In Cooperation With the Miami Conservancy District

Annual Peak-Flow and Peak Dam-Pool-Elevation Frequency Characteristics of Selected Dry Dams in the Great Miami River Basin, Ohio

Open-File Report 2009–1069

U.S. Department of the Interior
U.S. Geological Survey

Cover image: Aerial view of Taylorsville Dam, Montgomery County, Ohio. (Photo from Ohio Statewide Imagery Program .)

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KEN SALAZAR, Secretary

U.S. Geological Survey
Suzette M. Kimball, Acting Director

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Conversion Factors and Datums

Multiply	By	To obtain
	Length	
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
acre	4,047	square meter (m^2)
acre	0.004047	square kilometer (km^2)
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
cubic foot (ft^3)	0.02832	cubic meter (m^3)
acre-foot (acre-ft)	1,233	cubic meter (m^3)
	Flow rate	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
cubic foot per second per square mile [(ft^3/s)/mi^2]	0.01093	cubic meter per second per square kilometer [(m^3/s)/km^2]

Vertical coordinate information is referenced to the U.S. Army Corps of Engineers datum of 1912 (COE 1912).

Horizontal coordinate information is referenced North American Datum of 1983 (NAD 83).

Elevation, as used in this report, refers to distance above the vertical datum.

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By G. F. Koltun

Abstract

This report describes the results of a study to determine frequency characteristics of post-regulation annual peak flows at streamflow-gaging stations near the Taylorsville, Huffman, and Germantown dry dams in the Miami Conservancy District flood-protection system (southwestern Ohio), and of annual peak elevations of the corresponding dam pools. Log-Pearson Type III distributions were fit to annual peak flow values for the period 1921 or 1922 through 2007 (the most recent year of published peak flow values at the time of this analysis) and annual peak dam-pool storage values for the period 1922–2008 to determine peaks with recurrence intervals of 2, 5, 10, 25, 50, 100, 200, and 500 years. Once storages had been estimated for the various recurrence intervals, corresponding dam-pool elevations were determined from elevation-storage ratings provided by the Miami Conservancy District.

Introduction

The Miami Conservancy District (MCD), whose jurisdiction lies within the Great Miami River basin in southwestern Ohio (fig. 1), is responsible for the operation and maintenance of a flood-protection system that includes five gateless dry dams: Germantown, Englewood, Lockington, Taylorsville, and Huffman. These dams were designed to safely pass the Official Plan Flood (OPF), which is equal to the 1913 flood magnitude plus 40 percent additional flow (Miami Conservancy District, 2009). Flow through the dams is controlled by means of conduits designed to pass only the amount of water that can be conveyed within the banks of the downstream channel. Excess floodwaters are stored behind the dams in temporary pools, which gradually drain as inflow rates to the dam pools fall below the outflow rates. During times of low to moderate flow, water flows in the conduits through the dams unimpeded, leaving no permanent pools (hence the name "dry dams").

The dams were constructed simultaneously between 1918 and 1922. Streamflow-gaging stations have been operated near the outlets of each of the dams for all or most of the period since the dams were constructed. In addition, the MCD has collected and maintained records of annual peak dam-pool elevations as well as peak dam-pool elevations associated with selected smaller floods that resulted in water storage in the dam pools. Frequency characteristics of the peak flows discharged through the dams and of annual peak dam-pool elevations have been assessed in the past (Webber and Bartlett, 1977; Song, 1979); however, those assessments were based on appreciably less data than are currently available (2009).

Accurate information on peak flow and annual peak dam-pool-elevation frequency characteristics is important to regulators and emergency managers so that they can make informed decisions about flood-related risks. Consequently, there is a periodic need to reevaluate those characteristics to improve the accuracy of frequency estimates and to evaluate and reflect any changes in frequency characteristics that may result from changes in hydrology. To help meet that need, the U.S. Geological Survey (USGS), in cooperation with the Miami Conservancy District, did a study to characterize annual peak flows and peak dam-pool-elevation frequency characteristics of three of the dry dams in the Great Miami River basin, Ohio

Description of the Study Area

The part of the Great Miami River Basin within the jurisdictional boundaries of the MCD drains approximately 3,900 mi^2 in southwestern Ohio and small parts of Indiana. The MCD's jurisdictional boundary encompasses all of the Great Miami River drainage except that from the Whitewater River, which itself drains approximately 1,470 mi^2 (mostly from Indiana) and discharges to the Great Miami River about 6.3 mi upstream from its mouth. The Great Miami River Basin within the jurisdictional boundaries of the MCD will be referred to simply as "the basin" for the remainder of this report.

The basin lies almost entirely within the Till Plains section of the Central Lowlands physiographic province (Fenneman, 1938). Most of the basin was glaciated, resulting in flat to gently rolling land surfaces that are cut by steep-walled river valleys of low to moderate relief (DeBrewer and others, 2000). Glacial till overlies most of the basin; however, coarse-grained stratified sediments consisting of well-sorted sand and gravel also are common, particularly in river valleys.

The basin has a temperate continental climate characterized by well-defined winter and summer seasons that are accompanied by large annual temperature variations (Debrewer and others, 2000). On average, about 38.3 in. of precipitation falls annually within the basin, on the basis of data collected from 1915 through 2000 (Miami Conservancy

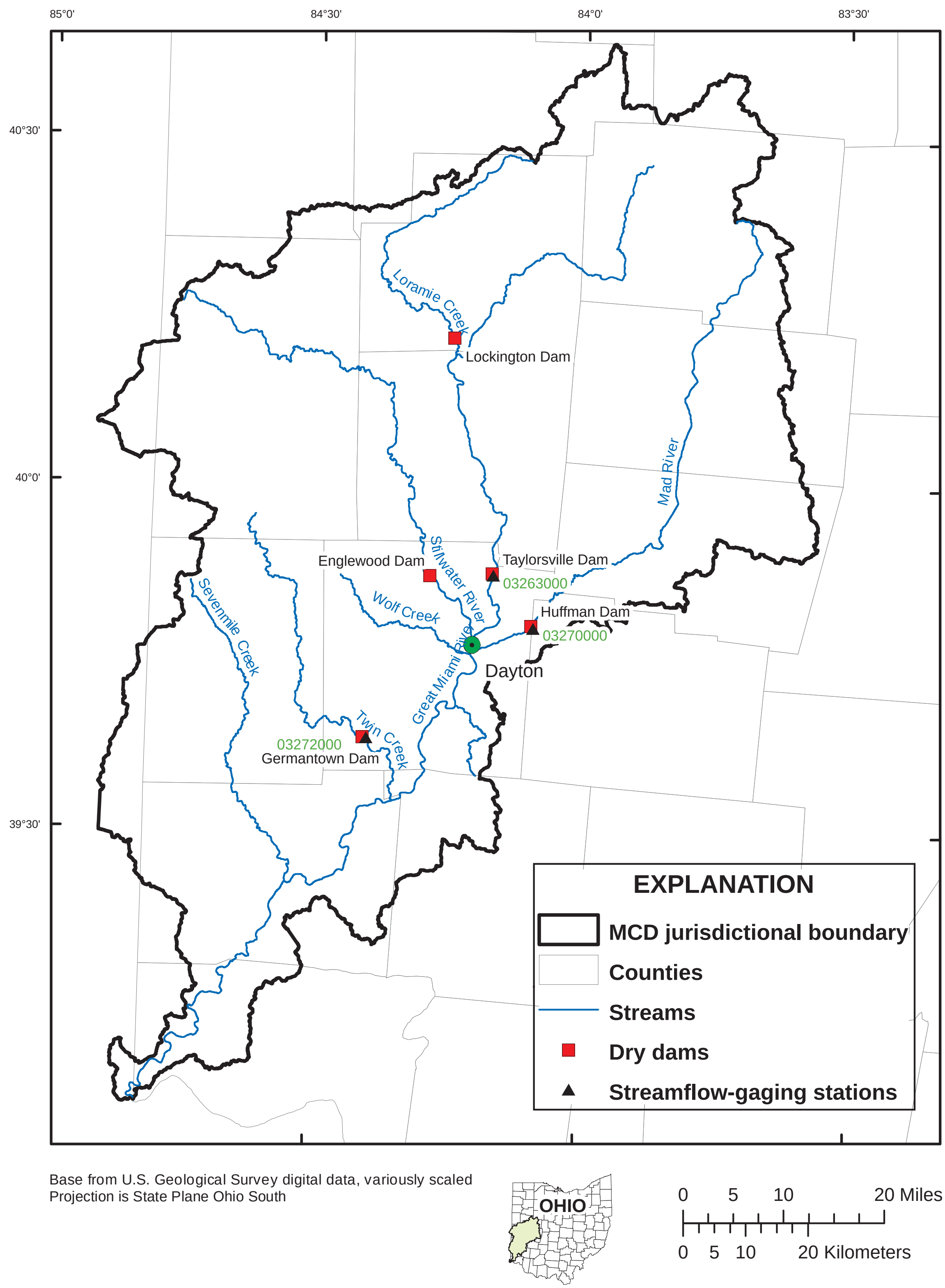

Figure 1. Locations of selected streamflow-gaging stations and dry dams in the Great Miami River Basin, Ohio.

District, 2007), with an average runoff of about 12.6 in. March through August tend to be the wettest months; January and February tend to be the driest (Debrewer and others, 2000).

The Taylorsville, Huffman, and Germantown dams discussed in this report are on the Great Miami River, Mad River, and Twin Creek, respectively. The drainage area upstream from the Taylorsville dam (at Taylorsville, Ohio) is the largest for the three dams at 1,149 mi^2. The drainage area upstream from Huffman dam (near Dayton, Ohio) is the second largest (635 mi^2) and the drainage area upstream from Germantown dam (near Germantown, Ohio) is the smallest (275 mi^2). A description of these and the other two dry dams in the MCD flood-protection system can be found at *http://www.miamiconservancy.org/flood/dams.asp*.

Purpose and Scope

The purpose of this report is to describe the results of a study to determine selected frequency characteristics of post-regulation annual peak flows measured at streamflow-gaging stations near the outlets of three of the five dry dams in the MCD flood-protection system (Taylorsville, Huffman, and Germantown) and to determine frequency characteristics of annual peak elevations in their corresponding dam pools. Because of the close proximity of the gaging stations to the dams, peak flows at the gaging stations are considered to be approximately equal to peak flows discharging through the dams. Frequency characteristics presented in this report are based on annual peak streamflows from water years 1921 or 1922 through 2007 and annual peak dam-pool elevations from water years[1] 1922 through 2008.

Data Aggregation and Quality-Assurance Checks

Annual peak flow values and the dates of their occurrence (Appendix 1, table 1–1) were retrieved from the USGS National Water Information System (NWIS) for USGS streamflow-gaging stations 03263000 (Great Miami River at Taylorsville, Ohio), 03270000 (Mad River near Dayton, Ohio), and 03272000 (Twin Creek near Germantown, Ohio). A suite of tests (Ryberg, 2008) were run on the annual peak flow data as quality-assurance checks. All potential data-quality issues identified in the tests were examined further to ensure that the peak flow data were accurate.

Annual peak dam-pool elevations and the dates of their occurrences were provided by the MCD. In most cases, these annual peak dam-pool elevations were determined from staff-gage readings made at the dams by MCD personnel. In some cases, the elevations were determined by means of automated equipment that measures and records the height of water above a reference datum.

[1] A water year is the period from October 1 to September 30 and is designated by the calendar year in which it ends.

As a quality-assurance check, annual peak dam-pool-elevation data were paired by date of occurrence with corresponding peak-flow values (when available) retrieved from NWIS.[2] Outflow ratings, developed by digitizing outlet-capacity rating curves contained in a MCD report (Miami Conservancy District, 1964), were used to estimate peak flows as a function of peak dam-pool elevations. The estimated peak flows were compared with peak-flow values retrieved from the NWIS database to ensure that there were no substantial discrepancies.

Determination of Peak Dam-Pool Storages

As discussed in more detail later, annual peak storages in the dam pools were used to determine frequency characteristics of peak dam-pool elevations. Elevation-storage ratings for the dam pools were provided to the USGS by the MCD. The MCD used a geographic information system to determine elevation-storage ratings for the dam pools on the basis of a 2.5-ft grid digital elevation model that was developed by the Ohio Statewide Imagery Program (a partnership between State agencies and the Federal government). Storages determined for elevations ranging from the conduit inverts to at or near the top of the dams (in 0.1-ft increments) were used in look-up form to determine the storages associated with the annual peak dam-pool elevations (Appendix 1, table 1-2).

Tests for Trends

The annual peak flow and peak dam-pool storage time series were tested for stationarity by means of the Kendall test for trends, as implemented in the USGS program SWSTAT (U.S. Geological Survey, 2009). The Kendall test for trends involves calculating a nonparametric measure of correlation (tau) between time and corresponding measures of some characteristic (in this case, annual peak flows or peak dam-pool storages). None of the time series exhibited statistically significant trends at $\alpha = 0.05$, thereby supporting the assumption of stationarity that is required for frequency analysis.

Frequency Analyses

Frequency analyses were done to estimate peak-flow and peak dam-pool-elevation magnitudes with recurrence intervals of 2, 5, 10, 25, 50, 100, 200, and 500 years (annual exceedance probabilities of 0.5, 0.2, 0.1, 0.04, 0.02, 0.01, 0.005, and 0.002, respectively). Methods used to compute these frequency characteristics are described below.

[2] The dates of peak streamflow and peak dam-pool storage for a given water year are not the same in all cases. There are a variety of reasons (for example, obstructions lodging in outflow conduits) that can cause this to occur.

Analysis of Peak Flows

Peak-flow frequency estimates were determined by fitting a log-Pearson Type III distribution to the base-10 logarithms of the annual peak-flow series. The peak flows corresponding to selected recurrence intervals were computed by the following equation:

$$\log_{10}(Q_t) = \overline{X} + K(S)$$

where

Q_t is the t-year-recurrence-interval peak flow, in cubic feet per second,

$\overline{X}$ is the mean of the logarithms of the annual peak flows,

K is a factor dependent on the recurrence interval and the skew coefficient of the log-transformed annual peak flow series, and

S is the standard deviation of the log-transformed annual peak-flow series.

Peak-flow frequency estimates were calculated with version 5.2 of the USGS program PKFQWin (U.S. Geological Survey, 2009), which is a Windows Operating System version of the USGS program PEAKFQ (Flynn and others, 2006). PKFQWin performs frequency analyses on the basis of guidelines established by the Interagency Advisory Committee on Water Data (1982). Station skew was used instead of the weighted skew in all cases because skews may be affected by regulation from the dry dams and therefore may be inconsistent with regional skew estimates. Peak-flow frequency estimates determined for stations 03263000, 03270000, and 03272000 are reported in table 1.

Table 1. Peak-flow frequency estimates at streamflow-gaging stations below three dry dams in the Great Miami River Basin, Ohio.

[ft^3/s, cubic feet per second]

Annual exceedance probability	Recurrence interval (years)	Peak streamflow (ft^3/s)	95-percent confidence limits	
			Lower (ft^3/s)	Upper (ft^3/s)
Great Miami River at Taylorsville, Ohio (03263000)				
0.500	2	15,000	14,000	16,100
0.200	5	20,100	18,600	21,900
0.100	10	22,800	20,900	25,200
0.040	25	25,700	23,400	28,800
0.020	50	27,500	24,900	31,000
0.010	100	29,000	26,200	33,000
0.005	200	30,400	27,300	34,700
0.002	500	32,000	28,600	36,700
Mad River near Dayton, Ohio (03270000)				
0.500	2	7,200	6,670	7,770
0.200	5	10,300	9,510	11,360
0.100	10	12,500	11,400	14,000
0.040	25	15,400	13,800	17,600
0.020	50	17,600	15,600	20,500
0.010	100	19,900	17,400	23,500
0.005	200	22,300	19,300	26,700
0.002	500	25,500	21,800	31,100
Twin Creek near Germantown, Ohio (03272000)				
0.500	2	6,120	5,840	6,420
0.200	5	7,240	6,880	7,670
0.100	10	7,700	7,290	8,210
0.040	25	8,100	7,640	8,680
0.020	50	8,300	7,820	8,920
0.010	100	8,450	7,950	9,100
0.005	200	8,570	8,050	9,240
0.002	500	8,670	8,140	9,360

Analysis of Annual Peak Dam-Pool Elevations

Frequency characteristics of peak dam-pool elevations were not determined from direct analysis of the annual peak dam-pool-elevation time series but instead were determined from corresponding annual peak dam-pool storages. Annual peak storage in the dam pool generally is closely related to annual peak streamflow at dry dams (fig. 2). The same cannot necessarily be said about the relation between peak flows and peak dam-pool elevations because elevation-storage relations vary as a function of water level at a given dam due to variable topography of the dam pools (fig. 3). An added benefit of analyzing storages instead of elevations is that the strong linear correlation between logarithms of annual peak flows and annual peak storages at dry dams gives theoretical support that a log-Pearson Type III distribution can be used to describe the storage-frequency characteristics.

Annual peak dam-pool-elevation frequency characteristics were estimated with version 5.2 of the USGS program PKFQWin (U.S. Geological Survey, 2009) by determining the parameters of a log-Pearson Type III distribution that fit the base-10 logarithms of the observed annual peak dam-pool storages. The log-Pearson Type III distribution was then used to estimated the peak dam-pool storages (and corresponding confidence limits) with recurrence intervals of 2, 5, 10, 25, 50, 100, 200, and 500 years. As described in Bulletin 17B (Interagency Advisory Committee on Water Data, 1982), conditional probability adjustments were made to the frequency estimates to account for zero-storage years (years in which peak flows were insufficient to cause water to go into dam-pool storage). Once storages had been estimated for the various recurrence intervals, corresponding dam-pool elevations were determined from the elevation-storage ratings discussed earlier. The resulting dam-pool-elevation frequency characteristics for the Taylorsville, Huffman, and Germantown Dams are listed in table 2.

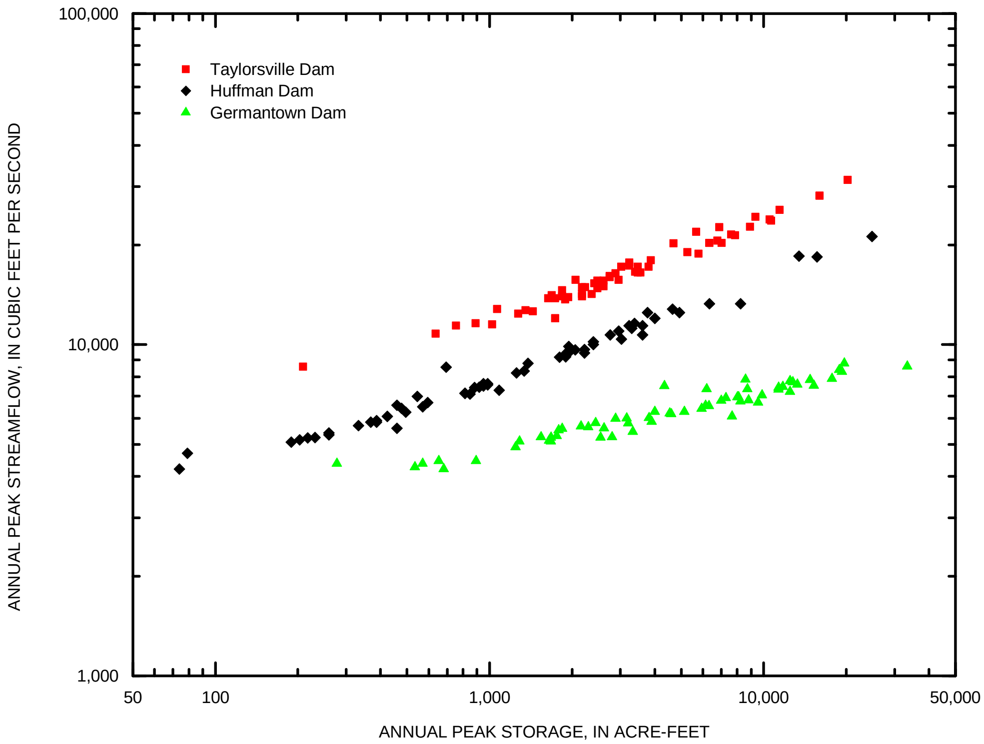

Figure 2. Scatterplot of annual peak flows against non-zero annual peak storages for the Taylorsville, Huffman, and Germantown Dams, Ohio, water years 1922–2007.

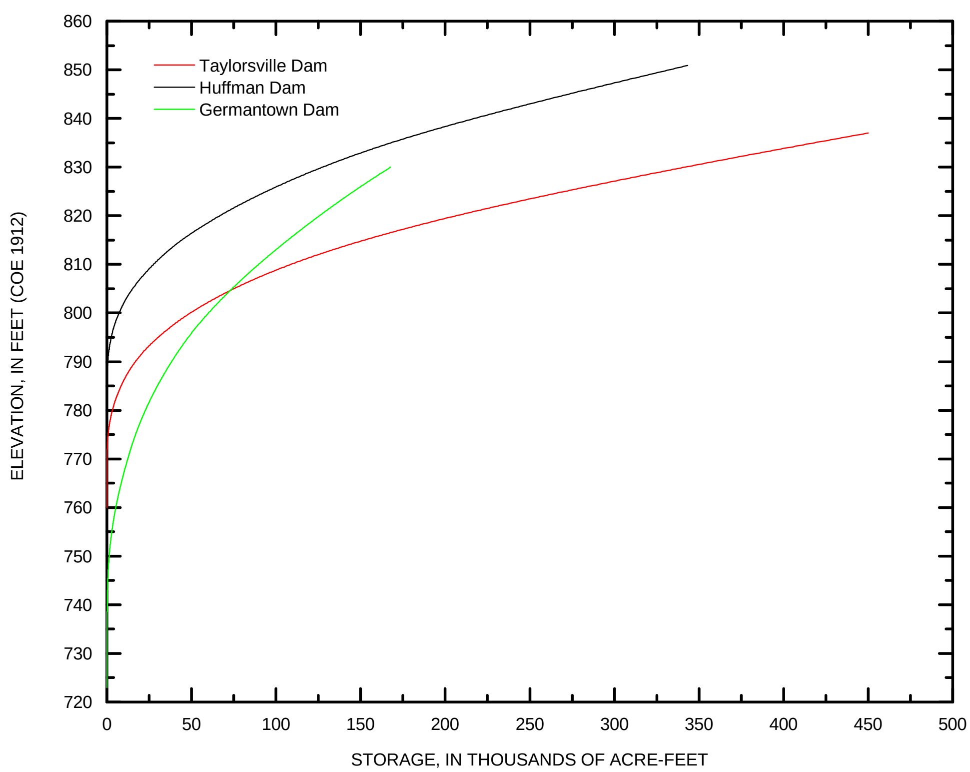

Figure 3. Plot of elevation against dam-pool storage for the Taylorsville, Huffman, and Germantown Dams, Ohio.

Table 2. Peak dam-pool-elevation frequency characteristics for three dry dams in the Great Miami River Basin, Ohio.

[Spillway and top-of-dam elevations are referenced to the U.S. Army Corps of Engineers 1912 datum]

Annual exceedance probability	Recurrence interval (years)	Peak dam-pool elevation (feet)	95-percent confidence limits	
			Lower (feet)	Upper (feet)
Taylorsville Dam (spillway, 818 feet; top of dam, 837 feet)				
0.5000	2.00	778.8	778.1	779.4
0.2000	5.00	782.3	781.4	783.5
0.1000	10.00	784.7	783.5	786.3
0.0400	25.00	787.7	786.0	790.0
0.0200	50.00	789.9	787.8	792.6
0.0100	100.00	792.0	789.6	795.1
0.0050	200.00	794.0	791.3	797.7
0.0020	500.00	796.7	793.5	801.2
Huffman Dam (spillway, 835 feet; top of dam, 850 feet)				
0.5000	2.00	791.0	790.3	791.7
0.2000	5.00	794.9	793.8	796.3
0.1000	10.00	797.8	796.2	799.7
0.0400	25.00	801.4	799.2	804.5
0.0200	50.00	804.2	801.4	808.1
0.0100	100.00	807.0	803.7	812.1
0.0050	200.00	810.0	805.9	816.3
0.0020	500.00	814.2	809.0	822.2
Germantown Dam (spillway, 815 feet; top of dam, 830 feet)				
0.5000	2.00	757.3	755.6	759.0
0.2000	5.00	766.2	763.6	769.7
0.1000	10.00	772.1	768.4	776.9
0.0400	25.00	778.9	774.2	785.0
0.0200	50.00	783.3	778.0	790.5
0.0100	100.00	787.3	781.3	795.6
0.0050	200.00	791.0	784.3	800.2
0.0020	500.00	795.5	788.0	805.7

Summary

This report describes the results of a study, done in cooperation with the Miami Conservancy District, to determine frequency characteristics of post-regulation annual peak flows at streamflow-gaging stations near three dry dams (Taylorsville, Huffman, and Germantown) in the MCD flood-protection system and annual peak elevations of the corresponding dam pools. These frequency characteristics are used by regulators and emergency managers to make informed decisions about flood-related risks.

Annual peak-flow time series obtained from the USGS NWIS database and annual peak dam-pool elevation time series provided by the MCD were checked to ensure accuracy, consistency, and stationarity. Log-Pearson Type III distributions were fit to annual peak flow values and annual peak dam-pool storage values to determine peaks with recurrence intervals of 2, 5, 10, 25, 50, 100, 200, and 500 years. Conditional probability adjustments were made to the dam-pool storage frequency estimates to account for zero-storage years. Once storages had been estimated for the various recurrence intervals, corresponding dam-pool elevations were determined from elevation-storage ratings provided by the MCD.

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Appendix 1. Annual Peak-Flow and Peak-Storage Data

Table 1–1. Annual peak streamflows for streamflow-gaging stations 03263000, 03270000, and 03272000, water years 1921–2007.

[ft³/s, cubic feet per second; nop, station not in operation; pre, preregulation]

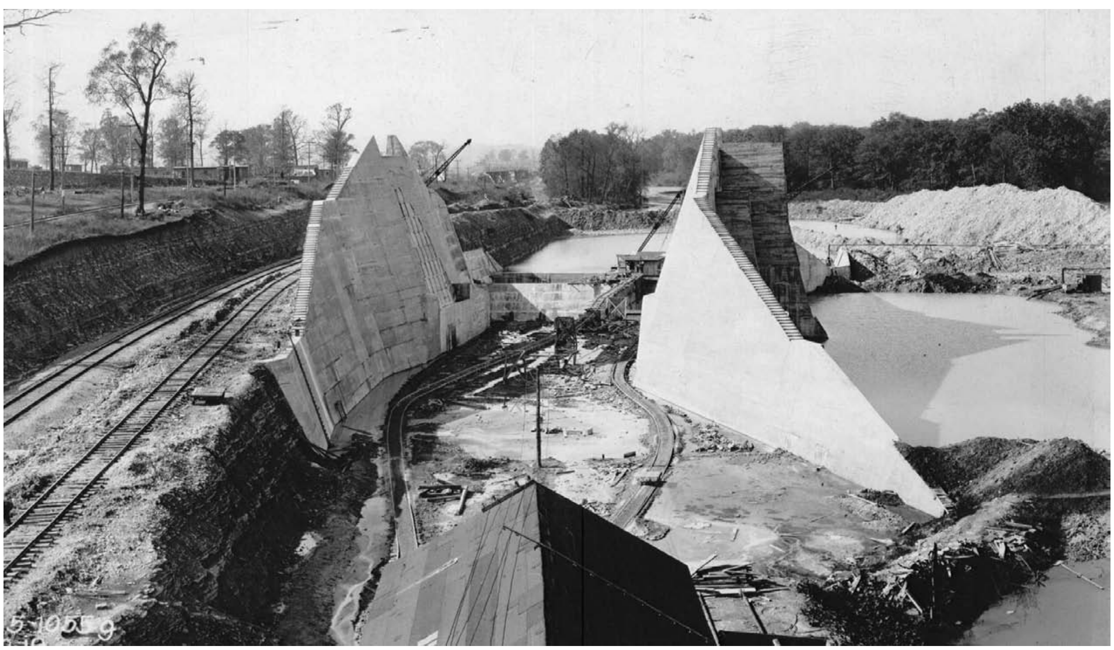
Water year	Great Miami River at Taylorsville (03263000)		Mad River near Dayton (03270000)		Twin Creek near Germantown (03272000)	
	Date	Peak flow (ft³/s)	Date	Peak flow (ft³/s)	Date	Peak flow (ft³/s)
1921	nop	nop	pre	pre	03/29/1921	5,630
1922	04/15/1922	17,300	04/15/1922	10,000	04/15/1922	6,070
1923	05/16/1923	10,600	03/16/1923	5,590	03/16/1923	4,270
1924	06/09/1924	21,600	03/29/1924	12,500	nop	nop
1925	04/22/1925	5,610	04/22/1925	6,060	nop	nop
1926	04/09/1926	13,800	04/09/1926	4,120	nop	nop
1927	03/22/1927	21,600	01/20/1927	9,880	04/05/1927	5,400
1928	12/14/1927	14,000	12/01/1927	6,420	12/01/1927	6,410
1929	02/26/1929	23,700	02/26/1929	18,400	02/27/1929	7,640
1930	01/10/1930	20,600	01/09/1930	10,600	01/10/1930	6,800
1931	04/04/1931	4,750	04/03/1931	2,450	04/03/1931	2,470
1932	01/18/1932	9,430	01/18/1932	8,560	01/17/1932	5,520
1933	05/14/1933	25,500	05/14/1933	12,500	12/31/1932	7,350
1934	03/03/1934	5,500	03/03/1934	4,530	03/27/1934	3,370
1935	05/04/1935	11,400	05/03/1935	3,850	05/03/1935	4,370
1936	02/27/1936	15,600	02/27/1936	6,570	02/26/1936	4,790
1937	01/15/1937	25,500	01/22/1937	15,400	01/15/1937	7,890
1938	04/09/1938	16,600	04/07/1938	7,500	03/16/1938	6,150
1939	06/19/1939	13,600	04/16/1939	6,620	04/16/1939	5,850
1940	04/21/1940	14,600	04/21/1940	5,590	04/20/1940	5,250
1941	06/16/1941	4,980	06/04/1941	1,380	06/11/1941	1,720
1942	04/11/1942	12,800	02/07/1942	3,600	02/07/1942	4,460
1943	03/20/1943	21,900	03/20/1943	11,200	03/20/1943	7,200
1944	04/12/1944	17,700	04/12/1944	7,620	04/12/1944	5,370
1945	06/19/1945	17,200	03/07/1945	11,400	03/06/1945	6,360
1946	02/14/1946	8,410	06/20/1946	4,520	02/14/1946	5,250
1947	06/03/1947	20,200	06/03/1947	12,000	06/02/1947	7,040
1948	02/14/1948	16,200	02/14/1948	13,300	02/14/1948	5,870
1949	01/06/1949	17,200	01/06/1949	9,440	01/05/1949	7,520
1950	01/16/1950	20,300	01/17/1950	9,200	01/16/1950	6,740
1951	12/04/1950	18,300	12/04/1950	9,680	02/21/1951	6,690
1952	01/27/1952	21,500	01/27/1952	13,300	01/27/1952	8,790
1953	05/22/1953	9,210	05/23/1953	5,340	03/04/1953	2,610
1954	06/17/1954	7,520	06/09/1954	2,750	04/17/1954	1,420
1955	02/22/1955	9,000	03/22/1955	4,680	03/22/1955	3,970
1956	02/26/1956	14,000	11/16/1955	6,430	11/17/1955	7,340
1957	06/29/1957	17,200	04/05/1957	10,400	04/04/1957	7,860
1958	06/14/1958	21,400	06/14/1958	10,700	06/11/1958	7,010

Table 1–1. Annual peak streamflows for streamflow-gaging stations 03263000, 03270000, and 03272000, water years 1921–2007.—Continued

Water Year	Great Miami River at Taylorsville (03263000)		Mad River near Dayton (03270000)		Twin Creek near Germantown (03272000)	
	Date	Peak Flow (ft^3/s)	Date	Peak Flow (ft^3/s)	Date	Peak Flow (ft^3/s)
1959	01/22/1959	31,400	01/22/1959	21,200	01/22/1959	8,590
1960	02/11/1960	6,310	05/28/1960	3,490	02/10/1960	2,970
1961	04/26/1961	16,100	04/26/1961	6,980	04/26/1961	6,300
1962	02/27/1962	12,400	02/27/1962	7,140	02/26/1962	5,790
1963	03/05/1963	24,300	03/05/1963	18,500	03/05/1963	8,400
1964	04/21/1964	18,800	03/10/1964	12,800	03/10/1964	7,420
1965	04/26/1965	11,500	04/26/1965	5,160	04/25/1965	4,900
1966	02/11/1966	8,570	02/11/1966	4,210	02/11/1966	4,430
1967	12/11/1966	12,200	05/07/1967	4,620	05/07/1967	5,980
1968	01/31/1968	10,800	05/28/1968	8,790	05/24/1968	7,760
1969	01/30/1969	12,700	08/10/1969	6,680	01/30/1969	6,010
1970	04/03/1970	13,900	04/03/1970	9,170	04/02/1970	6,280
1971	06/27/1971	13,100	06/26/1971	7,430	02/22/1971	5,260
1972	04/08/1972	11,600	12/30/1971	4,720	04/13/1972	4,210
1973	11/15/1972	14,100	06/20/1973	5,840	11/14/1972	5,300
1974	01/20/1974	15,700	04/02/1974	5,080	06/23/1974	5,800
1975	02/24/1975	22,600	02/24/1975	11,400	02/24/1975	7,460
1976	01/27/1976	11,400	01/26/1976	4,700	01/26/1976	5,140
1977	04/03/1977	9,420	04/03/1977	5,420	04/03/1977	5,460
1978	03/15/1978	14,900	03/15/1978	6,260	03/15/1978	6,530
1979	02/24/1979	14,200	09/15/1979	7,620	02/24/1979	7,500
1980	06/03/1980	15,300	06/29/1980	9,640	11/26/1979	5,660
1981	06/15/1981	14,900	06/06/1981	9,470	06/06/1981	4,370
1982	02/18/1982	15,600	02/01/1982	10,200	02/01/1982	6,950
1983	05/04/1983	10,900	05/02/1983	5,350	05/04/1983	5,590
1984	03/17/1984	10,100	03/16/1984	4,300	04/05/1984	4,450
1985	02/24/1985	16,400	02/23/1985	5,750	02/24/1985	5,310
1986	12/12/1985	13,800	03/13/1986	6,340	03/13/1986	5,640
1987	10/05/1986	18,000	10/05/1986	6,490	10/02/1986	6,270
1988	02/02/1988	6,320	02/02/1988	4,480	02/02/1988	5,260
1989	05/27/1989	17,200	05/27/1989	7,290	05/26/1989	7,330
1990	02/16/1990	16,000	07/13/1990	7,560	02/16/1990	6,180
1991	12/30/1990	25,200	12/31/1990	10,700	12/31/1990	7,590
1992	07/14/1992	13,700	07/18/1992	5,700	07/24/1992	4,880
1993	07/03/1993	15,000	07/02/1993	5,900	04/16/1993	5,110
1994	11/18/1993	14,200	01/28/1994	7,090	01/28/1994	5,990
1995	08/09/1995	23,900	08/09/1995	5,830	05/19/1995	6,000
1996	01/19/1996	16,500	04/30/1996	9,380	04/30/1996	7,710
1997	06/02/1997	16,500	06/02/1997	7,450	06/02/1997	6,780
1998	01/08/1998	12,300	05/08/1998	8,330	04/16/1998	5,590

Table 1–1. Annual peak streamflows for streamflow-gaging stations 03263000, 03270000, and 03272000, water years 1921–2007.—Continued

Water Year	Great Miami River at Taylorsville (03263000)		Mad River near Dayton (03270000)		Twin Creek near Germantown (03272000)	
	Date	Peak Flow (ft^3/s)	Date	Peak Flow (ft^3/s)	Date	Peak Flow (ft^3/s)
1999	01/23/1999	15,700	01/22/1999	5,250	01/23/1999	6,550
2000	04/08/2000	12,600	04/08/2000	8,210	04/08/2000	6,210
2001	05/19/2001	9,170	07/29/2001	5,230	04/11/2001	5,110
2002	12/18/2001	14,800	12/18/2001	7,140	12/18/2001	6,910
2003	07/10/2003	22,700	09/02/2003	6,070	07/07/2003	5,570
2004	01/05/2004	19,000	01/05/2004	11,000	01/05/2004	7,830
2005	01/06/2005	28,200	01/06/2005	11,600	01/06/2005	8,280
2006	03/13/2006	12,000	03/12/2006	5,890	03/13/2006	6,380
2007	03/24/2007	20,300	03/02/2007	8,990	03/02/2007	6,950



Construction of the outlet at Huffman Dam spillway. (Photo furnished by the Miami Conservancy District, copyright 1913–2009, all rights reserved; reproduced with permission.)

Table 1–2. Annual peak dam-pool storages for the Taylorsville, Huffman, and Germantown Dams, water years 1922–2008.

[ns, no storage]

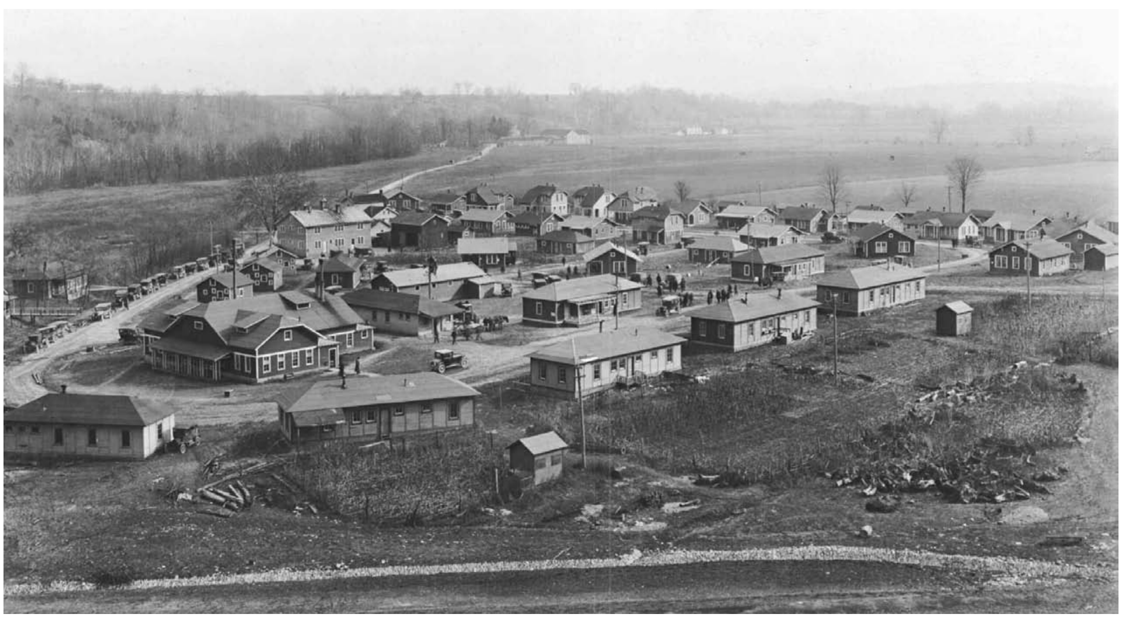
Water year	Taylorsville Dam		Huffman Dam		Germantown Dam	
	Date	Storage (acre-feet)	Date	Storage (acre-feet)	Date	Storage (acre-feet)
1922	04/15/1922	3,240	04/15/1922	2,390	04/15/1922	7,670
1923		ns		ns	03/16/1923	534
1924	06/08/1924	8,380	03/29/1924	4,920	03/29/1924	8,160
1925		ns		ns	09/19/1925	558
1926	04/09/1926	1,640	04/07/1926	79	09/02/1926	8,370
1927	03/21/1927	9,200	01/20/1927	1,950	04/06/1927	2,260
1928	12/14/1927	2,180	12/01/1927	477	12/01/1927	5,950
1929	02/26/1929	10,700	02/26/1929	15,600	02/26/1929	20,900
1930	01/10/1930	6,790	01/10/1930	1,290	01/10/1930	8,800
1931		ns		ns		ns
1932		ns	01/18/1932	695	01/17/1932	1,790
1933	05/14/1933	11,400	05/14/1933	3,770	12/31/1932	8,730
1934		ns		ns	12/17/1933	265
1935	05/03/1935	687		ns	05/03/1935	278
1936	02/27/1936	2,480	02/27/1936	459	02/27/1936	863
1937	01/14/1937	11,100	01/21/1937	8,480	01/15/1937	17,800
1938	04/09/1938	3,400	04/07/1938	949	03/14/1938	1,220
1939	04/16/1939	1,310	04/15/1939	670	04/16/1939	3,910
1940	04/21/1940	1,840	04/21/1940	459	04/20/1940	2,540
1941		ns		ns		ns
1942	04/11/1942	1,070		ns	02/07/1942	894
1943	03/20/1943	5,680	03/20/1943	3,300	03/20/1943	12,500
1944	04/12/1944	3,240	04/12/1944	949	04/11/1944	3,720
1945	06/18/1945	2,610	03/07/1945	3,610	03/07/1945	6,430
1946		ns		ns	02/14/1946	1,680
1947	06/03/1947	4,690	06/03/1947	4,000	06/02/1947	9,850
1948	04/14/1948	2,960	02/14/1948	6,340	02/13/1948	5,540
1949	01/06/1949	3,800	01/06/1949	2,220	01/05/1949	15,200
1950	01/16/1950	7,010	01/17/1950	1,900	01/16/1950	8,230
1951	02/21/1951	4,870	12/04/1950	2,220	02/21/1951	9,540
1952	01/27/1952	7,630	01/27/1952	8,220	01/27/1952	19,700
1953		ns		ns		ns
1954		ns		ns		ns
1955		ns		ns	03/21/1955	534
1956	02/26/1956	1,840	11/17/1955	520	11/17/1955	6,190
1957	06/29/1957	3,030	04/05/1957	3,020	04/04/1957	8,580
1958	06/14/1958	7,880	06/14/1958	3,610	08/02/1958	5,950

Table 1–2. Annual peak dam-pool storages for the Taylorsville, Huffman, and Germantown Dams, water years 1922–2008.—Continued

Water year	Taylorsville Dam		Huffman Dam		Germantown Dam	
	Date	Storage (acre-feet)	Date	Storage (acre-feet)	Date	Storage (acre-feet)
1959	01/22/1959	20,300	01/22/1959	24,800	01/22/1959	33,400
1960		ns		ns		ns
1961	04/26/1961	2,750	04/26/1961	545	04/25/1961	5,140
1962	02/27/1962	1,270	02/27/1962	813	02/26/1962	3,200
1963	03/05/1963	9,340	03/05/1963	13,400	03/05/1963	18,900
1964	04/21/1964	5,780	03/10/1964	4,650	03/10/1964	11,300
1965	04/26/1965	1,020	04/26/1965	203	04/25/1965	1,250
1966	02/11/1966	209	02/11/1966	203	02/10/1966	787
1967	05/08/1967	1,110		ns	05/07/1967	2,880
1968	01/31/1968	636	05/28/1968	74	05/24/1968	12,500
1969	01/30/1969	1,360	08/10/1969	595	01/30/1969	3,810
1970	04/03/1970	1,940	04/03/1970	1,800	04/02/1970	5,140
1971	06/26/1971	1,310	06/26/1971	881	02/22/1971	2,800
1972	04/08/1972	889		ns	04/13/1972	680
1973	11/15/1972	1,690	06/20/1973	387	11/14/1972	1,760
1974	01/20/1974	2,060	04/02/1974	189	06/23/1974	2,430
1975	02/24/1975	6,900	02/24/1975	3,220	02/24/1975	11,700
1976	01/27/1976	754	01/26/1976	79	01/26/1976	1,650
1977		ns	04/03/1977	259	04/03/1977	3,330
1978	03/15/1978	2,240	03/15/1978	495	03/15/1978	6,310
1979	02/24/1979	2,360	09/15/1979	983	02/24/1979	4,340
1980	06/03/1980	2,420	06/29/1980	2,050	11/26/1979	2,160
1981	06/15/1981	2,180	06/06/1981	1,950	06/06/1981	570
1982	02/18/1982	2,610	02/01/1982	2,390	02/01/1982	8,090
1983	05/03/1983	721	05/02/1983	259	05/03/1983	4,100
1984		ns		ns	04/05/1984	653
1985	02/24/1985	2,890	02/24/1985	351	02/23/1985	1,900
1986	12/12/1985	1,740	03/13/1986	495	03/13/1986	2,290
1987	10/05/1986	3,880	10/05/1986	570	10/02/1986	4,000
1988		ns		ns	02/02/1988	1,540
1989	05/27/1989	3,480	05/27/1989	1,080	05/26/1989	11,300
1990	02/16/1990	2,750	07/13/1990	983	02/16/1990	4,600
1991	12/31/1990	12,100	12/31/1990	2,760	12/31/1990	13,300
1992	07/14/1992	1,890	07/18/1992	333	04/19/1992	976
1993	07/03/1993	2,610	07/02/1993	387	04/16/1993	1,680
1994	11/18/1993	2,180	01/28/1994	847	01/28/1994	3,160
1995	08/09/1995	10,500	08/09/1995	369	05/18/1995	3,120
1996	01/19/1996	3,480	04/30/1996	1,900	04/30/1996	12,800
1997	06/02/1997	3,560	06/02/1997	915	06/02/1997	7,010
1998	01/09/1998	1,590	05/08/1998	1,340	04/16/1998	2,620

Table 1–2. Annual peak dam-pool storages for the Taylorsville, Huffman, and Germantown Dams, water years 1922–2008.—Continued

Water year	Taylorsville Dam		Huffman Dam		Germantown Dam	
	Date	Storage (acre-feet)	Date	Storage (acre-feet)	Date	Storage (acre-feet)
1999	01/23/1999	2,960	01/22/1999	231	01/23/1999	6,130
2000	04/08/2000	1,440	04/08/2000	1,250	04/08/2000	4,550
2001		ns	07/29/2001	217	04/11/2001	1,290
2002	12/18/2001	2,480	12/18/2001	813	12/18/2001	7,270
2003	07/10/2003	8,930	09/02/2003	423	07/07/2003	1,840
2004	01/05/2004	5,270	01/05/2004	2,960	01/05/2004	14,800
2005	01/06/2005	16,000	01/06/2005	3,380	01/06/2005	19,300
2006	03/13/2006	1,740	03/13/2006	387	03/12/2006	4,450
2007	03/24/2007	6,330	03/03/2007	1,650	03/02/2007	8,020
2008	03/20/2008	5,680	03/20/2008	2,220	03/20/2008	12,400



View of Germantown Dam construction-workers' camp in 1921. (Photo furnished by the Miami Conservancy District., copyright 1913–2009, all rights reserved; reproduced with permission.)

Koltun—**Annual Peak-Flow and Peak Dam-Pool-Elevation Frequency Characteristics of Selected Dry Dams, Great Miami Basin**—Open-File Report 2009–1069