# Traveltime and Dispersion Data, Including Associated Discharge and Water-Surface Elevation Data, for the Upper Ohio River, Pennsylvania, Ohio, and West Virginia; October through November 1991

By JEFFREY B. WILEY

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Charleston, West Virginia
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U.S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY
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## CONVERSION FACTORS, ABBREVIATED WATER QUALITY UNITS, AND VERTICAL DATUM

| Multiply | By | To obtain |
|---|---|---|
| cubic foot per second ($ft^3/s$) | 0.02832 | cubic meter per second |
| cubic inch ($in^3$) | 0.06102 | milliliter |
| foot (ft) | 0.3048 | meter |
| gallon (gal) | 3.785 | liter |
| mile (mi) | 1.609 | kilometer |
| pound, avoirdupois (lb) | 453.6 | gram |
| square mile ($mi^2$) | 2.590 | square kilometer |

### ABBREVIATED WATER-QUALITY UNITS

In this report, chemical concentration is given in micrograms per liter (µg/L). Micrograms per liter is a unit expressing the concentration of chemical constituents in solution as weight (micrograms) of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter.

### VERTICAL DATUM

**Sea level**: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

# Traveltime and Dispersion Data, Including Associated Discharge and Water-Surface Elevation Data, for the Upper Ohio River, Pennsylvania, Ohio, and West Virginia, October through November 1991

*By* Jeffrey B. Wiley

## Abstract

This report presents results of a study by the U.S. Geological Survey, in cooperation with the Ohio River Valley Water Sanitation Commission, to evaluate the traveltime and dispersion of a dye injection on the upper Ohio River. Traveltime and dispersion data, including discharge and water-surface elevation data, were collected to quantify the movement of a dye cloud in the mainstem of the upper Ohio River. The upper Ohio River originates at the confluence of the Allegheny and Monongahela Rivers, flows westward to the border of Pennsylvania, Ohio, and West Virginia, and then flows south-westward along the Ohio and West Virginia border. Knowledge of traveltime and dispersion of a soluble dye can assist river managers in mitigating the effects of an accidental spill. The potential for a spill is present because chemicals and wastes are transported by rail, pipeline, highway and barge on and near the river and tributary streams.

Daily mean discharge at 10 gaging stations and water-surface elevations for all regulated pools were collected from October 20 to November 24, 1991. Ohio River discharges were about 4,000 to 6,000 $ft^3/s$ at the Pennsylvania, Ohio, and West Virginia border during the dye study. Water-surface elevations in regulated pools indicated channel storage was fairly constant while the dye cloud was traveling through the pools.

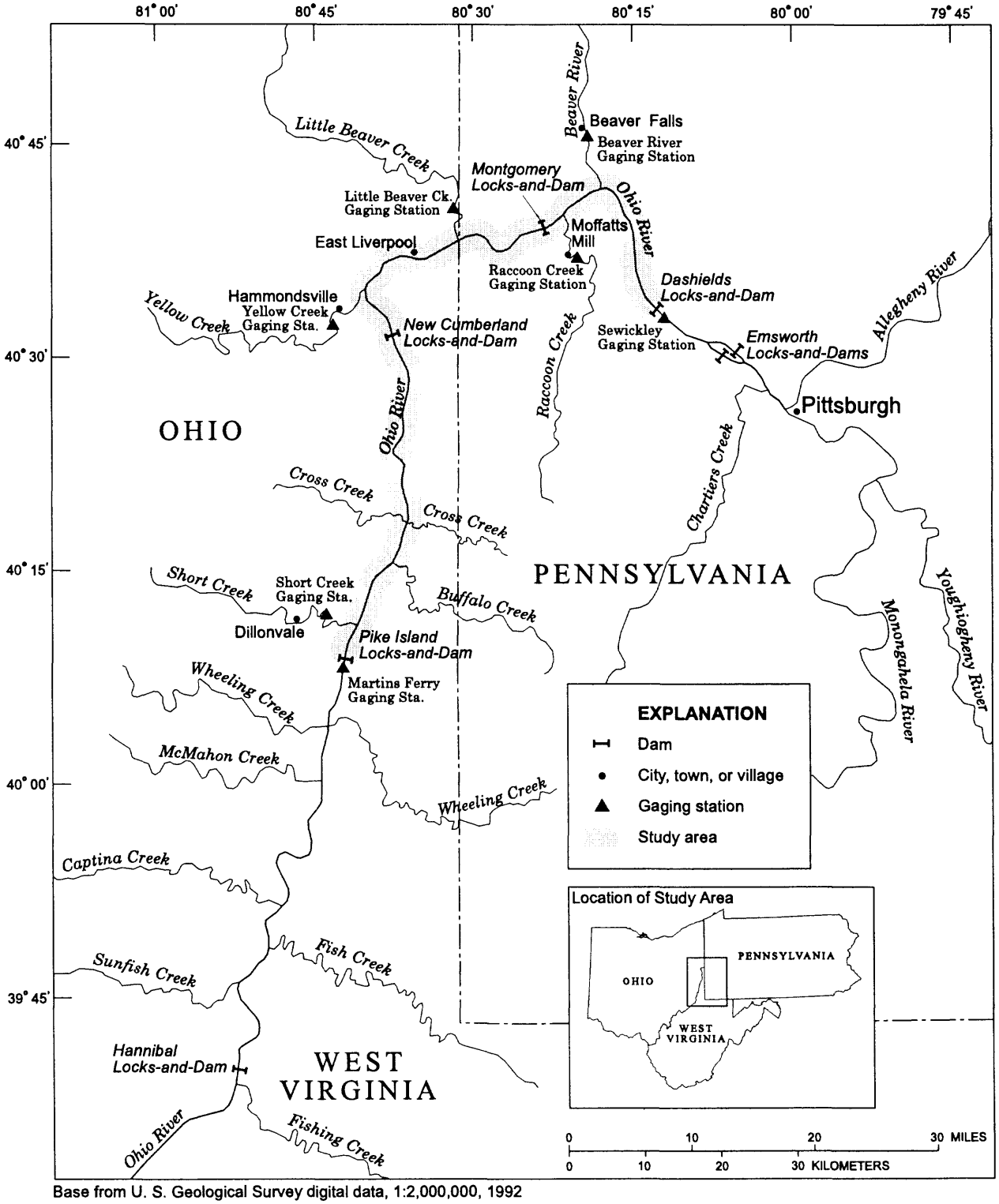
The traveltime of peak concentration between Dashields Locks-and-Dam and Pike Island Locks-and-Dam is 609 hours. Time of passage of the dye cloud at Dashields Locks-and-Dam and Pike Island Locks-and-Dam is 80 and 129 hours, respectively.

## INTRODUCTION

The Ohio River originates at the confluence of the Allegheny and Monongahela Rivers in western Pennsylvania at Pittsburgh, flows westward toward the Pennsylvania boundary with Ohio and West Virginia, and then flows south-westward along the Ohio and West Virginia boundaries (fig. 1).

The upper Ohio River provides water for municipalities and industries, and the river is used for transportation and recreation. Municipal and industrial intakes are scattered within and bordering the study area. The river is used for transporting manufacturing materials and natural resources. Recreational boating and fishing are common along the entire river.

Water quality of the upper Ohio River could be adversely affected by an accidental spill of a hazardous chemical or toxic waste. An accidental spill is possible due to transportation of chemicals and toxic waste by pipeline, rail, highway, and barge on and near the river and tributary streams. Knowledge of the movement of a spill can assist river managers in mitigation of environmental and human effects; water intakes could be closed or additional treatment could be applied, recreational uses of the river could be restricted, and regulation of streamflows could change the characteristics of the spill cloud.




Base from U. S. Geological Survey digital data, 1:2,000,000, 1992

**Figure 1.** Location of the upper Ohio River study area.

On October 23, 1991, a private engineering firm injected about 240 L (590 lb) of Rhodamine 20-percent dye into the Ohio River at a constant rate of 940 mL/min from 6:00 a.m. to 10:15 a.m. to study the plume of an outfall from a sewage-treatment plant at river mile 3.2. Downstream from the plume study, a resulting dye cloud provided an opportunity to monitor traveltime and dispersion of the mainstem of the upper Ohio River. The U.S. Geological Survey (USGS), in cooperation with the Ohio River Valley Water Sanitation Commission, undertook a data-collection program to quantify the movement of the dye cloud.

## Purpose and Scope

This report presents traveltime and dispersion data for the Ohio River from October 25 through November 23, 1991, in the study area from Dashields Locks-and-Dam to Pike Island Locks-and-Dam. Daily mean discharges are presented for 10 USGS streamflow-gaging stations and water-surface elevations are presented for all regulated pools, bordering and within the study area, during October 20 through November 24, 1991.

## Description of Study Area

The upstream limit of the study area is Dashields Locks-and-Dam (fig. 1) at river mile (RM) 13.3, 50 ft downstream from the USGS streamflow-gaging station, "03086000—Ohio River at Sewickley, PA," 7.1 mi downstream from Emsworth Locks-and-Dams (RM 6.2), and 13.3 mi downstream from the confluence of the Allegheny and Monongahela Rivers; the drainage area at the upstream limit is about 19,500 $mi^2$ (Lescinsky and others, 1993, p. 101; U.S. Army Corps of Engineers, 1993, charts 195-197).

The Ohio River flows westward from Dashields Locks-and-Dam (RM 13.3) through Montgomery Locks-and-Dam (RM 31.7) to the State boundary with Ohio and West Virginia (RM 40.0), and includes the tributaries of Beaver River (RM 25.5), Raccoon Creek (RM 29.6), and Little Beaver Creek (RM 39.5) (U.S. Army Corps of Engineers, 1993, charts 190-195). The drainage area at the State boundary with Ohio and West Virginia is 23,487 $mi^2$ (Pennsylvania Department of Environmental Resources, 1989, p. 169). USGS streamflow-gaging stations 03107500—Beaver River at Beaver Falls, PA; 03108000—Raccoon Creek at Moffatts Mill, PA; and 03109500—Little Beaver Creek near East Liverpool, OH, with drainage areas of 3,106, 178, and 496 $mi^2$, respectively, are within the drainage division of the Ohio River between Dashields Locks-and-Dam and the State boundary with Ohio and West Virginia (Lescinsky and others, 1993, p. 110-111, 113; Shindel and others, 1993, p. 48).

The Ohio River flows south from the State boundaries of Pennsylvania, Ohio, and West Virginia (RM 40.0) through New Cumberland Locks-and-Dam (RM 54.4) to Pike Island Locks-and-Dam (RM 84.2), and includes the tributaries of: Yellow Creek (RM 50.4); Cross Creek, WV (RM 71.6); Cross Creek, OH (RM 71.7); Buffalo Creek (RM 74.7); and Short Creek, OH (RM 81.4) (U.S. Army Corps of Engineers, 1993, charts 180-190). USGS streamflow-gaging stations 03110000—Yellow Creek near Hammondsville, OH, and 03111500—Short Creek near Dillonvale, OH, with drainage areas of 147 and 123 $mi^2$, respectively, are within the drainage division of the Ohio River between the State boundaries of Pennsylvania, Ohio, and West Virginia and Pike Island Locks-and-Dam (Shindel and others, 1993, p. 49-50).

The downstream limit of the study is Pike Island Locks-and-Dam (RM 84.2), 3.3 mi upstream from the USGS streamflow-gaging station 03111534—Ohio River at Martins Ferry, OH, (RM 87.5, and about 24,700 $mi^2$ drainage area), and 42.2 mi upstream from Hannibal Locks-and-Dam (RM 126.4) (U.S. Army Corps of Engineers, 1993, charts 172-180; Ward and others, 1993, p. 130).

## Acknowledgments

The author wishes to thank the U.S. Army Corps of Engineers for allowing access to river-structure properties, and providing water-surface elevations at the locks-and-dams. Thanks also to the East Liverpool Water-Treatment Plant for allowing access to properties and to the employees; Glenn Woodward, Mike Masters, Joe Miller, Jim Holmsted, and Dave Illig, for assistance in taking water samples. Mary Ann Silagy and Eric Piniero with Ohio EPA also assisted by providing samples at the East Liverpool Water-Treatment Plant. The author thanks the Allegheny County Sanitary Authority and The Chester Engineers for providing a sample of the dye injected.

## TRAVELTIME AND DISPERSION DATA

Traveltime and dispersion are two properties describing the movement of water in a river. Some stream characteristics affecting traveltime and dispersion are horizontal and vertical velocity distributions, eddies, pools, and river bends. River structures, such as bridges and dams, also can affect traveltime and dispersion. Traveltime and dispersion can be affected when regulation at a dam results in holding or releasing more water than is flowing into the controlled pool. Traveltime and dispersion in the general area of a locks-and-dams can be affected by changes in gate settings and lockages.

### Collection Methods

Measurements of traveltime and dispersion of a conservative-dye tracer are used to estimate the movement of water and waterborn solutes in a river system. Measurement techniques are well documented (Hubbard and others, 1982; Kilpatrick and Wilson, 1989). Usually, a fluorescent dye is injected into the river. Then, water samples are collected at various locations downstream, beyond the distance required for horizontal and vertical mixing. Methods of water-sample analysis are described by Wilson and others (1986).

A slight modification of the standard procedure was used for this study. The standard procedure calibrates a fluorometer by diluting the dye in a three-step procedure to a 100 µg/L working solution, and diluting the working solution into various concentrations expected during the study. A dye lot with the specific gravity of 1.19 is used in the standard procedure. Specific gravity of the dye used in this study was 1.115. In the standard procedure, 2,068 mL of water and 20 mL of dye are mixed in the first step of the three-step process to prepare the 100 µg/L working solution. In this study 1,936 mL of water were used in the first step to compensate for the difference in specific gravity.

About 240 L (590 lb) of 20-percent rhodamine-WT dye was injected into the Ohio River at RM 3.2 at a constant rate of 940 mL/min from 6:00 a.m. to 10:15 a.m. on October 23, 1991. Time since injection was measured from 6:00 a.m. on October 23, 1991. All times are for Eastern Standard time, no correction was made to Daylight Savings time. The dye cloud was sampled from Dashields Locks-and-Dam (RM 13.3) through Pike Island Locks-and-Dam (RM 84.2). Selected river locations are identified in table 1, including 5 primary sites where water samples were collected throughout the time of passage of the dye cloud and 10 secondary sites where water samples were collected for estimating only the traveltime of the leading edge of the dye cloud. Dye concentrations for the five primary sampling sites are presented in table 6 (at back of report) and fluorometer dial readings of water samples at the 10 secondary sampling sites are presented in table 7 (at back of report).

**Table 1.** Distances to selected locations downstream from the confluence of the Allegheny and Monongahela Rivers in the Ohio River study area

| Location | Distance (river mile) |
|---|---|
| Confluence of the Allegheny and Monongahela Rivers | 0 |
| Emsworth Locks-and-Dams | 6.2 |
| Dashields Locks-and-Dam[1] | 13.3 |
| Ambridge Highway Bridge[2] | 16.8 |
| Rochester-Monaca Highway Bridge[2] | 25.2 |
| Confluence of Beaver River | 25.5 |
| Vanport Highway Bridge[2] | 28.0 |
| Confluence of Raccoon Creek | 29.6 |
| Montgomery Locks-and-Dam[1] | 31.7 |
| Confluence of Little Beaver Creek | 39.5 |
| Pennsylvania, Ohio, and West Virginia State boundaries | 40.0 |
| East Liverpool Water-Treatment Plant[1] | 40.2 |
| Newell Highway Bridge[2] | 44.4 |
| Corps of Engineers boat launching ramp[2] | 46.2 |
| Confluence of Yellow Creek | 50.4 |
| New Cumberland Locks-and-Dam[1] | 54.4 |
| Steubenville-Weirton Highway Bridge[2] | 66.4 |
| Wheeling and Lake Erie Railroad Bridge[2] | 71.5 |
| Confluence of Cross Creek, WV | 71.6 |
| Confluence of Cross Creek, OH | 71.7 |
| Near town of Wellsburg[2] | 74.5 |
| Confluence of Buffalo Creek | 74.7 |
| Confluence of Short Creek, OH | 81.4 |
| Pike Island Locks-and-Dam[1] | 84.2 |
| Interstate 470 Highway Bridge[2] | 92.0 |
| Moundsville Highway Bridge[2] | 102.0 |
| Hannibal Locks-and-Dam | 126.4 |

[1]Primary sampling site—water samples were collected throughout the time of passage of the dye cloud.

[2]Secondary sampling site—water samples were collected for estimating only the traveltime of the leading edge of the dye cloud.

## Traveltime

Time-concentration curves were developed to identify traveltime and dispersion of the dye at five primary sampling sites where water samples were collected throughout the time of passage of the dye cloud (fig. 2). Traveltime of leading edge, peak concentration, and trailing edge at any primary sampling site can be determined from this graph. Reading from the *x*-axis of figure 2, the leading edge of the dye cloud arrived at Montgomery Locks-and-Dam at 191 hours after injection and at Pike Island Locks-and-Dam at 611 hours after injection (traveltimes of peak concentration and trailing edge can be determined similarly). Traveltime data at the five primary sampling sites shown in figure 2 are summarized in table 2. The time required for the dye cloud to move through the New Cumberland pool can be determined from table 2 as 327 hours (time since injection of the trailing edge at New Cumberland Locks-and-Dam minus time since injection of the leading edge at Montgomery Locks-and-Dam). Figure 2 or table 2 can be used to determine the traveltime of peak concentration between Dashields Locks-and-Dam and Pike Island Locks-and-Dam as 609 hours (677–68 hours).

The leading edge of the dye cloud at Dashields Locks-and-Dam was not measured because the dye cloud had arrived at this location before field personnel were able to respond. The leading edge was estimated based on the shape of the time-concentration curve as compared with time-concentration curves for other studies.

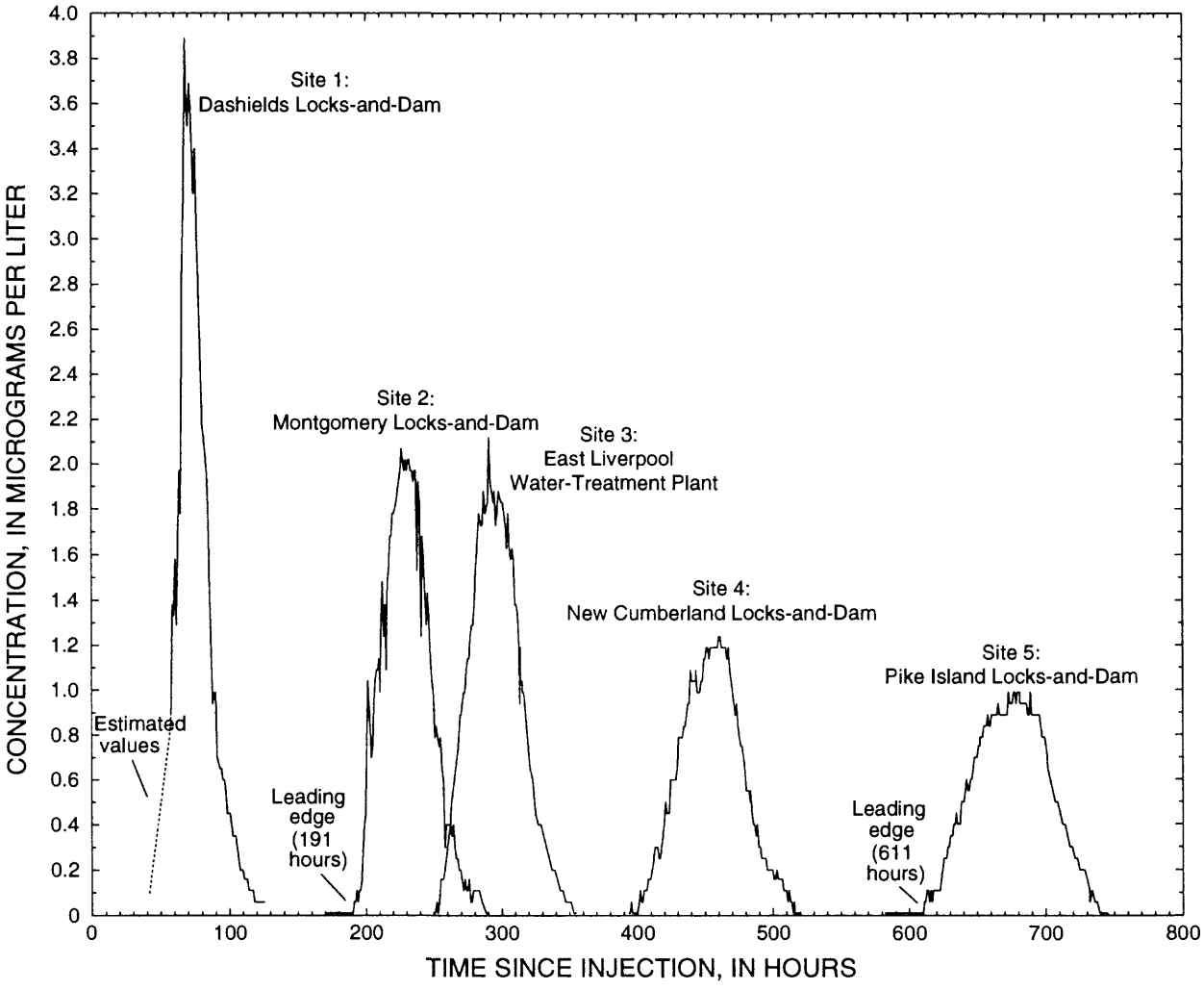



**Figure 2.** Time-concentration curves at the five primary sampling sites in the upper Ohio River study area.

**Table 2.** Traveltime data for the five primary sampling sites in the upper Ohio River study area

[e, estimated. mi, mile; h, hour; mi/h, mile per hour]

| Site | Site name | Distance | | | Leading edge | | | Peak concentration | | | Trailing edge | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ohio River Mile (mi) | Sub-reach length (mi) | From point of injection (mi) | Time since injection (h) | Travel-time (h) | Velocity (mi/h) | Time since injection | Travel-time (h) | Velocity (mi/h) | Time since injection | Travel-time (h) | Velocity (mi/h) |
| 1 | Dashields Locks-and-Dam | 13.3 | 18.4 | 10.1 | e42 | 146 | 0.13 | 68 | 161 | 0.11 | 122 | 166 | 0.11 |
| 2 | Montgomery Locks-and-Dam | 31.7 | 8.5 | 28.5 | 191 | 61 | .14 | 229 | 66 | .13 | 288 | 65 | .13 |
| 3 | East Liverpool Water-Treatment Plant | 40.2 | 14.2 | 37.0 | 252 | 149 | .10 | 295 | 166 | .09 | 353 | 165 | .09 |
| 4 | New Cumberland Locks-and-Dam | 54.4 | 29.8 | 51.2 | 401 | 210 | .14 | 461 | 216 | .14 | 518 | 222 | .13 |
| 5 | Pike Island Locks-and-Dam | 84.2 | | 81.0 | 611 | | | 677 | | | 740 | | |

**Table 3.** Dispersion data for the five primary sampling sites in the upper Ohio River study area

[**Site name**: RM, river mile. **Discharge at sampling site:** $Q$, cubic feet per second, where $Q$ is the average discharge over the time of passage of the dye cloud. **Percentage of recovery:** $R_p$, in percent = $(0.0457QA_c)/(V)$, where $V$ is the volume of dye in liters. **Conservative-peak concentration:** $Cp$, in micrograms per liter = $100(Cobs/Rp)$. **Peak concentration produced by 1 lb of dye**: $P1$, in micrograms per liter = $Cp/Wd$, where $Wd$ is the weight of pure dye in pounds. **Unit-peak concentration:** $Cup$, in micrograms-(cubic feet per second) per liter = $Q(Cp/Wd)$, where $Wd$ is the weight of pure dye in pounds. e, estimated; h, hour; L-h, liter-hour; lb, pound; µg/L, microgram per liter]

| Site | Site name | Time of passage of dye cloud (h) | Discharge at sampling site (*Q*) | Area under time concentration curve (*Ac*) (mg/L-h) | Percentage of recovery (*Rp*) | Observed-peak concentration (*Cobs*) (mg/L) | Conservative-peak concentration (*Cp*) | Peak concentration produced by 1 lb of dye (*P1*) | Unit peak concentration (*Cup*) |
|---|---|---|---|---|---|---|---|---|---|
| | **Injected about 240 L (590 lb) of 20-Percent Rhodamine-WT Dye (Specific Gravity = 1.115) Beginning at 0600 on October 23, 1991 at River Mile 3.2.** | | | | | | | | |
| 1 | Dashields Locks-and Dam (RM 13.3) | e80 | 4,900 | e91.16 | 85 | 3.89 | 4.58 | 0.039 | 190 |
| 2 | Montgomery Locks-and-Dam (RM 31.7) | 97 | e5,400 | 88.30 | 91 | 2.02 | 2.22 | .019 | 102 |
| 3 | East Liverpool Water-Treatment Plant (RM 40.2) | 101 | e6,500 | 86.75 | 107 | 2.12 | 1.98 | .017 | 109 |
| 4 | New Cumberland Locks-and-Dam (RM 54.4) | 115 | e8,000 | 80.82 | 83 | 1.24 | 1.49 | .013 | 101 |
| 5 | Pike Island Locks-and-Dam (RM 84.2) | 129 | e8,500 | 69.95 | 113 | .99 | .88 | .0074 | 63.1 |

Traveltime data collected at the five primary sites (table 6) were augmented by data collected at the 10 secondary sites (table 7). The resulting data set was used to estimate the traveltimes of the dye cloud within the regulated pools (fig. 3). Figure 3 indicates the dye cloud travels faster at the upstream end of a regulated pool than at the downstream end of the same pool; the relation between river mile and traveltime is not a straight line between dam locations, the line increases in slope as river mile increases. The dye cloud moves faster at the upper end of the pools than the lower end of the pools because at the upper end of the pools, stream velocities are greater, stream cross-sectional areas are less, and stream channel storage is less. Traveltime data at locations where the dye cloud was not sampled can be estimated using figure 3. Time required for the peak

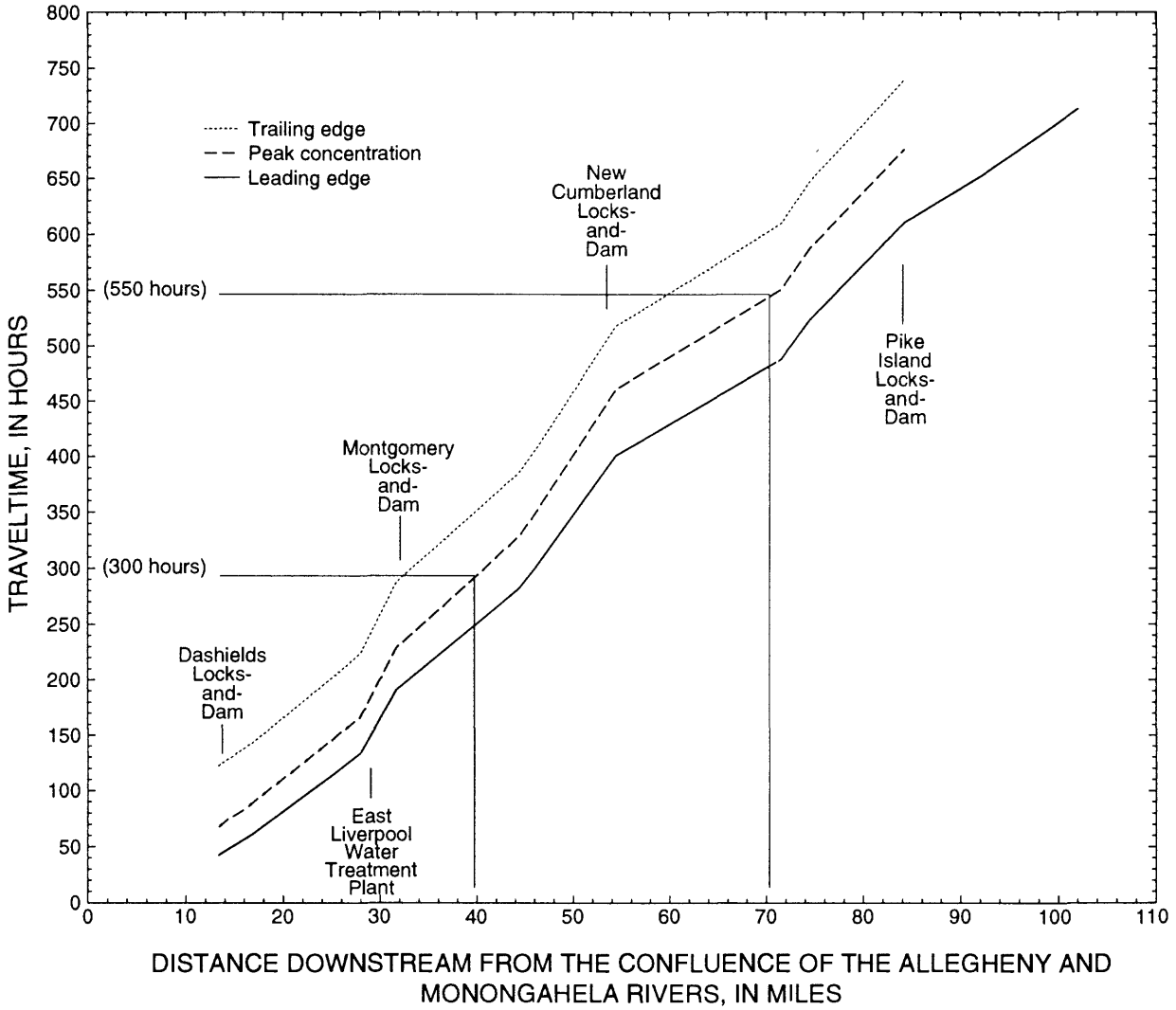



**Figure 3.** Traveltimes for distances downstream from the confluence of the Allegheny and Monongahela Rivers in the upper Ohio River study area.

concentration to travel from river-mile 40 (300 hours) to river-mile 70 (550 hours) is estimated from figure 3 as 250 hours, (550 − 300 hours), other traveltime data can be determined similarly.

## Dispersion

Time-concentration curves (fig. 2) illustrate stream dispersion, the peak concentration decreases as time since injection increases. This is not true when comparing the peak concentration at Montgomery Locks-and Dam with the peak concentration at the East Liverpool Water-Treatment Plant. Possible explanations for this anomaly include: the peak concentration at Montgomery Locks-and Dam was not sampled because the time interval between samples was too large to identify the sharpness of the spike in concentration; or, the sample collected at the East Liverpool Water-Treatment Plant was contaminated in the field or lab.

Time of passage of dye cloud (table 3) indicates dispersion, time of passage increases as time since injection increases. This relation also is illustrated in figure 3 by comparing traveltime estimates between the leading edge and trailing edge (time of passage of dye cloud) at one river-mile location with traveltime estimates at another river-mile location; note, in figure 3, as river mile increases the time of passage of dye cloud increases. Table 3 or figure 3 can be used to determine the time of passage of the dye cloud at Dashields Locks-and-Dam and Pike Island Locks-and-Dam as 80 and 129 hours, respectively.

Conservative-peak and unit-peak concentrations are shown in table 3. The conservative-peak concentration is the observed-peak concentration adjusted for any dye loss, and the unit-peak concentration is the conservative-peak concentration expressed as a concentration per unit weight of discharge. Differences of unit peak concentration are primarily due to differences in longitudinal dispersion. Conservative-peak and unit-peak concentrations can be used to develop relations to predict peak concentrations at discharges where samples are not taken; additional dye measurements are required to develop these relations.

Note, in table 3, the percentage of recovery in excess of 100 percent probably is due to uncertainties in river discharge.

## DISCHARGE AND WATER-SURFACE ELEVATION DATA

Discharge data describe the volume of water moving per unit time in a river system. Because of river regulation in this river system, water-surface elevation data are necessary to account for changes in water storage. Changes in discharge and water storage can affect traveltime and dispersion. For this study area of successive regulated pools: 1) as discharge increases, traveltime decreases and dispersion increases, and 2) as water storage increases, traveltime increases and dispersion decreases (considering multiple pools and assuming the locks-and-dams contribute significantly to the total rate of dispersion).

### Collection Methods

Discharge and water-surface elevation data are collected at established U.S. Geological Survey streamflow-gaging stations and Corps of Engineers Locks-and-Dams (table 4). Discharge at U.S. Geological Survey streamflow-gaging stations are measured by standard methods described by Rantz and others (1982). Daily mean discharge and water-surface elevation applicable to the time period of this dye study are presented in tables 5 and 8 (at back of report).

**Table 4.** Location and additional information for selected U.S. Geological Survey streamflow-gaging stations and Corps of Engineers Locks-and-Dams in the upper Ohio River study area

[RM, river mile as measured downstream from the confluence of the Allegheny and Monongahela Rivers; mi, mile; $mi^2$, square mile; --, indicates data not determined; "Yes" indicates data were collected; "No" indicates data were not collected]

| Location and description | Drainage area ($mi^2$) | Water-surface elevation data | Discharge data |
|---|---|---|---|
| Ohio River at Emsworth Locks-and-Dams, downstream of dams at RM 6.2 | -- | Yes | No |
| Ohio River at Sewickley, PA (03086000), at RM 13.3 | 19,500 | Yes[1] | Yes |
| Ohio River at Dashields Locks-and-Dam, upstream of dam at RM 13.3 | -- | Yes | No |
| Ohio River at Dashields Locks-and-Dam, downstream of dam at RM 13.3 | -- | Yes | No |
| Beaver River at Beaver Falls, PA (03107500), 5.5 mi upstream of mouth | 3,106 | Yes[1] | Yes |
| Raccoon Creek at Moffatts Mill, PA (03108000), 4.2 mi upstream of mouth | 178 | Yes[1] | Yes |
| Ohio River at Montgomery Locks-and-Dam, upstream of dam at RM 31.7 | -- | Yes | No |
| Ohio River at Montgomery Locks-and-Dam, downstream of dam at RM 31.7 | -- | Yes | No |
| Little Beaver Creek near East Liverpool, OH (03109500), 4 mi upstream of mouth | 496 | Yes[1] | Yes |
| Yellow Creek near Hammondsville, OH (03110000), 0.9 mi upstream of Brush Creek | 147 | Yes[1] | Yes |
| Ohio River at New Cumberland Locks-and-Dam, upstream of dam at RM 54.4 | -- | Yes | No |
| Ohio River at New Cumberland Locks-and-Dam, downstream of dam at RM 54.4 | -- | Yes | No |
| Short Creek near Dillonvale, OH (03111500), 2.9 mi upstream of Little Short Creek | 123 | Yes[1] | Yes |
| Ohio River at Pike Island Locks-and-Dam, upstream of dam at RM 84.2 | -- | Yes | No |
| Ohio River at Pike Island Locks-and-Dam, downstream of dam at RM 84.2 | -- | Yes | No |
| Ohio River at Martins Ferry, OH (03111534), at RM 87.5 | 24,700 | Yes[1] | Yes |
| Ohio River at Hannibal Locks-and-Dam, upstream of dam at RM 126.4 | -- | Yes | No |

[1]Water-surface elevation data are not presented in this report but are available from the indicated U.S. Geological Survey State office.

## Discharge

Ohio River discharges were about 4,000 to 6,000 $ft^3/s$ at the Pennsylvania, Ohio, and West Virginia border during the dye study as estimated from U.S. Geological Survey streamflow-gaging stations: Ohio River at Sewickley, PA (03086000); Beaver River at Beaver Falls, PA (03107500); and, Raccoon Creek at Moffatts Mill (03108000). Figures 4-6 and table 5 presents daily mean discharges from October 20, 1991, through November 24, 1991, for U.S. Geological Survey streamflow-gaging stations in the study for the stations listed above and: Little Beaver Creek near East Liverpool, OH (03109500); Yellow Creek near Hammondsville, OH (03110000); Short Creek near Dillonvale, OH (03111500); and, Ohio River at Martins Ferry, OH (03111534).

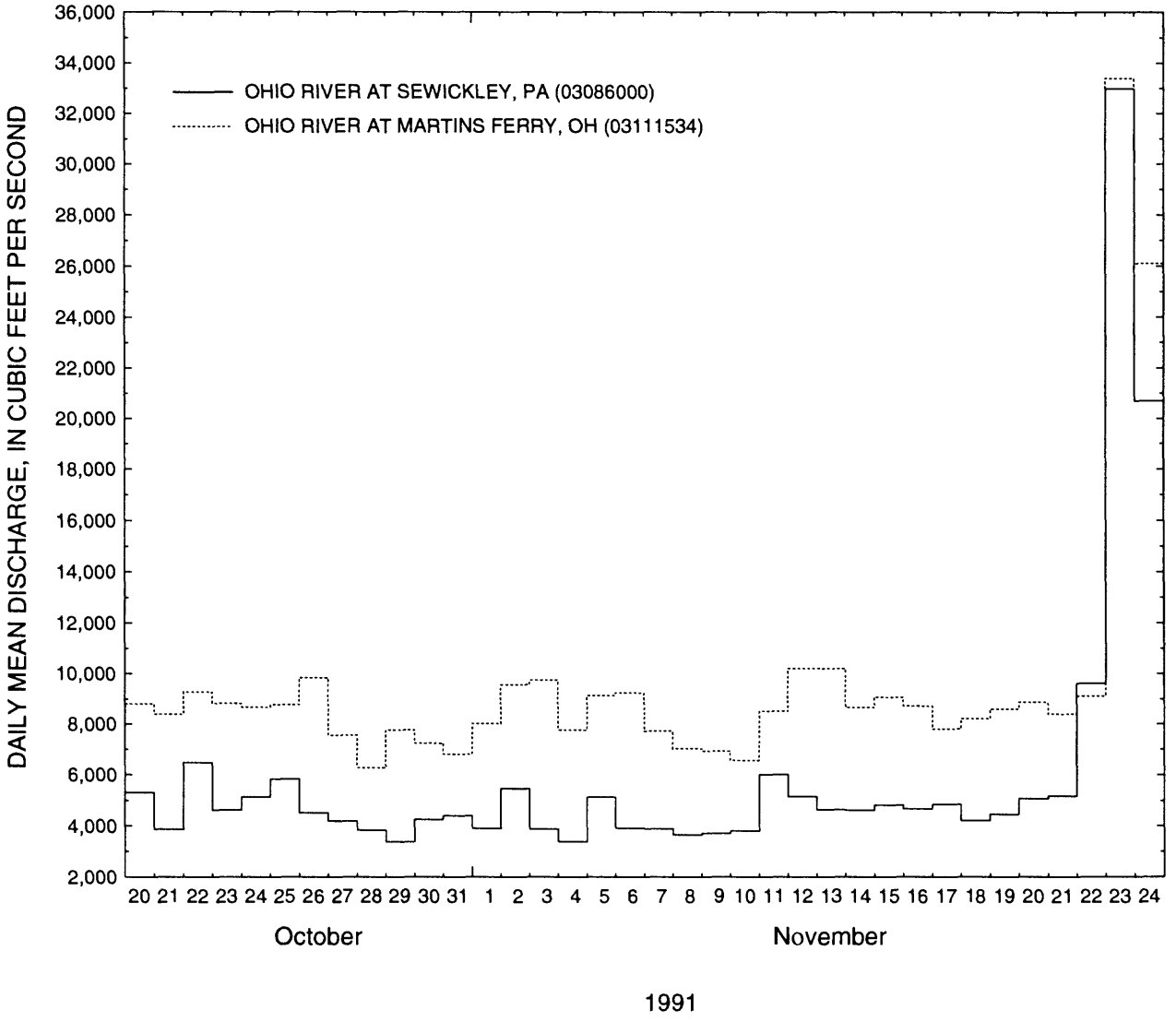



**Figure 4.** Daily mean discharges from October 20 through November 24 for Ohio River at Sewickley and Ohio River at Martins Ferry in the upper Ohio River study area.

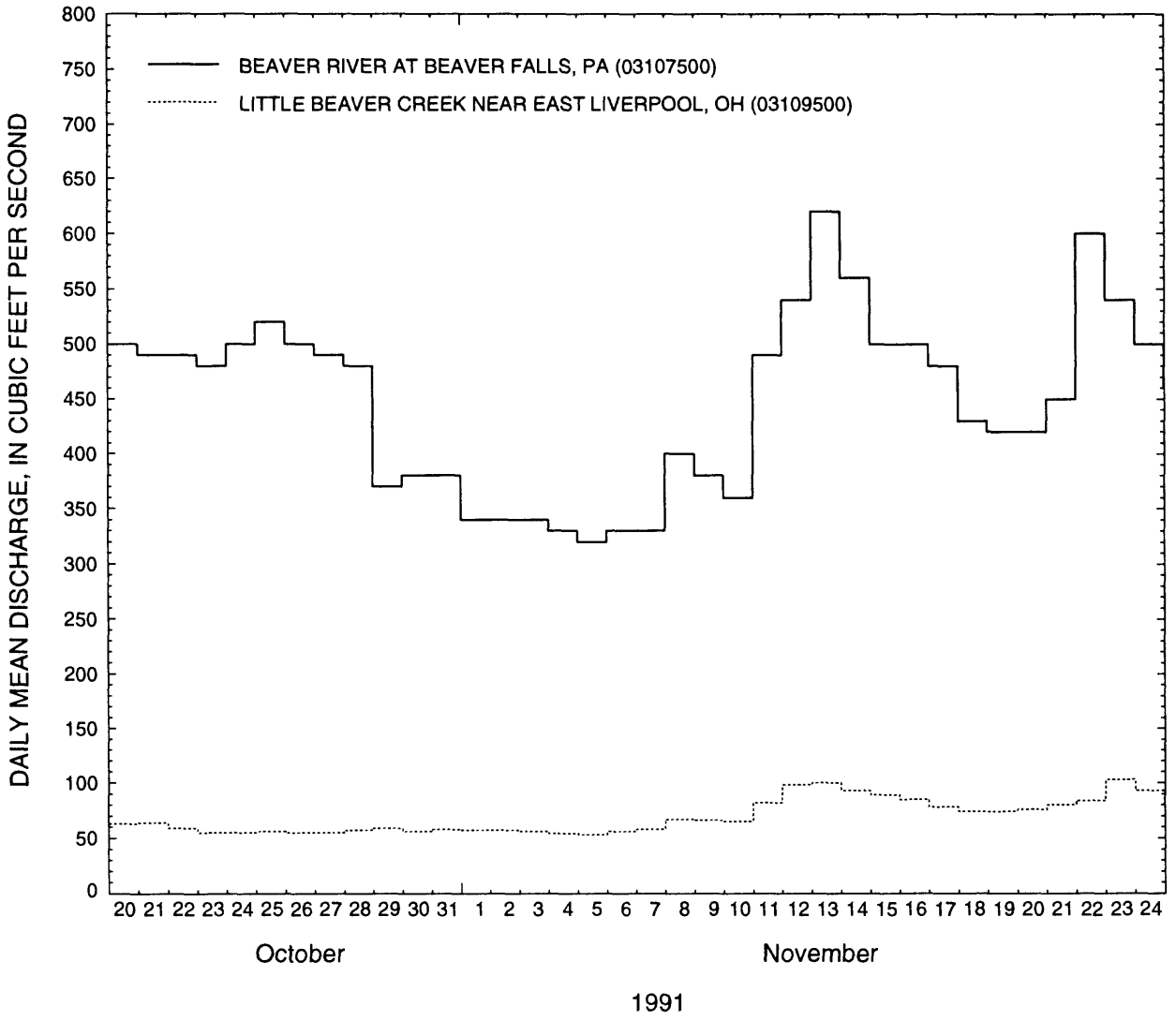



**Figure 5.** Daily mean discharges from October 20 through November 24 for Beaver River at Beaver Falls and Little Beaver Creek near East Liverpool in the upper Ohio River study area.

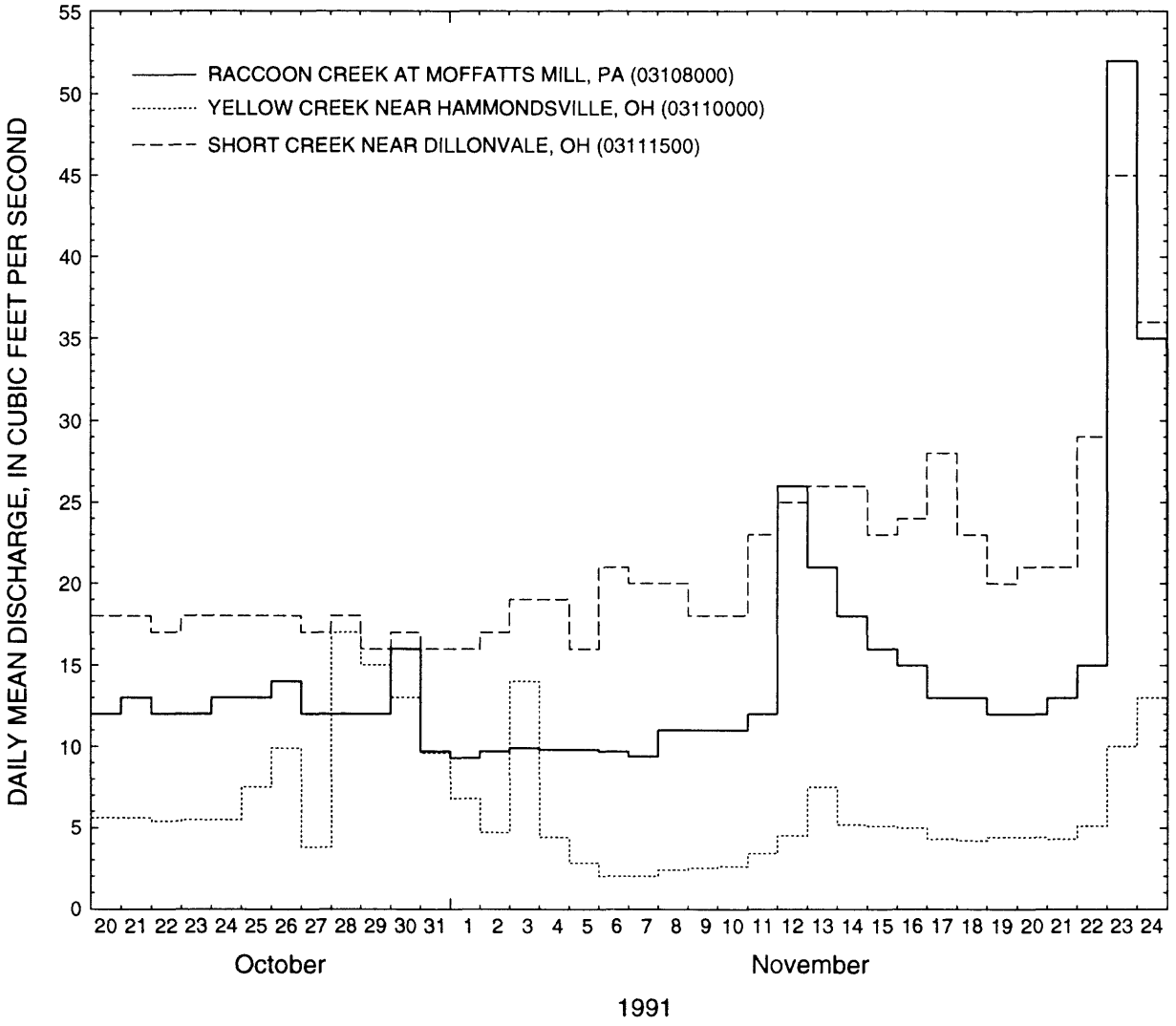



**Figure 6.** Daily mean discharges from October 20 through November 24 for Raccoon Creek at Moffatts Mill, Yellow Creek near Hammondsville, and Short Creek near Dillonvale in the upper Ohio River study area.

**Table 5.** Daily mean discharges at the indicated streamflow-gaging stations

[Discharge is in cubic feet per second. Estimated discharges are preceded with an "e."]

| Date | Discharge |
|---|---|
| **03086000 Ohio River at Sewickley, PA[1]** | |
| 10-20-91 | 5,310 |
| 10-21-91 | 3,860 |
| 10-22-91 | 6,460 |
| 10-23-91 | 4,620 |
| 10-24-91 | 5,140 |
| 10-25-91 | 5,830 |
| 10-26-91 | 4,520 |
| 10-27-91 | 4,190 |
| 10-28-91 | 3,830 |
| 10-29-91 | 3,370 |
| 10-30-91 | 4,250 |
| 10-31-91 | 4,400 |
| 11-01-91 | 3,890 |
| 11-02-91 | 5,460 |
| 11-03-91 | 3,870 |
| 11-04-91 | 3,390 |
| 11-05-91 | 5,140 |
| 11-06-91 | 3,910 |
| 11-07-91 | 3,880 |
| 11-08-91 | 3,650 |
| 11-09-91 | 3,710 |
| 11-10-91 | 3,810 |
| 11-11-91 | 6,010 |
| 11-12-91 | 5,160 |
| 11-13-91 | 4,640 |
| 11-14-91 | 4,620 |
| 11-15-91 | 4,830 |
| 11-16-91 | 4,680 |
| 11-17-91 | 4,850 |
| 11-18-91 | 4,210 |
| 11-19-91 | 4,450 |
| 11-20-91 | 5,080 |
| 11-21-91 | 5,190 |
| 11-22-91 | 9,620 |
| 11-23-91 | 33,000 |
| 11-24-91 | 20,700 |
| **03107500 Beaver River at Beaver Falls, PA[1]** | |
| 10-20-91 | e500 |
| 10-21-91 | e490 |
| 10-22-91 | e490 |
| 10-23-91 | e480 |
| 10-24-91 | e500 |
| 10-25-91 | e520 |
| 10-26-91 | e500 |
| 10-27-91 | e490 |
| 10-28-91 | e480 |
| 10-29-91 | e370 |
| 10-30-91 | e380 |
| 10-31-91 | e380 |

| Date | Discharge |
|---|---|
| **03107500 Beaver River at Beaver Falls, PA[1]—*Continued*** | |
| 11-01-91 | e340 |
| 11-02-91 | e340 |
| 11-03-91 | e340 |
| 11-04-91 | e330 |
| 11-05-91 | e320 |
| 11-06-91 | e330 |
| 11-07-91 | e330 |
| 11-08-91 | e400 |
| 11-09-91 | e380 |
| 11-10-91 | e360 |
| 11-11-91 | e490 |
| 11-12-91 | e540 |
| 11-13-91 | e620 |
| 11-14-91 | e560 |
| 11-15-91 | e500 |
| 11-16-91 | e500 |
| 11-17-91 | e480 |
| 11-18-91 | e430 |
| 11-19-91 | e420 |
| 11-20-91 | e420 |
| 11-21-91 | e450 |
| 11-22-91 | e600 |
| 11-23-91 | e540 |
| 11-24-91 | e500 |
| **03108000 Raccoon Creek at Moffatts Mill, PA[1]** | |
| 10-20-91 | 12 |
| 10-21-91 | 13 |
| 10-22-91 | 12 |
| 10-23-91 | 12 |
| 10-24-91 | 13 |
| 10-25-91 | 13 |
| 10-26-91 | 14 |
| 10-27-91 | 12 |
| 10-28-91 | 12 |
| 10-29-91 | 12 |
| 10-30-91 | 16 |
| 10-31-91 | 9.7 |
| 11-01-91 | 9.3 |
| 11-02-91 | 9.7 |
| 11-03-91 | 9.9 |
| 11-04-91 | 9.8 |
| 11-05-91 | 9.8 |
| 11-06-91 | 9.7 |
| 11-07-91 | 9.4 |
| 11-08-91 | 11 |
| 11-09-91 | 11 |
| 11-10-91 | 11 |
| 11-11-91 | 12 |
| 11-12-91 | 26 |

| Date | Discharge |
|---|---|
| **03108000 Raccoon Creek at Moffatts Mill, PA[1]—*Continued*** | |
| 11-13-91 | 21 |
| 11-14-91 | 18 |
| 11-15-91 | 16 |
| 11-16-91 | 15 |
| 11-17-91 | 13 |
| 11-18-91 | 13 |
| 11-19-91 | 12 |
| 11-20-91 | 12 |
| 11-21-91 | 13 |
| 11-22-91 | 15 |
| 11-23-91 | 52 |
| 11-24-91 | 35 |
| **03109500 Little Beaver Creek near East Liverpool, OH[2]** | |
| 10-20-91 | 63 |
| 10-21-91 | 64 |
| 10-22-91 | 59 |
| 10-23-91 | 55 |
| 10-24-91 | 55 |
| 10-25-91 | 56 |
| 10-26-91 | 55 |
| 10-27-91 | 55 |
| 10-28-91 | 57 |
| 10-29-91 | 59 |
| 10-30-91 | 56 |
| 10-31-91 | 58 |
| 11-01-91 | 57 |
| 11-02-91 | 57 |
| 11-03-91 | 56 |
| 11-04-91 | 54 |
| 11-05-91 | 53 |
| 11-06-91 | 56 |
| 11-07-91 | 58 |
| 11-08-91 | 67 |
| 11-09-91 | 66 |
| 11-10-91 | 65 |
| 11-11-91 | 82 |
| 11-12-91 | 98 |
| 11-13-91 | 100 |
| 11-14-91 | 93 |
| 11-15-91 | 89 |
| 11-16-91 | 85 |
| 11-17-91 | 78 |
| 11-18-91 | 74 |
| 11-19-91 | 74 |
| 11-20-91 | 76 |
| 11-21-91 | 80 |
| 11-22-91 | 84 |
| 11-23-91 | 103 |
| 11-24-91 | 93 |

| Date | Discharge |
|---|---|
| **03110000 Yellow Creek near Hammondsville, OH[2]** | |
| 10-20-91 | 5.6 |
| 10-21-91 | 5.6 |
| 10-22-91 | 5.4 |
| 10-23-91 | 5.5 |
| 10-24-91 | 5.5 |
| 10-25-91 | 7.5 |
| 10-26-91 | 9.9 |
| 10-27-91 | 3.8 |
| 10-28-91 | 17 |
| 10-29-91 | 15 |
| 10-30-91 | 13 |
| 10-31-91 | 9.6 |
| 11-01-91 | 6.8 |
| 11-02-91 | 4.7 |
| 11-03-91 | 14 |
| 11-04-91 | 4.4 |
| 11-05-91 | 2.8 |
| 11-06-91 | 2.0 |
| 11-07-91 | 2.0 |
| 11-08-91 | 2.4 |
| 11-09-91 | 2.5 |
| 11-10-91 | 2.6 |
| 11-11-91 | 3.4 |
| 11-12-91 | 4.5 |
| 11-13-91 | 7.5 |
| 11-14-91 | 5.2 |
| 11-15-91 | 5.1 |
| 11-16-91 | 5.0 |
| 11-17-91 | 4.3 |
| 11-18-91 | 4.2 |
| 11-19-91 | 4.4 |
| 11-20-91 | 4.4 |
| 11-21-91 | 4.3 |
| 11-22-91 | 5.1 |
| 11-23-91 | 10 |
| 11-24-91 | 13 |
| **03111500 Short Creek near Dillonvale, OH[2]** | |
| 10-20-91 | 18 |
| 10-21-91 | 18 |
| 10-22-91 | 17 |
| 10-23-91 | 18 |
| 10-24-91 | 18 |
| 10-25-91 | 18 |
| 10-26-91 | 18 |
| 10-27-91 | 17 |
| 10-28-91 | 18 |
| 10-29-91 | 16 |
| 10-30-91 | 17 |
| 10-31-91 | 16 |

**Table 5.** Daily mean discharges at the indicated streamflow-gaging stations—*Continued*

| Date | Discharge |
|---|---|
| **03111500 Short Creek near Dillonvale, OH[2]—*Continued*** | |
| 11-01-91 | 16 |
| 11-02-91 | 17 |
| 11-03-91 | 19 |
| 11-04-91 | 19 |
| 11-05-91 | 16 |
| 11-06-91 | 21 |
| 11-07-91 | 20 |
| 11-08-91 | 20 |
| 11-09-91 | 18 |
| 11-10-91 | 18 |
| 11-11-91 | 23 |
| 11-12-91 | 25 |
| 11-13-91 | 26 |
| 11-14-91 | 26 |
| 11-15-91 | 23 |
| 11-16-91 | 24 |
| 11-17-91 | 28 |
| 11-18-91 | 23 |
| 11-19-91 | 20 |
| 11-20-91 | 21 |
| 11-21-91 | 21 |
| 11-22-91 | 29 |
| 11-23-91 | 45 |
| 11-24-91 | 36 |
| **03111534 Ohio River at Martins Ferry, OH[3]** | |
| 10-20-91 | 8,810 |
| 10-21-91 | 8,400 |
| 10-22-91 | 9,280 |
| 10-23-91 | 8,830 |
| 10-24-91 | 8,680 |
| 10-25-91 | 8,780 |
| 10-26-91 | 9,840 |
| 10-27-91 | 7,550 |
| 10-28-91 | 6,270 |
| 10-29-91 | 7,760 |
| 10-30-91 | 7,240 |
| 10-31-91 | 6,810 |
| 11-01-91 | 8,010 |
| 11-02-91 | 9,560 |
| 11-03-91 | 9,740 |
| 11-04-91 | 7,760 |
| 11-05-91 | 9,140 |
| 11-06-91 | 9,250 |
| 11-07-91 | 7,710 |
| 11-08-91 | 7,020 |
| 11-09-91 | 6,930 |
| 11-10-91 | 6,560 |
| 11-11-91 | 8,510 |
| 11-12-91 | 10,200 |
| 11-13-91 | 10,200 |
| 11-14-91 | 8,660 |
| 11-15-91 | 9,070 |
| 11-16-91 | 8,720 |
| 11-17-91 | 7,790 |
| 11-18-91 | 8,210 |
| 11-19-91 | 8,590 |
| 11-20-91 | 8,870 |
| 11-21-91 | 8,400 |
| 11-22-91 | 9,120 |
| 11-23-91 | 33,400 |
| 11-24-91 | 26,100 |

[1]Lescinsky and others, 1993, pp. 101, 110, 113.
[2]Shindel and others, 1993, pp. 48-50.
[3]Ward and others, 1993, p. 130.

## Water-Surface Elevation

Water-surface elevations at Corp of Engineers Lock-and-Dams from October 20, 1991 through November 24, 1991 indicate channel storage was fairly consistent. Figures 7-11 and table 8 show water-surface elevations at the Dashields, Montgomery, New Cumberland, Pike Island, and Hannibal pools in feet above sea level. The differences between water-surface elevations at the upstream and downstream ends of the pools remained fairly constant while the dye cloud was traveling through the pools.

An increase in channel storage was indicated near the end of the study period. Water-surface elevations increased at the upstream end of the pools relative to those at the downstream end of the pools. Traveltime of the trailing edge of the dye cloud was slightly increased by the increase in channel storage in the Pike Island pool (fig. 10); this occurrence is indicated by the arrival of the trailing edge of the dye cloud at Pike Island Locks-and-Dam after the increase in water-surface elevations downstream of the New Cumberland Locks-and-Dam. Note, this slight increase in traveltime of the trailing edge of the dye cloud probably was less significant than the decrease in traveltime resulting from the increase in stream discharge (fig. 4).

The accuracy of the absolute water-surface elevations is questionable, but the relative difference between elevations used to describe changes in channel storage is accurate. In the New Cumberland pool (fig. 9), the water-surface elevations at the upstream end of the pool (downstream elevations at Montgomery Locks-and-Dam) are less than the water-surface elevations at the downstream end of the pool (upstream elevations at New Cumberland Locks-and-Dam). Water-surface elevations also are less at the upstream end than the downstream end of the Dashields pool (fig. 7). These errors in water-surface elevations probably are due to inaccurate gage readings. Gage readings at the Locks-and-Dams used for this study were those indicated on the "Monthly Gage Report—River Stage and Precipitation Data" logs provided by the U.S. Army Corps of Engineers. The U.S. Geological Survey and the U.S. Army Corps of Engineers have acknowledged possible inaccurate gage readings (James A. Kosky, U.S. Army Corps of Engineers, oral commun., 1996).

Gage datums are presented in figures 7-11 so that possible future revisions can be accounted for by applying a correction for datum differences to the water-surface elevation data presented in table 8.

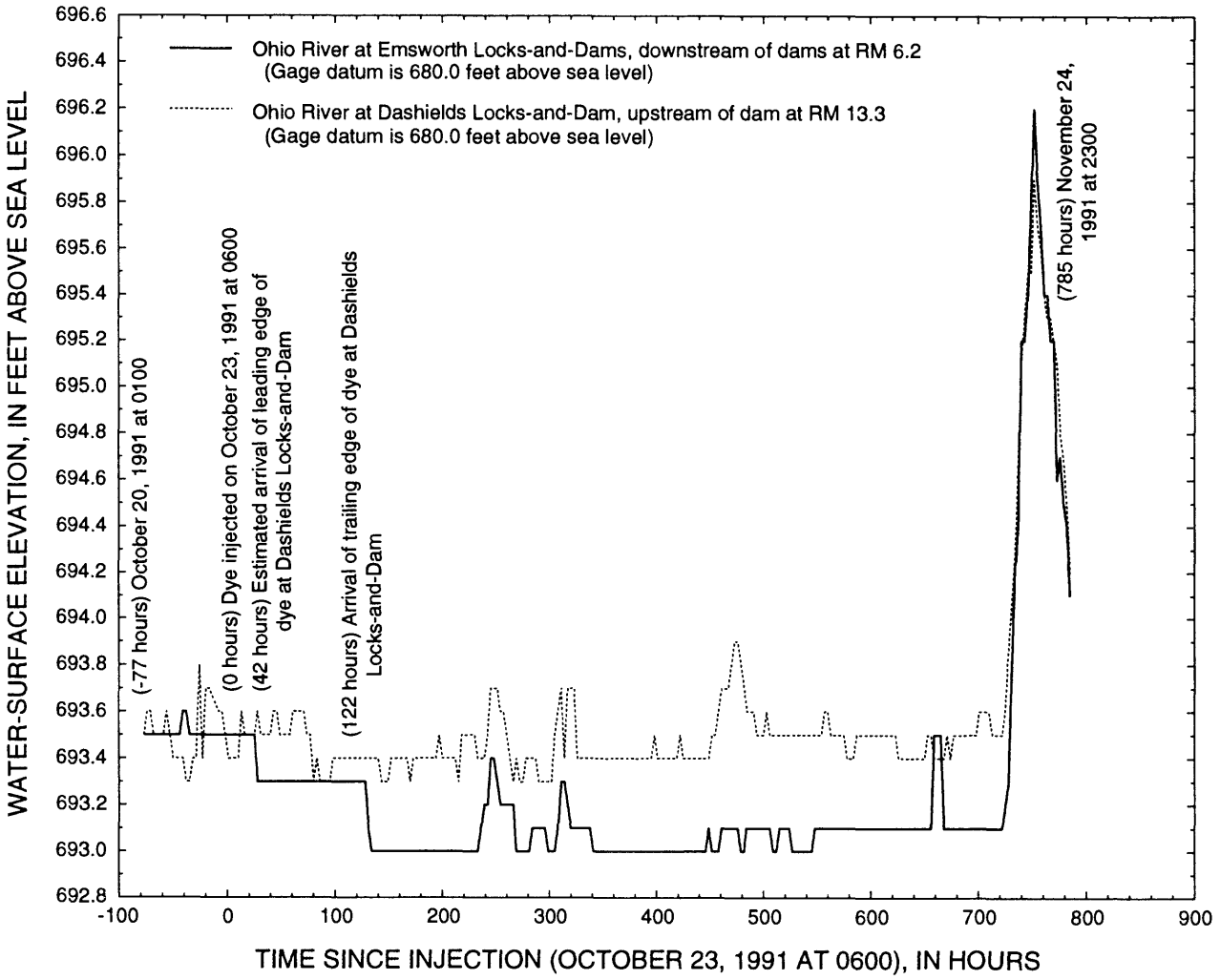



**Figure 7.** Water-surface elevations from October 20 through November 24 for the Dashields Locks-and-Dam pool in the upper Ohio River study area.

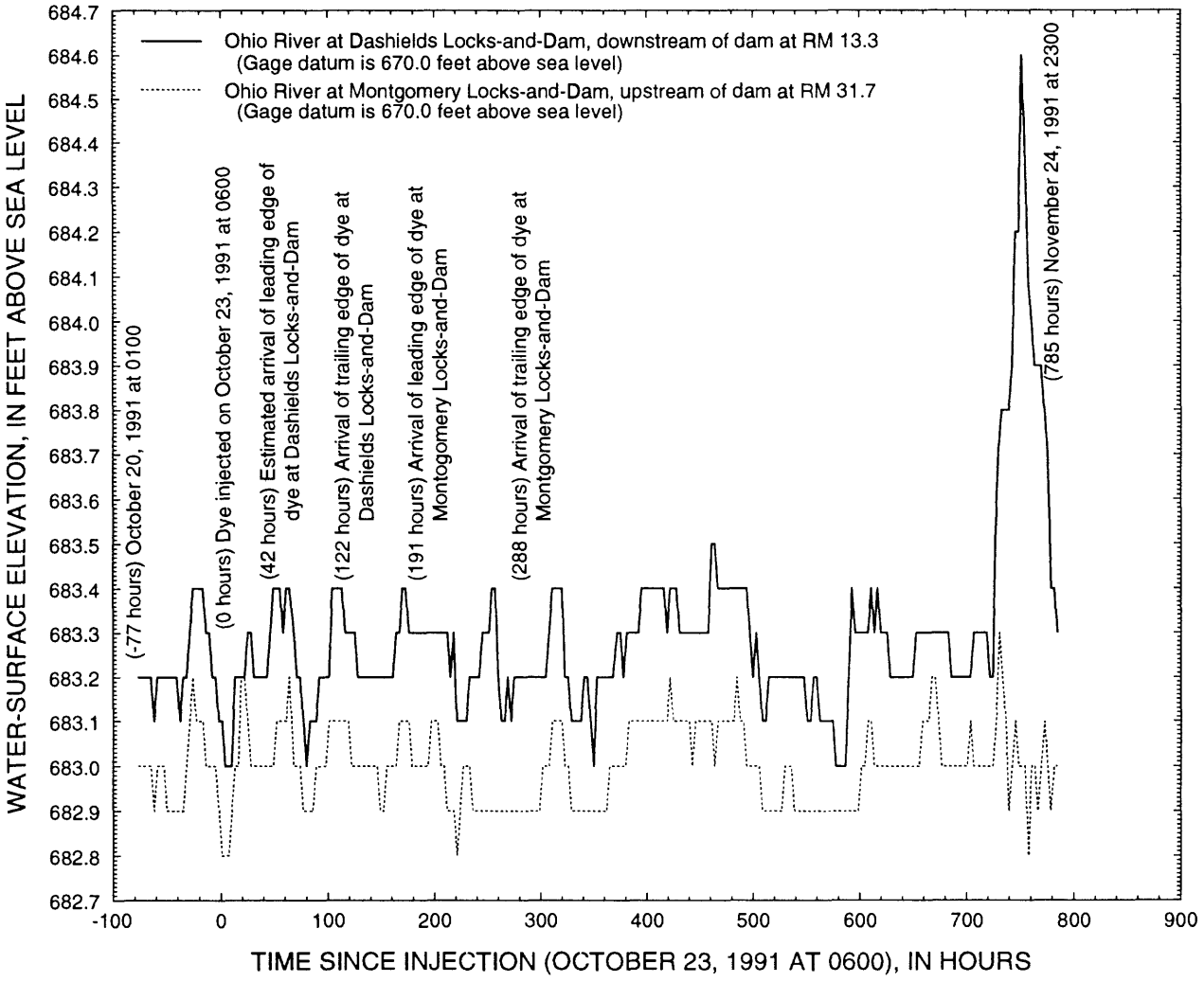



**Figure 8.** Water-surface elevations from October 20 through November 24 for the Montgomery Locks-and-Dam pool in the upper Ohio River study area.

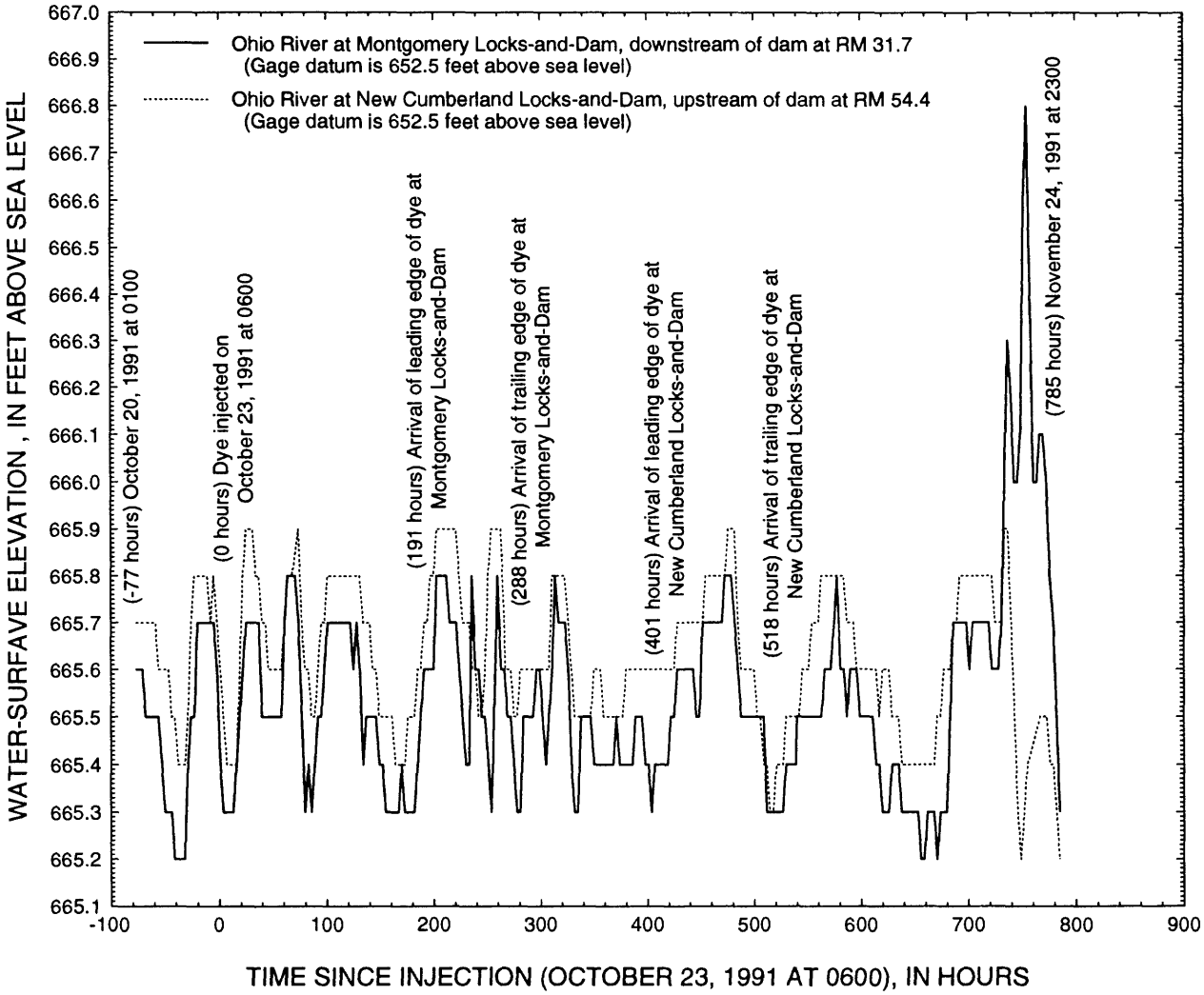



**Figure 9.** Water-surface elevations from October 20 through November 24 for the New Cumberland Locks-and-Dam pool in the upper Ohio River study area.

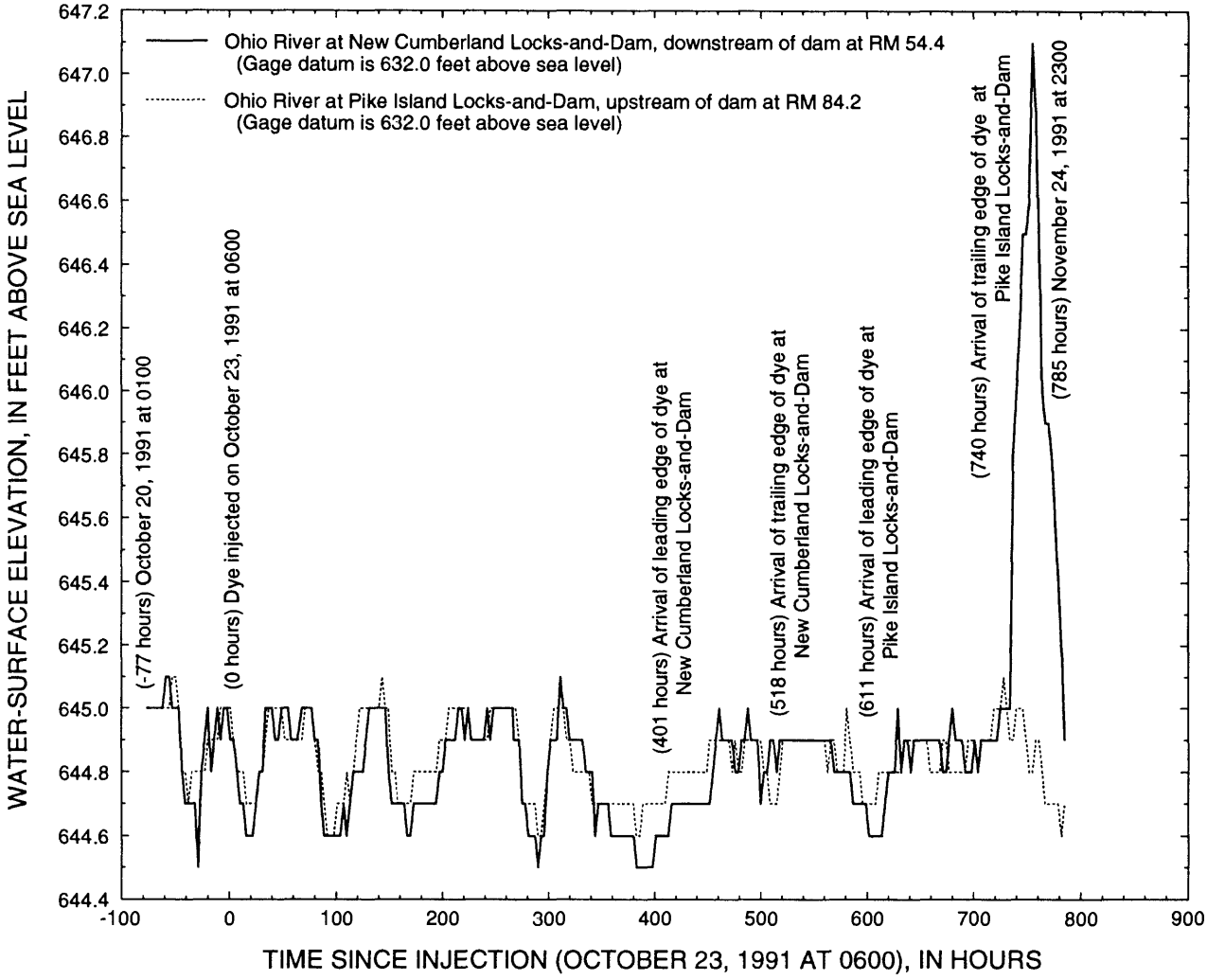



**Figure 10.** Water-surface elevations from October 20 through November 24 for the Pike Island Locks-and-Dam pool in the upper Ohio River study area.

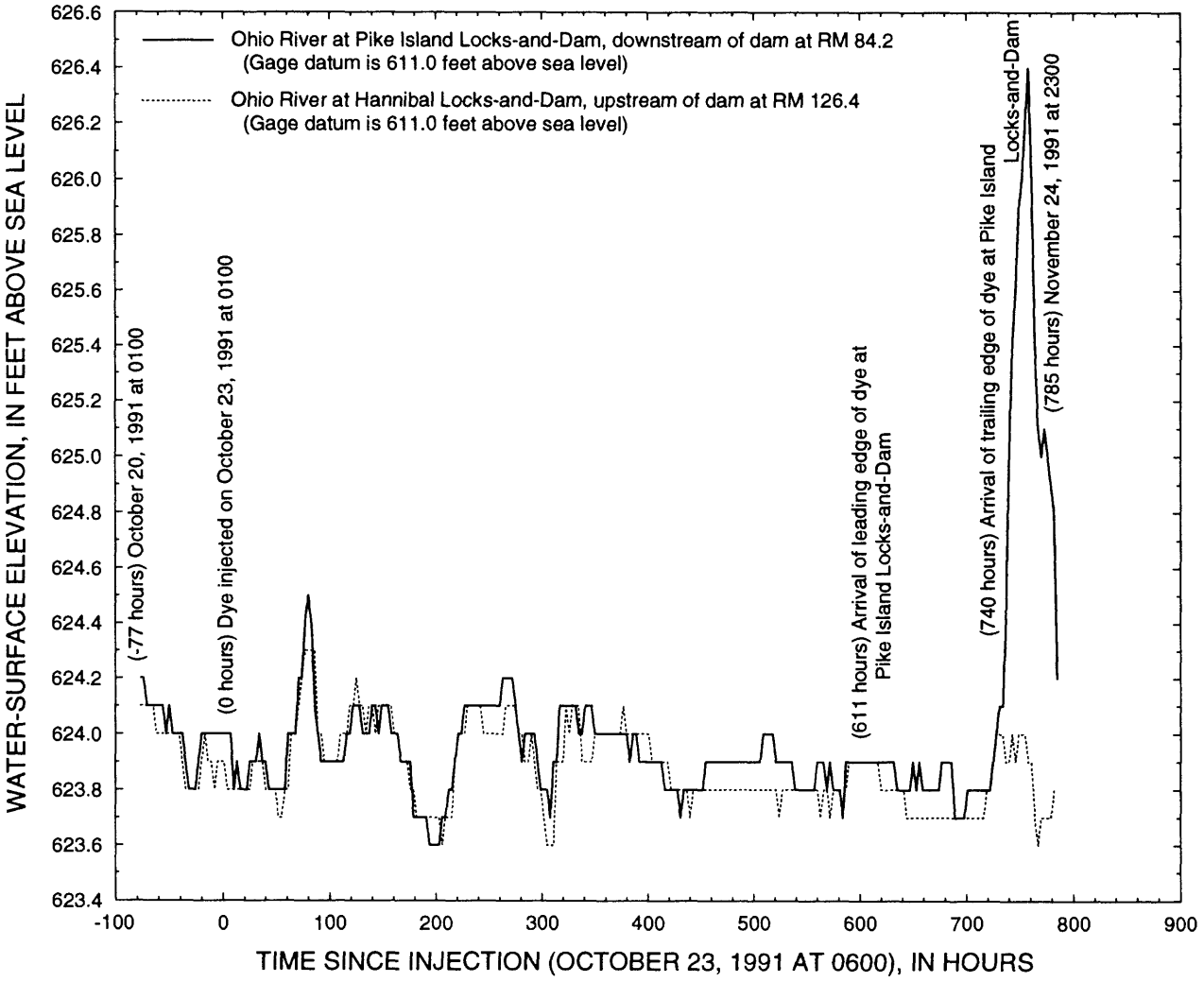



**Figure 11.** Water-surface elevations from October 20 through November 24 for the Hannibal Locks-and-Dam pool in the upper Ohio River study area.

## SUMMARY

The U.S. Geological Survey, in cooperation with the Ohio River Valley Water Sanitation Commission, measured the traveltime and dispersion of a dye injection on the upper Ohio River. About 240 L (590 lb) of 20-percent rhodamine-WT dye was injected into the Ohio River at river mile 3.2 at a constant rate of 940 mL/min from 6:00 a.m. to 10:15 a.m. on October 23, 1991.

The upper Ohio River originates at the confluence of the Allegheny and Monongahela Rivers, flows westward to the border of Pennsylvania, Ohio, and West Virginia, through Emsworth, Dashields, and Montgomery Locks-and-Dams. From the border, the River flows south-westward along the Ohio and West Virginia border through New Cumberland, Pike Island, and Hannibal Locks-and-Dams. The study area is limited to the Ohio River from Dashields Locks-and-Dam to Pike-Island Locks-and Dam.

Knowledge of traveltime and dispersion of a soluble dye can assist river managers mitigate effects of an accidental spill. The potential for a spill is present because chemicals and wastes are transported by rail, pipeline, highway and barge on and near the river and tributary streams.

Traveltime and dispersion data were collected from October 25 through November 23, 1991, when Ohio River discharges were about 4,000 to 6,000 $ft^3/s$ at the Pennsylvania, Ohio, and West Virginia border. Water-surface elevations in regulated pools indicated channel storage was fairly constant while the dye cloud was traveling through the pools.

The traveltime of peak concentration between Dashields Locks-and-Dam and Pike Island Locks-and-Dam is 609 hours. Time of passage of the dye cloud at Dashields Locks-and-Dam and Pike Island Locks-and-Dam is 80 and 129 hours, respectively.

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# TABLES 6-8

—PAGE 23 FOLLOWS—

**Table 6.** Unit times and concentrations at the five primary sampling sites in the upper Ohio River study area

[Time is Daylight Savings military time. Elapsed time is in percentage of hours since injection. Concentration is in micrograms per liter]

| Date | Time | Elapsed time | Concentration |
|---|---|---|---|
| **Dashields Locks-and-Dam, River Mile 13.3** | | | |
| 10-25-91 | 1530 | 57.50 | 0.89 |
| | 1631 | 58.52 | 1.38 |
| | 1733 | 59.55 | 1.33 |
| | 1834 | 60.57 | 1.58 |
| | 1936 | 61.60 | 1.29 |
| | 2037 | 62.62 | 1.68 |
| | 2139 | 63.65 | 1.97 |
| | 2240 | 64.67 | 1.78 |
| | 2342 | 65.70 | 2.86 |
| 10-26-91 | 0043 | 66.72 | 3.20 |
| | 0145 | 67.75 | 3.89 |
| | 0246 | 68.77 | 3.59 |
| | 0348 | 69.80 | 3.50 |
| | 0449 | 70.82 | 3.69 |
| | 0551 | 71.85 | 3.59 |
| | 0652 | 72.87 | 3.40 |
| | 0754 | 73.90 | 3.20 |
| | 0855 | 74.92 | 3.40 |
| | 0915 | 75.25 | 3.40 |
| | 1017 | 76.29 | 3.05 |
| | 1426 | 80.44 | 2.17 |
| | 1529 | 81.48 | 2.12 |
| | 1734 | 83.56 | 1.97 |
| | 1835 | 84.59 | 1.82 |
| | 1938 | 85.63 | 1.48 |
| | 2152 | 87.87 | .94 |
| | 2255 | 88.91 | .99 |
| | 2357 | 89.95 | .99 |
| 11-27-91 | 0059 | 90.99 | .70 |
| | 0304 | 93.07 | .65 |
| | 0407 | 94.11 | .65 |
| | 0508 | 95.14 | .60 |
| | 0611 | 96.18 | .60 |
| | 0713 | 97.22 | .55 |
| | 0816 | 98.26 | .45 |
| | 0918 | 99.30 | .45 |
| | 1020 | 100.34 | .45 |
| | 1123 | 101.38 | .40 |
| | 1225 | 102.42 | .35 |
| | 1230 | 102.50 | .35 |
| | 1332 | 103.54 | .35 |
| | 1435 | 104.58 | .35 |
| | 1537 | 105.62 | .30 |
| | 1640 | 106.67 | .25 |
| | 1743 | 107.71 | .20 |
| | 1845 | 108.75 | .20 |
| | 1947 | 109.79 | .20 |
| | 2050 | 110.83 | .16 |
| | 2055 | 110.92 | .16 |
| | 2158 | 111.96 | .16 |
| | 2300 | 113.00 | .16 |
| **Dashields Locks-and-Dam, River Mile 13.3—*Continued*** | | | |
| 11-28-91 | 0002 | 114.04 | 0.11 |
| | 0105 | 115.09 | .11 |
| | 0208 | 116.13 | .11 |
| | 0310 | 117.17 | .11 |
| | 0413 | 118.21 | .06 |
| | 0515 | 119.25 | .06 |
| | 0617 | 120.29 | .06 |
| | 0720 | 121.33 | .06 |
| | 0823 | 122.38 | .06 |
| | 0925 | 123.42 | .06 |
| | 1028 | 124.46 | .06 |
| | 1130 | 125.50 | .06 |
| **Montgomery Locks-and-Dam, River Mile 31.7** | | | |
| 10-30-91 | 0910 | 171.17 | 0.01 |
| 10-31-91 | 0128 | 187.47 | .01 |
| | 0320 | 189.33 | .01 |
| | 0416 | 190.27 | .01 |
| | 0512 | 191.20 | .06 |
| | 0608 | 192.13 | .06 |
| | 0704 | 193.07 | .11 |
| | 0800 | 194.00 | .06 |
| | 0856 | 194.93 | .11 |
| | 0952 | 195.87 | .11 |
| | 1048 | 196.80 | .16 |
| | 1148 | 197.80 | .30 |
| | 1244 | 198.73 | .40 |
| | 1340 | 199.67 | .45 |
| | 1436 | 200.60 | .79 |
| | 1532 | 201.53 | 1.04 |
| | 1800 | 204.00 | .70 |
| | 1856 | 204.93 | .75 |
| | 1952 | 205.87 | .94 |
| | 2049 | 206.82 | 1.04 |
| | 2145 | 207.75 | 1.09 |
| | 2241 | 208.68 | 1.09 |
| | 2337 | 209.62 | 1.14 |
| 11-01-91 | 0033 | 210.55 | .99 |
| | 0130 | 211.50 | 1.33 |
| | 0226 | 212.43 | 1.48 |
| | 0322 | 213.37 | 1.24 |
| | 0418 | 214.30 | 1.38 |
| | 0514 | 215.23 | 1.09 |
| | 0611 | 216.18 | 1.48 |
| | 0707 | 217.12 | 1.53 |
| | 0803 | 218.05 | 1.68 |
| | 0859 | 218.98 | 1.68 |
| | 0955 | 219.92 | 1.78 |
| | 1052 | 220.87 | 1.78 |
| | 1244 | 222.73 | 1.83 |
| | 1340 | 223.67 | 1.88 |

**Table 6.** Unit times and concentrations at the five primary sampling sites in the upper Ohio River study area—*Continued*

| Date | Time | Elapsed time | Concentration |
|---|---|---|---|
| **Montgomery Locks-and-Dam, River Mile 31.7—*Continued*** | | | |
| 11-01-91 | 1540 | 225.67 | 1.97 |
| | 1637 | 226.62 | 2.07 |
| | 1734 | 227.57 | 2.02 |
| | 1831 | 228.52 | 1.97 |
| | 1928 | 229.47 | 2.02 |
| | 2025 | 230.42 | 1.97 |
| | 2122 | 231.37 | 2.02 |
| | 2219 | 232.32 | 2.02 |
| | 2316 | 233.27 | 1.97 |
| 11-02-91 | 0013 | 234.22 | 1.97 |
| | 0110 | 235.17 | 1.92 |
| | 0207 | 236.12 | 1.97 |
| | 0304 | 237.07 | 1.97 |
| | 0401 | 238.02 | 1.53 |
| | 0458 | 238.97 | 1.92 |
| | 0555 | 239.92 | 1.83 |
| | 0652 | 240.87 | 1.24 |
| | 0749 | 241.82 | 1.68 |
| | 0846 | 242.77 | 1.58 |
| | 1040 | 244.67 | 1.29 |
| | 1137 | 245.62 | 1.43 |
| | 1233 | 246.55 | 1.33 |
| | 1343 | 247.71 | 1.14 |
| | 1444 | 248.74 | 1.04 |
| | 1547 | 249.78 | .99 |
| | 1649 | 250.81 | .79 |
| | 1751 | 251.85 | .84 |
| | 1853 | 252.89 | .79 |
| | 1955 | 253.92 | .75 |
| | 2058 | 254.96 | .79 |
| | 2159 | 255.99 | .65 |
| | 2302 | 257.03 | .60 |
| 11-03-91 | 0004 | 258.07 | .30 |
| | 0106 | 259.10 | .40 |
| | 0208 | 260.14 | .40 |
| | 0311 | 261.18 | .40 |
| | 0413 | 262.21 | .40 |
| | 0515 | 263.25 | .35 |
| | 0617 | 264.28 | .40 |
| | 0719 | 265.32 | .30 |
| | 0822 | 266.36 | .25 |
| | 0923 | 267.39 | .25 |
| | 1026 | 268.43 | .20 |
| | 1128 | 269.46 | .20 |
| | 1230 | 270.50 | .16 |
| | 1343 | 271.71 | .11 |
| | 1444 | 272.74 | .16 |
| | 1547 | 273.78 | .11 |
| | 1649 | 274.81 | .11 |
| | 1751 | 275.85 | .16 |
| | 1853 | 276.89 | .06 |
| | 1955 | 277.92 | .06 |
| 11-03-91 | 2058 | 278.96 | 0.11 |
| | 2159 | 279.99 | .11 |
| 11-04-91 | 0004 | 282.07 | .11 |
| | 0106 | 283.10 | .11 |
| | 0311 | 285.18 | .06 |
| | 0617 | 288.28 | .01 |
| | 0719 | 289.32 | .01 |
| | 0822 | 290.36 | .01 |
| **East Liverpool Water-Treatment Plant, River Mile 40.2** | | | |
| 11-02-91 | 1700 | 251.00 | 0.01 |
| | 1800 | 252.00 | .06 |
| | 1900 | 253.00 | .01 |
| | 2000 | 254.00 | .06 |
| | 2100 | 255.00 | .16 |
| | 2200 | 256.00 | .16 |
| | 2300 | 257.00 | .16 |
| | 2400 | 258.00 | .20 |
| 11-03-91 | 0100 | 259.00 | .25 |
| | 0200 | 260.00 | .30 |
| | 0300 | 261.00 | .35 |
| | 0400 | 262.00 | .40 |
| | 0500 | 263.00 | .50 |
| | 0600 | 264.00 | .55 |
| | 0700 | 265.00 | .60 |
| | 0800 | 266.00 | .65 |
| | 1000 | 268.00 | .75 |
| | 1115 | 269.25 | .89 |
| | 1200 | 270.00 | .89 |
| | 1300 | 271.00 | .94 |
| | 1400 | 272.00 | .99 |
| | 1500 | 273.00 | .99 |
| | 1600 | 274.00 | 1.09 |
| | 1700 | 275.00 | 1.14 |
| | 1800 | 276.00 | 1.14 |
| | 1900 | 277.00 | 1.24 |
| | 2000 | 278.00 | 1.29 |
| | 2100 | 279.00 | 1.29 |
| | 2200 | 280.00 | 1.38 |
| | 2300 | 281.00 | 1.53 |
| 11-4-91 | 0130 | 283.50 | 1.78 |
| | 0300 | 285.00 | 1.73 |
| | 0400 | 286.00 | 1.73 |
| | 0500 | 287.00 | 1.88 |
| | 0615 | 288.25 | 1.78 |
| | 0800 | 290.00 | 1.83 |
| | 0900 | 291.00 | 2.12 |
| | 1000 | 292.00 | 1.92 |
| | 1100 | 293.00 | 1.88 |
| | 1210 | 294.17 | 1.83 |
| | 1300 | 295.00 | 1.88 |
| | 1400 | 296.00 | 1.73 |

**Table 6.** Unit times and concentrations at the five primary sampling sites in the upper Ohio River study area—*Continued*

| Date | Time | Elapsed time | Concentration |
|---|---|---|---|
| **East Liverpool Water-Treatment Plant, River Mile 40.2—*Continued*** | | | |
| 11-04-91 | 1500 | 297.00 | 1.78 |
| | 1600 | 298.00 | 1.88 |
| | 1800 | 300.00 | 1.83 |
| | 1900 | 301.00 | 1.83 |
| | 2000 | 302.00 | 1.78 |
| | 2100 | 303.00 | 1.73 |
| | 2200 | 304.00 | 1.63 |
| | 2300 | 305.00 | 1.78 |
| | 2400 | 306.00 | 1.63 |
| 11-05-91 | 0100 | 307.00 | 1.58 |
| | 0210 | 308.17 | 1.63 |
| | 0300 | 309.00 | 1.58 |
| | 0400 | 310.00 | 1.38 |
| | 0500 | 311.00 | 1.38 |
| | 0600 | 312.00 | 1.33 |
| | 0700 | 313.00 | 1.19 |
| | 0730 | 313.50 | .94 |
| | 0800 | 314.00 | 1.19 |
| | 0805 | 314.08 | 1.04 |
| | 0915 | 315.25 | 1.04 |
| | 0930 | 315.50 | 0.99 |
| | 1030 | 316.50 | .99 |
| | 1500 | 321.00 | .65 |
| | 1700 | 323.00 | .60 |
| | 1900 | 325.00 | .45 |
| | 2100 | 327.00 | .40 |
| | 2300 | 329.00 | .40 |
| 11-06-91 | 0100 | 331.00 | .35 |
| | 0300 | 333.00 | .30 |
| | 0500 | 335.00 | .25 |
| | 0700 | 337.00 | .20 |
| | 0900 | 339.00 | .20 |
| | 1100 | 341.00 | .16 |
| | 1300 | 343.00 | .11 |
| | 1500 | 345.00 | .11 |
| | 1700 | 347.00 | .06 |
| | 1900 | 349.00 | .06 |
| | 2100 | 351.00 | .06 |
| | 2300 | 353.00 | .01 |
| 11-07-91 | 0100 | 355.00 | .01 |
| **New Cumberland Locks-and-Dam, River Mile 54.4** | | | |
| 11-08-91 | 1530 | 393.50 | 0.01 |
| | 1628 | 394.46 | .01 |
| | 1725 | 395.42 | .06 |
| | 1823 | 396.38 | .01 |
| | 1920 | 397.33 | .01 |
| | 2017 | 398.29 | .01 |
| | 2115 | 399.25 | .01 |
| | 2213 | 400.21 | .01 |
| | 2310 | 401.17 | .06 |
| 11-09-91 | 000/ | 402.12 | .11 |

| Date | Time | Elapsed time | Concentration |
|---|---|---|---|
| **New Cumberland Locks-and-Dam, River Mile 54.4—*Continued*** | | | |
| 11-09-91 | 0105 | 403.08 | 0.06 |
| | 0202 | 404.04 | .06 |
| | 0300 | 405.00 | .11 |
| | 0455 | 406.92 | .11 |
| | 0553 | 407.88 | .16 |
| | 0650 | 408.83 | .16 |
| | 0747 | 409.79 | .16 |
| | 0845 | 410.75 | .20 |
| | 0900 | 411.00 | .20 |
| | 0958 | 411.97 | .25 |
| | 1056 | 412.94 | .30 |
| | 1155 | 413.92 | .30 |
| | 1253 | 414.89 | .30 |
| | 1352 | 415.86 | .25 |
| | 1450 | 416.83 | .25 |
| | 1548 | 417.80 | .30 |
| | 1647 | 418.78 | .35 |
| | 1745 | 419.75 | .40 |
| | 1843 | 420.72 | .50 |
| | 1850 | 420.83 | .50 |
| | 1948 | 421.80 | .45 |
| | 2145 | 423.75 | .45 |
| | 2243 | 424.72 | .60 |
| | 2341 | 425.69 | .60 |
| 11-10-91 | 0040 | 426.66 | .60 |
| | 0138 | 427.63 | .60 |
| | 0236 | 428.60 | .60 |
| | 0335 | 429.58 | .65 |
| | 0433 | 430.55 | .79 |
| | 0629 | 432.49 | .79 |
| | 0728 | 433.46 | .79 |
| | 0826 | 434.44 | .84 |
| | 0925 | 435.41 | .84 |
| | 1030 | 436.50 | .89 |
| | 1128 | 437.47 | .94 |
| | 1227 | 438.45 | .94 |
| | 1325 | 439.42 | 1.09 |
| | 1424 | 440.40 | 1.04 |
| | 1522 | 441.37 | 1.04 |
| | 1621 | 442.35 | 1.04 |
| | 1719 | 443.32 | 1.04 |
| | 1725 | 443.42 | 1.09 |
| | 1824 | 444.40 | .99 |
| | 1922 | 445.37 | .99 |
| | 2020 | 446.34 | .99 |
| | 2119 | 447.32 | 1.04 |
| | 2218 | 448.30 | 1.04 |
| | 2316 | 449.27 | 1.14 |
| 11-11-91 | 0014 | 450.24 | 1.14 |
| | 0113 | 451.22 | 1.19 |
| | 0212 | 452.20 | 1.19 |
| | 0310 | 453.17 | 1.14 |

**Table 6.** Unit times and concentrations at the five primary sampling sites in the upper Ohio River study area—*Continued*

| Date | Time | Elapsed time | Concentration |
|---|---|---|---|
| **New Cumberland Locks-and-Dam, River Mile 54.4—*Continued*** | | | |
| 11-11-91 | 0408 | 454.14 | 1.19 |
| | 0507 | 455.12 | 1.19 |
| | 0606 | 456.10 | 1.19 |
| | 0704 | 457.07 | 1.19 |
| | 0802 | 458.04 | 1.19 |
| | 0901 | 459.02 | 1.19 |
| | 0920 | 459.33 | 1.19 |
| | 1020 | 460.33 | 1.24 |
| | 1120 | 461.33 | 1.24 |
| | 1220 | 462.33 | 1.19 |
| | 1320 | 463.33 | 1.19 |
| | 1420 | 464.33 | 1.19 |
| | 1520 | 465.33 | 1.19 |
| | 1620 | 466.33 | 1.14 |
| | 1720 | 467.33 | 1.14 |
| | 1725 | 467.42 | 1.19 |
| | 1825 | 468.41 | 1.09 |
| | 1925 | 469.41 | 1.04 |
| | 2024 | 470.40 | .99 |
| | 2223 | 472.39 | .89 |
| | 2323 | 473.39 | .94 |
| 11-12-91 | 0023 | 474.38 | .84 |
| | 0123 | 475.38 | .79 |
| | 0222 | 476.37 | .75 |
| | 0322 | 477.36 | .75 |
| | 0422 | 478.36 | .70 |
| | 0521 | 479.35 | .65 |
| | 0621 | 480.35 | .55 |
| | 0720 | 481.34 | .55 |
| | 0820 | 482.34 | .55 |
| | 0920 | 483.33 | .50 |
| | 0935 | 483.58 | .55 |
| | 1034 | 484.57 | .45 |
| | 1134 | 485.56 | .40 |
| | 1233 | 486.55 | .40 |
| | 1332 | 487.53 | .35 |
| | 1431 | 488.52 | .40 |
| | 1531 | 489.51 | .30 |
| | 1630 | 490.50 | .30 |
| | 1640 | 490.67 | .30 |
| | 1741 | 491.68 | .25 |
| | 1841 | 492.68 | .25 |
| | 1941 | 493.69 | .25 |
| | 2041 | 494.69 | .25 |
| | 2142 | 495.70 | .20 |
| | 2242 | 496.70 | .20 |
| | 2343 | 497.71 | .20 |
| 11-13-91 | 0043 | 498.71 | .20 |
| | 0143 | 499.72 | .20 |
| | 0243 | 500.72 | .16 |
| | 0344 | 501.73 | .16 |
| | 0444 | 502.73 | .20 |
| 11-13-91 | 0544 | 503.74 | 0.16 |
| | 0644 | 504.74 | .16 |
| | 0745 | 505.75 | .16 |
| | 0845 | 506.75 | .16 |
| | 0946 | 507.76 | .11 |
| | 1046 | 508.76 | .11 |
| | 1146 | 509.77 | .11 |
| | 1155 | 509.83 | .11 |
| | 1248 | 510.80 | .06 |
| | 1346 | 511.77 | .11 |
| | 1444 | 512.74 | .06 |
| | 1543 | 513.71 | .06 |
| | 1641 | 514.68 | .01 |
| | 1739 | 515.65 | .06 |
| | 1750 | 515.83 | .01 |
| | 1846 | 516.77 | .01 |
| | 1942 | 517.70 | .01 |
| | 2038 | 518.64 | .01 |
| | 2134 | 519.57 | .01 |
| **Pike Island Locks-and-Dam, River Mile 84.2** | | | |
| 11-16-91 | 1200 | 582.00 | 0.01 |
| | 1808 | 588.13 | .01 |
| 11-17-91 | 1630 | 610.50 | .01 |
| | 1700 | 611.00 | .06 |
| | 1758 | 611.96 | .06 |
| | 1855 | 612.92 | .11 |
| | 1953 | 613.88 | .11 |
| | 2050 | 614.84 | .06 |
| | 2148 | 615.80 | .11 |
| | 2246 | 616.76 | .06 |
| | 2343 | 617.72 | .11 |
| 11-18-91 | 0041 | 618.68 | .11 |
| | 0138 | 619.64 | .11 |
| | 0236 | 620.60 | .11 |
| | 0334 | 621.56 | .11 |
| | 0431 | 622.52 | .11 |
| | 0529 | 623.48 | .16 |
| | 0626 | 624.44 | .20 |
| | 0724 | 625.40 | .25 |
| | 0822 | 626.36 | .25 |
| | 0919 | 627.32 | .25 |
| | 1017 | 628.28 | .30 |
| | 1114 | 629.24 | .30 |
| | 1212 | 630.20 | .35 |
| | 1240 | 630.67 | .35 |
| | 1338 | 631.63 | .35 |
| | 1435 | 632.59 | .40 |
| | 1533 | 633.55 | .40 |
| | 1631 | 634.51 | .45 |
| | 1728 | 635.47 | .40 |
| | 1826 | 636.43 | .40 |

**Table 6.** Unit times and concentrations at the five primary sampling sites in the upper Ohio River study area—*Continued*

| Date | Time | Elapsed time | Concentration |
|---|---|---|---|
| **Pike Island Locks-and-Dam, River Mile 84.2—*Continued*** | | | |
| 11-18-91 | 1923 | 637.39 | 0.40 |
| | 2021 | 638.35 | .50 |
| | 2119 | 639.31 | .50 |
| | 2216 | 640.27 | .50 |
| | 2313 | 641.22 | .55 |
| 11-19-91 | 0011 | 642.18 | .60 |
| | 0108 | 643.14 | .55 |
| | 0206 | 644.10 | .55 |
| | 0303 | 645.06 | .60 |
| | 0401 | 646.02 | .60 |
| | 0459 | 646.98 | .65 |
| | 0556 | 647.94 | .70 |
| | 0654 | 648.90 | .70 |
| | 0752 | 649.86 | .70 |
| | 0849 | 650.82 | .75 |
| | 0947 | 651.78 | .75 |
| | 1000 | 652.00 | .79 |
| | 1057 | 652.95 | .79 |
| | 1155 | 653.91 | .79 |
| | 1252 | 654.86 | .84 |
| | 1349 | 655.81 | .84 |
| | 1446 | 656.77 | .84 |
| | 1543 | 657.72 | .89 |
| | 1640 | 658.67 | .84 |
| | 1738 | 659.63 | .84 |
| | 1835 | 660.58 | .89 |
| | 1845 | 660.75 | .89 |
| | 1941 | 661.69 | .89 |
| | 2037 | 662.62 | .89 |
| | 2134 | 663.56 | .89 |
| | 2230 | 664.50 | .89 |
| | 2326 | 665.43 | .94 |
| 11-20-91 | 0022 | 666.37 | .89 |
| | 0118 | 667.30 | .89 |
| | 0214 | 668.24 | .89 |
| | 0311 | 669.18 | .89 |
| | 0407 | 670.11 | .89 |
| | 0503 | 671.05 | .89 |
| | 0559 | 671.99 | .89 |
| | 0655 | 672.92 | .99 |
| | 0752 | 673.86 | .94 |
| | 0848 | 674.80 | .94 |
| | 0944 | 675.73 | .94 |
| | 1040 | 676.67 | .99 |
| | 1136 | 677.60 | .99 |
| | 1232 | 678.54 | .94 |
| | 1329 | 679.48 | .99 |
| | 1425 | 680.41 | .99 |
| | 1521 | 681.35 | .99 |

| Date | Time | Elapsed time | Concentration |
|---|---|---|---|
| **Pike Island Locks-and-Dam, River Mile 84.2—*Continued*** | | | |
| 11-20-91 | 1525 | 681.42 | 0.94 |
| | 1622 | 682.36 | .94 |
| | 1718 | 683.30 | .94 |
| | 1814 | 684.24 | .94 |
| | 1911 | 685.18 | .94 |
| | 2007 | 686.12 | .94 |
| | 2104 | 687.07 | .89 |
| | 2201 | 688.01 | .89 |
| | 2257 | 688.95 | .99 |
| | 2353 | 689.89 | .89 |
| 11-21-91 | 0050 | 690.83 | .89 |
| | 0146 | 691.77 | .89 |
| | 0243 | 692.71 | .89 |
| | 0339 | 693.65 | .89 |
| | 0435 | 694.59 | .89 |
| | 0532 | 695.53 | .89 |
| | 0629 | 696.48 | .84 |
| | 0725 | 697.42 | .79 |
| | 0822 | 698.36 | .79 |
| | 0918 | 699.30 | .79 |
| | 1014 | 700.24 | .75 |
| | 1111 | 701.18 | .70 |
| | 1130 | 701.50 | .65 |
| | 1504 | 705.07 | .55 |
| | 1651 | 706.85 | .50 |
| | 1838 | 708.64 | .50 |
| | 2025 | 710.42 | .45 |
| | 2212 | 712.20 | .40 |
| | 2359 | 713.99 | .40 |
| 11-22-91 | 0146 | 715.77 | .35 |
| | 0334 | 717.56 | .30 |
| | 0520 | 719.34 | .30 |
| | 0708 | 721.13 | .25 |
| | 0855 | 722.91 | .25 |
| | 1041 | 724.69 | .20 |
| | 1229 | 726.48 | .20 |
| | 1416 | 728.26 | .20 |
| | 1603 | 730.05 | .16 |
| | 1750 | 731.83 | .11 |
| | 1800 | 732.00 | .06 |
| | 1946 | 733.77 | .11 |
| | 2132 | 735.54 | .06 |
| | 2318 | 737.30 | .06 |
| 11-23-91 | 0104 | 739.07 | .01 |
| | 0250 | 740.84 | .01 |
| | 0437 | 742.61 | .01 |
| | 0623 | 744.38 | .01 |
| | 0808 | 746.14 | .00 |

**Table 7.** Times and fluorometer dial readings at the 10 secondary ssampling ites in the upper Ohio River study area

[Time is Eastern Standard military time. Elapsed time is in percentage of hours since injection. Dial reading is for 30X scale of the fluorometer]

| Date | Time | Elapsed time | Dial reading |
|---|---|---|---|
| **Ambridge Highway Bridge, River Mile 16.8** | | | |
| 10-25-91 | 1600 | 58.00 | 0.5 |
| | 1845 | 60.75 | 1 |
| | 2230 | 64.50 | 1 |
| 10-26-91 | 0725 | 73.42 | 15.5 |
| | 1135 | 77.58 | 21.5 |
| | 1705 | 83.08 | 31 |
| **Rochester-Monaca Highway Bridge, River Mile 25.2** | | | |
| 10-27-91 | 2130 | 111.50 | 1 |
| 10-28-91 | 0905 | 123.08 | .5 |
| | 2000 | 134.00 | 4 |
| 10-29-91 | 1105 | 149.08 | 11 |
| **Vanport Highway Bridge, River Mile 28.0** | | | |
| 10-28-91 | 1000 | 124.00 | 0.5 |
| | 2035 | 134.58 | .75 |
| 10-29-91 | 1035 | 148.58 | 1.5 |
| | 1950 | 157.83 | 3 |
| 10-30-91 | 0845 | 170.75 | 6.5 |
| | 1640 | 178.67 | 17 |
| **Newell Highway Bridge, River Mile 44.4** | | | |
| 11-03-91 | 1510 | 273.17 | 1 |
| | 1810 | 276.17 | 1 |
| 11-04-91 | 1025 | 292.42 | 2 |
| **Corps of Engineers Boat Launching Ramp, River Mile 46.2** | | | |
| 11-06-91 | 1700 | 323.00 | 8 |
| 11-07-91 | 1320 | 367.33 | 15 |
| **Steubenville-Weirton Highway Bridge, River Mile 66.4** | | | |
| 11-12-91 | 1020 | 484.33 | 6 |
| | 1730 | 491.50 | 8.5 |
| **Wheeling and Lake Erie Railroad Bridge, River Mile 71.5** | | | |
| 11-13-91 | 0945 | 507.75 | 2 |
| | 1840 | 516.67 | 9 |
| **Near Town of Wellsburg, River Mile 74.5** | | | |
| 11-14-91 | 1620 | 538.33 | 3 |
| 11-15-91 | 1700 | 563.00 | 13 |
| 11-17-91 | 0700 | 601.00 | 7 |
| **Interstate 470 Highway Bridge, River Mile 92.0** | | | |
| 11-19-91 | 1745 | 659.75 | 3 |
| 11-20-91 | 0912 | 675.20 | 6 |
| **Moundsville Highway Bridge, River Mile 102.0** | | | |
| 11-21-91 | 1355 | 703.92 | 1 |
| | 1840 | 708.67 | 1 |
| 11-22-91 | 0915 | 723.25 | 2.5 |
| | 1845 | 732.75 | 4 |

**Table 8.** Unit water-surface elevations at the indicated locks-and-dams in the upper Ohio River study area

[Time is Eastern Standard military time. Elapsed time is in percentage of hours since injection. Elevation is in feet above sea level]

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at Emsworth Locks-and-Dams, downstream of dams at RM 6.2** | | | |
| 10-20-91 | 0100 | -77.00 | 693.5 |
| 10-21-91 | 1000 | -44.00 | 693.5 |
| | 1300 | -41.00 | 693.6 |
| | 1600 | -38.00 | 693.6 |
| | 1900 | -35.00 | 693.5 |
| 10-24-91 | 0700 | 25.00 | 693.5 |
| | 1000 | 28.00 | 693.3 |
| 10-28-91 | 1400 | 128.00 | 693.3 |
| | 1700 | 131.00 | 693.1 |
| | 2000 | 134.00 | 693.0 |
| 11-01-91 | 2300 | 233.00 | 693.0 |
| 11-02-91 | 0200 | 236.00 | 693.1 |
| | 0500 | 239.00 | 693.2 |
| | 0800 | 242.00 | 693.2 |
| | 1100 | 245.00 | 693.4 |
| | 1400 | 248.00 | 693.4 |
| | 1700 | 251.00 | 693.3 |
| | 2000 | 254.00 | 693.2 |
| 11-03-91 | 0800 | 266.00 | 693.2 |
| | 1100 | 269.00 | 693.0 |
| | 2300 | 281.00 | 693.0 |
| 11-04-91 | 0200 | 284.00 | 693.1 |
| | 1400 | 296.00 | 693.1 |
| | 1700 | 299.00 | 693.0 |
| | 2300 | 305.00 | 693.0 |
| 11-05-91 | 0200 | 308.00 | 693.1 |
| | 0500 | 311.00 | 693.3 |
| | 0800 | 314.00 | 693.3 |
| | 1100 | 317.00 | 693.2 |
| | 1400 | 320.00 | 693.1 |
| 11-06-91 | 0800 | 338.00 | 693.1 |
| | 1100 | 341.00 | 693.0 |
| 11-10-91 | 2000 | 446.00 | 693.0 |
| | 2300 | 449.00 | 693.1 |
| 11-11-91 | 0200 | 452.00 | 693.0 |
| | 0800 | 458.00 | 693.0 |
| | 1100 | 461.00 | 693.1 |
| 11-12-91 | 0200 | 476.00 | 693.1 |
| | 0500 | 479.00 | 693.0 |
| | 0800 | 482.00 | 693.0 |
| | 1100 | 484.00 | 693.1 |
| 11-13-91 | 0800 | 506.00 | 693.1 |
| | 1100 | 509.00 | 693.0 |
| | 1400 | 512.00 | 693.0 |
| | 1700 | 515.00 | 693.1 |
| 11-14-91 | 0200 | 524.00 | 693.1 |
| | 0500 | 527.00 | 693.0 |
| | 2300 | 545.00 | 693.0 |
| 11-15-91 | 0200 | 548.00 | 693.1 |
| 11-19-91 | 1400 | 656.00 | 693.1 |
| | 1700 | 659.00 | 693.5 |
| | 2300 | 665.00 | 693.5 |
| 11-20-91 | 0200 | 668.00 | 693.1 |
| 11-22-91 | 0800 | 722.00 | 693.1 |
| | 1100 | 725.00 | 693.2 |
| | 1400 | 728.00 | 693.3 |
| | 1700 | 731.00 | 693.8 |
| | 2000 | 734.00 | 694.2 |
| | 2300 | 737.00 | 694.4 |
| 11-23-91 | 0200 | 740.00 | 695.2 |
| | 0500 | 743.00 | 695.2 |
| | 0800 | 746.00 | 695.4 |
| | 1100 | 749.00 | 695.8 |
| | 1400 | 752.00 | 696.2 |
| | 1700 | 755.00 | 695.9 |
| | 2000 | 758.00 | 695.7 |
| | 2300 | 761.00 | 695.4 |
| 11-24-91 | 0200 | 764.00 | 695.4 |
| | 0500 | 767.00 | 695.2 |
| | 0800 | 770.00 | 695.2 |
| | 1100 | 773.00 | 694.6 |
| | 1400 | 776.00 | 694.7 |
| | 1700 | 779.00 | 694.5 |
| | 2000 | 782.00 | 694.4 |
| | 2300 | 785.00 | 694.1 |
| **Ohio River at Dashields Locks-and-Dam, upstream of dam at RM 13.3** | | | |
| 10-20-91 | 0100 | -77.00 | 693.5 |
| | 0400 | -74.00 | 693.6 |
| | 0700 | -71.00 | 693.6 |
| | 1000 | -68.00 | 693.5 |
| | 1900 | -59.00 | 693.5 |
| | 2200 | -56.00 | 693.6 |
| 10-21-91 | 0100 | -53.00 | 693.5 |
| | 0400 | -50.00 | 693.4 |
| | 1300 | -41.00 | 693.4 |
| | 1600 | -38.00 | 693.3 |
| | 1900 | -35.00 | 693.3 |
| | 2200 | -32.00 | 693.4 |
| 10-22-91 | 0100 | -29.00 | 693.4 |
| | 0400 | -26.00 | 693.8 |
| | 0700 | -23.00 | 693.4 |
| | 1000 | -20.00 | 693.7 |
| | 1300 | -17.00 | 693.7 |
| | 2200 | -8.00 | 693.6 |

**Table 8.** Unit water-surface elevations at the indicated locks-and-dams in the upper Ohio River study area—*Continued*

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at Dashields Locks-and-Dam, upstream of dam at RM 13.3—*Continued*** | | | |
| 10-23-91 | 0100 | -5.00 | 693.6 |
| | 0400 | -2.00 | 693.5 |
| | 0700 | 1.00 | 693.4 |
| | 1600 | 10.00 | 693.4 |
| | 1900 | 13.00 | 693.6 |
| | 2200 | 16.00 | 693.5 |
| 10-24-91 | 0700 | 25.00 | 693.5 |
| | 1000 | 28.00 | 693.6 |
| | 1300 | 31.00 | 693.5 |
| | 2200 | 40.00 | 693.5 |
| 10-25-91 | 0100 | 43.00 | 693.6 |
| | 0400 | 46.00 | 693.6 |
| | 0700 | 49.00 | 693.5 |
| | 1600 | 58.00 | 693.5 |
| | 1900 | 61.00 | 693.6 |
| 10-26-91 | 0500 | 71.00 | 693.6 |
| | 0800 | 74.00 | 693.5 |
| | 1100 | 77.00 | 693.5 |
| | 1400 | 80.00 | 693.3 |
| | 1700 | 83.00 | 693.4 |
| | 2000 | 86.00 | 693.3 |
| 10-27-91 | 0500 | 95.00 | 693.3 |
| | 0800 | 98.00 | 693.4 |
| 10-29-91 | 0200 | 140.00 | 693.4 |
| | 0500 | 143.00 | 693.3 |
| | 1100 | 149.00 | 693.3 |
| | 1400 | 152.00 | 693.4 |
| 10-30-91 | 0500 | 167.00 | 693.4 |
| | 0800 | 170.00 | 693.3 |
| | 1100 | 173.00 | 693.4 |
| 10-31-91 | 0800 | 194.00 | 693.4 |
| | 1100 | 197.00 | 693.5 |
| | 1400 | 200.00 | 693.4 |
| 11-01-91 | 0200 | 212.00 | 693.4 |
| | 0500 | 215.00 | 693.3 |
| | 0800 | 218.00 | 693.5 |
| | 2000 | 230.00 | 693.5 |
| | 2300 | 233.00 | 693.4 |
| 11-02-91 | 0500 | 239.00 | 693.4 |
| | 0800 | 242.00 | 693.5 |
| | 1100 | 245.00 | 693.7 |
| | 1700 | 251.00 | 693.7 |
| | 2000 | 254.00 | 693.6 |
| | 2300 | 257.00 | 693.6 |
| 11-03-91 | 0200 | 260.00 | 693.5 |
| | 0500 | 263.00 | 693.4 |
| | 0800 | 266.00 | 693.3 |
| | 1100 | 269.00 | 693.4 |
| | 1400 | 272.00 | 693.3 |
| | 1700 | 275.00 | 693.3 |
| | 2000 | 278.00 | 693.4 |

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at Dashields Locks-and-Dam, upstream of dam at RM 13.3—*Continued*** | | | |
| 11-04-91 | 0500 | 287.00 | 693.4 |
| | 0800 | 290.00 | 693.3 |
| | 2000 | 302.00 | 693.3 |
| | 2300 | 305.00 | 693.5 |
| 11-05-91 | 0200 | 308.00 | 693.6 |
| | 0500 | 311.00 | 693.7 |
| | 0800 | 314.00 | 693.4 |
| | 1100 | 317.00 | 693.7 |
| | 1700 | 323.00 | 693.7 |
| | 2000 | 326.00 | 693.4 |
| 11-08-91 | 1700 | 395.00 | 693.4 |
| | 2000 | 398.00 | 693.5 |
| | 2300 | 401.00 | 693.4 |
| 11-09-91 | 1700 | 419.00 | 693.4 |
| | 2000 | 422.00 | 693.5 |
| | 2300 | 425.00 | 693.4 |
| 11-10-91 | 2300 | 449.00 | 693.4 |
| 11-11-91 | 0200 | 452.00 | 693.5 |
| | 0500 | 455.00 | 693.5 |
| | 0800 | 458.00 | 693.6 |
| | 1100 | 461.00 | 693.7 |
| | 1700 | 467.00 | 693.7 |
| | 2000 | 470.00 | 693.8 |
| | 2300 | 473.00 | 693.9 |
| 11-12-91 | 0200 | 476.00 | 693.9 |
| | 0500 | 479.00 | 693.8 |
| | 0800 | 482.00 | 693.7 |
| | 1100 | 485.00 | 693.6 |
| | 1700 | 491.00 | 693.6 |
| | 2000 | 494.00 | 693.5 |
| 11-13-91 | 0200 | 500.00 | 693.5 |
| | 0500 | 503.00 | 693.6 |
| | 0800 | 506.00 | 693.5 |
| 11-15-91 | 0800 | 554.00 | 693.5 |
| | 1100 | 557.00 | 693.6 |
| | 1400 | 560.00 | 693.6 |
| | 1700 | 563.00 | 693.5 |
| 11-16-91 | 0500 | 575.00 | 693.5 |
| | 0800 | 578.00 | 693.4 |
| | 1400 | 584.00 | 693.4 |
| | 1700 | 587.00 | 693.5 |
| 11-18-91 | 0500 | 623.00 | 693.5 |
| | 0800 | 626.00 | 693.4 |
| 11-19-91 | 0800 | 650.00 | 693.4 |
| | 1100 | 653.00 | 693.5 |
| | 1400 | 656.00 | 693.5 |
| | 1700 | 659.00 | 693.4 |
| 11-20-91 | 0200 | 668.00 | 693.4 |
| | 0500 | 671.00 | 693.5 |
| | 0800 | 674.00 | 693.4 |
| | 1100 | 677.00 | 693.5 |

**Table 8.** Unit water-surface elevations at the indicated locks-and-dams in the upper Ohio River study area—*Continued*

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at Dashields Locks-and-Dam, upstream of dam at RM 13.3—*Continued*** | | | |
| 11-21-91 | 0800 | 698.00 | 693.5 |
| | 1100 | 701.00 | 693.6 |
| | 2000 | 710.00 | 693.6 |
| | 2300 | 713.00 | 693.5 |
| 11-22-91 | 0800 | 722.00 | 693.5 |
| | 1100 | 725.00 | 693.6 |
| | 1400 | 727.00 | 693.8 |
| | 1700 | 730.00 | 694.0 |
| | 2000 | 733.00 | 694.2 |
| | 2300 | 736.00 | 694.5 |
| 11-23-91 | 0200 | 740.00 | 695.1 |
| | 0500 | 743.00 | 695.3 |
| | 0800 | 746.00 | 695.5 |
| | 1100 | 749.00 | 695.5 |
| | 1400 | 752.00 | 695.9 |
| | 1700 | 755.00 | 695.7 |
| | 2000 | 758.00 | 695.6 |
| | 2300 | 761.00 | 695.4 |
| 11-24-91 | 0200 | 764.00 | 695.3 |
| | 0500 | 767.00 | 695.3 |
| | 0800 | 770.00 | 695.2 |
| | 1100 | 773.00 | 695.1 |
| | 1400 | 776.00 | 694.8 |
| | 1700 | 779.00 | 694.7 |
| | 2000 | 782.00 | 694.5 |
| | 2300 | 785.00 | 694.2 |
| **Ohio River at Dashields Locks-and-Dam, downstream of dam at RM 13.3** | | | |
| 10-20-91 | 0100 | -77.00 | 683.2 |
| | 1300 | -65.00 | 683.2 |
| | 1600 | -62.00 | 683.1 |
| | 1900 | -59.00 | 683.2 |
| 10-21-91 | 1300 | -41.00 | 683.2 |
| | 1600 | -38.00 | 683.1 |
| | 1900 | -35.00 | 683.2 |
| | 2200 | -32.00 | 683.2 |
| 10-22-91 | 0100 | -29.00 | 683.3 |
| | 0400 | -26.00 | 683.4 |
| | 1300 | -17.00 | 683.4 |
| | 1600 | -14.00 | 683.3 |
| | 1900 | -11.00 | 683.3 |
| | 2300 | -8.00 | 683.2 |
| 10-23-91 | 0100 | -5.00 | 683.2 |
| | 0400 | -2.00 | 683.1 |
| | 0700 | 1.00 | 683.1 |
| | 1000 | 4.00 | 683.0 |
| | 1600 | 10.00 | 683.0 |
| | 1900 | 13.00 | 683.2 |
| 10-24-91 | 0400 | 22.00 | 683.2 |
| | 0700 | 25.00 | 683.3 |
| | 1000 | 28.00 | 683.3 |
| | 1300 | 31.00 | 683.2 |

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at Dashields Locks-and-Dam, downstream of dam at RM 13.3—*Continued*** | | | |
| 10-25-91 | 0100 | 43.00 | 683.2 |
| | 0400 | 46.00 | 683.3 |
| | 0700 | 49.00 | 683.4 |
| | 1300 | 55.00 | 683.4 |
| | 1600 | 58.00 | 683.3 |
| | 1900 | 61.00 | 683.4 |
| | 2200 | 64.00 | 683.4 |
| 10-26-91 | 0200 | 68.00 | 683.3 |
| | 0500 | 71.00 | 683.2 |
| | 0800 | 74.00 | 683.2 |
| | 1100 | 77.00 | 683.1 |
| | 1400 | 80.00 | 683.0 |
| | 1700 | 83.00 | 683.1 |
| | 2300 | 89.00 | 683.1 |
| 10-27-91 | 0200 | 92.00 | 683.2 |
| | 1100 | 101.00 | 683.2 |
| | 1400 | 104.00 | 683.4 |
| | 2300 | 113.00 | 683.4 |
| 10-28-91 | 0200 | 116.00 | 683.3 |
| | 1100 | 125.00 | 683.3 |
| | 1400 | 128.00 | 683.2 |
| 10-29-91 | 2300 | 161.00 | 683.2 |
| | 0200 | 164.00 | 683.3 |
| | 0500 | 167.00 | 683.3 |
| | 0800 | 170.00 | 683.4 |
| | 1100 | 173.00 | 683.4 |
| | 1400 | 176.00 | 683.3 |
| 11-01-91 | 0200 | 212.00 | 683.3 |
| | 0500 | 215.00 | 683.2 |
| | 0800 | 218.00 | 683.3 |
| | 1100 | 221.00 | 683.1 |
| | 2000 | 230.00 | 683.1 |
| | 2300 | 233.00 | 683.2 |
| 11-02-91 | 0800 | 242.00 | 683.2 |
| | 1100 | 245.00 | 683.3 |
| | 1700 | 251.00 | 683.3 |
| | 2000 | 254.00 | 683.4 |
| | 2300 | 257.00 | 683.4 |
| 11-03-91 | 0200 | 260.00 | 683.2 |
| | 0500 | 263.00 | 683.1 |
| | 0800 | 266.00 | 683.1 |
| | 1100 | 269.00 | 683.2 |
| | 1400 | 272.00 | 683.1 |
| | 1700 | 275.00 | 683.2 |
| 11-04-91 | 2300 | 305.00 | 683.2 |
| 11-05-91 | 0200 | 308.00 | 683.3 |
| | 0500 | 311.00 | 683.4 |
| | 1400 | 320.00 | 683.4 |
| | 1700 | 323.00 | 683.2 |
| | 2000 | 326.00 | 683.2 |
| | 2300 | 329.00 | 683.1 |

**Table 8.** Unit water-surface elevations at the indicated locks-and-dams in the upper Ohio River study area—*Continued*

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at Dashields Locks-and-Dam, downstream of dam at RM 13.3—*Continued*** | | | |
| 11-06-91 | 0800 | 338.00 | 683.1 |
| | 1100 | 341.00 | 683.2 |
| | 1400 | 344.00 | 683.2 |
| | 1700 | 347.00 | 683.1 |
| | 2000 | 350.00 | 683.0 |
| | 2300 | 353.00 | 683.2 |
| 11-07-91 | 1400 | 368.00 | 683.2 |
| | 1700 | 372.00 | 683.3 |
| | 2000 | 375.00 | 683.3 |
| | 2300 | 378.00 | 683.2 |
| 11-08-91 | 0200 | 381.00 | 683.3 |
| | 1400 | 392.00 | 683.3 |
| | 1700 | 395.00 | 683.4 |
| 11-09-91 | 1400 | 416.00 | 683.4 |
| | 1700 | 419.00 | 683.3 |
| | 2000 | 422.00 | 683.4 |
| 11-10-91 | 0200 | 428.00 | 683.4 |
| | 0500 | 431.00 | 683.3 |
| 11-11-91 | 0800 | 458.00 | 683.3 |
| | 1100 | 461.00 | 683.5 |
| | 1400 | 464.00 | 683.5 |
| | 1700 | 467.00 | 683.4 |
| 11-12-91 | 2000 | 494.00 | 683.4 |
| | 2300 | 497.00 | 683.3 |
| 11-13-91 | 0200 | 500.00 | 683.2 |
| | 0500 | 503.00 | 683.3 |
| | 0800 | 506.00 | 683.2 |
| | 1100 | 509.00 | 683.1 |
| | 1400 | 512.00 | 683.1 |
| | 1700 | 515.00 | 683.2 |
| 11-15-91 | 0200 | 548.00 | 683.2 |
| | 0500 | 551.00 | 683.1 |
| | 0800 | 554.00 | 683.1 |
| | 1100 | 557.00 | 683.2 |
| | 1400 | 560.00 | 683.2 |
| | 1700 | 563.00 | 683.1 |
| 11-16-91 | 0500 | 575.00 | 683.1 |
| | 0800 | 578.00 | 683.0 |
| | 1700 | 587.00 | 683.0 |
| | 2000 | 590.00 | 683.2 |
| | 2300 | 593.00 | 683.4 |
| 11-17-91 | 0200 | 596.00 | 683.3 |
| | 1400 | 608.00 | 683.3 |
| | 1700 | 611.00 | 683.4 |
| | 2000 | 614.00 | 683.3 |
| | 2300 | 617.00 | 683.4 |
| 11-18-91 | 0200 | 620.00 | 683.3 |
| | 0800 | 626.00 | 683.3 |
| | 1100 | 629.00 | 683.2 |
| 11-19-91 | 0800 | 650.00 | 683.2 |
| | 1100 | 653.00 | 683.3 |

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at Dashields Locks-and-Dam, downstream of dam at RM 13.3—*Continued*** | | | |
| 11-20-91 | 1700 | 683.00 | 683.3 |
| | 2000 | 686.00 | 683.2 |
| 11-21-91 | 1400 | 704.00 | 683.2 |
| | 1700 | 707.00 | 683.3 |
| 11-22-91 | 0500 | 719.00 | 683.3 |
| | 0800 | 722.00 | 683.2 |
| | 1100 | 725.00 | 683.2 |
| | 1400 | 727.00 | 683.5 |
| | 1700 | 730.00 | 683.7 |
| | 2000 | 733.00 | 683.8 |
| 11-23-91 | 0200 | 740.00 | 683.8 |
| | 0500 | 743.00 | 683.9 |
| | 0800 | 746.00 | 684.2 |
| | 1100 | 749.00 | 684.2 |
| | 1400 | 752.00 | 684.6 |
| | 1700 | 755.00 | 684.4 |
| | 2000 | 758.00 | 684.1 |
| | 2300 | 761.00 | 684.0 |
| 11-24-91 | 0200 | 764.00 | 683.9 |
| | 0800 | 770.00 | 683.9 |
| | 1100 | 773.00 | 683.8 |
| | 1400 | 776.00 | 683.7 |
| | 1700 | 779.00 | 683.4 |
| | 2000 | 782.00 | 683.4 |
| | 2300 | 785.00 | 683.3 |
| **Ohio River at Montgomery Locks-and-Dam, upstream of dam at RM 31.7** | | | |
| 10-20-91 | 0100 | -77.00 | 683.0 |
| | 1300 | -65.00 | 683.0 |
| | 1600 | -62.00 | 682.9 |
| | 1900 | -59.00 | 683.0 |
| 10-21-91 | 0100 | -53.00 | 683.0 |
| | 0400 | -50.00 | 682.9 |
| | 1900 | -35.00 | 682.9 |
| | 2200 | -32.00 | 683.0 |
| 10-22-91 | 0100 | -29.00 | 683.1 |
| | 0400 | -26.00 | 683.2 |
| | 0700 | -23.00 | 683.1 |
| | 1300 | -17.00 | 683.1 |
| | 1600 | -14.00 | 683.0 |
| 10-23-91 | 0100 | -5.00 | 683.0 |
| | 0400 | -2.00 | 682.9 |
| | 0700 | 1.00 | 682.8 |
| | 1300 | 7.00 | 682.8 |
| | 1600 | 10.00 | 682.9 |
| | 1900 | 13.00 | 683.0 |
| | 2200 | 16.00 | 683.0 |
| 10-24-91 | 0100 | 19.00 | 683.2 |
| | 0400 | 22.00 | 683.2 |
| | 0700 | 25.00 | 683.1 |
| | 1000 | 28.00 | 683.0 |

**Table 8.** Unit water-surface elevations at the indicated locks-and-dams in the upper Ohio River study area—*Continued*

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at Montgomery Locks-and-Dam, upstream of dam at RM 31.7—*Continued*** | | | |
| 10-25-91 | 0700 | 49.00 | 683.0 |
| | 1000 | 52.00 | 683.1 |
| | 1900 | 61.00 | 683.1 |
| | 2300 | 64.00 | 683.2 |
| 10-26-91 | 0200 | 68.00 | 683.0 |
| | 0800 | 74.00 | 683.0 |
| | 1100 | 77.00 | 682.9 |
| | 2000 | 86.00 | 682.9 |
| | 2300 | 89.00 | 683.0 |
| 10-27-91 | 0800 | 98.00 | 683.0 |
| | 1100 | 101.00 | 683.1 |
| 10-28-91 | 0500 | 119.00 | 683.1 |
| | 0800 | 122.00 | 683.0 |
| 10-29-91 | 0800 | 146.00 | 683.0 |
| | 1100 | 149.00 | 682.9 |
| | 1400 | 152.00 | 682.9 |
| | 1700 | 155.00 | 683.0 |
| 10-30-91 | 0200 | 164.00 | 683.0 |
| | 0500 | 167.00 | 683.1 |
| | 1400 | 176.00 | 683.1 |
| | 1700 | 179.00 | 683.0 |
| 10-31-91 | 0800 | 194.00 | 683.0 |
| | 1100 | 197.00 | 683.1 |
| | 1700 | 203.00 | 683.1 |
| | 2000 | 206.00 | 683.0 |
| | 2300 | 209.00 | 683.0 |
| 11-01-91 | 0200 | 212.00 | 682.9 |
| | 0800 | 218.00 | 682.9 |
| | 1100 | 221.00 | 682.8 |
| | 1400 | 224.00 | 682.9 |
| | 1700 | 227.00 | 683.0 |
| | 2300 | 233.00 | 683.0 |
| 11-02-91 | 0200 | 236.00 | 682.9 |
| 11-04-91 | 1700 | 299.00 | 682.9 |
| | 2000 | 302.00 | 683.0 |
| 11-05-91 | 0200 | 308.00 | 683.0 |
| | 0500 | 311.00 | 683.1 |
| | 1400 | 320.00 | 683.1 |
| | 1700 | 323.00 | 683.0 |
| | 2000 | 326.00 | 683.0 |
| | 2300 | 329.00 | 682.9 |
| 11-07-91 | 0800 | 362.00 | 682.9 |
| | 1100 | 365.00 | 683.0 |
| 11-08-91 | 0200 | 380.00 | 683.0 |
| | 0500 | 383.00 | 683.1 |
| 11-09-91 | 1700 | 419.00 | 683.1 |
| | 2000 | 422.00 | 683.2 |
| | 2300 | 425.00 | 683.1 |
| 11-10-91 | 1400 | 440.00 | 683.1 |
| | 1700 | 443.00 | 683.0 |
| | 2000 | 446.00 | 683.1 |

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at Montgomery Locks-and-Dam, upstream of dam at RM 31.7—*Continued*** | | | |
| 11-11-91 | 1100 | 461.00 | 683.1 |
| | 1400 | 464.00 | 683.0 |
| | 1700 | 467.00 | 683.1 |
| 11-12-91 | 0800 | 482.00 | 683.1 |
| | 1100 | 485.00 | 683.2 |
| | 1400 | 488.00 | 683.1 |
| | 1700 | 491.00 | 683.1 |
| | 2000 | 494.00 | 683.0 |
| 11-13-91 | 0800 | 506.00 | 683.0 |
| | 1100 | 509.00 | 682.9 |
| 11-14-91 | 0500 | 527.00 | 682.9 |
| | 0800 | 530.00 | 683.0 |
| | 1400 | 536.00 | 683.0 |
| | 1700 | 539.00 | 682.9 |
| 11-17-91 | 0500 | 599.00 | 682.9 |
| | 0800 | 602.00 | 683.0 |
| | 1100 | 605.00 | 683.0 |
| | 1400 | 608.00 | 683.1 |
| | 1700 | 611.00 | 683.1 |
| | 2000 | 614.00 | 683.0 |
| 11-19-91 | 1400 | 656.00 | 683.0 |
| | 1700 | 659.00 | 683.1 |
| | 2300 | 665.00 | 683.1 |
| 11-20-91 | 0200 | 668.00 | 683.2 |
| | 0500 | 671.00 | 683.2 |
| | 0800 | 674.00 | 683.1 |
| | 1100 | 677.00 | 683.0 |
| 11-21-91 | 1100 | 701.00 | 683.0 |
| | 1400 | 704.00 | 683.1 |
| | 1700 | 707.00 | 683.0 |
| 11-22-91 | 1100 | 725.00 | 683.0 |
| | 1400 | 728.00 | 683.1 |
| | 1700 | 731.00 | 683.3 |
| | 2000 | 734.00 | 683.2 |
| | 2300 | 737.00 | 683.1 |
| 11-23-91 | 0200 | 740.00 | 682.9 |
| | 0500 | 743.00 | 683.0 |
| | 0800 | 746.00 | 683.1 |
| | 1100 | 749.00 | 683.0 |
| | 1700 | 755.00 | 683.0 |
| | 2000 | 758.00 | 682.8 |
| | 2300 | 761.00 | 683.0 |
| 11-24-91 | 0200 | 764.00 | 683.0 |
| | 0500 | 767.00 | 682.9 |
| | 0800 | 770.00 | 683.0 |
| | 1100 | 773.00 | 683.1 |
| | 1400 | 776.00 | 683.0 |
| | 1700 | 779.00 | 682.9 |
| | 2000 | 782.00 | 683.0 |
| | 2300 | 785.00 | 683.0 |

**Table 8.** Unit water-surface elevations at the indicated locks-and-dams in the upper Ohio River study area—*Continued*

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at Montgomery Locks-and-Dam, downstream of dam at RM 31.7** | | | |
| 10-20-91 | 0100 | -77.00 | 665.6 |
| | 0700 | -71.00 | 665.6 |
| | 1000 | -68.00 | 665.5 |
| | 2200 | -56.00 | 665.5 |
| 10-21-91 | 0100 | -53.00 | 665.4 |
| | 0400 | -50.00 | 665.3 |
| | 1000 | -44.00 | 665.3 |
| | 1300 | -41.00 | 665.2 |
| | 2200 | -32.00 | 665.2 |
| 10-22-91 | 0100 | -29.00 | 665.4 |
| | 0400 | -26.00 | 665.5 |
| | 0700 | -23.00 | 665.5 |
| | 1000 | -20.00 | 665.7 |
| 10-23-91 | 0100 | -5.00 | 665.7 |
| | 0400 | -2.00 | 665.6 |
| | 0700 | 1.00 | 665.4 |
| | 1000 | 4.00 | 665.3 |
| | 1900 | 13.00 | 665.3 |
| | 2200 | 16.00 | 665.4 |
| 10-24-91 | 0100 | 19.00 | 665.5 |
| | 0400 | 22.00 | 665.6 |
| | 0700 | 25.00 | 665.7 |
| | 1900 | 37.00 | 665.7 |
| | 2200 | 40.00 | 665.5 |
| 10-25-91 | 1600 | 58.00 | 665.5 |
| | 1900 | 61.00 | 665.7 |
| | 2300 | 64.00 | 665.8 |
| 10-26-91 | 0500 | 71.00 | 665.8 |
| | 0800 | 74.00 | 665.7 |
| | 1100 | 77.00 | 665.5 |
| | 1400 | 80.00 | 665.3 |
| | 1700 | 83.00 | 665.4 |
| | 2000 | 86.00 | 665.3 |
| | 2300 | 89.00 | 665.4 |
| 10-27-91 | 0200 | 92.00 | 665.5 |
| | 0500 | 95.00 | 665.5 |
| | 0800 | 98.00 | 665.6 |
| | 1100 | 101.00 | 665.7 |
| 10-28-91 | 0800 | 122.00 | 665.7 |
| | 1100 | 125.00 | 665.6 |
| | 1400 | 128.00 | 665.7 |
| | 1700 | 131.00 | 665.6 |
| | 2000 | 134.00 | 665.4 |
| | 2300 | 137.00 | 665.5 |
| 10-29-91 | 0800 | 146.00 | 665.5 |
| | 1100 | 149.00 | 665.4 |
| | 1400 | 152.00 | 665.4 |
| | 1700 | 155.00 | 665.3 |
| 10-30-91 | 0500 | 167.00 | 665.3 |
| | 0800 | 170.00 | 665.4 |
| | 1100 | 173.00 | 665.3 |
| | 1900 | 182.00 | 665.3 |
| | 2300 | 185.00 | 665.4 |

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at Montgomery Locks-and-Dam, downstream of dam at RM 31.7—*Continued*** | | | |
| 10-31-91 | 0200 | 188.00 | 665.5 |
| | 0500 | 191.00 | 665.6 |
| | 1400 | 200.00 | 665.6 |
| | 1700 | 203.00 | 665.8 |
| 11-01-91 | 0200 | 212.00 | 665.8 |
| | 0500 | 215.00 | 665.7 |
| | 1100 | 221.00 | 665.7 |
| | 1400 | 224.00 | 665.6 |
| | 1700 | 227.00 | 665.5 |
| | 2000 | 230.00 | 665.4 |
| | 2300 | 233.00 | 665.4 |
| 11-02-91 | 0200 | 236.00 | 665.8 |
| | 0500 | 239.00 | 665.6 |
| | 0800 | 242.00 | 665.6 |
| | 1100 | 245.00 | 665.5 |
| | 1400 | 248.00 | 665.5 |
| | 1700 | 251.00 | 665.4 |
| | 2000 | 254.00 | 665.3 |
| 11-03-91 | 0200 | 260.00 | 665.8 |
| | 0500 | 263.00 | 665.6 |
| | 0800 | 266.00 | 665.6 |
| | 1100 | 269.00 | 665.5 |
| | 1400 | 272.00 | 665.5 |
| | 1700 | 275.00 | 665.4 |
| | 2000 | 278.00 | 665.3 |
| | 2300 | 281.00 | 665.3 |
| 11-04-91 | 0200 | 284.00 | 665.5 |
| | 1100 | 293.00 | 665.5 |
| | 1400 | 296.00 | 665.6 |
| | 1700 | 299.00 | 665.6 |
| | 2000 | 302.00 | 665.5 |
| | 2300 | 305.00 | 665.4 |
| 11-05-91 | 0200 | 308.00 | 665.5 |
| | 0500 | 311.00 | 665.6 |
| | 0800 | 314.00 | 665.8 |
| | 1100 | 317.00 | 665.7 |
| | 1700 | 323.00 | 665.7 |
| | 2000 | 326.00 | 665.6 |
| | 2300 | 329.00 | 665.4 |
| 11-06-91 | 0200 | 332.00 | 665.3 |
| | 0500 | 335.00 | 665.3 |
| | 0800 | 338.00 | 665.5 |
| | 1700 | 347.00 | 665.5 |
| | 2000 | 350.00 | 665.4 |
| 11-07-91 | 1400 | 368.00 | 665.4 |
| | 1700 | 371.00 | 665.5 |
| | 2000 | 374.00 | 665.4 |
| 11-08-91 | 0800 | 386.00 | 665.4 |
| | 1100 | 389.00 | 665.5 |
| | 1700 | 395.00 | 665.5 |
| | 2000 | 398.00 | 665.4 |
| | 2300 | 401.00 | 665.4 |

**Table 8.** Unit water-surface elevations at the indicated locks-and-dams in the upper Ohio River study area—*Continued*

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at Montgomery Locks-and-Dam, downstream of dam at RM 31.7—*Continued*** | | | |
| 11-09-91 | 0200 | 404.00 | 665.3 |
| | 0500 | 407.00 | 665.4 |
| | 1700 | 419.00 | 665.4 |
| | 2000 | 422.00 | 665.5 |
| | 2300 | 425.00 | 665.5 |
| 11-10-91 | 0200 | 428.00 | 665.6 |
| | 1700 | 443.00 | 665.6 |
| | 2000 | 446.00 | 665.5 |
| | 2300 | 449.00 | 665.5 |
| 11-11-91 | 0200 | 452.00 | 665.7 |
| | 2000 | 470.00 | 665.7 |
| | 2300 | 473.00 | 665.8 |
| 11-12-91 | 0500 | 479.00 | 665.8 |
| | 0800 | 482.00 | 665.7 |
| | 1100 | 485.00 | 665.6 |
| | 1400 | 488.00 | 665.5 |
| 11-13-91 | 1100 | 509.00 | 665.5 |
| | 1400 | 512.00 | 665.3 |
| 11-14-91 | 0500 | 527.00 | 665.3 |
| | 0800 | 530.00 | 665.4 |
| | 1700 | 539.00 | 665.4 |
| | 2000 | 540.00 | 665.5 |
| 11-15-91 | 1700 | 563.00 | 665.5 |
| | 2000 | 566.00 | 665.6 |
| 11-16-91 | 0200 | 572.00 | 665.6 |
| | 0500 | 575.00 | 665.7 |
| | 0800 | 578.00 | 665.8 |
| | 1100 | 581.00 | 665.6 |
| | 1400 | 584.00 | 665.6 |
| | 1700 | 587.00 | 665.5 |
| | 2000 | 590.00 | 665.6 |
| 11-17-91 | 0200 | 596.00 | 665.6 |
| | 0500 | 599.00 | 665.5 |
| | 1700 | 611.00 | 665.5 |
| | 2000 | 614.00 | 665.4 |
| | 2300 | 617.00 | 665.4 |
| 11-18-91 | 0200 | 620.00 | 665.3 |
| | 0800 | 626.00 | 665.3 |
| | 1100 | 629.00 | 665.4 |
| | 1700 | 635.00 | 665.4 |
| | 2000 | 638.00 | 665.3 |
| 11-19-91 | 1100 | 653.00 | 665.3 |
| | 1400 | 656.00 | 665.2 |
| | 1700 | 659.00 | 665.2 |
| | 2000 | 662.00 | 665.3 |
| 11-20-91 | 0200 | 668.00 | 665.3 |
| | 0500 | 671.00 | 665.2 |
| | 0800 | 674.00 | 665.3 |
| | 1400 | 680.00 | 665.3 |
| | 1700 | 683.00 | 665.5 |
| | 2000 | 686.00 | 665.7 |
| 11-21-91 | 0800 | 698.00 | 665.7 |
| | 1100 | 701.00 | 665.6 |
| | 1400 | 704.00 | 665.7 |
| 11-22-91 | 0500 | 719.00 | 665.7 |
| | 0800 | 722.00 | 665.6 |
| | 1400 | 728.00 | 665.6 |
| | 1700 | 731.00 | 665.7 |
| | 2000 | 734.00 | 666.0 |
| | 2300 | 737.00 | 666.3 |
| 11-23-91 | 0200 | 740.00 | 666.2 |
| | 0500 | 743.00 | 666.0 |
| | 0800 | 746.00 | 666.0 |
| | 1100 | 749.00 | 666.1 |
| | 1400 | 752.00 | 666.6 |
| | 1700 | 755.00 | 666.8 |
| | 2000 | 758.00 | 666.4 |
| | 2300 | 761.00 | 666.0 |
| 11-24-91 | 0200 | 764.00 | 666.0 |
| | 0500 | 767.00 | 666.1 |
| | 0800 | 770.00 | 666.1 |
| | 1100 | 773.00 | 666.0 |
| | 1400 | 776.00 | 665.8 |
| | 1700 | 779.00 | 665.7 |
| | 2000 | 782.00 | 665.5 |
| | 2300 | 785.00 | 665.3 |
| **Ohio River at New Cumberland Locks-and-Dam, upstream of dam at RM 54.4** | | | |
| 10-20-91 | 0100 | -77.00 | 665.7 |
| | 1900 | -59.00 | 665.7 |
| | 2200 | -56.00 | 665.6 |
| 10-21-91 | 0700 | -47.00 | 665.6 |
| | 1000 | -44.00 | 665.5 |
| | 1300 | -41.00 | 665.5 |
| | 1600 | -38.00 | 665.4 |
| | 2200 | -32.00 | 665.4 |
| 10-22-91 | 0100 | -29.00 | 665.5 |
| | 0400 | -26.00 | 665.7 |
| | 0700 | -23.00 | 665.8 |
| | 1900 | -11.00 | 665.8 |
| | 2200 | -8.00 | 665.7 |
| 10-23-91 | 0100 | -5.00 | 665.8 |
| | 0400 | -2.00 | 665.7 |
| | 0700 | 1.00 | 665.6 |
| | 1000 | 4.00 | 665.5 |
| | 1300 | 7.00 | 665.4 |
| | 2200 | 16.00 | 665.4 |
| 10-24-91 | 0100 | 19.00 | 665.6 |
| | 0400 | 22.00 | 665.8 |
| | 0700 | 25.00 | 665.9 |
| | 1300 | 31.00 | 665.9 |
| | 1600 | 34.00 | 665.8 |
| | 1900 | 37.00 | 665.8 |

**Table 8.** Unit water-surface elevations at the indicated locks-and-dams in the upper Ohio River study area—*Continued*

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at New Cumberland Locks-and-Dam, upstream of dam at RM 54.4—*Continued*** | | | |
| 10-24-91 | 2200 | 40.00 | 665.7 |
| 10-25-91 | 0100 | 43.00 | 665.7 |
| | 0400 | 46.00 | 665.6 |
| | 1600 | 58.00 | 665.6 |
| | 1900 | 61.00 | 665.7 |
| | 2200 | 64.00 | 665.8 |
| 10-26-91 | 0200 | 68.00 | 665.8 |
| | 0800 | 74.00 | 665.9 |
| | 1100 | 77.00 | 665.7 |
| | 1400 | 80.00 | 665.6 |
| | 1700 | 83.00 | 665.6 |
| | 2000 | 86.00 | 665.5 |
| | 2300 | 89.00 | 665.5 |
| 10-27-91 | 0200 | 92.00 | 665.6 |
| | 0500 | 95.00 | 665.7 |
| | 0800 | 98.00 | 665.7 |
| | 1100 | 101.00 | 665.8 |
| 10-28-91 | 1700 | 131.00 | 665.8 |
| | 2000 | 134.00 | 665.7 |
| 10-29-91 | 0200 | 140.00 | 665.7 |
| | 0500 | 143.00 | 665.6 |
| | 0800 | 146.00 | 665.6 |
| | 1100 | 149.00 | 665.5 |
| | 2300 | 161.00 | 665.5 |
| 10-30-91 | 0200 | 164.00 | 665.4 |
| | 1100 | 173.00 | 665.4 |
| | 1400 | 176.00 | 665.5 |
| | 2000 | 182.00 | 665.5 |
| | 2300 | 185.00 | 665.6 |
| 10-31-91 | 0200 | 188.00 | 665.6 |
| | 0500 | 191.00 | 665.7 |
| | 0800 | 194.00 | 665.7 |
| | 1100 | 197.00 | 665.8 |
| | 1400 | 200.00 | 665.8 |
| | 1700 | 203.00 | 665.9 |
| 11-01-91 | 1100 | 221.00 | 665.9 |
| | 1400 | 224.00 | 665.8 |
| | 1700 | 227.00 | 665.7 |
| | 2300 | 233.00 | 665.7 |
| 11-02-91 | 0200 | 236.00 | 665.6 |
| | 0500 | 239.00 | 665.6 |
| | 0800 | 242.00 | 665.5 |
| | 1100 | 245.00 | 665.5 |
| | 1400 | 248.00 | 665.6 |
| | 1700 | 251.00 | 665.8 |
| | 2000 | 254.00 | 665.9 |
| 11-03-91 | 0500 | 263.00 | 665.9 |
| | 0800 | 266.00 | 665.7 |
| | 1100 | 267.00 | 665.6 |
| | 1400 | 272.00 | 665.6 |
| | 1700 | 275.00 | 665.5 |
| | 2000 | 278.00 | 665.5 |
| | 2300 | 281.00 | 665.6 |

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at New Cumberland Locks-and-Dam, upstream of dam at RM 54.4—*Continued*** | | | |
| 11-05-91 | 0200 | 308.00 | 665.6 |
| | 0500 | 311.00 | 665.8 |
| | 1700 | 323.00 | 665.8 |
| | 2000 | 326.00 | 665.7 |
| | 2300 | 329.00 | 665.6 |
| 11-06-91 | 0200 | 332.00 | 665.5 |
| | 1700 | 347.00 | 665.5 |
| | 2000 | 350.00 | 665.6 |
| 11-07-91 | 0200 | 356.00 | 665.6 |
| | 0500 | 359.00 | 665.5 |
| | 2300 | 377.00 | 665.5 |
| 11-08-91 | 0200 | 380.00 | 665.6 |
| 11-09-91 | 2300 | 425.00 | 665.6 |
| 11-10-91 | 0200 | 428.00 | 665.7 |
| 11-11-91 | 0200 | 452.00 | 665.7 |
| | 0500 | 455.00 | 665.8 |
| | 2300 | 473.00 | 665.8 |
| 11-12-91 | 0200 | 476.00 | 665.9 |
| | 0800 | 482.00 | 665.9 |
| | 1100 | 485.00 | 665.7 |
| | 1400 | 488.00 | 665.6 |
| 11-13-91 | 0200 | 500.00 | 665.6 |
| | 0500 | 503.00 | 665.5 |
| | 0800 | 506.00 | 665.5 |
| | 1100 | 509.00 | 665.4 |
| | 1400 | 512.00 | 665.4 |
| | 1700 | 515.00 | 665.3 |
| | 2000 | 518.00 | 665.3 |
| | 2300 | 521.00 | 665.4 |
| 11-14-91 | 0500 | 527.00 | 665.4 |
| | 0800 | 530.00 | 665.5 |
| | 2000 | 542.00 | 665.5 |
| | 2300 | 545.00 | 665.6 |
| 11-15-91 | 0500 | 551.00 | 665.6 |
| | 0800 | 554.00 | 665.7 |
| | 1400 | 560.00 | 665.7 |
| | 1700 | 563.00 | 665.8 |
| 11-16-91 | 1400 | 584.00 | 665.8 |
| | 1700 | 587.00 | 665.7 |
| | 2300 | 593.00 | 665.7 |
| 11-17-91 | 0200 | 596.00 | 665.6 |
| | 2000 | 614.00 | 665.6 |
| | 2300 | 617.00 | 665.5 |
| 11-18-91 | 0200 | 620.00 | 665.6 |
| | 0800 | 626.00 | 665.6 |
| | 1100 | 629.00 | 665.5 |
| | 1700 | 635.00 | 665.5 |
| | 2000 | 638.00 | 665.4 |
| 11-20-91 | 0200 | 668.00 | 665.4 |
| | 0500 | 671.00 | 665.5 |
| | 0800 | 674.00 | 665.5 |
| | 1100 | 677.00 | 665.6 |
| | 1700 | 683.00 | 665.6 |

**Table 8.** Unit water-surface elevations at the indicated locks-and-dams in the upper Ohio River study area—*Continued*

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at New Cumberland Locks-and-Dam, upstream of dam at RM 54.4—*Continued*** | | | |
| 11-20-91 | 2000 | 686.00 | 665.7 |
| | 2300 | 689.00 | 665.7 |
| 11-21-91 | 0200 | 692.00 | 665.8 |
| 11-22-91 | 0800 | 722.00 | 665.8 |
| | 1100 | 725.00 | 665.7 |
| | 1700 | 731.00 | 665.7 |
| | 2000 | 734.00 | 665.9 |
| | 2300 | 737.00 | 665.9 |
| 11-23-91 | 0200 | 740.00 | 665.7 |
| | 0500 | 743.00 | 665.5 |
| | 0800 | 746.00 | 665.3 |
| | 1100 | 749.00 | 665.2 |
| | 1400 | 752.00 | 665.3 |
| | 1700 | 755.00 | 665.4 |
| 11-24-91 | 0200 | 764.00 | 665.4 |
| | 0500 | 767.00 | 665.5 |
| | 1100 | 773.00 | 665.5 |
| | 1400 | 776.00 | 665.4 |
| | 1700 | 779.00 | 665.4 |
| | 2000 | 782.00 | 665.3 |
| | 2300 | 785.00 | 665.2 |
| **Ohio River at New Cumberland Locks-and-Dam, downstream of dam at RM 54.4** | | | |
| 10-20-91 | 0100 | -77.00 | 645.0 |
| | 1600 | -62.00 | 645.0 |
| | 1900 | -59.00 | 645.1 |
| | 2200 | -56.00 | 645.1 |
| 10-21-91 | 0100 | -53.00 | 645.0 |
| | 0700 | -47.00 | 645.0 |
| | 1000 | -44.00 | 644.8 |
| | 1300 | -41.00 | 644.7 |
| | 2200 | -32.00 | 644.7 |
| 10-22-91 | 0100 | -29.00 | 644.5 |
| | 0400 | -26.00 | 644.8 |
| | 0700 | -23.00 | 644.9 |
| | 1000 | -20.00 | 645.0 |
| | 1300 | -17.00 | 644.8 |
| | 1600 | -14.00 | 644.9 |
| | 1900 | -11.00 | 645.0 |
| | 2200 | -8.00 | 644.9 |
| 10-23-91 | 0100 | -5.00 | 645.0 |
| | 0400 | -2.00 | 645.0 |
| | 0700 | 1.00 | 644.9 |
| | 1000 | 4.00 | 644.9 |
| | 1300 | 7.00 | 644.8 |
| | 1600 | 10.00 | 644.7 |
| | 1900 | 13.00 | 644.7 |
| | 2200 | 16.00 | 644.6 |
| 10-24-91 | 0400 | 22.00 | 644.6 |
| | 0700 | 25.00 | 644.7 |
| | 1000 | 28.00 | 644.8 |
| | 1300 | 31.00 | 644.8 |

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at New Cumberland Locks-and-Dam, downstream of dam at RM 54.4—*Continued*** | | | |
| 10-24-91 | 1600 | 34.00 | 645.0 |
| | 2200 | 40.00 | 645.0 |
| 10-25-91 | 0100 | 43.00 | 644.9 |
| | 0400 | 46.00 | 644.9 |
| | 0700 | 49.00 | 645.0 |
| | 1300 | 55.00 | 645.0 |
| | 1600 | 58.00 | 644.9 |
| | 2200 | 64.00 | 644.9 |
| 10-26-91 | 0200 | 68.00 | 645.0 |
| | 1100 | 77.00 | 645.0 |
| | 1400 | 80.00 | 644.9 |
| | 1700 | 83.00 | 644.9 |
| | 2000 | 86.00 | 644.7 |
| | 2300 | 89.00 | 644.6 |
| 10-27-91 | 1400 | 104.00 | 644.6 |
| | 1700 | 107.00 | 644.7 |
| | 2000 | 110.00 | 644.6 |
| | 2300 | 113.00 | 644.7 |
| 10-28-91 | 0200 | 116.00 | 644.8 |
| | 1100 | 125.00 | 644.8 |
| | 1400 | 128.00 | 644.9 |
| | 1700 | 131.00 | 645.0 |
| 10-29-91 | 0800 | 146.00 | 645.0 |
| | 1100 | 149.00 | 644.8 |
| | 1400 | 152.00 | 644.7 |
| 10-30-91 | 0200 | 164.00 | 644.7 |
| | 0500 | 167.00 | 644.6 |
| | 0800 | 170.00 | 644.6 |
| | 1100 | 173.00 | 644.7 |
| 10-31-91 | 0800 | 194.00 | 644.7 |
| | 1100 | 197.00 | 644.8 |
| | 1400 | 200.00 | 644.8 |
| | 1700 | 203.00 | 644.9 |
| 11-01-91 | 0200 | 212.00 | 644.9 |
| | 0500 | 215.00 | 645.0 |
| | 0800 | 218.00 | 645.0 |
| | 1100 | 221.00 | 644.9 |
| | 1400 | 224.00 | 645.0 |
| | 1700 | 227.00 | 644.9 |
| 11-02-91 | 0500 | 239.00 | 644.9 |
| | 0800 | 242.00 | 645.0 |
| | 1100 | 245.00 | 644.9 |
| | 1400 | 248.00 | 645.0 |
| 11-03-91 | 0800 | 266.00 | 645.0 |
| | 1100 | 267.00 | 644.9 |
| | 1400 | 272.00 | 644.9 |
| | 1700 | 275.00 | 644.7 |
| | 2000 | 278.00 | 644.7 |
| | 2300 | 281.00 | 644.6 |
| 11-04-91 | 0500 | 287.00 | 644.6 |
| | 0800 | 290.00 | 644.5 |
| | 1100 | 293.00 | 644.6 |

**Table 8.** Unit water-surface elevations at the indicated locks-and-dams in the upper Ohio River study area—*Continued*

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at New Cumberland Locks-and-Dam, downstream of dam at RM 54.4—*Continued*** | | | |
| 11-04-91 | 1400 | 296.00 | 644.6 |
| | 1700 | 299.00 | 644.8 |
| | 2000 | 302.00 | 644.9 |
| 11-05-91 | 0200 | 308.00 | 644.9 |
| | 0500 | 311.00 | 645.1 |
| | 0800 | 314.00 | 645.0 |
| | 1100 | 317.00 | 645.0 |
| | 1400 | 320.00 | 644.9 |
| 11-06-91 | 0200 | 332.00 | 644.9 |
| | 0500 | 335.00 | 644.8 |
| | 1100 | 341.00 | 644.8 |
| | 1400 | 344.00 | 644.6 |
| | 1700 | 347.00 | 644.7 |
| 11-07-91 | 0200 | 356.00 | 644.7 |
| | 0500 | 359.00 | 644.6 |
| 11-08-91 | 0200 | 380.00 | 644.6 |
| | 0500 | 383.00 | 644.5 |
| | 2000 | 398.00 | 644.5 |
| | 2300 | 401.00 | 644.6 |
| 11-09-91 | 1100 | 413.00 | 644.6 |
| | 1400 | 416.00 | 644.7 |
| 11-11-91 | 0200 | 452.00 | 644.7 |
| | 0500 | 455.00 | 644.8 |
| | 0800 | 458.00 | 644.9 |
| | 1100 | 461.00 | 645.0 |
| | 1400 | 464.00 | 644.9 |
| | 2300 | 473.00 | 644.9 |
| 11-12-91 | 0200 | 476.00 | 644.8 |
| | 0500 | 479.00 | 644.8 |
| | 0800 | 482.00 | 644.9 |
| | 1100 | 485.00 | 644.9 |
| | 1400 | 488.00 | 645.0 |
| | 1700 | 491.00 | 644.9 |
| | 2300 | 497.00 | 644.9 |
| 11-13-91 | 0200 | 500.00 | 644.7 |
| | 0500 | 503.00 | 644.8 |
| | 0800 | 506.00 | 644.8 |
| | 1100 | 509.00 | 644.9 |
| | 1400 | 512.00 | 644.9 |
| | 1700 | 515.00 | 644.8 |
| | 2000 | 518.00 | 644.9 |
| 11-15-91 | 2000 | 566.00 | 644.9 |
| | 2300 | 569.00 | 644.8 |
| 11-16-91 | 1400 | 584.00 | 644.8 |
| | 1700 | 587.00 | 644.7 |
| 11-17-91 | 0500 | 599.00 | 644.7 |
| | 0800 | 602.00 | 644.6 |
| | 2000 | 614.00 | 644.6 |
| | 2300 | 617.00 | 644.7 |
| 11-18-91 | 0200 | 620.00 | 644.8 |
| | 0800 | 626.00 | 644.8 |
| | 1100 | 629.00 | 645.0 |
| 11-18-91 | 1400 | 632.00 | 644.8 |
| | 1700 | 635.00 | 644.9 |
| | 2000 | 638.00 | 644.9 |
| | 2300 | 641.00 | 644.8 |
| 11-19-91 | 0200 | 644.00 | 644.9 |
| 11-20-91 | 0200 | 668.00 | 644.9 |
| | 0500 | 671.00 | 644.8 |
| | 0800 | 674.00 | 644.8 |
| | 1100 | 677.00 | 644.9 |
| | 1400 | 680.00 | 645.0 |
| | 1700 | 683.00 | 644.9 |
| | 2300 | 689.00 | 644.9 |
| 11-21-91 | 0200 | 692.00 | 644.8 |
| | 0800 | 698.00 | 644.8 |
| | 1100 | 701.00 | 644.9 |
| | 1400 | 704.00 | 644.8 |
| | 1700 | 707.00 | 644.9 |
| 11-22-91 | 0800 | 722.00 | 644.9 |
| | 1100 | 725.00 | 645.0 |
| | 2000 | 734.00 | 645.0 |
| | 2300 | 737.00 | 645.8 |
| 11-23-91 | 0200 | 740.00 | 646.0 |
| | 0500 | 743.00 | 646.2 |
| | 0800 | 746.00 | 646.5 |
| | 1100 | 749.00 | 646.5 |
| | 1400 | 752.00 | 646.6 |
| | 1700 | 755.00 | 647.1 |
| | 2000 | 758.00 | 646.9 |
| | 2300 | 761.00 | 646.5 |
| 11-24-91 | 0200 | 764.00 | 646.0 |
| | 0500 | 767.00 | 645.9 |
| | 0800 | 770.00 | 645.9 |
| | 1100 | 773.00 | 645.8 |
| | 1400 | 776.00 | 645.6 |
| | 1700 | 779.00 | 645.4 |
| | 2000 | 782.00 | 645.2 |
| | 2300 | 785.00 | 644.9 |
| **Ohio River at Pike Island Locks-and-Dam, upstream of dam at RM 84.2** | | | |
| 10-20-91 | 0100 | -77.00 | 645.0 |
| | 2200 | -56.00 | 645.0 |
| 10-21-91 | 0100 | -53.00 | 645.1 |
| | 0400 | -50.00 | 645.1 |
| | 0700 | -47.00 | 645.0 |
| | 1000 | -44.00 | 644.8 |
| | 1300 | -41.00 | 644.8 |
| | 1600 | -38.00 | 644.7 |
| | 1900 | -35.00 | 644.8 |
| 10-22-91 | 0700 | -23.00 | 644.8 |
| | 1000 | -20.00 | 644.9 |
| | 1900 | -11.00 | 644.9 |
| | 2200 | -8.00 | 645.0 |

**Table 8.** Unit water-surface elevations at the indicated locks-and-dams in the upper Ohio River study area—*Continued*

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at Pike Island Locks-and-Dam, upstream of dam at RM 84.2—*Continued*** | | | |
| 10-23-91 | 0700 | 1.00 | 645.0 |
| | 1000 | 4.00 | 644.9 |
| | 1300 | 7.00 | 644.8 |
| | 1900 | 13.00 | 644.8 |
| | 2200 | 16.00 | 644.7 |
| 10-24-91 | 0700 | 25.00 | 644.7 |
| | 1000 | 28.00 | 644.8 |
| | 1300 | 31.00 | 644.8 |
| | 1600 | 34.00 | 644.9 |
| | 1900 | 37.00 | 645.0 |
| 10-25-91 | 0700 | 49.00 | 645.0 |
| | 1000 | 52.00 | 644.9 |
| 10-26-91 | 0200 | 68.00 | 644.9 |
| | 0500 | 71.00 | 645.0 |
| | 1100 | 77.00 | 645.0 |
| | 1400 | 80.00 | 644.9 |
| | 1700 | 83.00 | 644.8 |
| | 2000 | 86.00 | 644.8 |
| | 2300 | 89.00 | 644.7 |
| 10-27-91 | 0200 | 92.00 | 644.6 |
| | 0800 | 98.00 | 644.6 |
| | 1100 | 101.00 | 644.7 |
| | 1700 | 107.00 | 644.7 |
| | 2000 | 110.00 | 644.8 |
| | 2300 | 113.00 | 644.7 |
| 10-28-91 | 0200 | 116.00 | 644.8 |
| | 0500 | 119.00 | 644.9 |
| | 0800 | 122.00 | 645.0 |
| 10-29-91 | 0200 | 140.00 | 645.0 |
| | 0500 | 143.00 | 645.1 |
| | 0800 | 146.00 | 645.0 |
| | 1100 | 149.00 | 645.0 |
| | 1400 | 152.00 | 644.8 |
| | 1700 | 155.00 | 644.8 |
| | 2000 | 158.00 | 644.7 |
| 10-30-91 | 0800 | 170.00 | 644.7 |
| | 1100 | 173.00 | 644.8 |
| 10-31-91 | 0800 | 194.00 | 644.8 |
| | 1100 | 197.00 | 644.9 |
| | 1700 | 203.00 | 644.9 |
| | 2000 | 206.00 | 645.0 |
| 11-01-91 | 1400 | 224.00 | 645.0 |
| | 1700 | 227.00 | 644.9 |
| 11-02-91 | 0800 | 242.00 | 644.9 |
| | 1100 | 245.00 | 645.0 |
| 11-03-91 | 1100 | 269.00 | 645.0 |
| | 1400 | 272.00 | 644.9 |
| | 1700 | 275.00 | 644.7 |
| 11-04-91 | 0500 | 287.00 | 644.7 |
| | 0800 | 290.00 | 644.6 |
| | 1100 | 293.00 | 644.6 |
| | 1400 | 296.00 | 644.7 |
| 11-04-91 | 1700 | 299.00 | 644.8 |
| | 2000 | 302.00 | 644.9 |
| | 2300 | 305.00 | 645.0 |
| 11-05-91 | 0800 | 314.00 | 645.0 |
| | 1100 | 317.00 | 644.9 |
| | 1400 | 320.00 | 644.9 |
| | 1700 | 323.00 | 644.8 |
| 11-06-91 | 0800 | 338.00 | 644.8 |
| | 1100 | 341.00 | 644.7 |
| | 0200 | 380.00 | 644.7 |
| | 0500 | 383.00 | 644.6 |
| | 0800 | 386.00 | 644.6 |
| | 1100 | 389.00 | 644.7 |
| 11-09-91 | 0800 | 410.00 | 644.7 |
| | 1100 | 413.00 | 644.8 |
| 11-10-91 | 2300 | 449.00 | 644.8 |
| 11-11-91 | 0200 | 452.00 | 644.9 |
| | 2000 | 470.00 | 644.9 |
| | 2300 | 473.00 | 644.8 |
| 11-12-91 | 0200 | 476.00 | 644.9 |
| | 0500 | 479.00 | 644.8 |
| | 0800 | 482.00 | 644.8 |
| | 1100 | 485.00 | 644.9 |
| 11-13-91 | 0200 | 500.00 | 644.9 |
| | 0500 | 503.00 | 644.8 |
| | 0800 | 506.00 | 644.8 |
| | 1100 | 509.00 | 644.7 |
| | 1700 | 515.00 | 644.7 |
| | 2000 | 518.00 | 644.8 |
| | 2300 | 521.00 | 644.9 |
| 11-15-91 | 1400 | 560.00 | 644.9 |
| | 1700 | 563.00 | 644.8 |
| | 2000 | 566.00 | 644.9 |
| | 2300 | 569.00 | 644.9 |
| 11-16-91 | 0200 | 572.00 | 644.8 |
| | 0800 | 578.00 | 644.8 |
| | 1100 | 581.00 | 645.0 |
| | 1400 | 584.00 | 644.9 |
| | 1700 | 587.00 | 644.8 |
| | 2300 | 593.00 | 644.8 |
| 11-17-91 | 0200 | 596.00 | 644.7 |
| | 1400 | 608.00 | 644.7 |
| | 1700 | 611.00 | 644.8 |
| 11-18-91 | 1400 | 632.00 | 644.8 |
| | 1700 | 635.00 | 644.9 |
| 11-19-91 | 1400 | 656.00 | 644.9 |
| | 1700 | 659.00 | 644.8 |
| 11-20-91 | 0200 | 668.00 | 644.8 |
| | 0500 | 671.00 | 644.9 |
| | 0800 | 674.00 | 644.9 |

**Table 8.** Unit water-surface elevations at the indicated locks-and-dams in the upper Ohio River study area—*Continued*

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at Pike Island Locks-and-Dam, upstream of dam at RM 84.2—*Continued*** | | | |
| 11-20-91 | 1100 | 677.00 | 644.8 |
| 11-21-91 | 0200 | 692.00 | 644.8 |
| | 0500 | 695.00 | 644.9 |
| | 1100 | 701.00 | 644.9 |
| | 1400 | 704.00 | 644.8 |
| | 1700 | 707.00 | 644.9 |
| 11-22-91 | 0200 | 716.00 | 644.9 |
| | 0500 | 719.00 | 645.0 |
| | 1100 | 725.00 | 645.0 |
| | 1400 | 728.00 | 645.1 |
| | 1700 | 731.00 | 645.0 |
| | 2000 | 734.00 | 644.9 |
| | 2300 | 737.00 | 644.9 |
| 11-23-91 | 0200 | 740.00 | 645.0 |
| | 0800 | 746.00 | 645.0 |
| | 1100 | 749.00 | 644.9 |
| | 1400 | 752.00 | 644.8 |
| | 1700 | 755.00 | 644.8 |
| | 2000 | 758.00 | 644.9 |
| | 2300 | 761.00 | 644.9 |
| 11-24-91 | 0200 | 764.00 | 644.8 |
| | 0500 | 767.00 | 644.7 |
| | 1700 | 779.00 | 644.7 |
| | 2000 | 782.00 | 644.6 |
| | 2300 | 785.00 | 644.7 |
| **Ohio River at Pike Island Locks-and-Dam, downstream of dam at RM 84.2** | | | |
| 10-20-91 | 0100 | -77.00 | 624.2 |
| | 0400 | -74.00 | 624.2 |
| | 0700 | -71.00 | 624.1 |
| | 2200 | -56.00 | 624.1 |
| 10-21-91 | 0100 | -53.00 | 624.0 |
| | 0400 | -50.00 | 624.1 |
| | 0700 | -47.00 | 624.0 |
| | 1600 | -38.00 | 624.0 |
| | 1900 | -35.00 | 623.9 |
| | 2200 | -32.00 | 623.8 |
| 10-22-91 | 0400 | -26.00 | 623.8 |
| | 0700 | -23.00 | 623.9 |
| | 1000 | -20.00 | 624.0 |
| 10-23-91 | 1300 | 7.00 | 624.0 |
| | 1600 | 10.00 | 623.8 |
| | 1900 | 13.00 | 623.9 |
| | 2200 | 16.00 | 623.8 |
| 10-24-91 | 0400 | 22.00 | 623.8 |
| | 0700 | 25.00 | 623.9 |
| | 1300 | 31.00 | 623.9 |
| | 1600 | 34.00 | 624.0 |
| | 1900 | 37.00 | 623.9 |
| | 2200 | 40.00 | 623.9 |
| 10-25-91 | 0100 | 43.00 | 623.8 |
| | 1600 | 58.00 | 623.8 |

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at Pike Island Locks-and-Dam, downstream of dam at RM 84.2—*Continued*** | | | |
| 10-25-91 | 1900 | 61.00 | 624.0 |
| 10-26-91 | 0200 | 68.00 | 624.0 |
| | 0500 | 71.00 | 624.2 |
| | 0800 | 74.00 | 624.2 |
| | 1100 | 77.00 | 624.4 |
| | 1400 | 80.00 | 624.5 |
| | 1700 | 83.00 | 624.4 |
| | 2000 | 86.00 | 624.1 |
| | 2300 | 89.00 | 624.0 |
| 10-27-91 | 0200 | 92.00 | 623.9 |
| | 2300 | 113.00 | 623.9 |
| 10-28-91 | 0200 | 116.00 | 624.0 |
| | 0500 | 119.00 | 624.0 |
| | 0800 | 122.00 | 624.1 |
| | 1400 | 128.00 | 624.1 |
| | 1700 | 131.00 | 624.0 |
| | 2300 | 137.00 | 624.0 |
| 10-29-91 | 0200 | 140.00 | 624.1 |
| | 0500 | 143.00 | 624.1 |
| | 0800 | 146.00 | 624.0 |
| | 1100 | 149.00 | 624.1 |
| | 1700 | 155.00 | 624.1 |
| | 2000 | 158.00 | 624.0 |
| 10-30-91 | 0200 | 164.00 | 624.0 |
| | 0500 | 167.00 | 623.9 |
| | 1400 | 176.00 | 623.9 |
| | 1700 | 179.00 | 623.7 |
| 10-31-91 | 0500 | 191.00 | 623.7 |
| | 0800 | 194.00 | 623.6 |
| | 1700 | 203.00 | 623.6 |
| | 2000 | 206.00 | 623.7 |
| | 2300 | 209.00 | 623.7 |
| 11-01-91 | 0200 | 212.00 | 623.8 |
| | 0500 | 215.00 | 623.8 |
| | 0800 | 218.00 | 623.9 |
| | 1100 | 221.00 | 624.0 |
| | 1400 | 224.00 | 624.0 |
| | 1700 | 227.00 | 624.1 |
| 11-03-91 | 0200 | 260.00 | 624.1 |
| | 0500 | 263.00 | 624.2 |
| | 1400 | 272.00 | 624.2 |
| | 1700 | 275.00 | 624.1 |
| | 2000 | 278.00 | 624.0 |
| | 2300 | 281.00 | 623.9 |
| 11-04-91 | 0200 | 284.00 | 624.0 |
| | 1100 | 293.00 | 624.0 |
| | 1400 | 296.00 | 623.9 |
| | 1700 | 299.00 | 623.8 |
| | 2300 | 305.00 | 623.8 |
| 11-05-91 | 0200 | 308.00 | 623.7 |
| | 0500 | 311.00 | 623.9 |
| | 0800 | 314.00 | 623.9 |

**Table 8.** Unit water-surface elevations at the indicated locks-and-dams in the upper Ohio River study area—*Continued*

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at Pike Island Locks-and-Dam, downstream of dam at RM 84.2—*Continued*** | | | |
| 11-05-91 | 1100 | 317.00 | 624.1 |
| 11-06-91 | 0200 | 332.00 | 624.1 |
| | 0500 | 335.00 | 624.0 |
| | 0800 | 338.00 | 624.0 |
| | 1100 | 341.00 | 624.1 |
| | 1700 | 347.00 | 624.1 |
| 11-05-91 | 2000 | 350.00 | 624.0 |
| 11-08-91 | 0200 | 380.00 | 624.0 |
| | 0500 | 383.00 | 623.9 |
| | 0800 | 386.00 | 624.0 |
| | 1100 | 389.00 | 624.0 |
| | 1400 | 392.00 | 623.9 |
| 11-09-91 | 1100 | 413.00 | 623.9 |
| | 1400 | 416.00 | 623.8 |
| 11-10-91 | 0200 | 428.00 | 623.8 |
| | 0500 | 431.00 | 623.7 |
| | 0800 | 434.00 | 623.8 |
| 11-11-91 | 0200 | 452.00 | 623.8 |
| | 0500 | 455.00 | 623.9 |
| 11-13-91 | 0800 | 506.00 | 623.9 |
| | 1100 | 509.00 | 624.0 |
| | 2000 | 518.00 | 624.0 |
| | 2300 | 521.00 | 623.9 |
| 11-14-91 | 1400 | 536.00 | 623.9 |
| | 1700 | 539.00 | 623.8 |
| 11-15-91 | 1100 | 557.00 | 623.8 |
| | 1400 | 560.00 | 623.9 |
| | 2000 | 566.00 | 623.9 |
| | 2300 | 569.00 | 623.8 |
| 11-16-91 | 0200 | 572.00 | 623.9 |
| | 0500 | 575.00 | 623.8 |
| | 1100 | 581.00 | 623.8 |
| | 1400 | 584.00 | 623.7 |
| | 1700 | 587.00 | 623.9 |
| 11-18-91 | 1400 | 632.00 | 623.9 |
| | 1700 | 635.00 | 623.8 |
| 11-19-91 | 0500 | 647.00 | 623.8 |
| | 0800 | 650.00 | 623.9 |
| | 1100 | 653.00 | 623.8 |
| | 1400 | 656.00 | 623.9 |
| | 1700 | 659.00 | 623.8 |
| 11-20-91 | 0800 | 674.00 | 623.8 |
| | 1100 | 677.00 | 623.9 |
| | 2000 | 686.00 | 623.9 |
| | 2300 | 689.00 | 623.7 |
| 11-21-91 | 0800 | 698.00 | 623.7 |
| | 1100 | 701.00 | 623.8 |
| 11-22-91 | 0800 | 722.00 | 623.8 |
| | 1100 | 725.00 | 623.9 |
| | 1400 | 728.00 | 624.0 |
| | 1700 | 731.00 | 624.1 |
| | 2000 | 734.00 | 624.1 |
| | 2300 | 737.00 | 624.4 |

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at Pike Island Locks-and-Dam, downstream of dam at RM 84.2—*Continued*** | | | |
| 11-23-91 | 0200 | 740.00 | 625.0 |
| | 0500 | 743.00 | 625.4 |
| | 0800 | 746.00 | 625.6 |
| | 1100 | 749.00 | 625.9 |
| | 1400 | 752.00 | 626.0 |
| | 1700 | 755.00 | 626.2 |
| | 2000 | 758.00 | 626.4 |
| | 2300 | 761.00 | 626.0 |
| 11-24-91 | 0200 | 764.00 | 625.4 |
| | 0500 | 767.00 | 625.1 |
| | 0800 | 770.00 | 625.0 |
| | 1100 | 773.00 | 625.1 |
| | 1400 | 776.00 | 625.0 |
| | 1700 | 779.00 | 624.9 |
| | 2000 | 782.00 | 624.8 |
| | 2300 | 785.00 | 624.2 |
| **Ohio River at Hannibal Locks-and-Dam, upstream of dam at RM 126.4** | | | |
| 10-20-91 | 0100 | -77.00 | 624.1 |
| | 1300 | -65.00 | 624.1 |
| | 1600 | -62.00 | 624.0 |
| 10-21-91 | 1300 | -41.00 | 624.0 |
| | 1600 | -38.00 | 623.9 |
| | 1900 | -35.00 | 623.8 |
| 10-22-91 | 0700 | -23.00 | 623.8 |
| | 1000 | -20.00 | 623.9 |
| | 1300 | -17.00 | 624.0 |
| | 1600 | -14.00 | 623.9 |
| | 1900 | -11.00 | 623.9 |
| | 2200 | -8.00 | 623.8 |
| 10-23-91 | 0100 | -5.00 | 623.9 |
| | 0700 | 1.00 | 623.9 |
| | 1000 | 4.00 | 623.8 |
| 10-24-91 | 0700 | 25.00 | 623.8 |
| | 1000 | 28.00 | 623.9 |
| | 1900 | 37.00 | 623.9 |
| | 2200 | 40.00 | 623.8 |
| 10-25-91 | 0700 | 49.00 | 623.8 |
| | 1000 | 52.00 | 623.7 |
| | 1300 | 55.00 | 623.7 |
| | 1600 | 58.00 | 623.8 |
| | 1900 | 61.00 | 623.8 |
| | 2200 | 64.00 | 624.0 |
| 10-26-91 | 0200 | 68.00 | 624.0 |
| | 0500 | 71.00 | 624.1 |
| | 0800 | 74.00 | 624.2 |
| | 1100 | 77.00 | 624.3 |
| | 2000 | 86.00 | 624.3 |
| | 2300 | 89.00 | 624.0 |
| 10-27-91 | 0200 | 92.00 | 624.0 |
| | 0500 | 95.00 | 623.9 |
| | 1700 | 107.00 | 623.9 |
| | 2000 | 110.00 | 624.0 |

**Table 8.** Unit water-surface elevations at the indicated locks-and-dams in the upper Ohio River study area—*Continued*

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at Hannibal Locks-and-Dam, upstream of dam at RM 126.4—*Continued*** | | | |
| 10-28-91 | 0200 | 116.00 | 624.0 |
| | 0500 | 119.00 | 624.1 |
| | 0800 | 122.00 | 624.1 |
| | 1100 | 125.00 | 624.2 |
| | 1400 | 128.00 | 624.1 |
| | 1700 | 131.00 | 624.1 |
| | 2000 | 134.00 | 624.0 |
| | 2300 | 137.00 | 624.1 |
| 10-29-91 | 0200 | 140.00 | 624.1 |
| | 0500 | 143.00 | 624.0 |
| | 0800 | 146.00 | 624.1 |
| | 2000 | 158.00 | 624.1 |
| | 2300 | 161.00 | 624.0 |
| 10-30-91 | 0200 | 164.00 | 624.0 |
| | 0500 | 167.00 | 623.9 |
| | 1100 | 173.00 | 623.9 |
| | 1400 | 176.00 | 623.8 |
| | 1700 | 179.00 | 623.8 |
| | 2000 | 182.00 | 623.7 |
| 10-31-91 | 1700 | 203.00 | 623.7 |
| | 2000 | 206.00 | 623.6 |
| | 2300 | 209.00 | 623.7 |
| 11-01-91 | 0500 | 215.00 | 623.7 |
| | 0800 | 218.00 | 623.9 |
| | 1100 | 221.00 | 624.0 |
| | 1700 | 227.00 | 624.0 |
| | 2000 | 230.00 | 624.1 |
| 11-02-91 | 0800 | 242.00 | 624.1 |
| | 1100 | 245.00 | 624.0 |
| 11-03-91 | 0500 | 263.00 | 624.0 |
| | 0800 | 266.00 | 624.1 |
| | 1700 | 275.00 | 624.1 |
| | 2000 | 278.00 | 624.0 |
| | 2300 | 281.00 | 624.0 |
| 11-04-91 | 0200 | 284.00 | 623.9 |
| | 0500 | 287.00 | 623.9 |
| | 0800 | 290.00 | 624.0 |
| | 1100 | 293.00 | 623.9 |
| | 1400 | 296.00 | 623.8 |
| | 1700 | 299.00 | 623.8 |
| | 2000 | 302.00 | 623.7 |
| | 2300 | 305.00 | 623.6 |
| 11-05-91 | 0500 | 311.00 | 623.6 |
| | 0800 | 314.00 | 623.9 |
| | 1400 | 320.00 | 623.9 |
| | 1700 | 323.00 | 624.1 |
| | 2000 | 326.00 | 624.0 |
| | 2300 | 329.00 | 624.1 |

| Date | Time | Elapsed time | Elevation |
|---|---|---|---|
| **Ohio River at Hannibal Locks-and-Dam, upstream of dam at RM 126.4—*Continued*** | | | |
| 11-06-91 | 0500 | 335.00 | 624.1 |
| | 0800 | 338.00 | 623.9 |
| | 1700 | 347.00 | 623.9 |
| | 2000 | 350.00 | 624.0 |
| 11-07-91 | 2000 | 374.00 | 624.0 |
| | 2300 | 377.00 | 624.1 |
| 11-08-91 | 0200 | 380.00 | 624.0 |
| | 2300 | 401.00 | 624.0 |
| 11-09-91 | 0200 | 404.00 | 623.9 |
| | 1700 | 419.00 | 623.9 |
| | 2000 | 422.00 | 623.8 |
| 11-10-91 | 1100 | 437.00 | 623.8 |
| | 1400 | 440.00 | 623.7 |
| | 1700 | 443.00 | 623.8 |
| 11-13-91 | 2300 | 521.00 | 623.8 |
| 11-14-91 | 0200 | 524.00 | 623.7 |
| | 0500 | 527.00 | 623.8 |
| 11-15-91 | 1400 | 560.00 | 623.8 |
| | 1700 | 563.00 | 623.7 |
| | 2000 | 566.00 | 623.8 |
| | 2300 | 569.00 | 623.8 |
| 11-16-91 | 0200 | 572.00 | 623.7 |
| | 0500 | 575.00 | 623.8 |
| | 1700 | 587.00 | 623.8 |
| | 2000 | 590.00 | 623.9 |
| 11-17-91 | 2300 | 617.00 | 623.9 |
| 11-18-91 | 0200 | 620.00 | 623.8 |
| | 2300 | 641.00 | 623.8 |
| 11-19-91 | 0200 | 644.00 | 623.7 |
| 11-22-91 | 0200 | 716.00 | 623.7 |
| | 0500 | 719.00 | 623.8 |
| | 0800 | 722.00 | 623.8 |
| | 1100 | 725.00 | 623.9 |
| | 1400 | 728.00 | 624.0 |
| | 2000 | 734.00 | 624.0 |
| | 2300 | 737.00 | 623.9 |
| 11-23-91 | 0200 | 740.00 | 623.9 |
| | 0500 | 743.00 | 624.0 |
| | 0800 | 746.00 | 623.9 |
| | 1100 | 749.00 | 624.0 |
| | 1700 | 755.00 | 624.0 |
| | 2000 | 758.00 | 623.9 |
| | 2300 | 761.00 | 623.9 |
| 11-24-91 | 0200 | 764.00 | 623.7 |
| | 0500 | 767.00 | 623.6 |
| | 0800 | 770.00 | 623.7 |
| | 1700 | 779.00 | 623.7 |
| | 2000 | 782.00 | 623.8 |
| | 2300 | 785.00 | 623.8 |