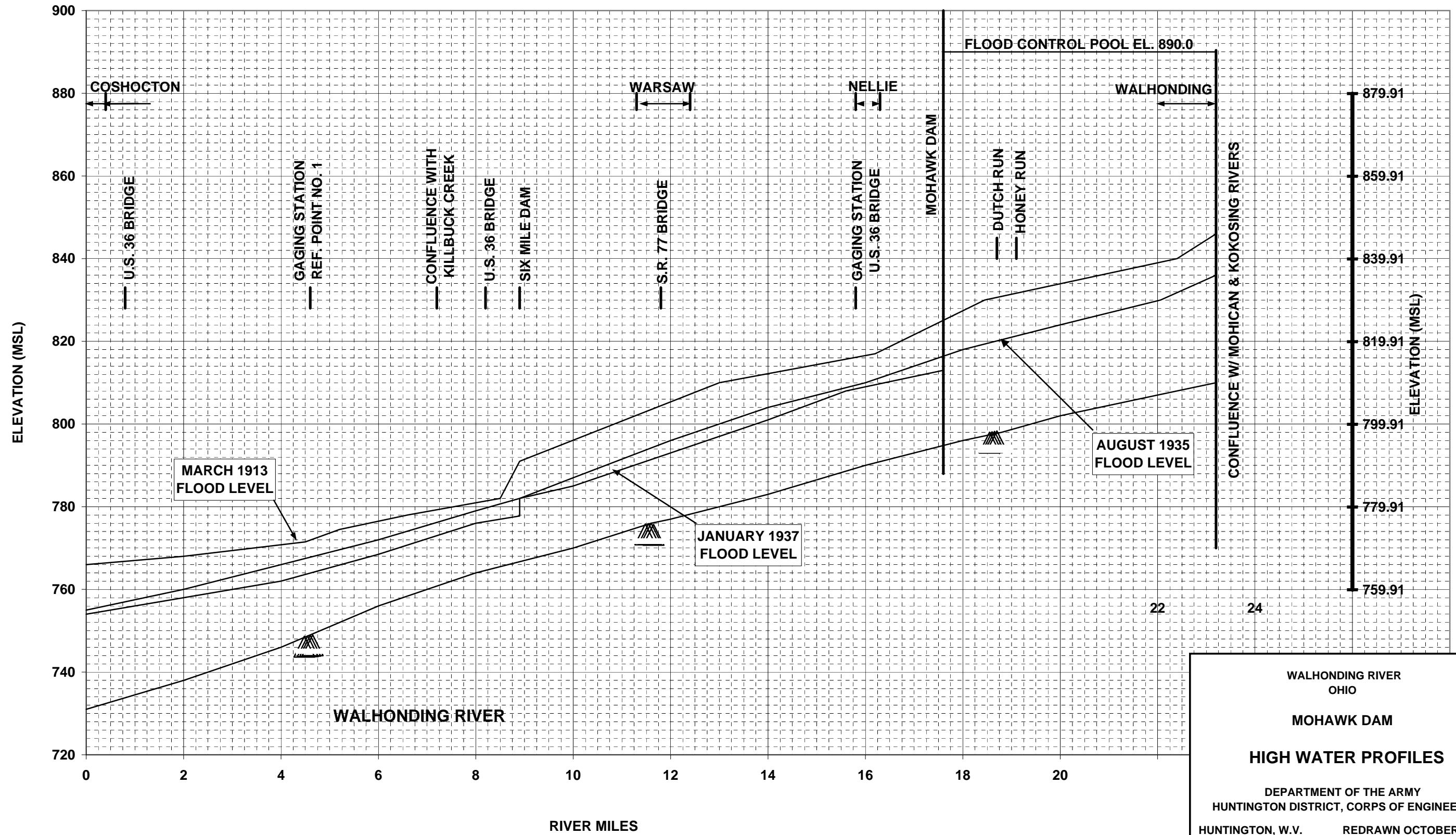


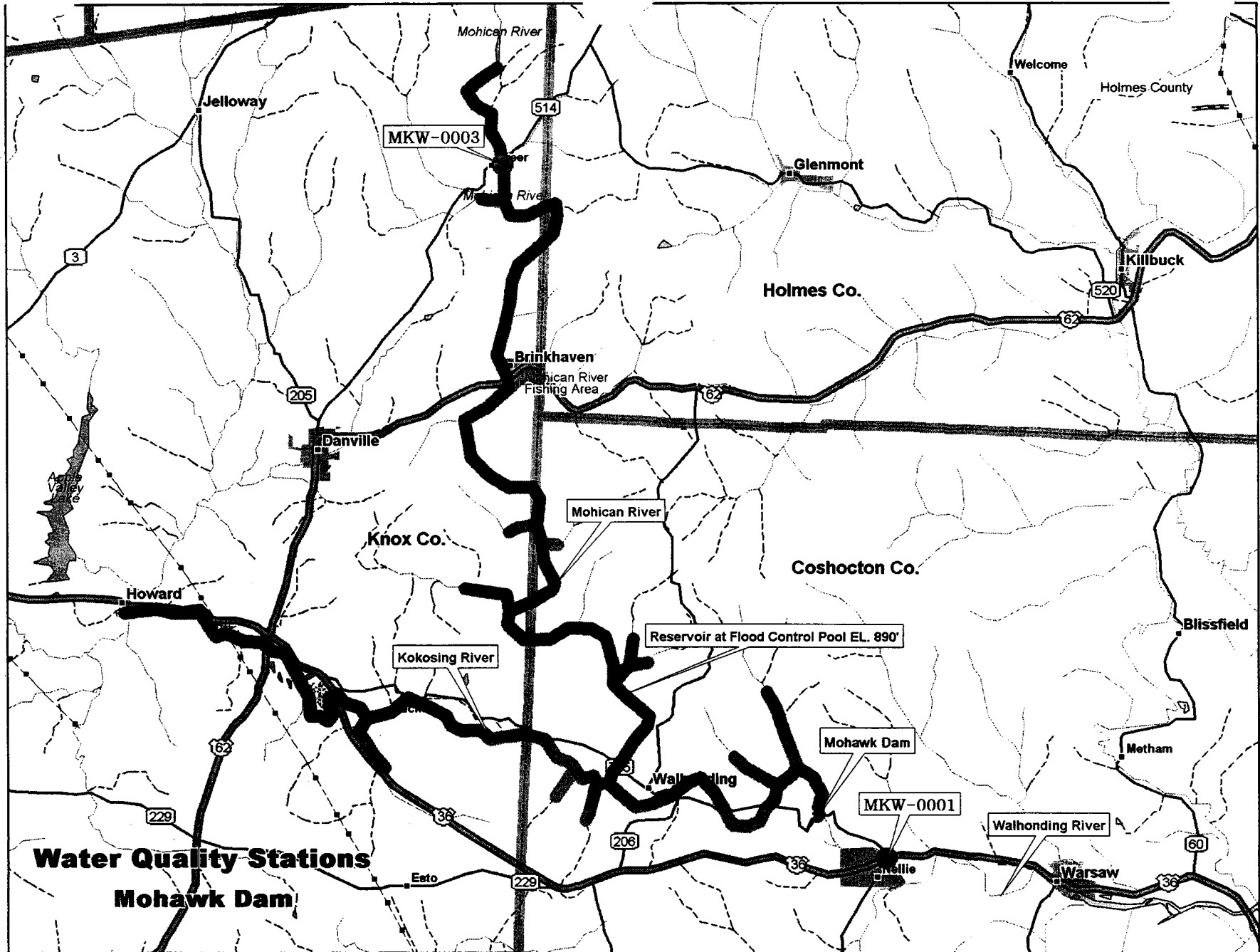
WALHONDING RIVER  
OHIO

MOHAWK DAM

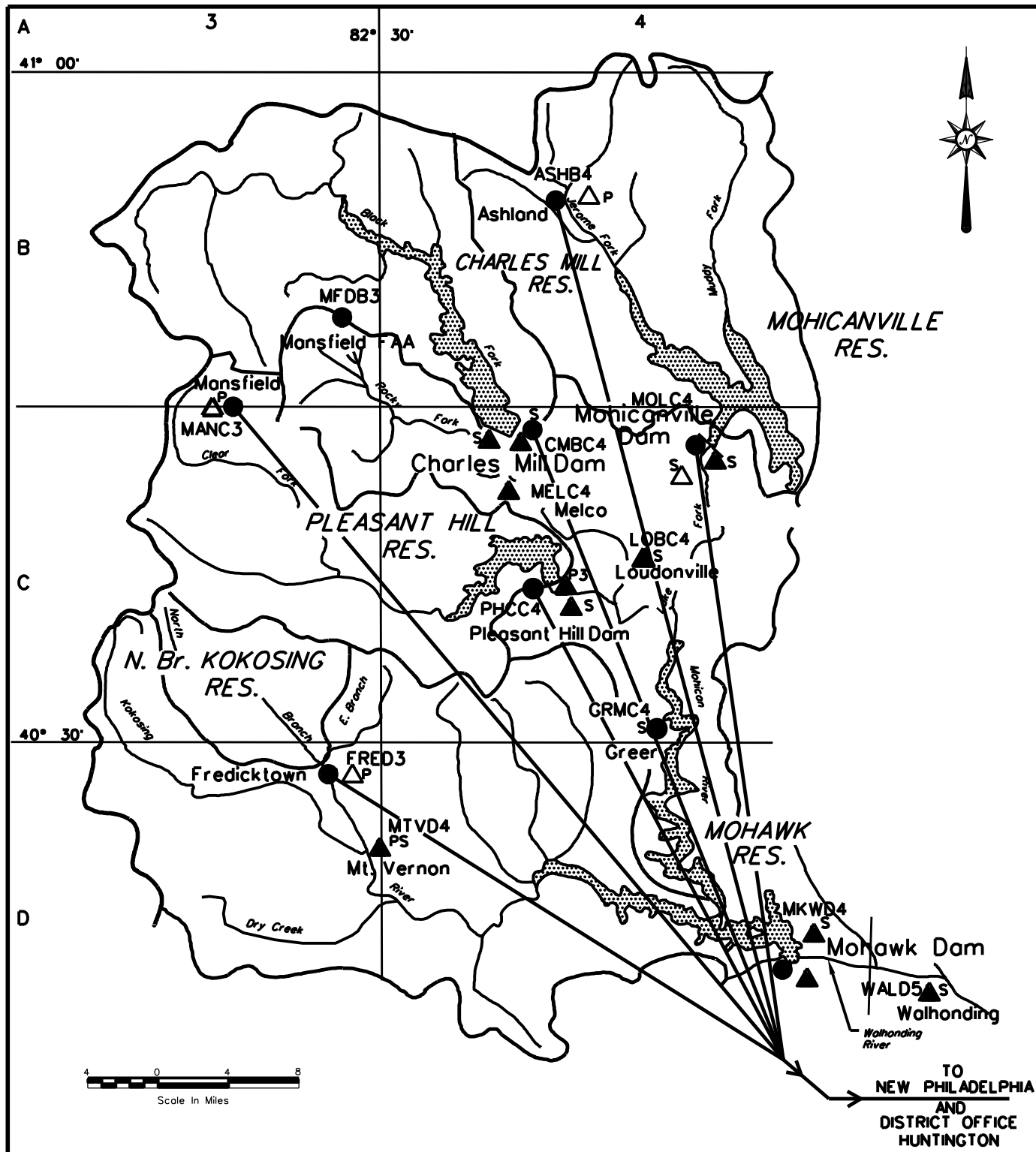
**ANNUAL & MONTHLY FLOW DURATION  
AT NELLIE, OHIO**

DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
HUNTINGTON W. VA. REDRAWN OCTOBER 1999





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Scale: 1 : 150,000 Map Rotation: 0° Magnetic Declination: 7.1°W



**LEGEND**

- WATERSHED BOUNDARY LINE
- RESERVOIR
- REPORTING PRECIPITATION STATION
- PRECIPITATION
- STAGE
- SATELLITE DATA PLATFORM
- SATELLITE DATA PLATFORMS PLANNED
- TELEPHONE AND RADIO BACKUP
- TELEPHONE OBSERVERS

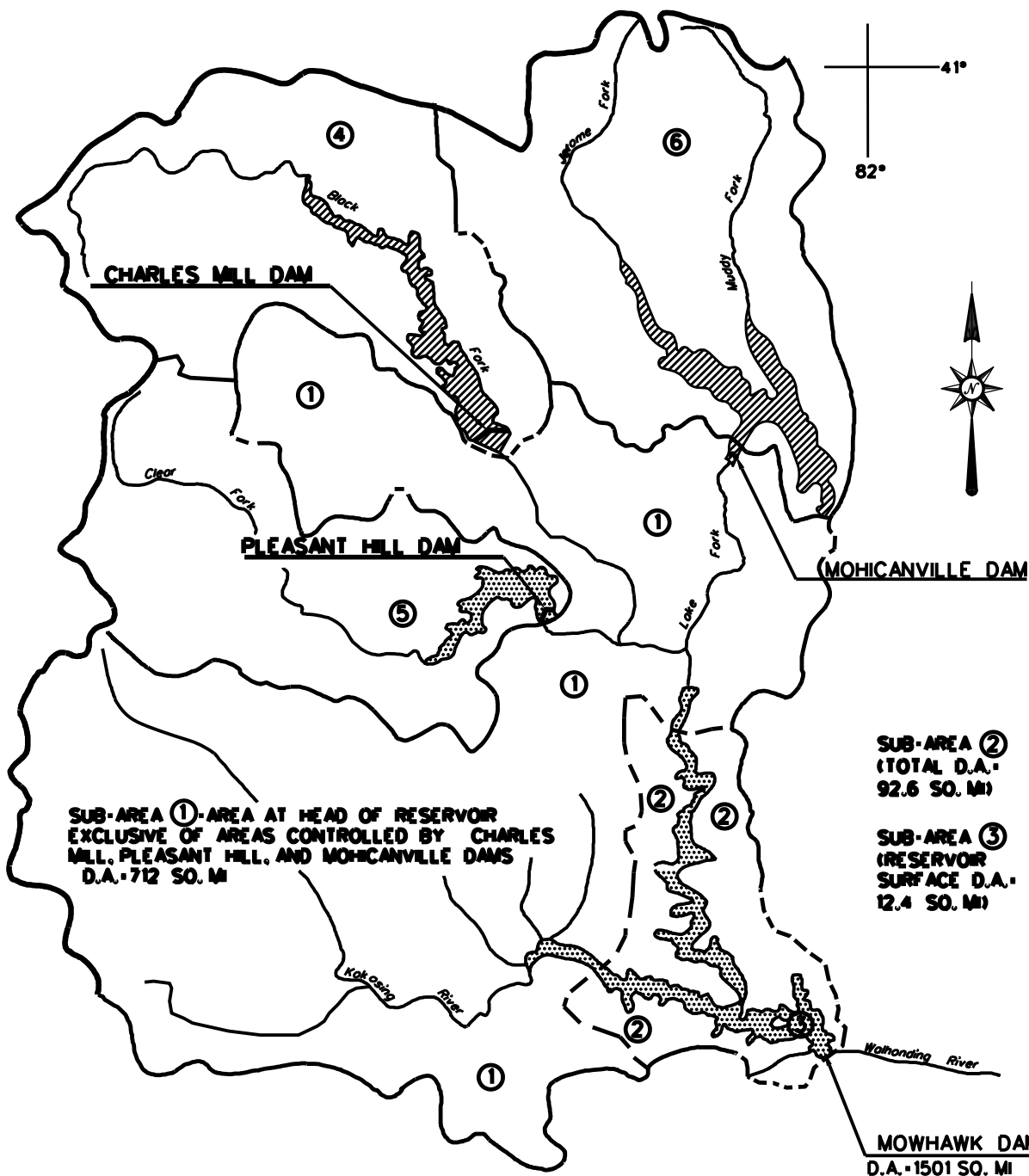
TUSCARAWAS RIVER  
OHIO

**MOHAWK DAM**

**HYDROLOGIC NETWORK**

DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT CORPS OF ENGINEERS  
HUNTINGTON, W. VA.      REDRAWN: OCT. 1999

TO  
NEW PHILADELPHIA  
AND  
DISTRICT OFFICE  
HUNTINGTON



SUB-AREA ① - AREA AT HEAD OF RESERVOIR EXCLUSIVE OF AREAS CONTROLLED BY CHARLES MILL, PLEASANT HILL, AND MOHICANVILLE DAMS  
D.A. 712 SO. MI

SUB-AREA ②  
(TOTAL D.A. 92.6 SO. MI)

SUB-AREA ③  
(RESERVOIR SURFACE D.A. 12.4 SO. MI)

MOHAWK DAM  
D.A. 1501 SO. MI



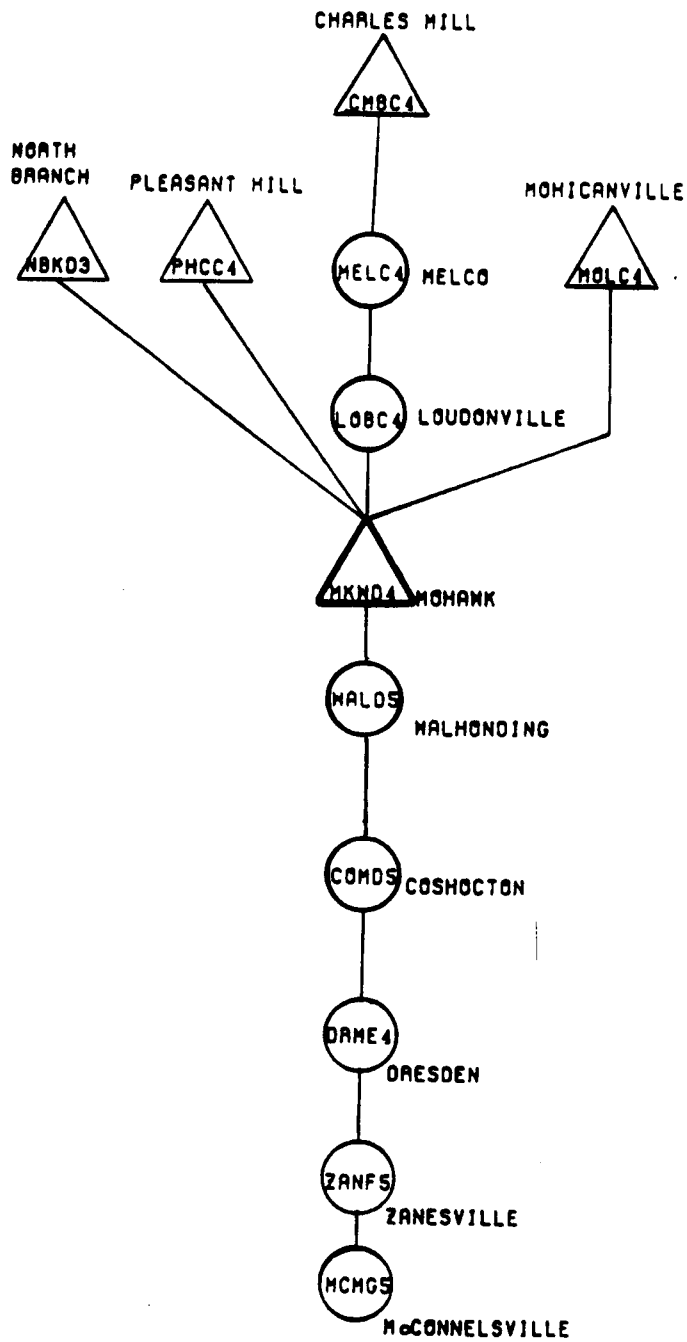
TUSCARAWAS RIVER  
OHIO

MOHAWK DAM

FORECAST AREA REACHES

DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
HUNTINGTON, W. VA. REDRAWN: OCT. 1999

MOHAWK DAM - MUSKINGUM RIVER BASIN  
BASIN CONFIGURATION



MOHAWK RESERVOIR  
WALHONDING RIVER

AREA AND CAPACITY TABLES

DRAINAGE AREA:

UNCONTROLLED = 776 SQ. MI.  
CONTROLLED = 728 SQ. MI.  
TOTAL = 1504 SQ. MI.

1 IN. RUNOFF = 41,387 AC. FT.  
(UNCONTROLLED AREA)

POOL ELEV.	CAPACITY		AREA IN ACRES	POOL ELEV.	CAPACITY		AREA IN ACRES
	AC. FT.	INCHES			AC. FT.	INCHES	
795	0	0.00	0	815	2,520	0.06	400
796	2	0.00	3	816	2,950	0.07	450
797	9	0.00	11	817	3,430	0.08	500
798	26	0.00	22	818	3,960	0.10	560
799	52	0.00	30	819	4,550	0.11	620
800	86	0.00	37	820	5,200	0.13	690
801	130	0.00	50	821	5,920	0.14	750
802	186	0.00	62	822	6,700	0.16	810
803	255	0.01	75	823	7,550	0.18	880
804	335	0.01	88	824	8,470	0.20	960
805	430	0.01	99	825	9,460	0.23	1,030
806	535	0.01	112	826	10,500	0.25	1,110
807	655	0.02	128	827	11,700	0.28	1,190
808	790	0.02	142	828	12,900	0.31	1,270
809	940	0.02	159	829	14,200	0.34	1,350
810	1,110	0.03	182	830	15,600	0.38	1,440
811	1,310	0.03	220	831	17,100	0.41	1,530
812	1,550	0.04	260	832	18,700	0.45	1,630
813	1,830	0.04	300	833	20,400	0.49	1,730
814	2,150	0.05	350	834	22,100	0.53	1,830

MOHAWK RESERVOIR  
WALHONDING RIVER

AREA AND CAPACITY TABLES

DRAINAGE AREA:

UNCONTROLLED = 776 SQ. MI.  
CONTROLLED = 728 SQ. MI.  
TOTAL = 1504 SQ. MI.

1 IN. RUNOFF = 41,387 AC. FT.  
(UNCONTROLLED AREA)

POOL ELEV.	CAPACITY		AREA IN ACRES	POOL ELEV.	CAPACITY		AREA IN ACRES
	AC. FT.	INCHES			AC. FT.	INCHES	
835	24,000	0.58	1,920	855	82,800	2.00	4,040
836	26,000	0.63	2,010	856	86,900	2.10	4,140
837	28,000	0.68	2,090	857	91,100	2.20	4,240
838	30,200	0.73	2,170	858	95,400	2.31	4,330
839	32,400	0.78	2,260	859	99,700	2.41	4,420
840	34,700	0.84	2,340	860	104,200	2.52	4,510
841	37,100	0.90	2,450	861	108,800	2.63	4,610
842	39,600	0.96	2,570	862	113,400	2.74	4,710
843	42,200	1.02	2,690	863	118,200	2.86	4,800
844	45,000	1.09	2,820	864	123,100	2.97	4,900
845	47,800	1.15	2,930	865	128,000	3.09	4,990
846	50,800	1.23	3,060	866	133,000	3.21	5,070
847	53,900	1.30	3,160	867	138,100	3.34	5,150
848	57,200	1.38	3,280	868	143,300	3.46	5,240
849	60,500	1.46	3,390	869	148,600	3.59	5,330
850	63,900	1.54	3,500	870	154,000	3.72	5,420
851	67,500	1.63	3,610	871	159,400	3.85	5,510
852	71,200	1.72	3,720	872	165,000	3.99	5,610
853	74,900	1.81	3,830	873	170,700	4.12	5,710
854	78,800	1.90	3,940	874	176,400	4.26	5,810

MOHAWK RESERVOIR  
WALHONDING RIVER

AREA AND CAPACITY TABLES

DRAINAGE AREA:

UNCONTROLLED = 776 SQ. MI.  
CONTROLLED = 728 SQ. MI.  
TOTAL = 1504 SQ. MI.

1 IN. RUNOFF = 41,387 AC. FT.  
(UNCONTROLLED AREA)

POOL ELEV.	CAPACITY		AREA IN ACRES	POOL ELEV.	CAPACITY		AREA IN ACRES
	AC. FT.	INCHES			AC. FT.	INCHES	
875	182,300	4.40	5,910	895	326,800	7.90	8,800
876	188,200	4.55	6,020	896	335,700	8.11	8,990
877	194,300	4.69	6,130	897	344,800	8.33	9,190
878	200,500	4.84	6,250	898	354,100	8.56	9,380
879	206,800	5.00	6,370	899	363,600	8.79	9,580
<i>108</i> 880	213,300	5.15	6,490	900	373,300	9.02	9,820
881	219,800	5.31	6,610				
882	226,500	5.47	6,730				
883	233,300	5.64	6,860				
884	240,200	5.80	6,990				
<del>885</del>	247,300	5.98	7,140				
886	254,500	6.15	7,290				
887	261,900	6.33	7,450				
888	269,400	6.51	7,610				
889	277,100	6.70	7,780				
<i>Spelling</i> 890	285,000	6.89	7,950				
891	293,000	7.08	8,110				
892	301,200	7.28	8,280				
893	309,600	7.48	8,450				
894	318,100	7.69	8,630				

RECORD OF DEVIATION  
FROM  
APPROVED WATER CONTROL PLAN

DATE: 27 October 2003  
DEVIATION NO.: WY04-05

JS

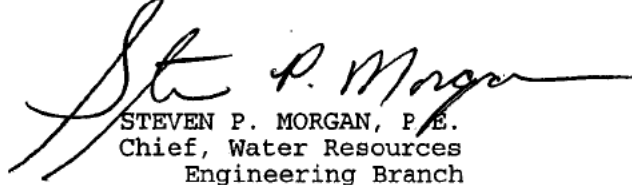
DEVIATION: Delaware Lake

1. This is to confirm the following communication between Mr. Tim Curran, CELRH-EC-WM, and Mr. Pat Morgan, CELRH-EC-W, concerning a deviation from the approved water control plan.
2. Deviation. Effective on 27 October 2003, the Project will operate to achieve and maintain a pool elevation of 916.0 feet. Effective on the 1st and 2<sup>nd</sup> of November 2003 between 0700 and 1700 hours, the Project will release a flow of 1000 cfs. Overnight on the 1<sup>st</sup>, the Project will maintain a pool elevation of 915.25 feet. At 1700 hrs on the 2<sup>nd</sup>, the Project will return to normal operation.
3. Purpose. The purpose of this deviation is to provide Fast Water Training as requested by ODNR.
4. Results. This deviation will have minimal impact on both the pool and downstream stages. The project should not have any problem achieving the temporary level and as project begins drawdown on November 1<sup>st</sup> a small drop below seasonal pool during the provision of this operation will not significantly impact recreation. Downstream fluctuation will be within normal ranges and at a level which does not adversely effect downstream recreation.
5. Coordination. Coordination between Jim Schray and Vince Marchese, EC-WM, and Ben O'Dell, OR-DDO, and Beth Pratt [REDACTED], ODNR.
6. Approval recommended.



TIMOTHY W. CURRAN, P.E.  
Chief, Water Management Section

APPROVED:



STEVEN P. MORGAN, P.E.  
Chief, Water Resources  
Engineering Branch

MOHAWK

PERCENT STORAGE UTILIZATION - ANNUAL

ELEV	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
795	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
796	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
797	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
798	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
799	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
800	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04
801	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06
802	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.09
803	0.09	0.09	0.09	0.10	0.10	0.10	0.11	0.11	0.11	0.11
804	0.12	0.12	0.12	0.13	0.13	0.13	0.14	0.14	0.14	0.15
805	0.15	0.15	0.16	0.16	0.16	0.17	0.17	0.18	0.18	0.18
806	0.19	0.19	0.20	0.20	0.20	0.21	0.21	0.22	0.22	0.23
807	0.23	0.23	0.24	0.24	0.25	0.25	0.26	0.26	0.27	0.27
808	0.28	0.28	0.29	0.29	0.30	0.30	0.31	0.31	0.32	0.32
809	0.33	0.34	0.34	0.35	0.35	0.36	0.36	0.37	0.38	0.38
810	0.39	0.40	0.40	0.41	0.42	0.42	0.43	0.44	0.44	0.45
811	0.46	0.47	0.48	0.48	0.49	0.50	0.51	0.52	0.53	0.53
812	0.54	0.55	0.56	0.57	0.58	0.59	0.60	0.61	0.62	0.63
813	0.64	0.65	0.66	0.67	0.68	0.70	0.71	0.72	0.73	0.74
814	0.75	0.77	0.78	0.79	0.80	0.82	0.83	0.84	0.86	0.87
815	0.88	0.90	0.91	0.93	0.94	0.96	0.97	0.99	1.00	1.02
816	1.04	1.05	1.07	1.08	1.10	1.12	1.13	1.15	1.17	1.19
817	1.20	1.22	1.24	1.26	1.28	1.29	1.31	1.33	1.35	1.37
818	1.39	1.41	1.43	1.45	1.47	1.49	1.51	1.53	1.55	1.57
819	1.60	1.62	1.64	1.66	1.68	1.71	1.73	1.75	1.79	1.80
820	1.82	1.85	1.87	1.90	1.92	1.95	1.97	2.00	2.03	2.05
821	2.08	2.10	2.13	2.16	2.18	2.21	2.24	2.27	2.29	2.32
822	2.35	2.38	2.41	2.44	2.47	2.50	2.53	2.56	2.59	2.62
823	2.65	2.68	2.71	2.74	2.78	2.81	2.84	2.87	2.91	2.94
824	2.97	3.01	3.04	3.07	3.11	3.14	3.18	3.21	3.25	3.28
825	3.32	3.35	3.39	3.42	3.46	3.49	3.53	3.57	3.61	3.65
826	3.69	3.73	3.77	3.81	3.85	3.89	3.94	3.98	4.02	4.06
827	4.11	4.15	4.19	4.23	4.27	4.31	4.35	4.40	4.44	4.48
828	4.53	4.57	4.61	4.66	4.70	4.75	4.80	4.84	4.89	4.94
829	4.98	5.03	5.08	5.13	5.17	5.22	5.27	5.32	5.37	5.42
830	5.47	5.52	5.58	5.63	5.68	5.73	5.79	5.84	5.89	5.95
831	6.00	6.05	6.11	6.16	6.22	6.26	6.33	6.39	6.45	6.50
832	6.56	6.62	6.68	6.74	6.80	6.86	6.92	6.98	7.04	7.10
833	7.16	7.21	7.27	7.33	7.39	7.45	7.51	7.57	7.63	7.69
834	7.75	7.82	7.89	7.95	8.02	8.08	8.15	8.22	8.29	8.35
835	8.42	8.49	8.56	8.63	8.70	8.77	8.84	8.91	8.98	9.05

MOHAWK

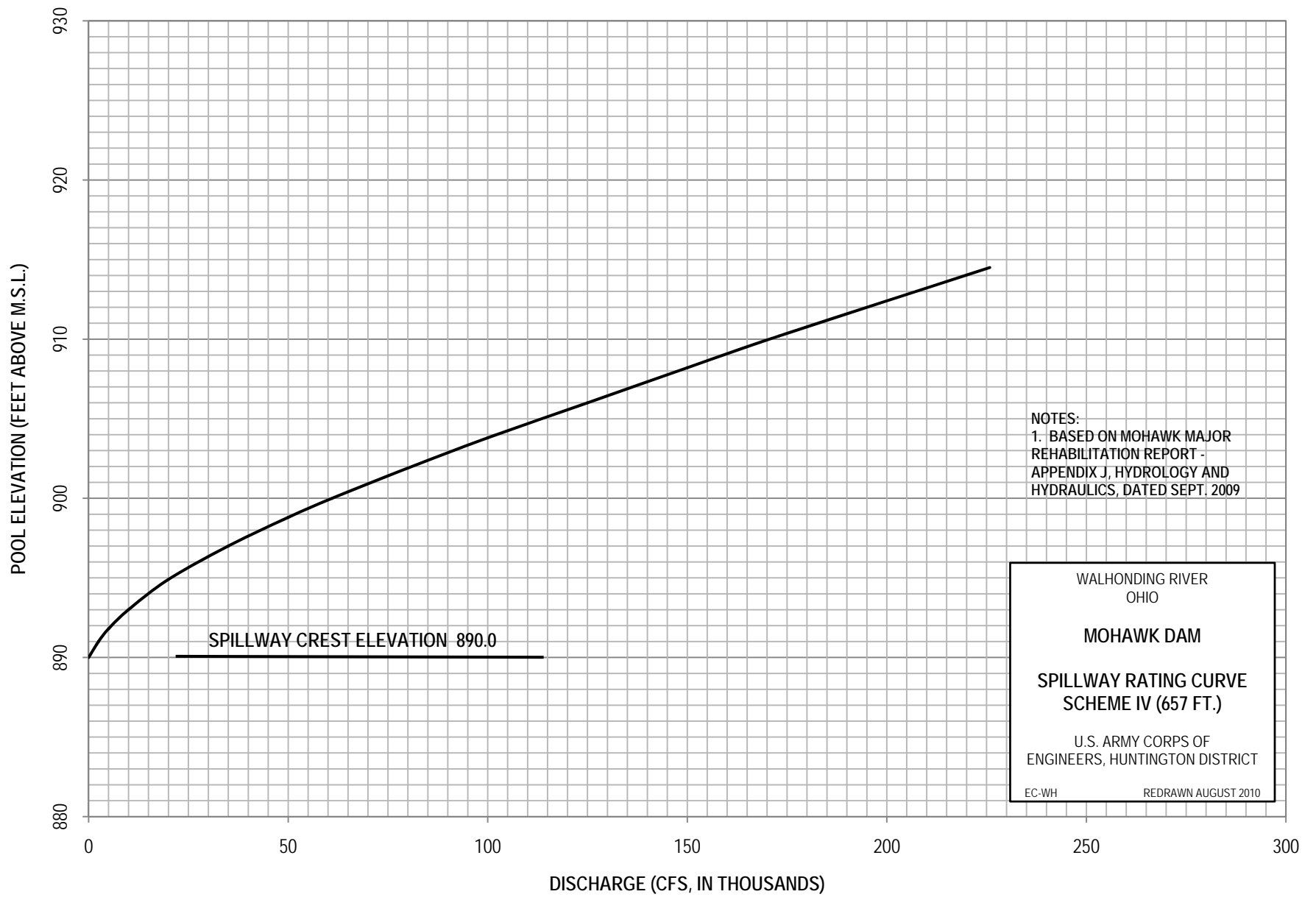
PERCENT STORAGE UTILIZATION - ANNUAL

ELEV	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
836	9.12	9.19	9.26	9.33	9.40	9.47	9.54	9.61	9.68	9.75
837	9.82	9.90	9.98	10.06	10.13	10.21	10.29	10.37	10.44	10.52
838	10.60	10.67	10.75	10.82	10.90	10.98	11.06	11.13	11.21	11.29
839	11.37	11.45	11.53	11.61	11.69	11.77	11.85	11.93	12.01	12.09
840	12.18	12.26	12.34	12.42	12.51	12.59	12.68	12.76	12.85	12.93
841	13.02	13.10	13.19	13.28	13.36	13.45	13.54	13.63	13.72	13.81
842	13.89	13.98	14.07	14.16	14.25	14.34	14.43	14.53	14.62	14.71
843	14.81	14.91	15.00	15.10	15.20	15.30	15.40	15.49	15.59	15.69
844	15.79	15.88	15.98	16.08	16.17	16.27	16.37	16.47	16.57	16.67
845	16.77	16.88	16.98	17.08	17.19	17.29	17.40	17.51	17.61	17.72
846	17.82	17.93	18.04	18.14	18.25	18.36	18.47	18.58	18.69	18.80
847	18.91	19.03	19.14	19.26	19.38	19.49	19.61	19.72	19.84	19.95
848	20.07	20.18	20.30	20.41	20.53	20.64	20.76	20.88	20.99	21.11
849	21.23	21.34	21.46	21.58	21.70	21.82	21.94	22.06	22.18	22.30
850	22.42	22.55	22.67	22.80	22.92	23.05	23.18	23.30	23.43	23.56
851	23.68	23.81	23.94	24.07	24.20	24.33	24.46	24.59	24.72	24.85
852	24.98	25.11	25.24	25.36	25.49	25.62	25.75	25.88	26.02	26.15
853	26.28	26.42	26.55	26.69	26.82	26.96	27.10	27.24	27.37	27.51
854	27.65	27.79	27.93	28.07	28.21	28.35	28.49	28.63	28.77	28.91
855	29.05	29.20	29.34	29.48	29.62	29.77	29.91	30.06	30.20	30.35
856	30.49	30.64	30.78	30.93	31.08	31.22	31.37	31.52	31.67	31.82
857	31.97	32.12	32.27	32.42	32.57	32.72	32.87	33.02	33.17	33.32
858	33.47	33.62	33.77	33.92	34.07	34.22	34.37	34.52	34.68	34.83
859	34.98	35.14	35.30	35.45	35.61	35.77	35.93	36.08	36.24	36.40
860	36.56	36.72	36.88	37.05	37.21	37.37	37.53	37.69	37.85	38.01
861	38.18	38.33	38.49	38.65	38.81	38.97	39.14	39.30	39.46	39.63
862	39.79	39.96	40.12	40.29	40.46	40.63	40.80	40.97	41.13	41.30
863	41.47	41.65	41.82	41.99	42.16	42.33	42.51	42.68	42.85	43.02
864	43.19	43.36	43.53	43.71	43.88	44.05	44.22	44.39	44.57	44.74
865	44.91	45.09	45.26	45.44	45.61	45.79	45.96	46.14	46.31	46.49
866	46.67	46.84	47.02	47.20	47.38	47.56	47.74	47.92	48.10	48.28
867	48.46	48.64	48.82	49.00	49.18	49.36	49.55	49.73	49.91	50.10
868	50.28	50.47	50.65	50.84	51.02	51.21	51.39	51.58	51.77	51.95
869	52.14	52.33	52.52	52.71	52.90	53.09	53.28	53.47	53.66	53.85
870	54.04	54.22	54.41	54.60	54.79	54.97	55.16	55.35	55.55	55.74
871	55.93	56.13	56.32	56.52	56.71	56.91	57.11	57.30	57.50	57.70
872	57.90	58.10	58.30	58.50	58.70	58.90	59.10	59.30	59.50	59.70
873	59.90	60.09	60.29	60.49	60.69	60.89	61.09	61.29	61.49	61.69
874	61.90	62.10	62.31	62.52	62.72	62.93	63.14	63.34	63.55	63.76
875	63.97	64.17	64.37	64.58	64.79	64.99	65.20	65.41	65.62	65.83

MOHAWK

PERCENT STORAGE UTILIZATION - ANNUAL

ELEV	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
876	66.04	66.25	66.46	66.67	66.89	67.10	67.32	67.53	67.75	67.96
877	68.18	68.39	68.61	68.83	69.04	69.26	69.48	69.70	69.91	70.13
878	70.35	70.57	70.79	71.01	71.23	71.45	71.67	71.89	72.11	72.34
879	72.56	72.79	73.02	73.25	73.47	73.70	73.93	74.16	74.39	74.61
880	74.84	75.07	75.29	75.52	75.75	75.97	76.20	76.43	76.66	76.89
881	77.12	77.36	77.59	77.83	78.06	78.29	78.53	78.77	79.00	79.24
882	79.47	79.71	79.95	80.19	80.42	80.66	80.90	81.14	81.38	81.62
883	81.86	82.10	82.34	82.58	82.82	83.06	83.30	83.55	83.79	84.04
884	84.28	84.53	84.78	85.03	85.27	85.52	85.77	86.02	86.27	86.52
885	86.77	87.02	87.27	87.52	87.77	88.03	88.28	88.53	88.79	89.04
886	89.30	89.56	89.82	90.07	90.33	90.59	90.85	91.11	91.37	91.63
887	91.90	92.16	92.42	92.68	92.94	93.20	93.47	93.73	94.00	94.26
888	94.53	94.79	95.06	95.33	95.60	95.87	96.14	96.41	96.68	96.96
889	97.23	97.50	97.78	98.06	98.33	98.61	98.89	99.17	99.44	99.72
890	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION  
 EXPANDED RATING TABLE DATE PRINTED 01/25/82  
 03138500 WALHONDING R BL MOHAWK DAM AT NELLIE OH TYPE LOG (SCALE OFFSET = 4.30) RATING NO 04

BASED ON \_\_\_\_\_ DISCHARGE MEASUREMENTS, NO. \_\_\_\_\_, AND \_\_\_\_\_, AND IS \_\_\_\_\_ WELL DEFINED BETWEEN \_\_\_\_\_ AND \_\_\_\_\_  
 FROM \_\_\_\_\_ TO \_\_\_\_\_, FROM \_\_\_\_\_ TO \_\_\_\_\_ \*COMP BY \_\_\_\_\_ DATE \_\_\_\_\_  
 \*CKD. BY \_\_\_\_\_ DATE \_\_\_\_\_ ZERO = 790.0

GAGE HEIGHT IN FEET	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION)											DIFF IN Q PER TENTH GH
	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09		
4.40	5.50	6.15	6.80	7.45	8.09	8.74	9.40	10.0	10.7	11.4	6.6	
4.50	12.1	12.8	13.6	14.4	15.2	16.0	16.8	17.6	18.4	19.2	7.9	
4.60	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.1	28.1	29.2	10.2	
4.70	30.2	31.3	32.4	33.6	34.7	35.9	37.1	38.3	39.6	40.8	11.9	
4.80	42.1	43.5	44.9	46.3	47.7	49.1	50.5	52.0	53.4	54.9	14.4	
4.90	56.5	58.2	59.9	61.6	63.3	65.0	66.8	68.6	70.3	72.2	17.5	
5.00	74.0	76.3	78.7	81.0	83.5	85.9	88.4	91.0	93.5	96.1	24.8	
5.10	98.8	101.5	104.2	107.0	109.8	112.7	115.6	118.5	121.5	124.5	28.8	
5.20	127.6	130.7	133.9	137.0	140.3	143.5	146.8	150.2	153.6	157.0	33.0	
5.30	160.6	164.3	168.1	171.9	175.7	179.6	183.5	187.5	191.5	195.6	39.1	
5.40	199.8	203.9	208.1	212.4	216.7	221.1	225.5	230.0	234.5	239.0	43.8	
5.50	243.5	248.1	252.8	257.5	262.3	267.1	271.9	276.8	281.8	286.8	48.3	
5.60	291.8	296.9	302.1	307.2	312.5	317.8	323.1	328.5	334.0	339.5	53.2	
5.70	345.0	350.4	355.8	361.3	366.8	372.3	377.9	383.6	389.3	395.0	55.8	
5.80	400.8	406.6	412.5	418.4	424.3	430.3	436.4	442.5	448.6	454.8	60.3	
5.90	461.1	467.3	473.7	480.0	486.5	492.9	499.4	506.0	512.4	518.9	64.3	
6.00	525.4	532.0	538.6	545.2	551.9	558.6	565.4	572.2	579.0	585.9	67.5	
6.10	592.9	599.9	606.9	614.0	621.1	628.2	635.4	642.7	650.0	657.3	71.8	
6.20	664.7	672.1	679.6	687.1	694.6	702.2	709.8	717.5	725.2	733.0	75.9	
6.30	740.6	748.2	755.9	763.6	771.4	779.2	787.0	794.9	802.8	810.8	78.2	
6.40	818.8	826.8	834.9	843.0	851.2	859.4	867.6	875.9	884.2	892.6	82.2	
6.50	901.0	909.4	917.9	926.4	935.0	943.6	952.2	960.9	969.6	978.4	86.2	
6.60	987.2	996.1	1005	1014	1023	1032	1041	1050	1059	1068	90	
6.70	1077	1086	1095	1104	1113	1122	1132	1141	1150	1160	92	
6.80	1169	1178	1188	1197	1207	1217	1226	1236	1245	1255	96	
6.90	1265	1275	1285	1294	1304	1314	1324	1334	1344	1355	100	
7.00	1365	1375	1385	1395	1406	1416	1426	1437	1447	1458	104	
7.10	1468	1479	1489	1500	1510	1521	1531	1542	1552	1563	105	
7.20	1573	1584	1594	1605	1616	1626	1637	1648	1659	1670	107	
7.30	1681	1691	1702	1713	1724	1736	1747	1758	1769	1780	111	
7.40	1791	1803	1814	1825	1837	1848	1860	1871	1883	1894	114	
7.50	1906	1917	1929	1941	1952	1964	1976	1988	2000	2011	118	
7.60	2023	2035	2047	2059	2071	2084	2096	2108	2120	2131	119	
7.70	2142	2154	2165	2176	2187	2199	2210	2222	2233	2244	114	
7.80	2256	2267	2279	2290	2302	2314	2325	2337	2349	2360	116	
7.90	2372	2384	2396	2407	2419	2431	2443	2455	2467	2479	119	
8.00	2491	2503	2515	2527	2539	2551	2563	2575	2587	2600	121	
8.10	2612	2624	2636	2649	2661	2673	2686	2698	2711	2723	124	

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

EXPANDED RATING TABLE DATE PRINTED 01/25/82

03138500

WALMONDING R BL MUHAWK DAM AT NELLIE OH

TYPE LOG(SCALE OFFSET = 4.30)

RATING NO 04

GAGE HEIGHT IN FEET	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION)											DIFF IN Q PER TENTH CM
	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	04	
8.20	2735	2748	2761	2773	2786	2798	2811	2824	2836	2849	126	
8.30	2862	2874	2887	2900	2913	2925	2938	2951	2963	2976	127	
8.40	2989	3002	3015	3027	3040	3053	3066	3079	3092	3105	129	
8.50	3118	3131	3144	3157	3170	3183	3197	3210	3223	3236	131	
8.60	3249	3263	3276	3289	3303	3316	3329	3343	3356	3370	134	
8.70	3383	3397	3410	3424	3437	3451	3465	3478	3492	3506	136	
8.80	3519	3533	3547	3560	3574	3588	3602	3616	3630	3644	138	
8.90	3658	3672	3686	3700	3714	3728	3742	3756	3770	3784	141	
9.00	3798	3812	3827	3841	3855	3869	3884	3898	3912	3927	143	
9.10	3941	3956	3970	3984	3997	4011	4025	4039	4052	4066	139	
9.20	4080	4094	4108	4121	4135	4149	4163	4177	4191	4205	139	
9.30	4219	4233	4247	4261	4275	4289	4303	4317	4332	4346	141	
9.40	4360	4374	4388	4403	4417	4431	4445	4460	4474	4488	143	
9.50	4503	4517	4531	4545	4560	4575	4589	4604	4618	4633	145	
9.60	4647	4662	4676	4691	4706	4720	4735	4749	4764	4779	146	
9.70	4794	4808	4823	4838	4853	4867	4882	4897	4912	4927	148	
9.80	4942	4957	4972	4987	5002	5017	5032	5047	5062	5077	150	
9.90	5092	5107	5122	5137	5152	5167	5183	5198	5213	5228	152	
10.00	5243	5259	5274	5289	5305	5320	5335	5350	5365	5380	151	
10.10	5395	5410	5425	5440	5455	5470	5485	5500	5515	5531	151	
10.20	5546	5561	5576	5591	5607	5622	5637	5652	5668	5683	152	
10.30	5698	5714	5729	5744	5760	5775	5790	5806	5821	5837	154	
10.40	5852	5868	5883	5899	5914	5930	5945	5961	5977	5992	156	
10.50	6008	6024	6039	6055	6071	6086	6102	6118	6134	6149	157	
10.60	6165	6181	6197	6213	6228	6244	6260	6276	6292	6308	159	
10.70	6324	6340	6356	6372	6388	6404	6420	6436	6452	6468	160	
10.80	6484	6500	6516	6532	6549	6565	6581	6597	6613	6630	162	
10.90	6646	6662	6678	6695	6711	6727	6744	6760	6776	6793	163	
11.00	6809	6825	6842	6858	6875	6891	6908	6924	6941	6957	165	
11.10	6974	6990	7007	7023	7040	7057	7073	7090	7107	7124	167	
11.20	7140	7157	7174	7191	7208	7225	7241	7258	7275	7292	169	
11.30	7309	7326	7343	7360	7377	7394	7411	7428	7445	7462	170	
11.40	7479	7497	7514	7531	7548	7565	7582	7599	7617	7634	172	
11.50	7651	7668	7686	7703	7720	7738	7755	7772	7790	7807	173	
11.60	7824	7842	7859	7877	7894	7912	7929	7947	7964	7982	175	
11.70	7999	8017	8034	8052	8070	8087	8105	8122	8140	8158	176	
11.80	8175	8193	8211	8229	8246	8264	8282	8300	8318	8335	178	
11.90	8353	8371	8389	8407	8425	8443	8461	8478	8496	8514	179	
12.00	8532	8550	8568	8586	8604	8623	8641	8659	8677	8695	181	
12.10	8713	8731	8749	8767	8786	8804	8822	8840	8859	8877	182	
12.20	8895	8913	8932	8950	8968	8987	9005	9023	9042	9060	184	
12.30	9079	9097	9116	9134	9152	9171	9189	9208	9226	9245	185	
12.40	9264	9282	9301	9319	9338	9357	9375	9394	9413	9431	186	

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

EXPANDED RATING TABLE DATE PRINTED 01/25/82

03138500

WALHONDING R BL MOHAWK DAM AT NELLIE OH

TYPE LOG(SCALE OFFSET = 4.30)

RATING NO 04

GAGE HEIGHT IN FEET	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION)										DIFF IN Q PFR TENTH GH
	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	
12.50	9450	9469	9487	9506	9525	9543	9562	9581	9599	9618	187
12.60	9637	9655	9674	9693	9712	9731	9749	9768	9787	9806	188
12.70	9825	9844	9863	9881	9900	9919	9938	9957	9976	9995	190
12.80	10010	10030	10050	10070	10090	10110	10130	10150	10170	10190	190
12.90	10210	10220	10240	10260	10280	10300	10320	10340	10360	10380	190
13.00	10400	10420	10440	10460	10470	10490	10510	10530	10550	10570	190
13.10	10590	10610	10630	10650	10670	10690	10710	10730	10750	10770	190
13.20	10790	10810	10820	10840	10860	10880	10900	10920	10940	10960	200
13.30	10980	11000	11020	11040	11060	11080	11100	11120	11140	11160	200
13.40	11180	11200	11220	11240	11260	11280	11300	11320	11340	11360	200
13.50	11380	11400	11420	11440	11460	11480	11500	11520	11540	11560	200
13.60	11580	11600	11620	11640	11660	11680	11700	11720	11740	11760	200
13.70	11780	11800	11820	11840	11860	11880	11900	11920	11940	11960	200
13.80	11980	12000	12020	12040	12060	12090	12110	12130	12150	12170	200
13.90	12190	12210	12230	12250	12270	12290	12310	12330	12350	12370	210
14.00	12390	12410	12430	12460	12480	12500	12520	12540	12560	12580	210
14.10	12600	12620	12640	12660	12680	12700	12720	12740	12760	12780	200
14.20	12800	12820	12840	12860	12870	12890	12910	12930	12950	12970	200
14.30	12990	13010	13030	13050	13070	13090	13110	13130	13150	13170	200
14.40	13190	13210	13230	13250	13270	13290	13310	13330	13350	13370	200
14.50	13390	13410	13430	13450	13470	13490	13510	13530	13550	13570	200
14.60	13590	13610	13630	13650	13670	13690	13710	13730	13750	13770	200
14.70	13790	13810	13830	13850	13870	13890	13910	13930	13950	13970	200
14.80	13990	14020	14040	14060	14080	14100	14120	14140	14160	14180	200
14.90	14200	14220	14240	14260	14280	14300	14320	14340	14360	14380	200
15.00	14400	14420	14440	14460	14480	14510	14530	14550	14570	14590	210
15.10	14610	14630	14650	14670	14690	14710	14730	14750	14770	14790	210
15.20	14810	14830	14860	14880	14900	14920	14940	14960	14980	15000	210
15.30	15020	15040	15060	15080	15100	15130	15150	15170	15190	15210	210
15.40	15230	15250	15270	15290	15310	15330	15360	15380	15400	15420	210
15.50	15440	15460	15480	15500	15520	15540	15570	15590	15610	15630	210
15.60	15650	15670	15690	15710	15730	15750	15780	15800	15820	15840	210
15.70	15860	15880	15900	15920	15950	15970	15990	16010	16030	16050	210
15.80	16070	16090	16120	16140	16160	16180	16200	16220	16240	16260	210
15.90	16290	16310	16330	16350	16370	16390	16410	16440	16460	16480	210
16.00	16500										

# DISCHARGE RATING

## WALHONDING REFERENCE POINT NO. 1

GA. HT.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF
Feet	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs
2.0											
.1											
.2											
.3											
.4											
.5											
.6											
.7											
.8											
.9	395	397	399	401	403	405	407	409	411	413	
3.0	415	417	418	420	421	423	424	426	427	429	
.1	430	432	434	436	438	440	442	444	446	448	
.2	450	453	455	458	460	463	465	468	470	473	
.3	475	478	481	484	487	490	493	496	499	502	
.4	505	509	512	516	519	523	526	530	533	537	
.5	540	544	548	552	556	560	564	568	572	576	
.6	580	586	592	598	604	610	616	622	628	634	
.7	640	648	656	664	672	680	688	696	704	712	
.8	720	730	740	750	760	770	780	790	800	810	
.9	820	831	841	852	862	873	883	894	904	915	
4.0	925	937	948	960	971	983	994	1006	1017	1029	
.1	1040	1051	1063	1074	1086	1098	1109	1120	1132	1143	
.2	1155	1166	1178	1190	1201	1212	1224	1235	1247	1258	
.3	1270	1281	1293	1304	1316	1327	1339	1350	1362	1374	
.4	1385	1396	1408	1420	1431	1442	1454	1466	1477	1488	
.5	1500	1512	1523	1534	1546	1558	1569	1580	1592	1604	
.6	1615	1626	1638	1650	1661	1672	1684	1695	1707	1818	
.7	1730	1742	1753	1764	1776	1788	1799	1810	1822	1833	
.8	1845	1856	1868	1880	1891	1902	1914	1926	1937	1948	
.9	1960	1972	1983	1994	2006	2018	2029	2040	2052	2063	
	2075	2086	2098	2110	2121	2132	2144	2156	2167	2178	

JUNE 1987

# DISCHARGE RATING

## WALHONDING REFERENCE POINT NO. 1

GA. HT.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF
Feet	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs
5.0	2190	2202	2213	2224	2236	2248	2259	2270	2282	2293	
.1	2305	2316	2328	2340	2351	2362	2374	2385	2397	2408	
.2	2420	2432	2443	2454	2466	2478	2489	2500	2512	2524	
.3	2535	2546	2558	2570	2581	2592	2604	2616	2627	2638	
.4	2650	2661	2673	2684	2696	2708	2719	2730	2742	2754	
.5	2765	2776	2788	2799	2811	2822	2834	2846	2857	2868	
.6	2880	2892	2904	2916	2928	2940	2952	2964	2976	2988	
.7	3000	3012	3024	3036	3048	3060	3072	3084	3096	3108	
.8	3120	3132	3144	3156	3168	3180	3192	3204	3216	3228	
.9	3240	3252	3264	3276	3288	3300	3312	3324	3336	3348	
6.0	3360	3372	3384	3396	3408	3420	3432	3444	3456	3468	
.1	3480	3492	3504	3516	3528	3540	3552	3564	3576	3588	
.2	3600	3612	3624	3636	3648	3660	3672	3684	3696	3708	
.3	3720	3732	3744	3756	3768	3780	3792	3804	3816	3828	
.4	3840	3852	3865	3878	3890	3902	3915	3928	3940	3952	
.5	3965	3978	3990	4002	4015	4028	4040	4052	4065	4078	
.6	4090	4102	4115	4128	4140	4152	4165	4178	4190	4202	
.7	4215	4228	4240	4252	4265	4278	4290	4302	4315	4328	
.8	4340	4353	4366	4379	4392	4405	4418	4431	4444	4457	
.9	4470	4483	4496	4509	4522	4535	4548	4561	4574	4587	
7.0	4600	4613	4626	4639	4652	4665	4678	4691	4704	4717	
.1	4730	4743	4756	4769	4782	4795	4808	4821	4834	4847	
.2	4860	4874	4887	4900	4914	4928	4941	4954	4968	4981	
.3	4995	5008	5022	5036	5049	5062	5076	5090	5103	5116	
.4	5130	5144	5157	5170	5184	5198	5211	5224	5238	5251	
.5	5265	5278	5292	5306	5319	5332	5346	5360	5373	5386	
.6	5400	5414	5427	5440	5454	5468	5481	5494	5508	5521	
.7	5535	5548	5562	5576	5589	5602	5616	5630	5643	5656	
.8	5670	5684	5698	5712	5726	5740	5754	5768	5782	5796	
.9	5810	5824	5838	5852	5866	5880	5894	5908	5922	5936	

JUNE 1987

# DISCHARGE RATING

## WALHONDING REFERENCE POINT NO. 1

GA. HT.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF
Feet	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs
8.0	5950	5965	5980	5995	6010	6025	6040	6055	6070	6085	
.1	6100	6115	6130	6145	6160	6175	6190	6205	6220	6235	
.2	6250	6265	6280	6295	6310	6325	6340	6355	6370	6385	
.3	6400	6416	6432	6448	6464	6480	6496	6512	6528	6544	
.4	6560	6576	6592	6608	6624	6640	6656	6672	6688	6704	
.5	6720	6736	6752	6768	6784	6800	6816	6832	6848	6864	
.6	6880	6896	6912	6928	6944	6960	6976	6992	7008	7024	
.7	7040	7056	7072	7088	7104	7120	7136	7152	7168	7184	
.8	7200	7217	7234	7251	7268	7285	7302	7319	7336	7353	
.9	7370	7387	7404	7421	7438	7455	7472	7489	7506	7523	
9.0	7540	7557	7574	7591	7608	7625	7642	7659	7676	7693	
.1	7710	7727	7744	7761	7778	7795	7812	7829	7846	7863	
.2	7880	7897	7914	7931	7948	7965	7982	7999	8016	8033	
.3	8050	8067	8084	8101	8118	8135	8152	8169	8186	8203	
.4	8220	8238	8256	8274	8292	8310	8328	8346	8364	8382	
.5	8400	8418	8436	8454	8472	8490	8508	8526	8544	8562	
.6	8580	8598	8616	8634	8652	8670	8688	8706	8724	8742	
.7	8760	8778	8796	8814	8832	8850	8868	8886	8904	8922	
.8	8940	8958	8976	8994	9012	9030	9048	9066	9084	9102	
.9	9120	9138	9156	9174	9192	9210	9228	9246	9264	9282	
10.0	9300	9318	9336	9354	9372	9390	9408	9426	9444	9462	
.1	9480	9498	9516	9534	9552	9570	9588	9606	9624	9642	
.2	9660	9678	9697	9716	9734	9752	9771	9790	9808	9826	
.3	9845	9864	9882	9900	9919	9938	9956	9974	9993	10012	
.4	10030	10048	10067	10086	10104	10122	10141	10160	10178	10196	
.5	10215	10234	10252	10270	10289	10308	10326	10344	10363	10382	
.6	10400	10418	10437	10455	10474	10492	10511	10530	10548	10566	
.7	10585	10604	10622	10640	10659	10678	10696	10714	10733	10752	
.8	10770	10789	10807	10826	10844	10862	10881	10900	10918	10936	
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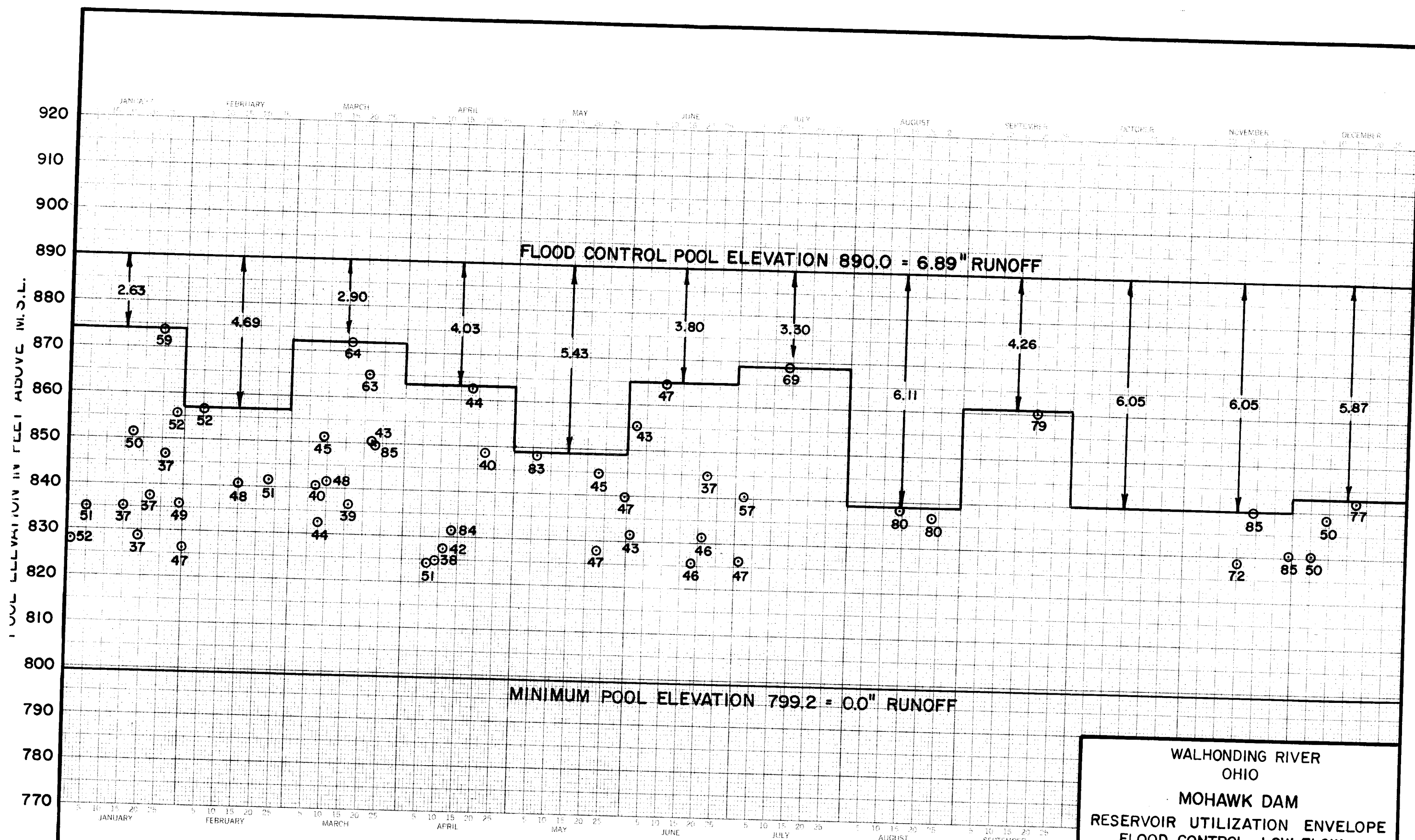
JUNE 1987

# DISCHARGE RATING

## WALHONDING REFERENCE POINT NO. 1

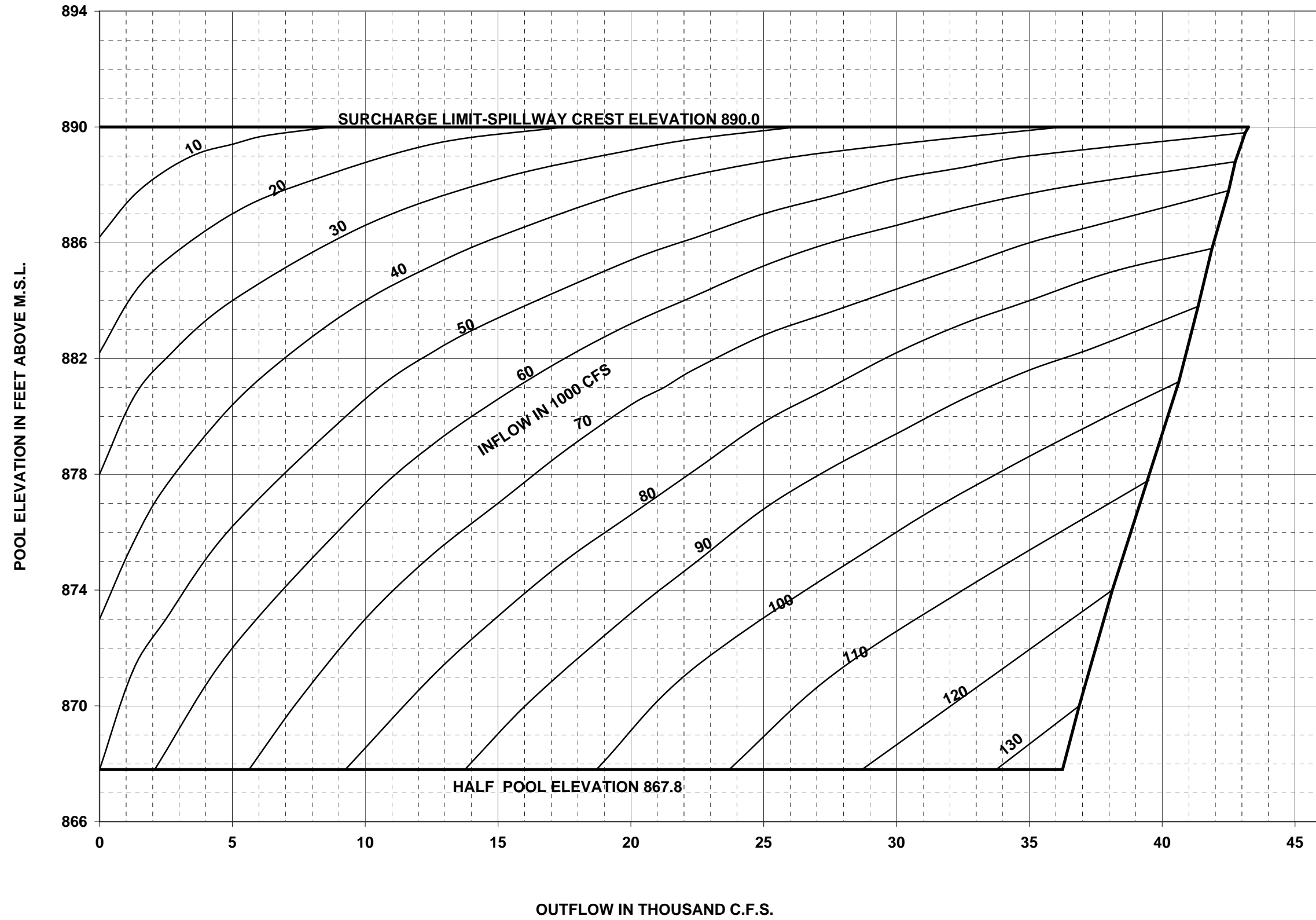
GA. HT.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF
Feet	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs
11.0	11140	11161	11181	11202	11222	11243	11264	11284	11305	11325	
.1	11346	11367	11387	11408	11428	11449	11470	11490	11511	11531	
.2	11552	11572	11593	11614	11634	11655	11676	11696	11717	11737	
.3	11758	11779	11799	11820	11840	11861	11882	11902	11923	11943	
.4	11964	11985	12005	12026	12046	12067	12088	12108	12129	12149	
.5	12170	12191	12211	12232	12252	12273	12294	12314	12335	12355	
.6	12376	12397	12417	12438	12458	12479	12500	12520	12541	12561	
.7	12582	12602	12623	12644	12664	12685	12706	12726	12747	12767	
.8	12788	12809	12829	12850	12870	12891	12912	12932	12953	12973	
.9	12994	13015	13035	13056	13076	13097	13118	13138	13159	13179	
12.0	13200	13226	13251	13276	13302	13328	13353	13378	13404	13430	
.1	13455	13480	13506	13532	13557	13583	13608	13634	13659	13685	
.2	13710	13736	13761	13786	13812	13838	13863	13888	13914	13940	
.3	13965	13990	14016	14041	14067	14092	14118	14144	14169	14194	
.4	14220	14246	14271	14296	14322	14348	14373	14399	14424	14450	
.5	14475	14500	14526	14552	14577	14602	14628	14653	14679	14704	
.6	14730	14756	14781	14806	14832	14858	14883	14909	14934	14960	
.7	14985	15010	15036	15062	15087	15112	15138	15164	15189	15214	
.8	15240	15266	15291	15317	15342	15368	15393	15418	15444	15470	
.9	15495	15520	15546	15572	15597	15622	15648	15674	15699	15724	
13.0	15750	15780	15811	15842	15872	15902	15933	15964	15994	16024	
.1	16055	16086	16116	16146	16177	16208	16238	16268	16299	16330	
.2	16360	16390	16421	16452	16482	16512	16543	16574	16604	16634	
.3	16665	16696	16726	16756	16787	16818	16848	16878	16909	16940	
.4	16970	17000	17031	17062	17092	17122	17153	17184	17214	17244	
.5	17275	17306	17336	17366	17397	17428	17458	17488	17519	17550	
.6	17580	17610	17641	17671	17702	17732	17763	17794	17824	17854	
.7	17885	17916	17946	17976	18007	18038	18068	18098	18129	18160	
.8	18190	18220	18251	18282	18312	18342	18373	18404	18434	18465	
.9	18495	18526	18556	18586	18617	18648	18678	18709	18739	18770	

JUNE 1987



- NOTES**
- (1) DRAINAGE AREA = 1504 SQ. MI.
  - (2) ONE INCH RUNOFF = 41,387 AC. FT.
  - (3) PERIOD OF RECORD: 1937 - 1986
  - (4) ○ CREST POOL ELEVATION OF A RISE AND YEAR (1959) IN WHICH IT OCCURRED

WALHONDING RIVER  
 OHIO  
 MOHAWK DAM  
 RESERVOIR UTILIZATION ENVELOPE  
 FLOOD CONTROL, LOW FLOW  
 AND SEASONAL POOL  
 U.S. ARMY ENGINEER DISTRICT, HUNTINGTON  
 CORPS OF ENGINEERS  
 HUNTINGTON, W.VA.                      JANUARY 1987



**OPERATING INSTRUCTIONS**

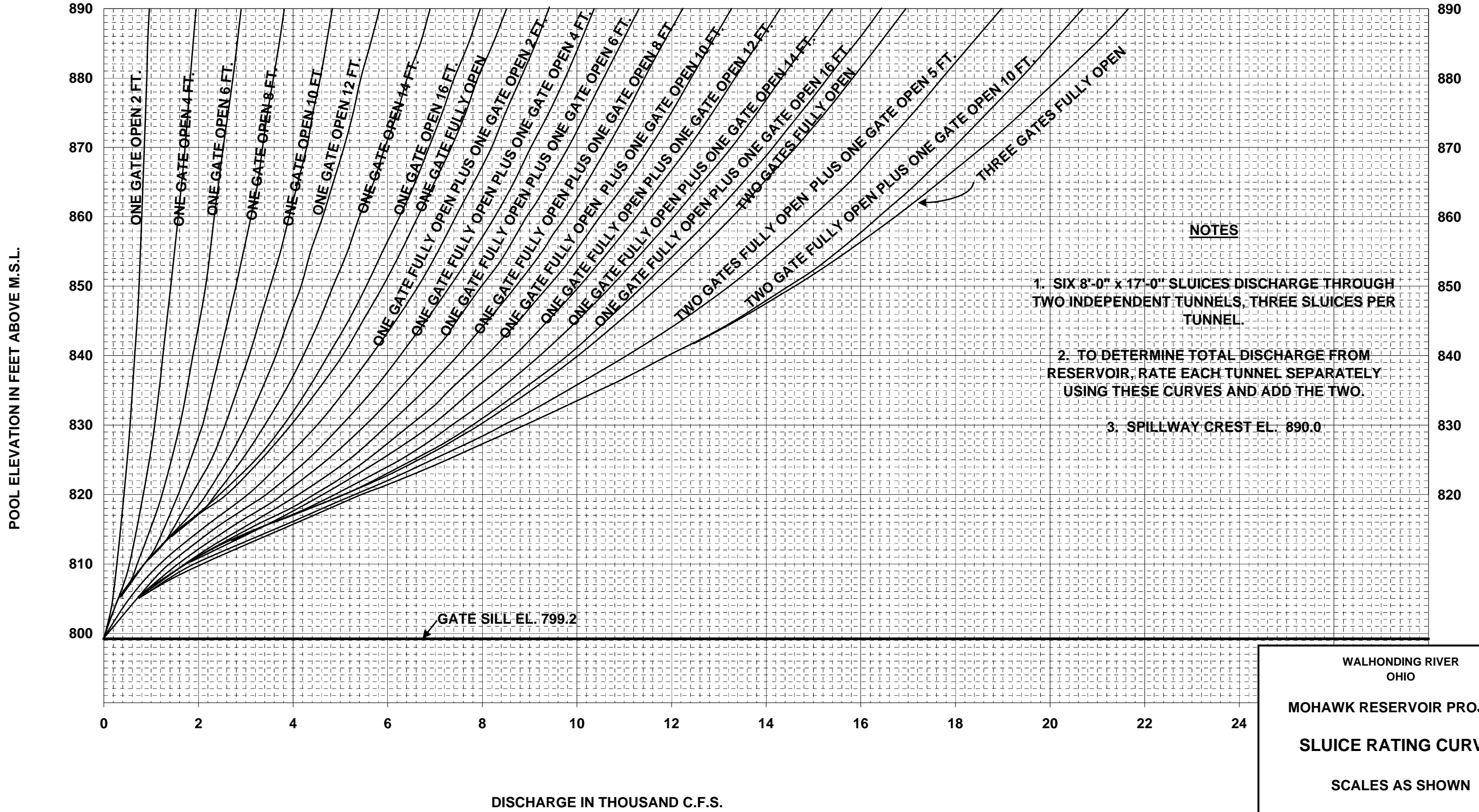
1. FOLLOW REGULAR FLOOD CONTROL REGULATION UNTIL LARGER RELEASES ARE REQUIRED BY THIS SCHEDULE.
2. ADJUST THE OUTFLOW EACH HOUR ON THE BASIS OF THE AVERAGE INFLOW FOR THE PRECEDING HOUR AND THE CURRENT RESERVOIR ELEVATION AS INDICATED BY THE CURVE.
3. IF THE RESERVOIR ELEVATION CRESTS ABOVE SPILLWAY ELEVATION OF 890.0. MAINTAIN CURRENT GATE OPENINGS UNTIL THE ELEVATION HAS RECEDED TO SPILLWAY ELEVATION.
4. MAINTAIN POOL ELEVATION AT SPILLWAY LEVEL OR AT MAXIMUM ATTAINED ELEVATION, IF BELOW SPILLWAY LEVEL, UNTIL TIME TO DRAW POOL DOWN BY RELEASING THE MAXIMUM ALLOWABLE SEASONAL DISCHARGE RATE.

WALHONDING RIVER  
OHIO

MOHAWK RESERVOIR

**OFFICE REGULATION SCHEDULE  
FOR SPILLWAY DESIGN FLOOD**

DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
HUNTINGTON, W.V. REDRAWN OCTOBER 1999



**NOTES**

- SIX 8'-0" x 17'-0" SLUICES DISCHARGE THROUGH TWO INDEPENDENT TUNNELS, THREE SLUICES PER TUNNEL.
- TO DETERMINE TOTAL DISCHARGE FROM RESERVOIR, RATE EACH TUNNEL SEPARATELY USING THESE CURVES AND ADD THE TWO.
- SPILLWAY CREST EL. 890.0

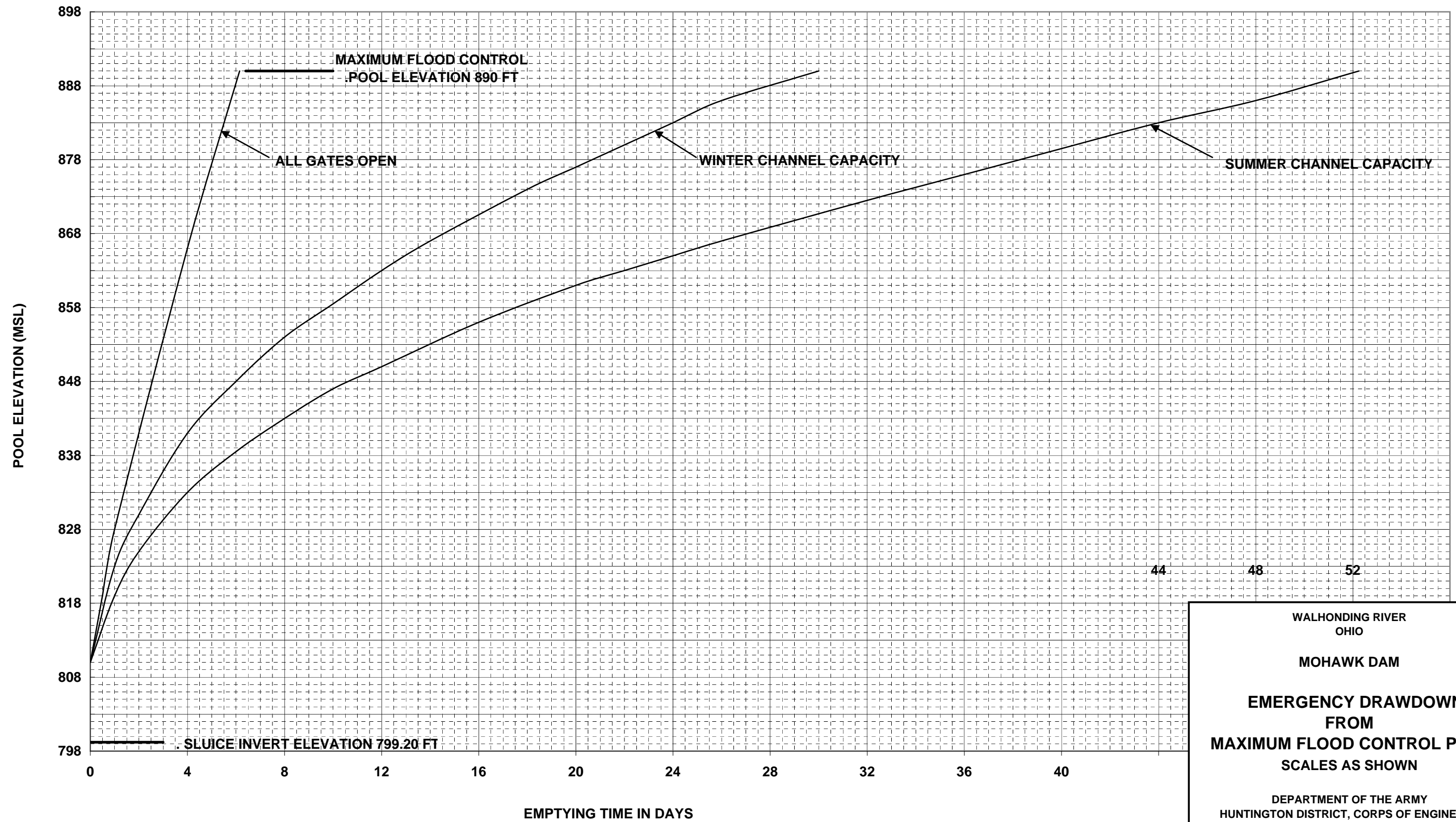
WALHONDING RIVER  
OHIO

**MOHAWK RESERVOIR PROJECT**

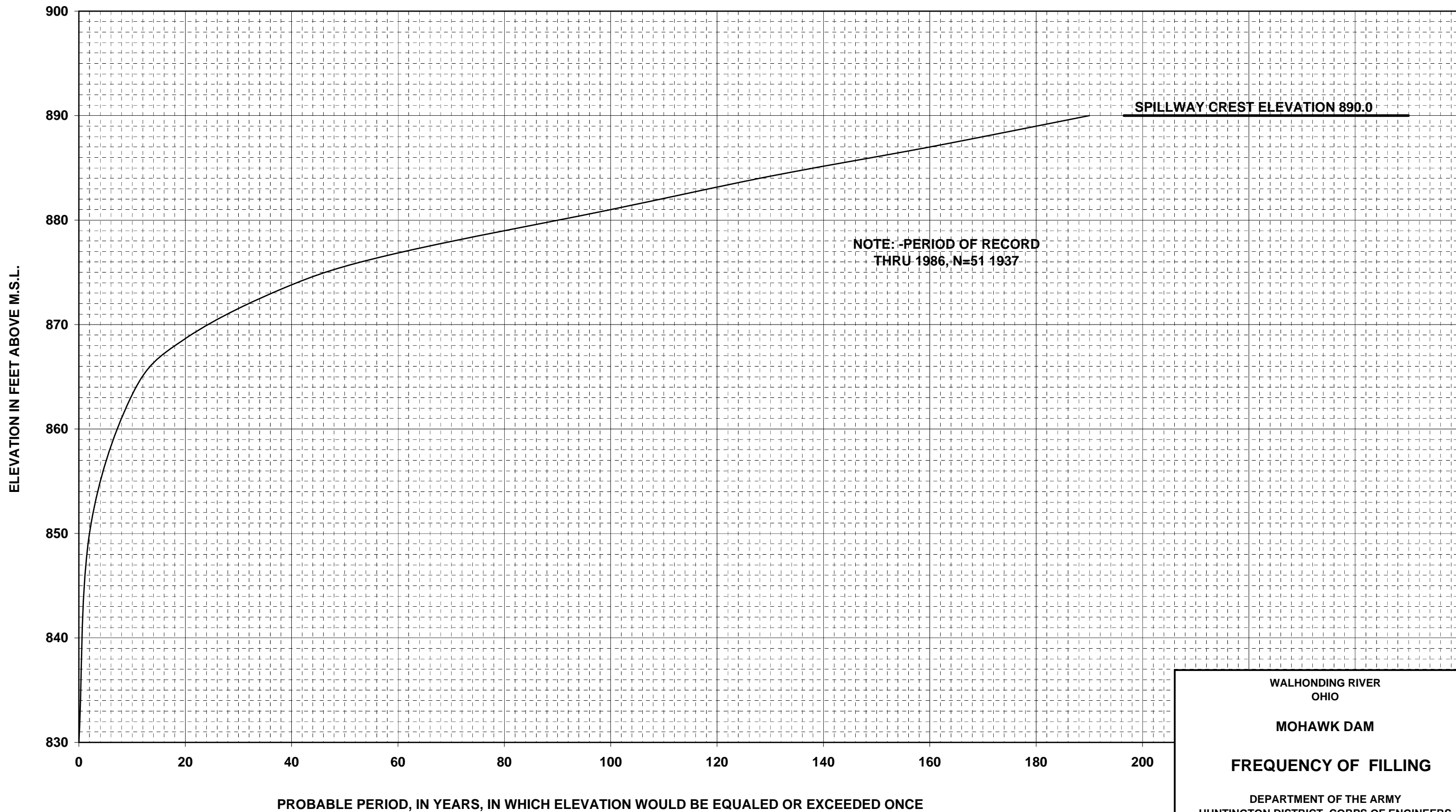
**SLUICE RATING CURVES**

SCALES AS SHOWN

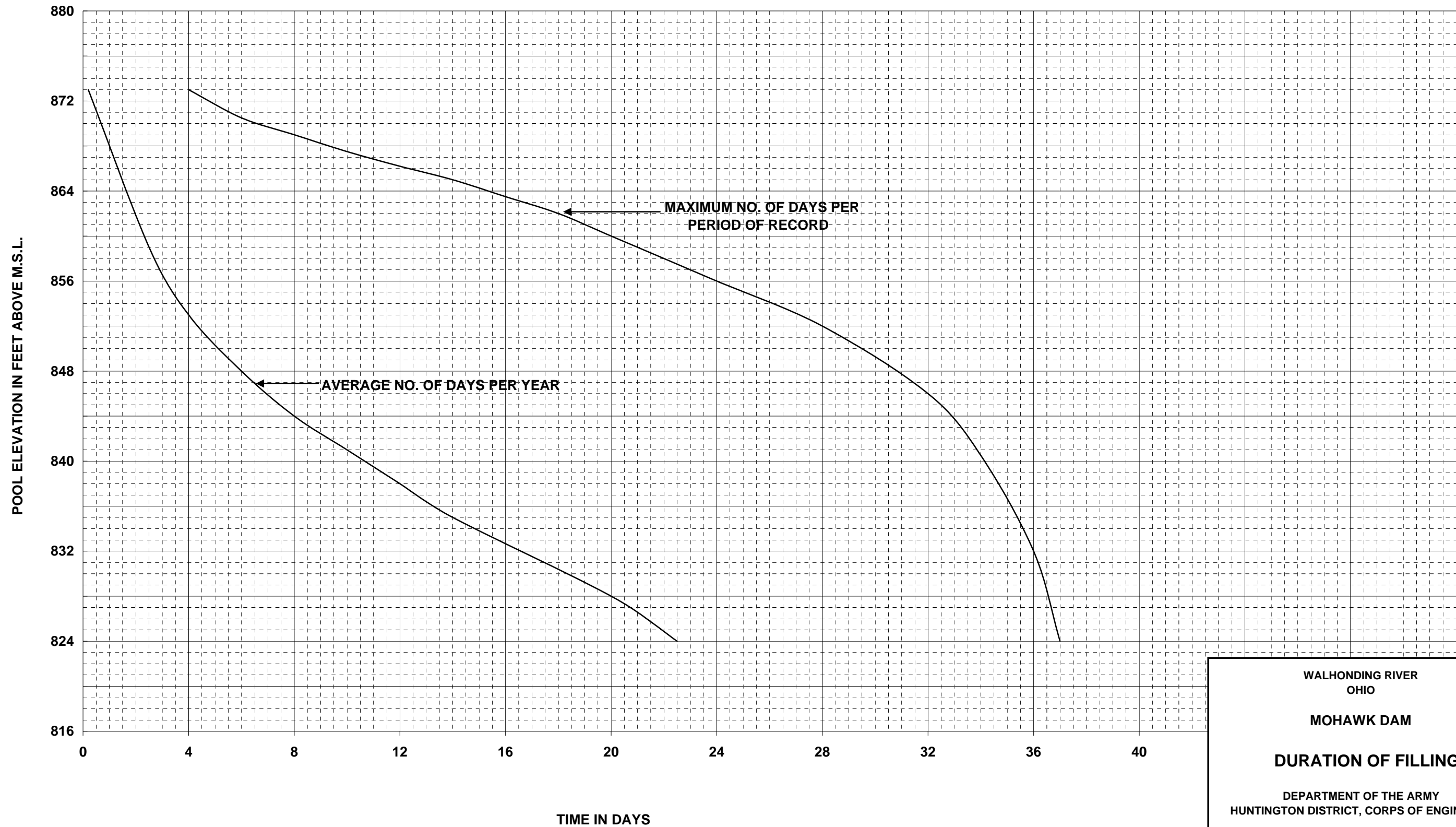
DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
HUNTINGTON, W.V. REDRAWN OCTOBER 1999



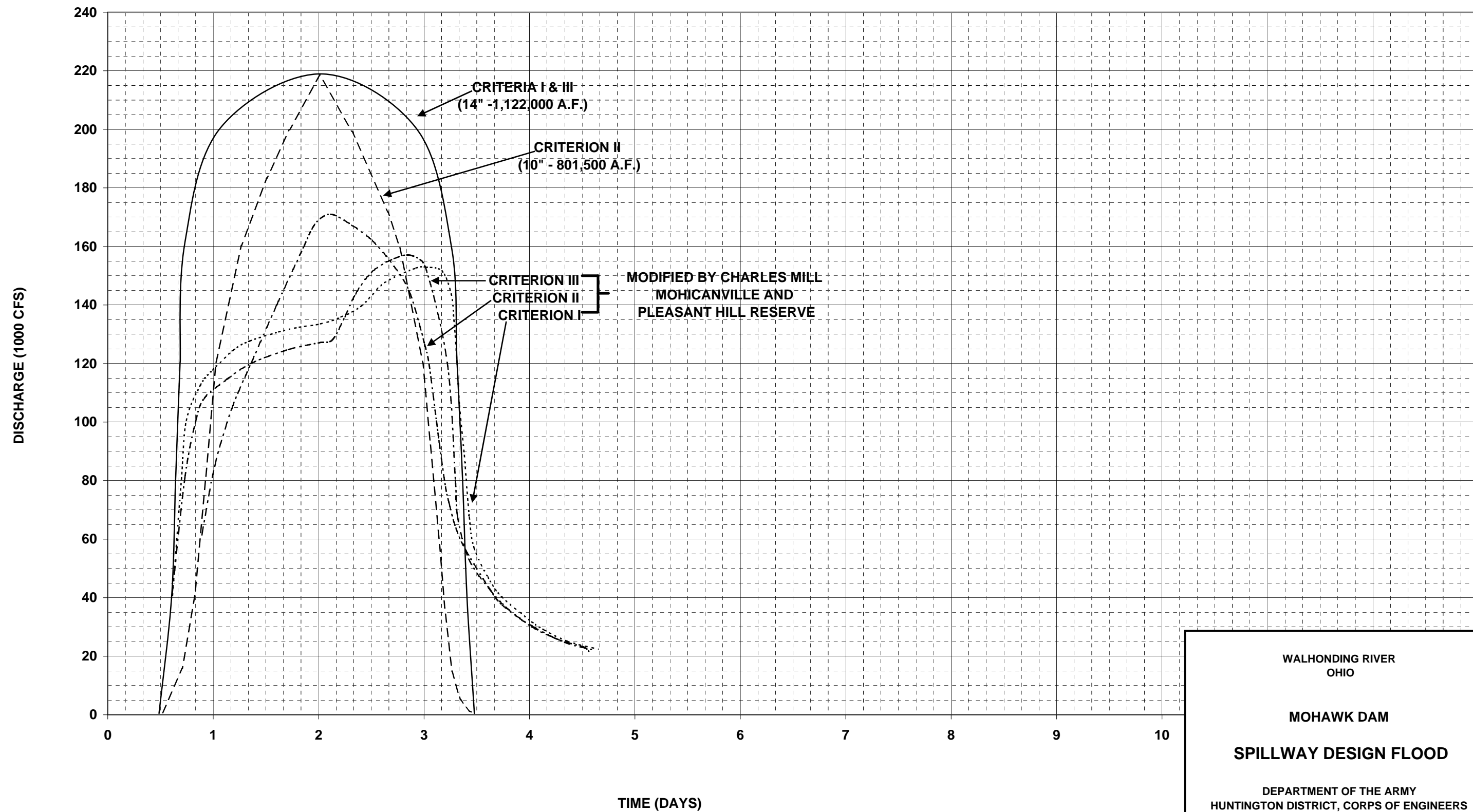
WALHONDING RIVER  
 OHIO  
  
 MOHAWK DAM  
  
**EMERGENCY DRAWDOWN  
 FROM  
 MAXIMUM FLOOD CONTROL POOL  
 SCALES AS SHOWN**  
  
 DEPARTMENT OF THE ARMY  
 HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
  
 HUNTINGTON, W.V.      REDRAWN OCTOBER 1999



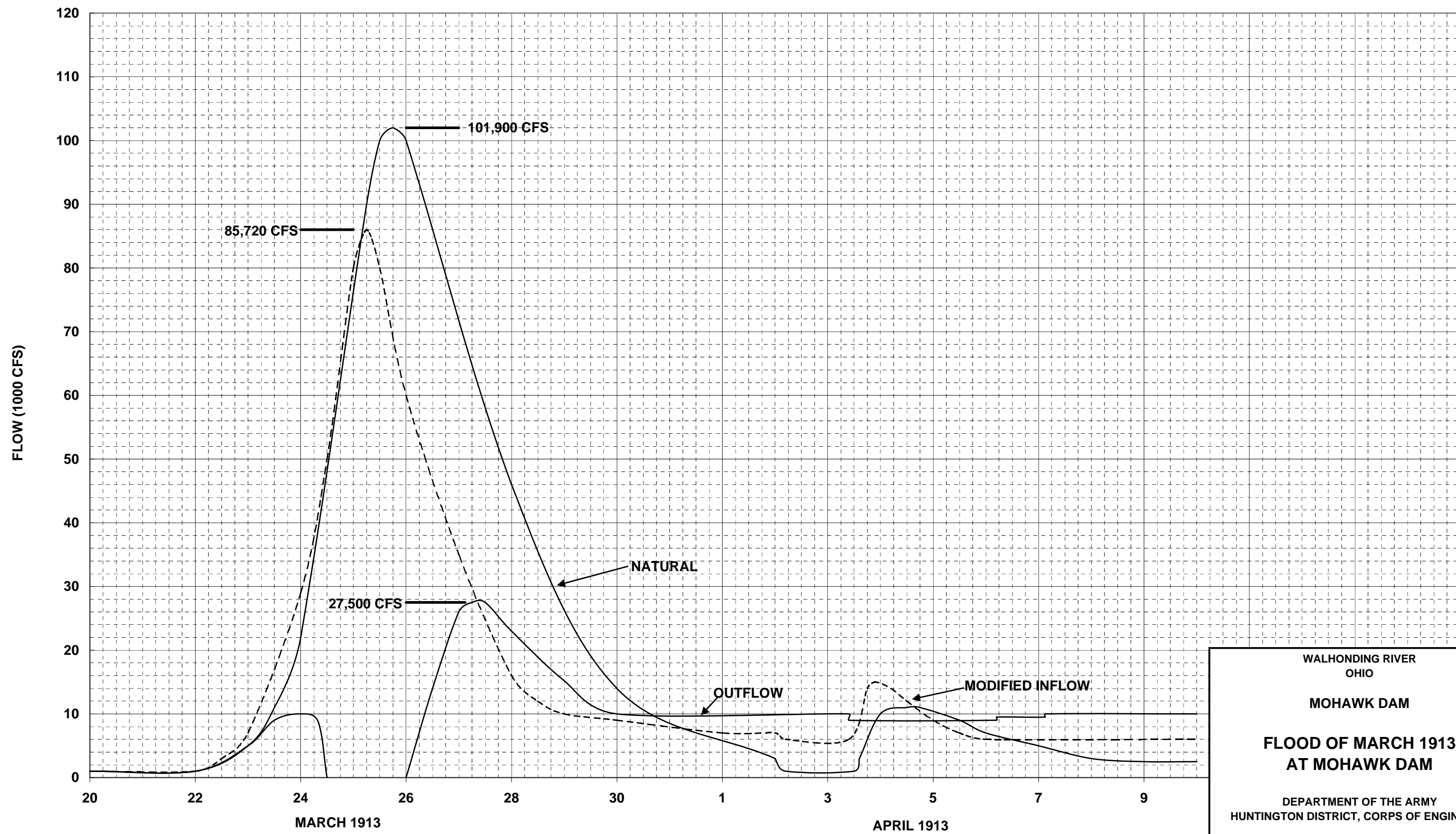
WALHONDING RIVER  
 OHIO  
  
 MOHAWK DAM  
  
**FREQUENCY OF FILLING**  
  
 DEPARTMENT OF THE ARMY  
 HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
  
 HUNTINGTON, W.V. REDRAWN OCTOBER 1999



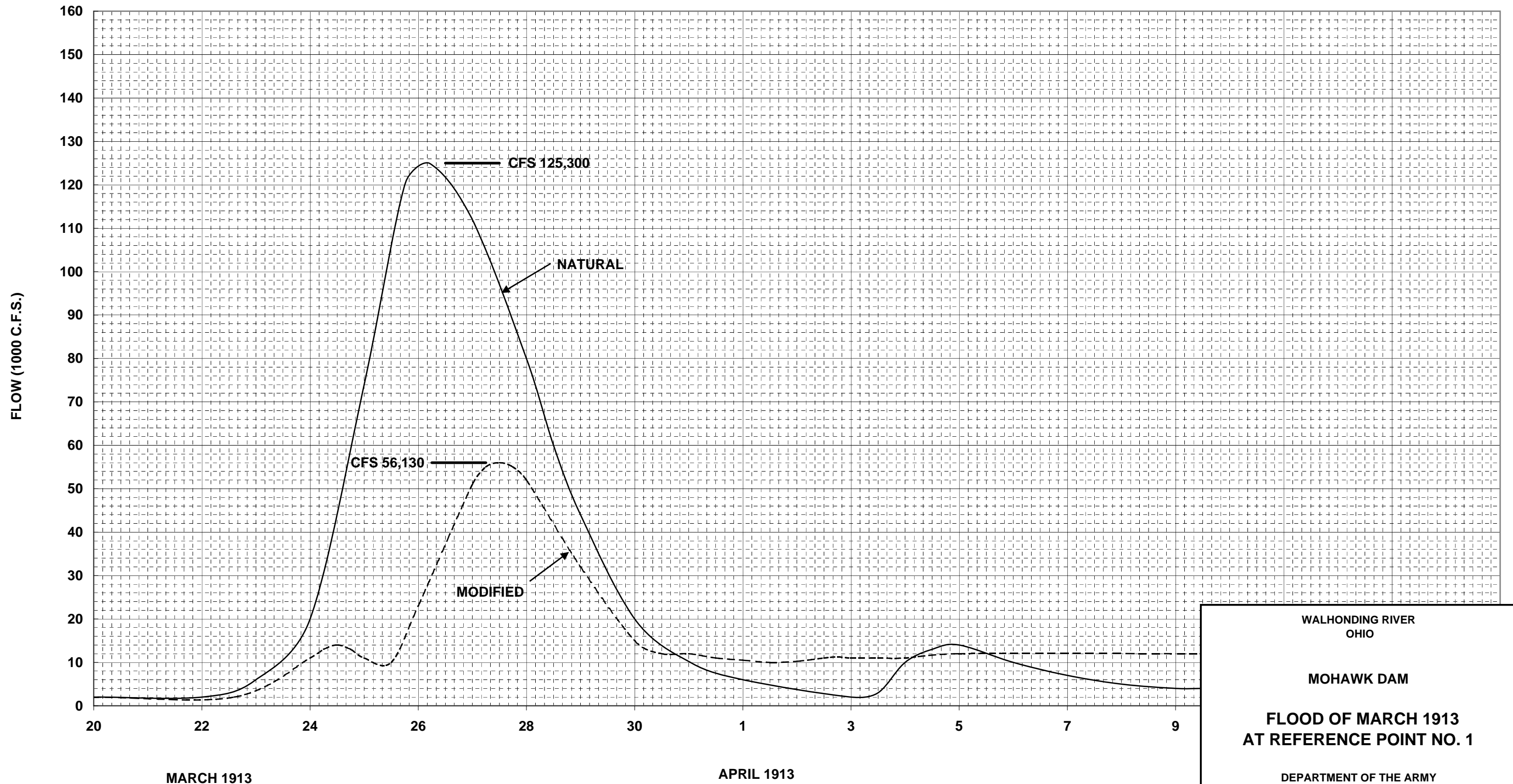
WALHONDING RIVER  
 OHIO  
  
 MOHAWK DAM  
  
**DURATION OF FILLING**  
  
 DEPARTMENT OF THE ARMY  
 HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
  
 HUNTINGTON, W.V. REDRAWN OCTOBER 1999



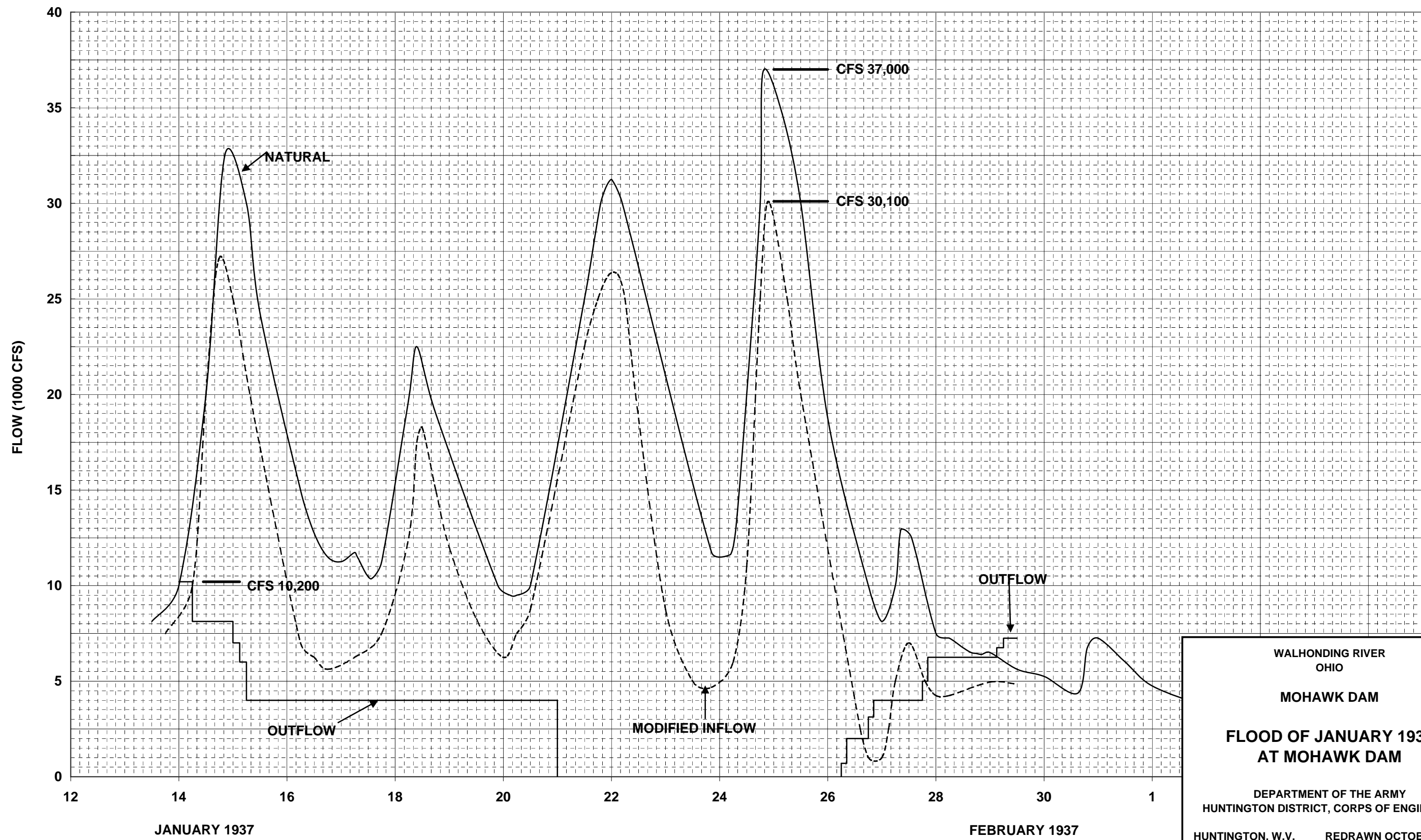
**WALHONDING RIVER**  
**OHIO**  
  
**MOHAWK DAM**  
  
**SPILLWAY DESIGN FLOOD**  
  
 DEPARTMENT OF THE ARMY  
 HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
  
 HUNTINGTON, W.V. REDRAWN OCTOBER 1999



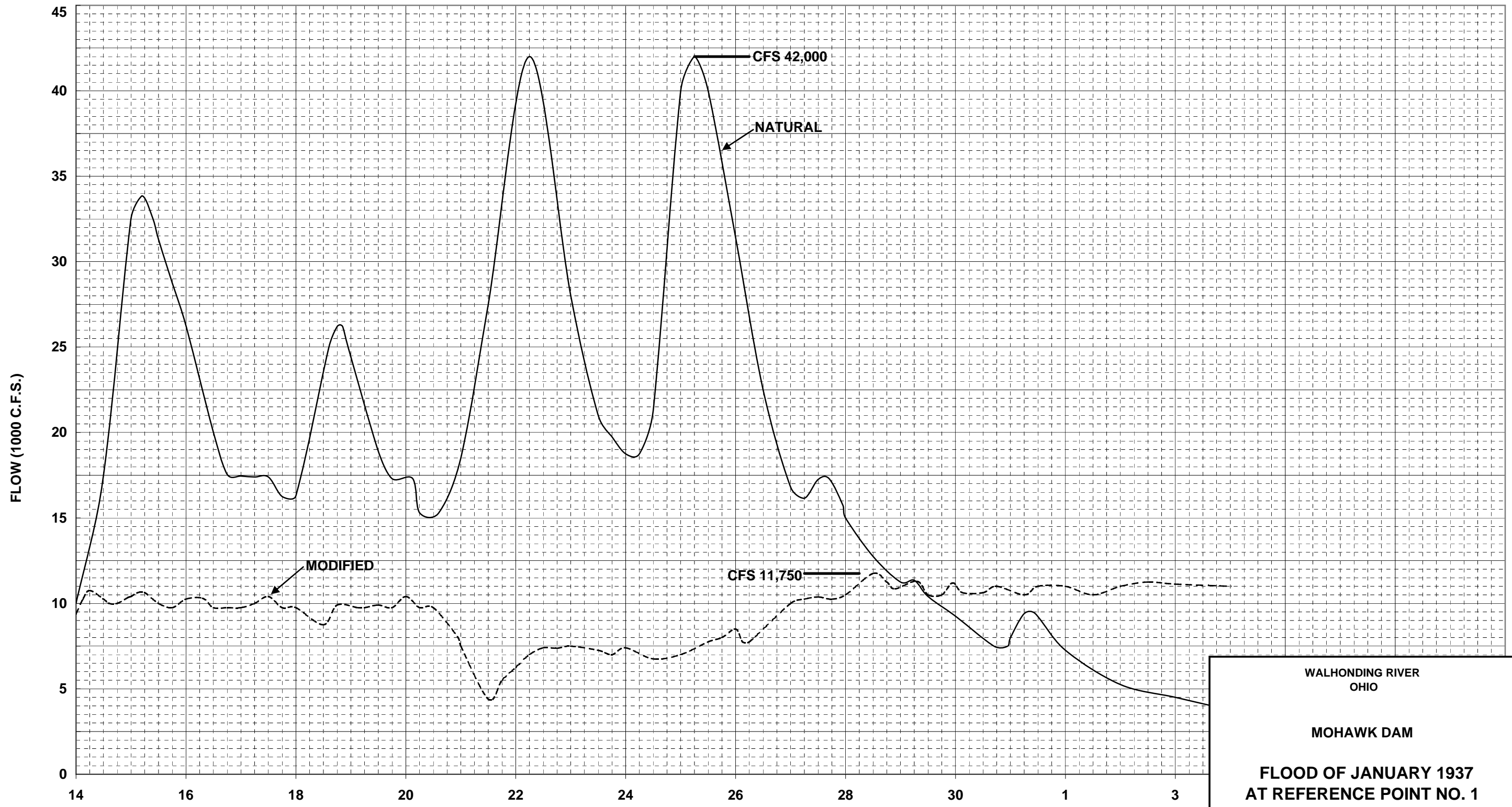
WALHONDING RIVER  
 OHIO  
  
 MOHAWK DAM  
  
**FLOOD OF MARCH 1913  
 AT MOHAWK DAM**  
  
 DEPARTMENT OF THE ARMY  
 HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
  
 HUNTINGTON, W.V. REDRAWN OCTOBER 1999



WALHONDING RIVER  
 OHIO  
  
 MOHAWK DAM  
  
**FLOOD OF MARCH 1913  
 AT REFERENCE POINT NO. 1**  
  
 DEPARTMENT OF THE ARMY  
 HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
  
 HUNTINGTON, W.V. REDRAWN OCTOBER 1999



WALHONDING RIVER  
 OHIO  
  
 MOHAWK DAM  
  
**FLOOD OF JANUARY 1937  
 AT MOHAWK DAM**  
  
 DEPARTMENT OF THE ARMY  
 HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
 HUNTINGTON, W.V.      REDRAWN OCTOBER 1999



JANUARY 1937

FEBRUARY 1937

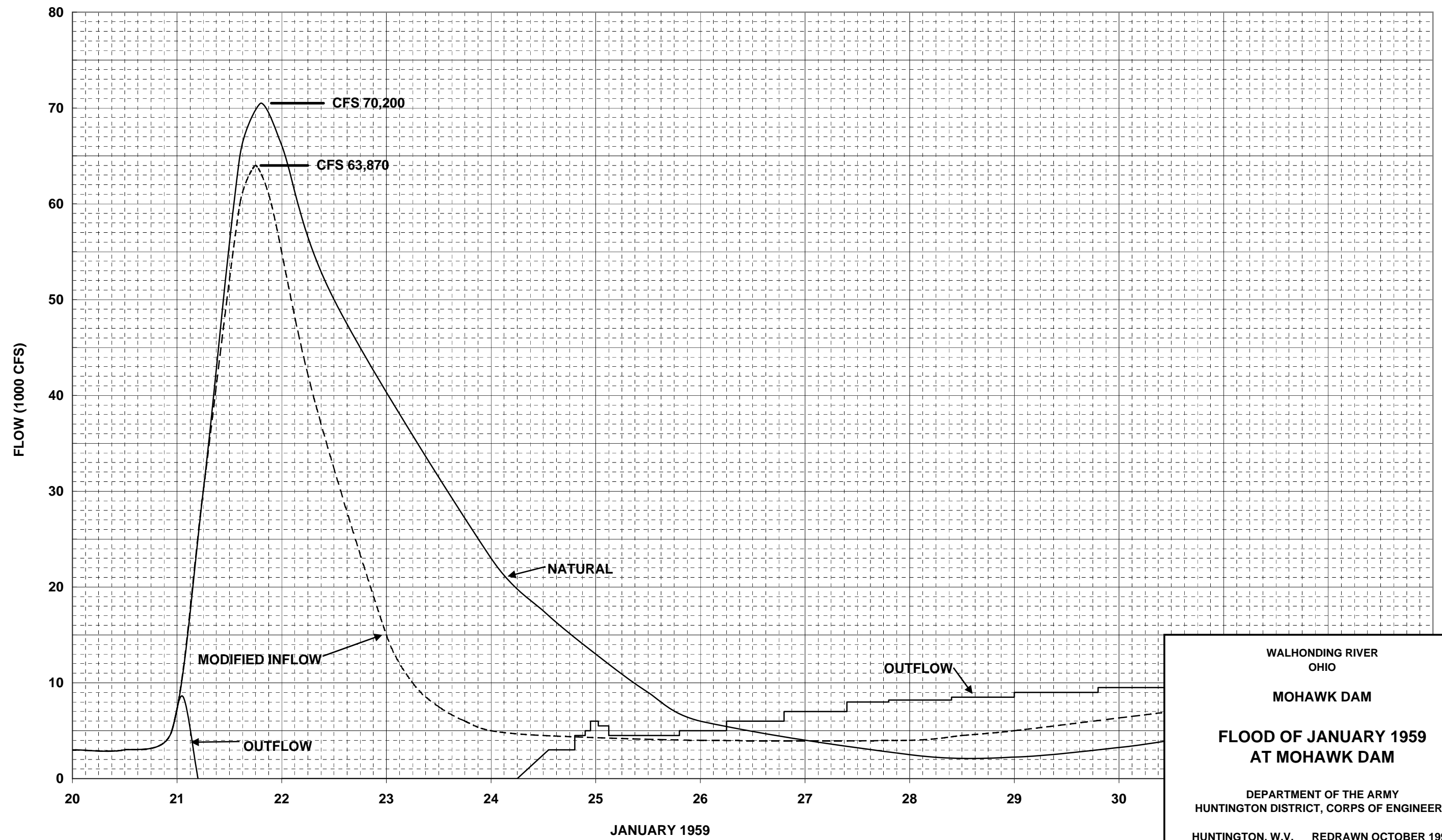
WALHONDING RIVER  
OHIO

MOHAWK DAM

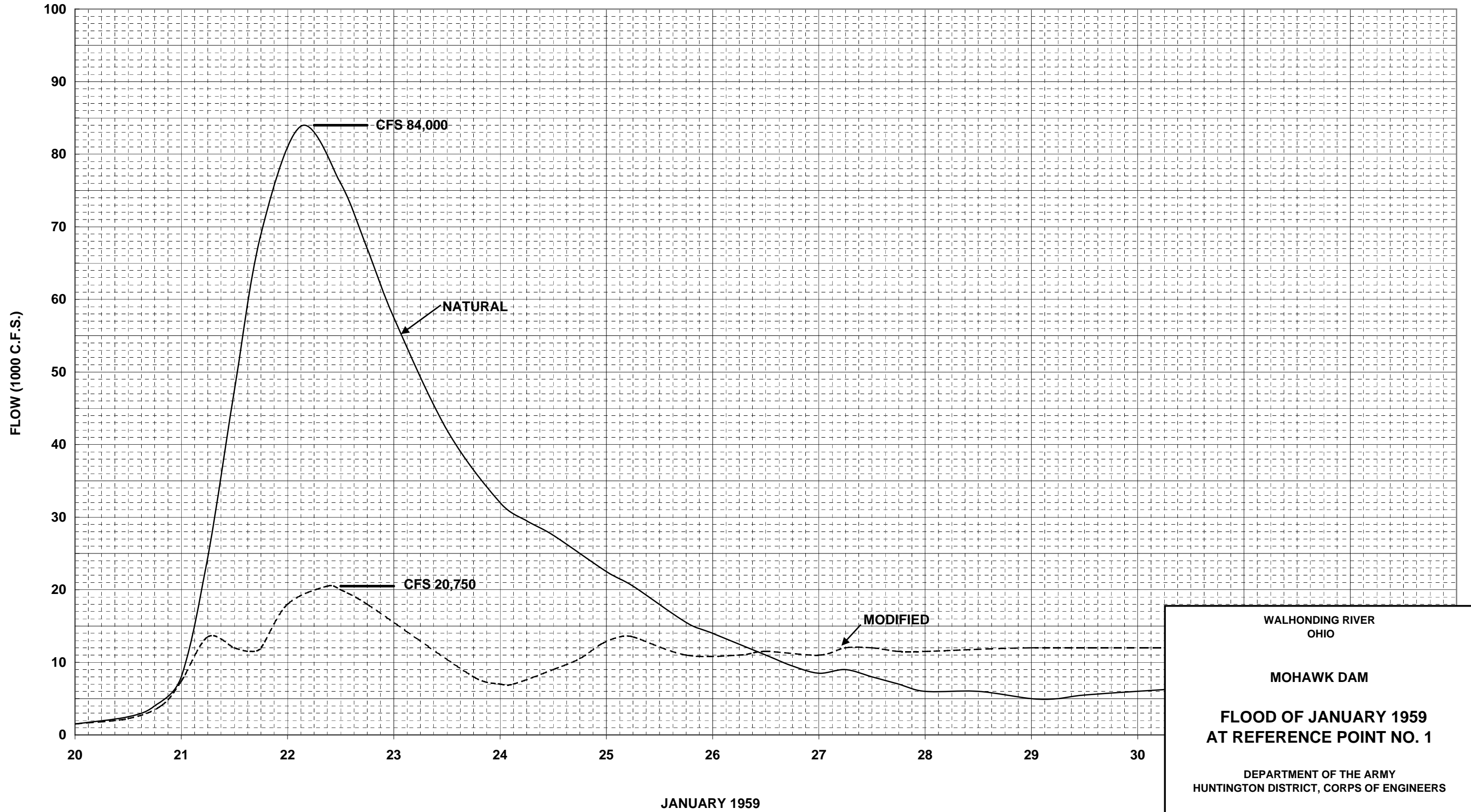
**FLOOD OF JANUARY 1937  
AT REFERENCE POINT NO. 1**

DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

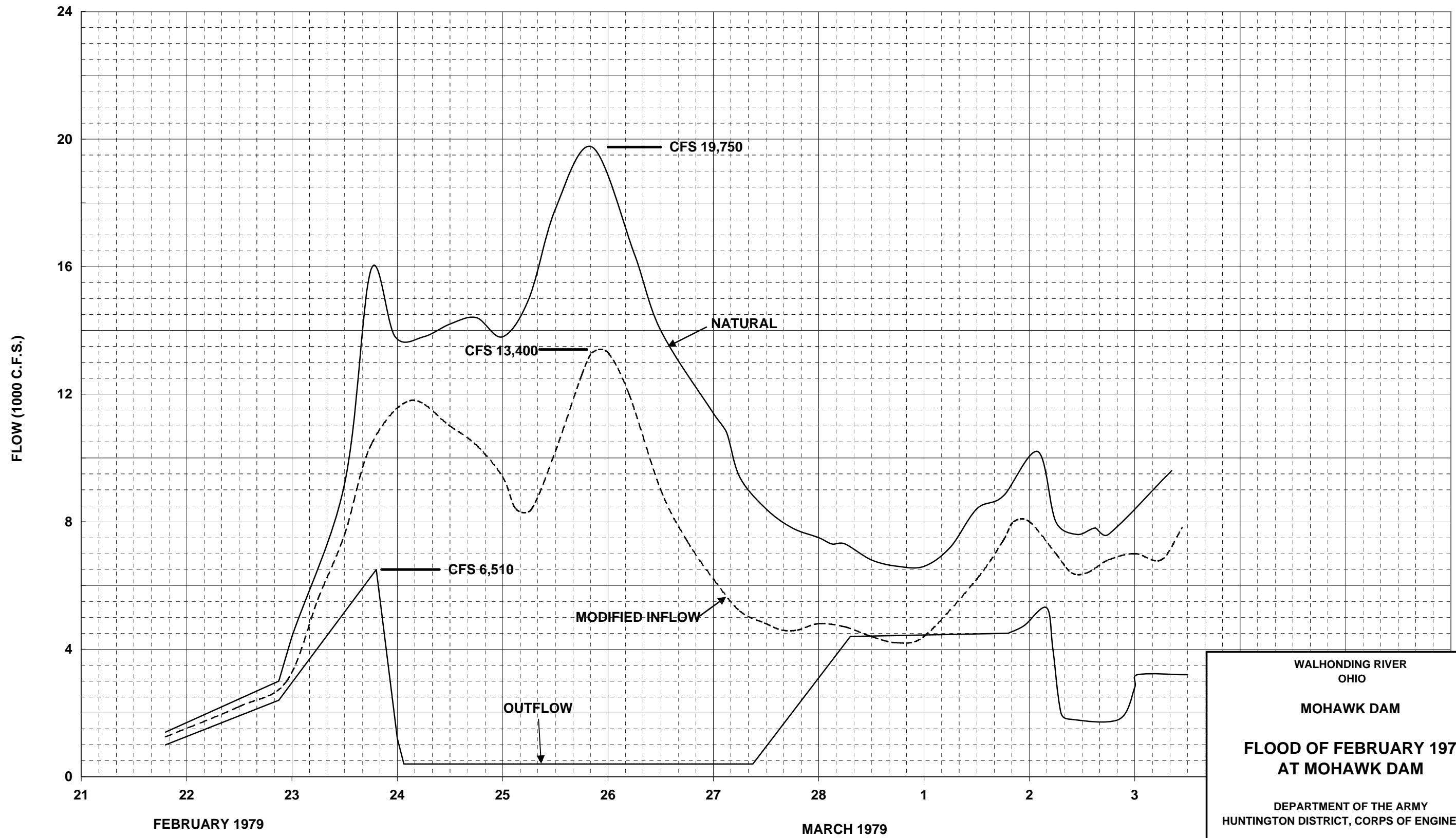
HUNTINGTON, W.V. REDRAWN OCTOBER 1999



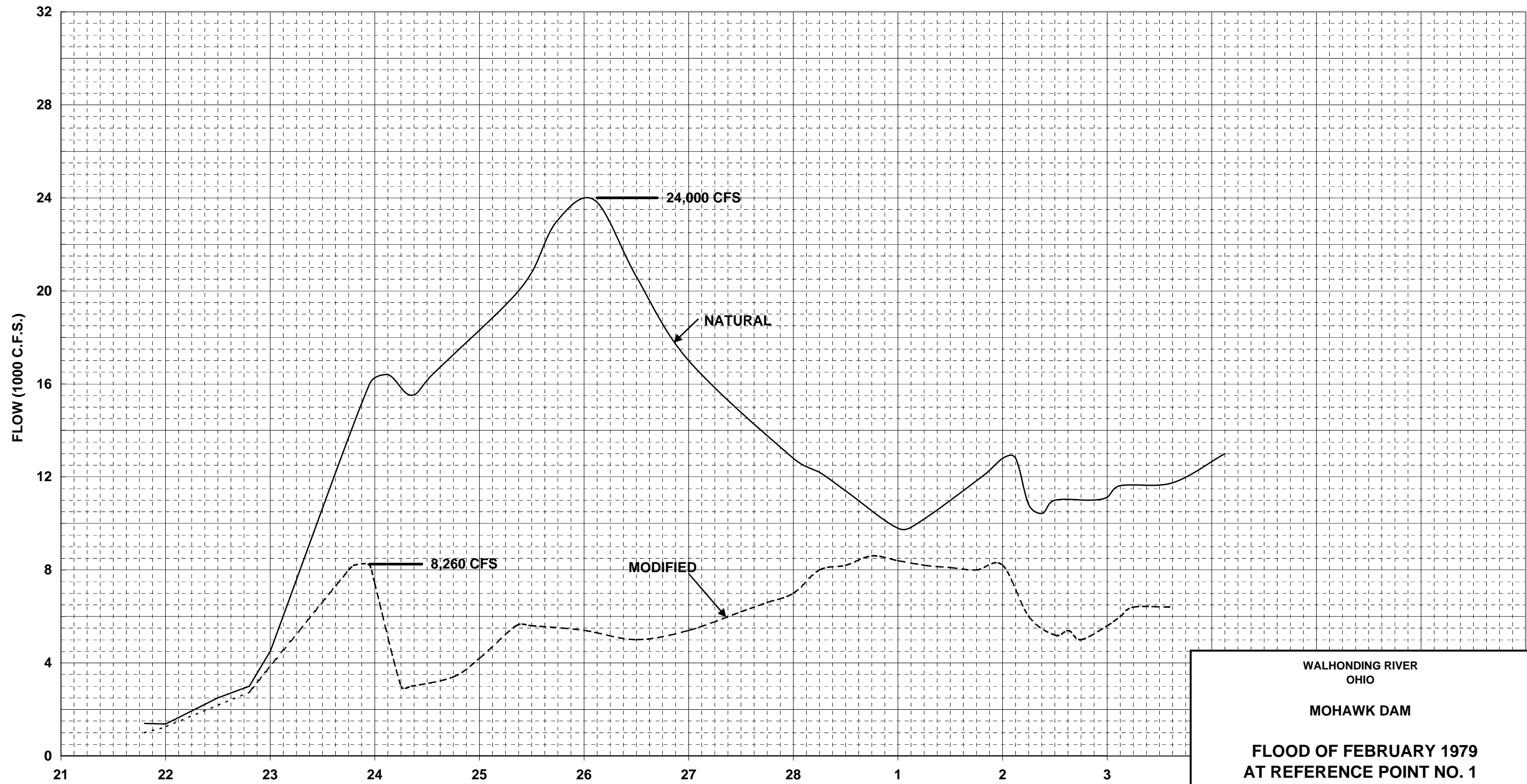
WALHONDING RIVER  
 OHIO  
  
 MOHAWK DAM  
  
**FLOOD OF JANUARY 1959  
 AT MOHAWK DAM**  
  
 DEPARTMENT OF THE ARMY  
 HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
 HUNTINGTON, W.V. REDRAWN OCTOBER 1999



WALHONDING RIVER  
 OHIO  
  
 MOHAWK DAM  
  
**FLOOD OF JANUARY 1959  
 AT REFERENCE POINT NO. 1**  
  
 DEPARTMENT OF THE ARMY  
 HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
  
 HUNTINGTON, W.V. REDRAWN OCTOBER 1999



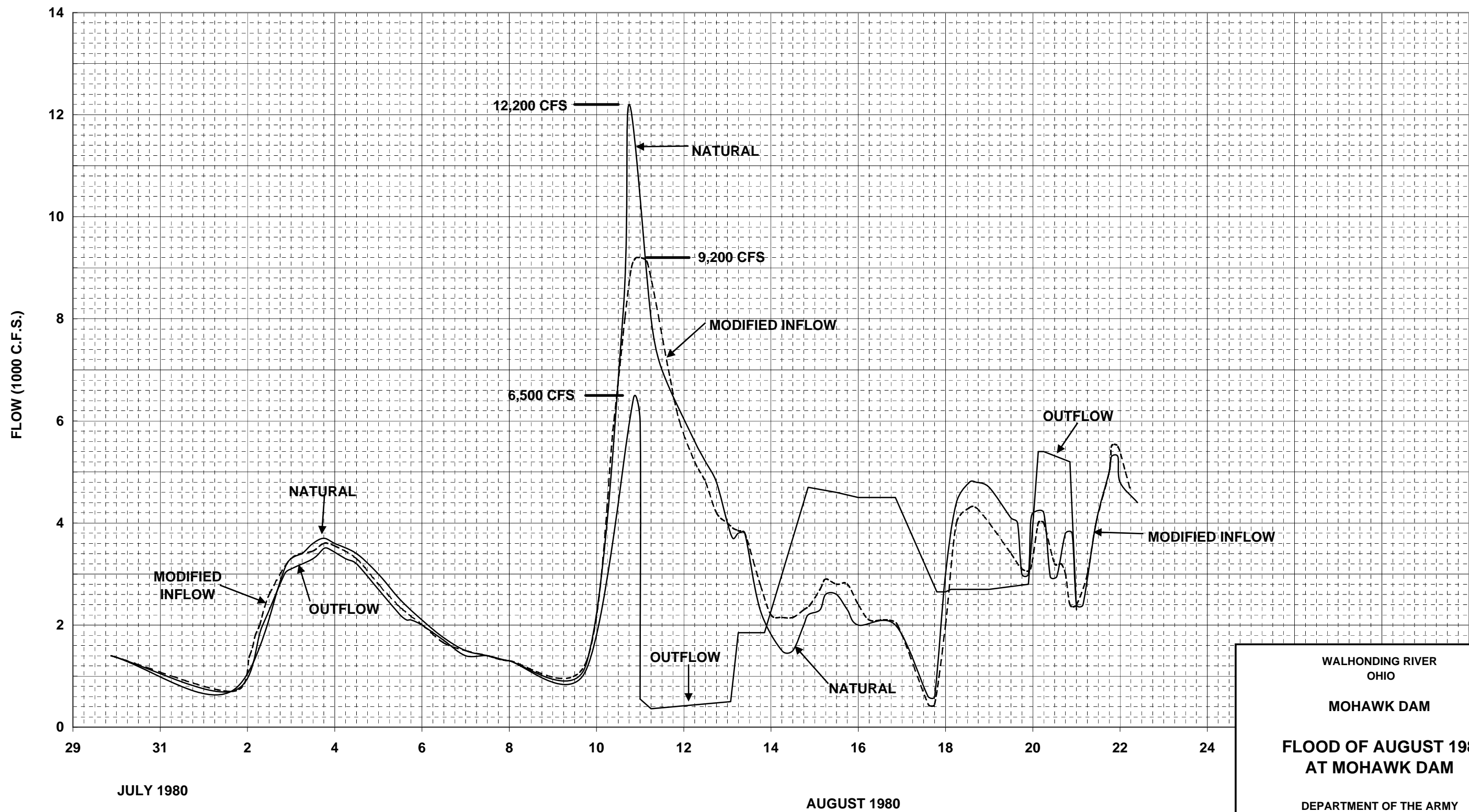
WALHONDING RIVER  
 OHIO  
  
 MOHAWK DAM  
  
**FLOOD OF FEBRUARY 1979  
 AT MOHAWK DAM**  
  
 DEPARTMENT OF THE ARMY  
 HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
  
 HUNTINGTON, W.V. REDRAWN OCTOBER 1999



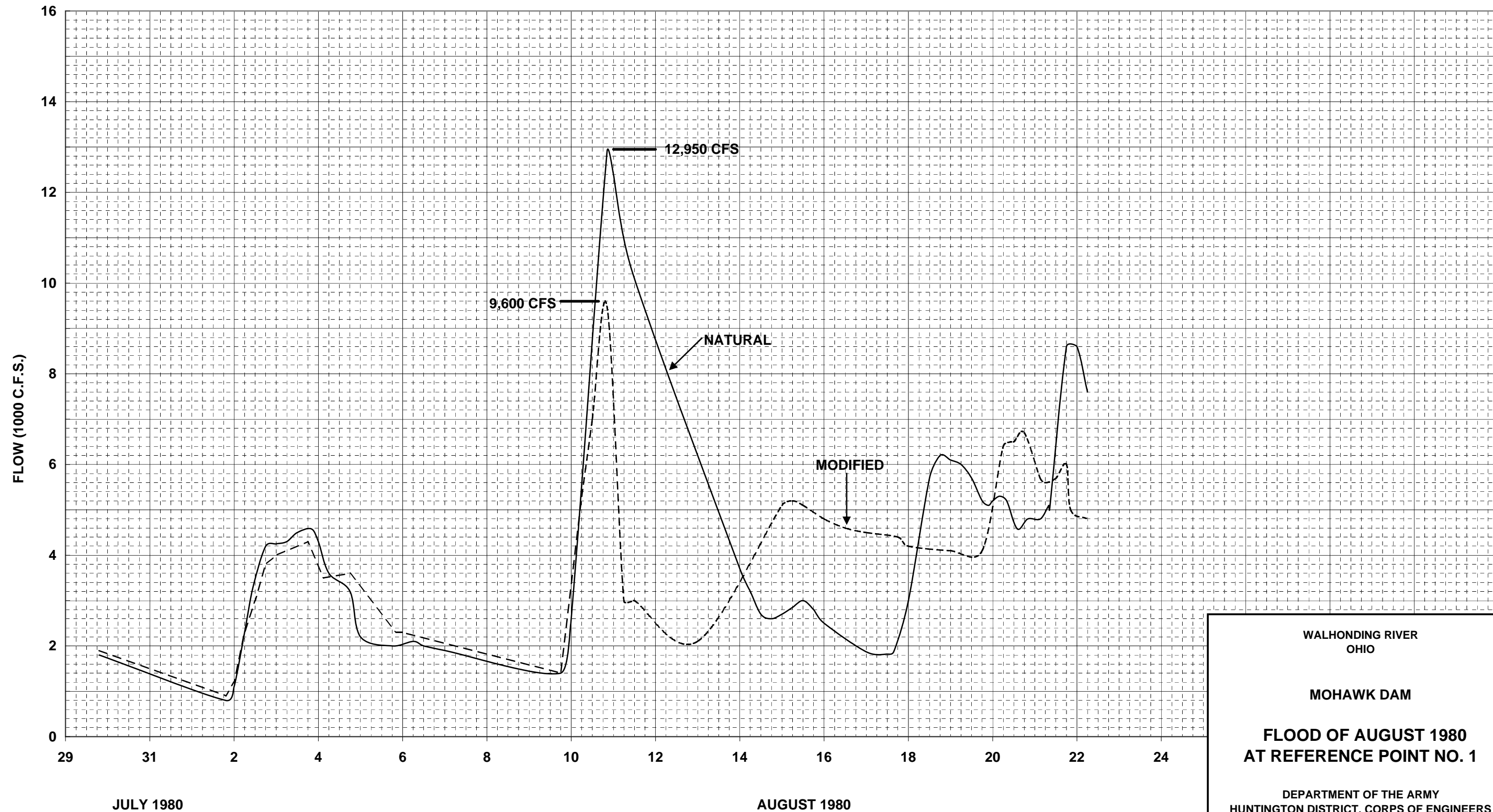
FEBRUARY 1979

MARCH 1979

WALHONDING RIVER  
 OHIO  
  
 MOHAWK DAM  
  
**FLOOD OF FEBRUARY 1979  
 AT REFERENCE POINT NO. 1**  
  
 DEPARTMENT OF THE ARMY  
 HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
 HUNTINGTON, W.V. REDRAWN OCTOBER 1999

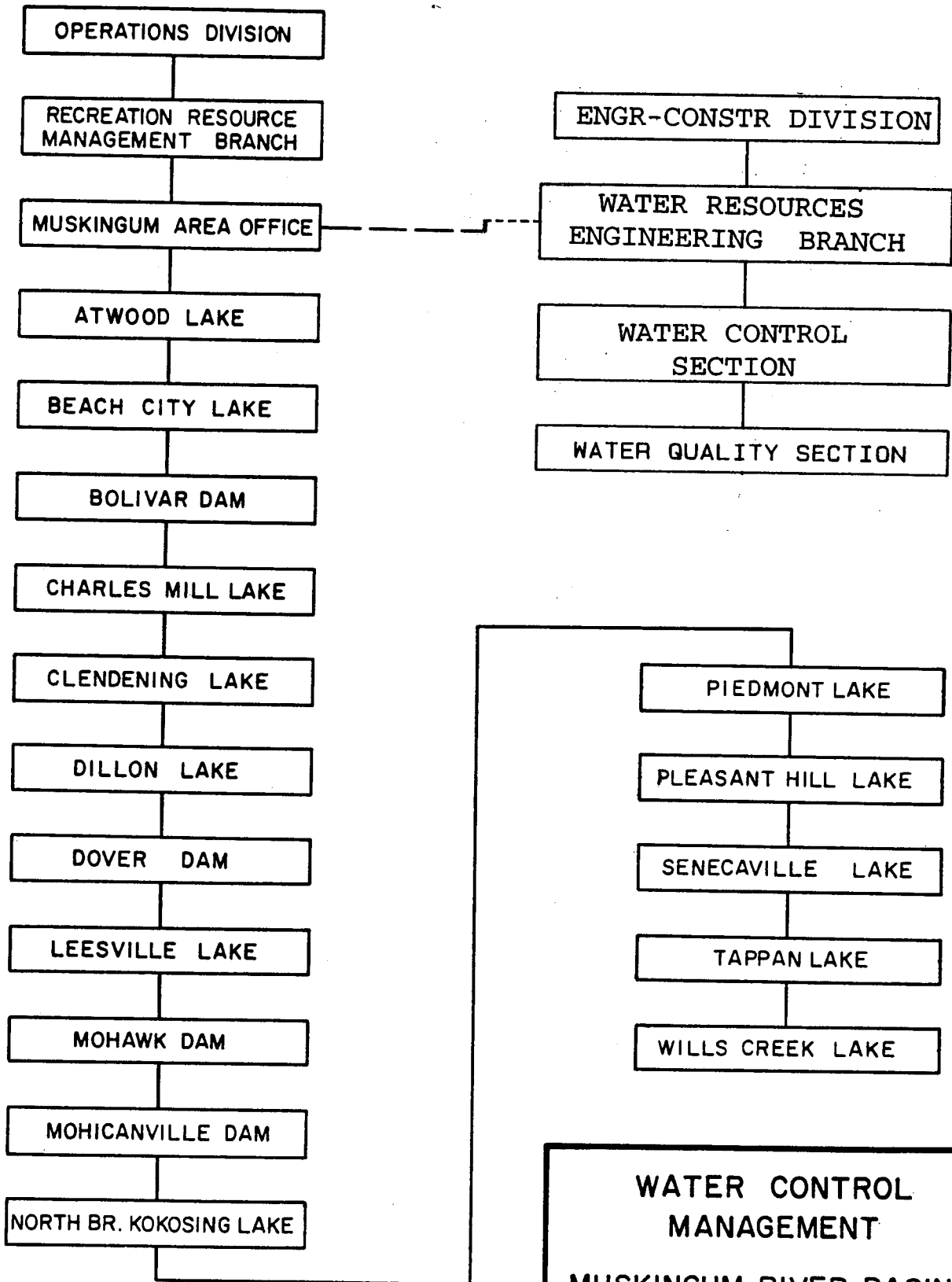


WALHONDING RIVER  
 OHIO  
  
 MOHAWK DAM  
  
**FLOOD OF AUGUST 1980  
 AT MOHAWK DAM**  
  
 DEPARTMENT OF THE ARMY  
 HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
 HUNTINGTON, W.V. REDRAWN OCTOBER 1999



WALHONDING RIVER  
 OHIO  
  
 MOHAWK DAM  
  
**FLOOD OF AUGUST 1980  
 AT REFERENCE POINT NO. 1**  
  
 DEPARTMENT OF THE ARMY  
 HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
 HUNTINGTON, W.V.      REDRAWN OCTOBER 1999

WATER CONTROL MANAGEMENT  
MUSKINGUM RIVER BASIN  
NORMAL ORGANIZATION



WATER CONTROL  
MANAGEMENT  
MUSKINGUM RIVER BASIN  
NORMAL ORGANIZATION

**WATER RESOURCES ENGINEERING BRANCH  
FLOOD EMERGENCY ORGANIZATION**

**CHIEF, WATER RESOURCES ENGINEERING BRANCH**

**CHIEF, WATER CONTROL SECTION**

**RESOURCE MANAGER MUSKINGUM AREA**

**MOHAWK DAM**

**OTHER AREA PROJECTS**

**WATER RESOURCES ENGINEERING BRANCH  
FLOOD EMERGENCY ORGANIZATION**

WATER RESOURCES ENGINEERING BRANCH  
FLOOD EMERGENCY ORGANIZATION

CHIEF, WATER RESOURCES ENGINEERING BRANCH

HYDROLOGY AND  
HYDRAULIC DESIGN

WATER QUALITY SECTION

WATER CONTROL SECTION

MUSKINGUM BASIN

SCIOTO & HOCKING BASINS

LITTLE KANAWHA, KANAWHA  
& GUYANDOTTE BASINS

TWELVEPOLE & LITTLE  
SANDY BASINS

BIG SANDY BASIN

MUSKINGUM AREA-  
15 RESERVOIRS

SCIOTO & HOCKING  
AREA-5 RESERVOIRS

LITTLE KANAWHA, KANAWHA  
& GUYANDOTTE AREA-5  
RESERVOIRS

TWELVEPOLE & LITTLE SANDY  
AREA-3 RESERVOIRS

BIG SANDY AREA -  
5 RESERVOIRS

WATER RESOURCES ENGINEERING BRANCH  
FLOOD EMERGENCY ORGANIZATION

U.S. ARMY CORPS OF ENGINEERS  
HUNTINGTON DISTRICT

NATIONAL WEATHER SERVICE  
PRECIPITATION AND STREAMFLOW  
DATA - RIVER FORECASTS

U.S. GEOLOGICAL SURVEY  
DISCHARGE MEASUREMENTS

OHIO DEPT. OF NATURAL RESOURCES  
FISH & WILDLIFE CONSERVATION  
BOATING SAFETY - ENFORCEMENT  
OF HUNTING & FISHING  
REGULATIONS & LICENSES

MUSKINGUM WATERSHED  
CONSERVANCY DISTRICT  
MANAGES AND/OR LEASES  
THE LAND AND WATER  
RESOURCES - INCLUDING  
RECREATION FACILITIES

DISTRICT RELATIONS WITH  
OTHER AGENCIES  
  
MOHAWK DAM

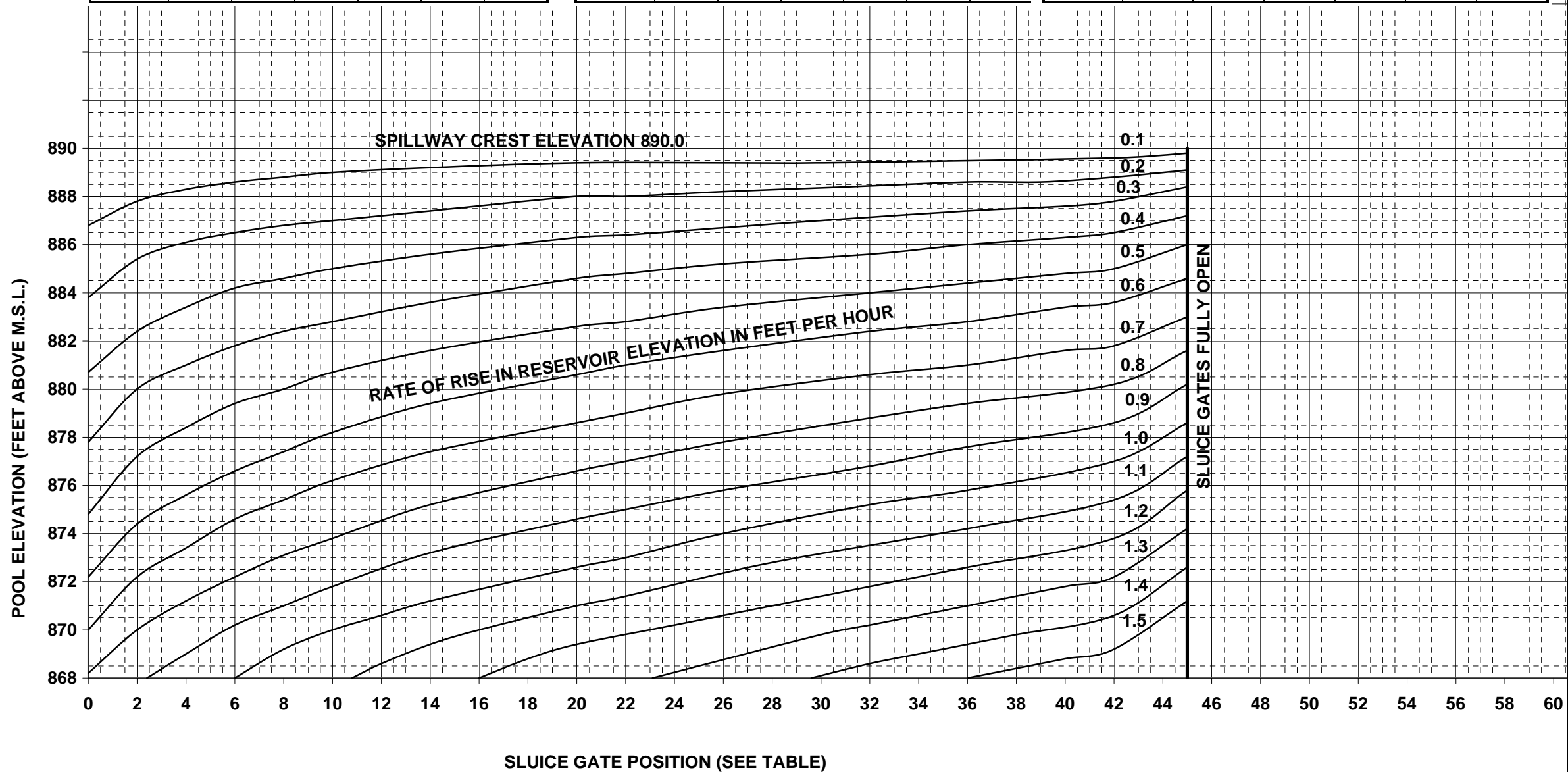
SLUICE GATE POSITION NO.	SLUICE GATE NO. 1	SLUICE GATE NO. 2	SLUICE GATE NO. 3	SLUICE GATE NO. 4	SLUICE GATE NO. 5	SLUICE GATE NO. 6
1	0 FT.	1 FT.	0 FT.	0 FT.	1 FT.	0 FT.
2	0 FT.	1 FT.	1 FT.	1 FT.	1 FT.	0 FT.
3	1 FT.	1 FT.	1 FT.	1 FT.	1 FT.	1 FT.
4	1 FT.	2 FT.	1 FT.	1 FT.	2 FT.	1 FT.
5	1 FT.	2 FT.	2 FT.	2 FT.	2 FT.	1 FT.
6	2 FT.	2 FT.	2 FT.	2 FT.	2 FT.	2 FT.
7	2 FT.	3 FT.	2 FT.	2 FT.	3 FT.	2 FT.
8	2 FT.	3 FT.	3 FT.	3 FT.	3 FT.	2 FT.
9	3 FT.	3 FT.	3 FT.	3 FT.	3 FT.	3 FT.
10	3 FT.	4 FT.	3 FT.	3 FT.	4 FT.	3 FT.
11	3 FT.	4 FT.	4 FT.	4 FT.	4 FT.	3 FT.
12	4 FT.	4 FT.	4 FT.	4 FT.	4 FT.	4 FT.
13	4 FT.	5 FT.	4 FT.	4 FT.	5 FT.	4 FT.
14	4 FT.	5 FT.	5 FT.	5 FT.	5 FT.	4 FT.
15	5 FT.	5 FT.	5 FT.	5 FT.	5 FT.	5 FT.

SLUICE GATE POSITION NO.	SLUICE GATE NO. 1	SLUICE GATE NO. 2	SLUICE GATE NO. 3	SLUICE GATE NO. 4	SLUICE GATE NO. 5	SLUICE GATE NO. 6
16	5 FT.	6 FT.	5 FT.	5 FT.	6 FT.	5 FT.
17	5 FT.	6 FT.	6 FT.	6 FT.	6 FT.	5 FT.
18	6 FT.	6 FT.	6 FT.	6 FT.	6 FT.	6 FT.
19	6 FT.	7 FT.	6 FT.	6 FT.	7 FT.	6 FT.
20	6 FT.	7 FT.	7 FT.	7 FT.	7 FT.	6 FT.
21	7 FT.	7 FT.	7 FT.	7 FT.	7 FT.	7 FT.
22	7 FT.	8 FT.	7 FT.	7 FT.	8 FT.	7 FT.
23	7 FT.	8 FT.	8 FT.	8 FT.	8 FT.	7 FT.
24	8 FT.	8 FT.	8 FT.	8 FT.	8 FT.	8 FT.
25	8 FT.	9 FT.	8 FT.	8 FT.	9 FT.	8 FT.
26	8 FT.	9 FT.	9 FT.	9 FT.	9 FT.	8 FT.
27	9 FT.	9 FT.	9 FT.	9 FT.	9 FT.	9 FT.
28	9 FT.	5 FT.	9 FT.	9 FT.	10 FT.	9 FT.
29	9 FT.	10 FT.	10 FT.	10 FT.	10 FT.	9 FT.
30	10 FT.	10 FT.	10 FT.	10 FT.	10 FT.	10 FT.

SLUICE GATE POSITION NO.	SLUICE GATE NO. 1	SLUICE GATE NO. 2	SLUICE GATE NO. 3	SLUICE GATE NO. 4	SLUICE GATE NO. 5	SLUICE GATE NO. 6
31	10 FT.	10 FT.	11 FT.	11 FT.	10 FT.	10 FT.
32	10 FT.	11 FT.	11 FT.	11 FT.	11 FT.	10 FT.
33	11 FT.	11 FT.	11 FT.	11 FT.	11 FT.	11 FT.
34	11 FT.	11 FT.	12 FT.	12 FT.	11 FT.	11 FT.
35	11 FT.	12 FT.	12 FT.	12 FT.	12 FT.	11 FT.
36	12 FT.	12 FT.	12 FT.	12 FT.	12 FT.	12 FT.
37	12 FT.	12 FT.	13 FT.	13 FT.	12 FT.	12 FT.
38	12 FT.	13 FT.	13 FT.	13 FT.	13 FT.	12 FT.
39	13 FT.	13 FT.	13 FT.	13 FT.	13 FT.	13 FT.
40	13 FT.	13 FT.	14 FT.	14 FT.	13 FT.	13 FT.
41	13 FT.	14 FT.	14 FT.	14 FT.	14 FT.	13 FT.
42	14 FT.	14 FT.	14 FT.	14 FT.	14 FT.	14 FT.
43	14 FT.	14 FT.	Full Open	Full Open	14 FT.	14 FT.
44	14 FT.	Full Open	Full Open	Full Open	Full Open	14 FT.
45	Full Open	Full Open	Full Open	Full Open	Full Open	Full Open

**OPERATING INSTRUCTIONS**

1. SEE SEPARATE INSTRUCTIONS AS TO WHEN RESERVOIR MAY BE OPERATED WITHOUT SPECIFIC INSTRUCTIONS MUSKIGUM AREA OFFICE.
2. READ THE "LAKE" GAGE EVERY HOUR AND COMPUTE THE RISE IN POOL ELEVATION DURING THE PRECEDING HOUR.
3. ADJUST THE GATE SETTINGS EACH HOUR ON OBTAIN THE SLUICE GATE POSITION FROM THE SET OF CURVES. OBTAIN THE SLUICE GATE POSITION FROM THE SET OF CURVES AND OBTAIN SLUICE GATE OPENINGS FROM THE TABLE.
4. WHEN THE RESERVOIR LEVEL EXCEEDS SPILLWAY ELEVATION AND THEN STARTS TO FALL, MAINTAIN THE CURRENT GATE SETTINGS UNTIL THE POOL RECEDES TO SPILLWAY ELEVATION 890.0.
5. HOLD THE POOL AT SPILLWAY ELEVATION 890.0 OR AT MAXIMUM LEVEL ATTAINED, IF BELOW SPILLWAY ELEVATION, UNTIL ORDERED BY SPECIAL DIRECTIVE TO BEGIN DRAWDOWN OPERATION.
6. IF A SECOND RISE OCCURS WHILE THE POOL IS BEING HELD AT MAXIMUM LEVEL, RESUME OPERATION IN ACCORDANCE WITH RATE OF RISE CURVES AND ABOVE INSTRUCTIONS.



WALHONDING RIVER  
OHIO

**MOHAWK RESERVOIR PROJECT**

**EMERGENCY OPERATION SCHEDULE**

DEPARTMENT OF THE ARMY  
HUNTINGTON DISTRICT, CORPS OF ENGINEERS  
HUNTINGTON, W.V. REDRAWN OCTOBER 1999