Floods of May and June 2004 in Central and Eastern Ohio: FEMA Disaster Declaration 1519

By Andrew D. Ebner, David E. Straub, and Jonathan D. Lageman

In cooperation with the Ohio Emergency Management Agency

Open-File Report 2008–1290

U.S. Department of the Interior
U.S. Geological Survey
U.S. Department of the Interior
DIRK KEMPTHORNE, Secretary

U.S. Geological Survey
Mark D. Myers, Director


For product and ordering information:
World Wide Web: http://www.usgs.gov/pubprod
Telephone: 1-888-ASK-USGS

For more information on the USGS—the Federal source for science about the Earth, its natural and living resources, natural hazards, and the environment:
Telephone: 1-888-ASK-USGS

Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Although this report is in the public domain, permission must be secured from the individual copyright owners to reproduce any copyrighted materials contained within this report.

Suggested citation:
Contents

Abstract...........................................................................................................................................................1
Introduction.....................................................................................................................................................1
Antecedent Climatic Conditions....................................................................................................................3
May 18–25, 2004, Flood................................................................................................................................3
  Storms of May 17–23, 2004........................................................................................................................3
  General Description of the May 18–25, 2004, Flood..............................................................................5
    Areal Distribution.................................................................................................................................5
    Flood Stages, Streamflows, and Recurrence Intervals...........................................................................5
June 9, 2004, Flood....................................................................................................................................18
  Storms of June 9, 2004............................................................................................................................18
  General Description of the June 9, 2004, Flood...................................................................................18
    Areal Distribution...............................................................................................................................18
    Flood Stages, Streamflows, and Recurrence Intervals.......................................................................18
June 11–18, 2004, Flood............................................................................................................................18
  Storms of June 11–17, 2004......................................................................................................................22
  General Description of the June 11–18, 2004, Flood............................................................................22
    Areal Distribution...............................................................................................................................22
    Flood Stages, Streamflows, and Recurrence Intervals.......................................................................29
Flood and Storm Damages Associated with FEMA-1519-DR.................................................................29
Summary........................................................................................................................................................33
Acknowledgments.........................................................................................................................................33
References Cited.............................................................................................................................................33
Appendix 1. Details of Hydrologic and Hydraulic Analyses.................................................................35
  1–A. West Fork Duck Creek near the Village of Belle Valley............................................................36
  1–B. Plum Creek near the City of Brunswick.......................................................................................37
  1–C. West Branch Sunday Creek and West Branch Sunday Creek Tributary near the Village of Hemlock............................................................38
  1–D. East Branch Rocky River Tributary R9 near the City of North Royalton..............................39
  1–E. Mud Brook Tributary 1C and Cuyahoga River Tributary 1A near the City of Stow.........40

Figures

1–15. Maps showing:
  1. Ohio counties declared disaster areas under FEMA declaration 1519.................................2
  2. Regionally averaged monthly total precipitation and percentage of normal precipitation for the 10 climatic regions of Ohio for A, March and B, April 2004.........................................................4
  3. Isohyetal map of 7-day rainfall totals in Ohio for May 17–23, 2004........................................6
  4. Locations of selected U.S. Geological Survey streamgages that are referred to in this report.................................................................................................................................8
5. Selected areas of southeastern Ohio affected by flooding during May 18–25, 2004 ................................................................. 10
6. Selected areas of eastern Ohio affected by flooding during May 18–25, 2004 ...................................................................... 11
7. Selected areas of northeastern Ohio affected by flooding during May 18–25, 2004 .................................................................. 12
8. Selected areas of northern Ohio affected by flooding during May 18–25, 2004 ..................................................................... 13
9. Isohyetal map of 6-hour rainfall totals from 3:00 p.m. to 9:00 p.m. on June 9, 2004 ................................................................. 19
10. Selected areas of northern Ohio affected by flooding on June 9, 2004 ................................................................. 21
11. Isohyetal map of 7-day rainfall totals in Ohio for June 11–17, 2004 .................................................................................. 23
12. Selected areas of eastern Ohio affected by flooding during June 11–17, 2004 ................................................................. 25
13. Selected areas of north-central Ohio affected by flooding during June 11–17, 2004 .................................................................. 26
14. Selected areas of southwestern, western, and central Ohio affected by flooding during June 11–17, 2004 ........................................ 27
15. Selected areas of east-central Ohio affected by flooding during June 11–17, 2004 ................................................................. 28

1–A1–1–E1. Maps showing:
1–A1. Location of the West Fork Duck Creek study reach for the Village of Belle Valley, Ohio ..................................................... 36
1–B1. Location of the Plum Creek study reach for the City of Brunswick, Ohio ................................................................. 37
1–C1. Location of the West Branch Sunday Creek and West Branch Sunday Creek Tributary study reaches for the Village of Hemlock, Ohio .................................................................................. 38
1–D1. Location of the East Branch Rocky River Tributary R9 study reach for the City of North Royalton, Ohio .................................................. 39
1–E1. Location of the Mud Brook Tributary 1C and Cuyahoga River Tributary 1A study reaches for the City of Stow, Ohio .................................................................................. 40

1–A2. Graph showing flood profiles for West Fork Duck Creek near the Village of Belle Valley for the 10-, 50-, 100-, and 500-year-recurrence-interval floods ................................................................ 53
1–A3. Photograph showing cross-section locations for flood profiles on West Fork Duck Creek near the Village of Belle Valley, Ohio .................................................................................. 54
1–B2. Graph showing flood profiles for Plum Creek near the City of Brunswick for the 10-, 50-, 100-, and 500-year-recurrence-interval floods .................................................................................. 60
1–B3. Photograph showing cross-section locations for flood profiles on Plum Creek near the City of Brunswick, Ohio .................................................................................. 61
1–C2. Graph showing flood profiles for West Branch Sunday Creek near the Village of Hemlock for the 10-, 50-, 100-, and 500-year-recurrence-interval floods .................................................................................. 66
1–C3. Graph showing flood profiles for West Branch Sunday Creek Tributary near the Village of Hemlock for the 10-, 50-, 100-, and 500-year-recurrence-interval floods .................................................................................. 66
1–C4. Photograph showing cross-section locations for flood profiles on West Branch Sunday Creek near the Village of Hemlock, Ohio .................................................................................. 67
1–C5. Photograph showing cross-section locations for flood profiles on West Branch Sunday Creek Tributary near the Village of Hemlock, Ohio .................................................................................. 68
1–D2. Graph showing flood profiles for East Branch Rocky River Tributary R9 near the City of North Royalton for the 10-, 50-, 100-, and 500-year-recurrence-interval floods .................................................................................. 72
Tables

1. Precipitation totals and recurrence intervals for selected National Weather Service rain gages in Ohio for May 17–23, 2004....................................................7
2. Areas and streams affected by flooding during May 18–25, 2004....................................................9
3. Peak stages, peak streamflows, and estimated recurrence-interval ranges at selected USGS streamgages in Ohio, May 18–25, 2004....................................................14
4. Precipitation totals and recurrence intervals for selected Northeast Ohio Regional Sewer District rain gages in Cuyahoga County, Ohio, on June 9, 2004....................................................20
5. Areas and streams affected by flooding on June 9, 2004....................................................20
6. Peak stages, peak streamflows, and estimated recurrence-interval ranges at selected USGS streamgages in Cuyahoga County, Ohio, June 9, 2004....................................................20
7. Precipitation totals and recurrence intervals for selected National Weather Service rain gages in Ohio for June 11–17, 2004....................................................24
8. Areas and streams affected by flooding during June 11–18, 2004....................................................24
9. Peak stages, peak streamflows, and estimated recurrence-interval ranges at selected USGS streamgages in Ohio, June 11–18, 2004....................................................30
1–1. Summary of existing FIS(s) for selected streams in disaster area FEMA–1519–DR........35
1–2. Summary of the explanatory-variable values used in the regression equations and the resulting 10-, 50-, 100-, and 500-year flood-peak discharge estimates..........42
1–3. Summary of the hydraulic model version and analysis date for each of the studied stream reaches..........................................................................................43
1–A1. Summary of hydraulic-structure solutions for the 10-, 50-, 100-, and 500-year profiles of West Fork Duck Creek near the Village of Belle Valley........................................46
1–A2. Comparison of published coordinates to USGS-surveyed coordinates and bench marks used in the study of Duck Creek near the Village of Belle Valley.................47
1–B1. Summary of hydraulic-structure solutions for the 10-, 50-, 100-, and 500-year profiles of Plum Creek near the City of Brunswick..................................................56
1–B2. Comparison of published coordinates to USGS-surveyed coordinates and bench marks used in the study of Plum Creek near the City of Brunswick.................57
1–C1. Summary of hydraulic-structure solutions for the 10-, 50-, 100-, and 500-year profiles of West Branch Sunday Creek and West Branch Sunday Creek Tributary near the Village of Hemlock..................................................63
Conversion Factors and Abbreviations

<table>
<thead>
<tr>
<th>Multiply</th>
<th>By</th>
<th>To obtain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Length</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>inch (in.)</td>
<td>25.4</td>
<td>millimeter (mm)</td>
</tr>
<tr>
<td>foot (ft)</td>
<td>0.3048</td>
<td>meter (m)</td>
</tr>
<tr>
<td>mile (mi)</td>
<td>1.609</td>
<td>kilometer (km)</td>
</tr>
<tr>
<td><strong>Area</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>square mile (mi²)</td>
<td>2.590</td>
<td>square kilometer (km²)</td>
</tr>
<tr>
<td><strong>Flow rate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>foot per second (ft/s)</td>
<td>0.3048</td>
<td>meter per second (m/s)</td>
</tr>
<tr>
<td>cubic foot per second (ft³/s)</td>
<td>0.02832</td>
<td>cubic meter per second (m³/s)</td>
</tr>
</tbody>
</table>

Vertical coordinate information is referenced to North American Vertical Datum of 1988 (NAVD 88), the National Geodetic Vertical Datum of 1929 (NGVD 29), and the U.S. Army Corps of Engineers 1912 Datum (COE 1912), as noted.

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

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

Abbreviations

FEMA – Federal Emergency Management Agency  
NWS – National Weather Service  
FIS – Flood Insurance Study  
Ohio EMA – Ohio Emergency Management Agency  
GPS – Global Positioning System  
RTK – Real-Time Kinematic  
GIS – Geographical Information System  
TIN – Triangulated Irregular Network  
NEORSD – Northeast Ohio Regional Sewer District  
USACE – United States Army Corps of Engineers  
NGS – National Geodetic Survey  
USGS – U.S. Geological Survey  
NOAA – National Oceanic and Atmospheric Administration  
USC&GS – United States Coast & Geodetic Survey
Abstract

Several severe thunderstorms that passed through Ohio between May 17 and June 17, 2004, produced large amounts of rain in an already wet central and eastern Ohio, resulting in flooding in this region from May 18 to June 21, 2004. Record peak streamflow occurred at three U.S. Geological Survey (USGS) streamgages. Damages caused by the flooding resulting from these storms were severe enough that 25 counties in central and eastern Ohio were declared Federal disaster areas. In all, there were two storm- or flood-related deaths, 3,529 private structures damaged or destroyed, and an estimated $43 million in damages.

This report describes the meteorological factors that resulted in severe flooding in central and eastern Ohio between May 18 and June 21, 2004, and addresses the damages caused by the storms and flooding. Peak-stage, peak-streamflow, and recurrence-interval data are reported for selected USGS streamgages. Flood profiles determined by the USGS are presented for selected streams.

Introduction

Several severe thunderstorms\(^1\) crossed Ohio between May 17 and June 17, 2004, causing flooding in central and eastern Ohio. The Federal Emergency Management Agency (FEMA) declared 25 counties affected by these storms as disaster areas (FEMA–1519–DR, Ohio, declared on June 3, 2004, with an incident period from May 18 through June 21, 2004). Figure 1 shows the 25 counties that were declared Federal disaster areas and whether they were declared to be eligible for Individual Assistance\(^2\), Public Assistance\(^3\), or both (Federal Emergency Management Agency, 2007). In many of these counties, several floods occurred during this month-long period.

Because of the magnitude of these floods, the U.S. Geological Survey (USGS), in cooperation with the Ohio Emergency Management Agency (Ohio EMA), completed a study to document this historic event. Documentation of floods can assist Federal, State, and local agencies in making informed decisions on flood-plain management and flood-emergency practices. Flood profiles were developed for West Fork Duck Creek near the Village of Belle Valley (appendix 1–A), Plum Creek near the City of Brunswick (appendix 1–B), West Branch Sunday Creek near the Village of Hemlock (appendix 1–C), a tributary of West Branch Sunday Creek near the Village of Hemlock (appendix 1–C), a tributary of East Branch Rocky River near the City of North Royalton (appendix 1–D), and a tributary of Mud Brook near the City of Stow (appendix 1–E), and a tributary of the Cuyahoga River near the City of Stow (appendix 1–E) as requested by Ohio EMA.

The disaster declaration is divided into three separate flood events in this report: May 18–25, 2004; June 9, 2004; and June 11–18, 2004. This report describes the weather conditions leading to each flood. A general description of each flood is also presented, along with damage estimates.

---

\(^1\) Severe thunderstorms are defined as those that produce wind gusts equal to or greater than 50 knots and (or) hail at least three-quarters of an inch in diameter and (or) produces a tornado (National Weather Service, 2007a).

\(^2\) Individual Assistance is defined as assistance to individuals and households.

\(^3\) Public Assistance is defined as assistance to State and local governments for the repair or replacement of disaster-damaged public facilities.
Figure 1. Ohio counties declared disaster areas under FEMA declaration 1519 (modified from Federal Emergency Management Agency, 2007).
Antecedent Climatic Conditions

Unusually wet conditions that preceded the floods in Ohio during May and June of 2004 contributed to the severity of flooding. Climatic conditions prior to the flooding are presented in this section.

March 2004. The National Oceanic and Atmospheric Administration (NOAA) divides Ohio into 10 regions based on similar climatological characteristics. Much of the eastern two-thirds of the State received above-normal precipitation, whereas the western third received below-normal precipitation (fig. 2A). The State as a whole was 0.15 in. above normal for the month, with an average precipitation of 3.32 in. The North Central, Central Hills, and Northeast Regions (Ohio's snowbelt is contained within these regions) were all well above normal precipitation for March (fig. 2A)(Cashell and Kirk, 2004a).

April 2004. Precipitation totals in the eastern and south-central parts of the State were above normal for the month, whereas the western part of the State was below normal (fig. 2B). As a whole, the State was 0.28 in. below normal for the month, with an average precipitation of 3.30 in. The Northeast Hills Region received the most precipitation with 4.48 in., and the Northwest Region received the least precipitation with only 0.82 in. (fig. 2B) (Cashell and Kirk, 2004b).

May 18–25, 2004, Flood

Storms between May 17 and 23, 2004, led to flooding in central and eastern Ohio from May 18 to 25, 2004. These storms crossed central and eastern Ohio following a wetter than normal March and April (fig. 2A, B).

Storms of May 17–23, 2004

From May 17 to 23, 2004, winds from the southwest brought moisture-laden air from the Gulf of Mexico into Ohio. This led to high levels of moisture convergence, which increases the potential for high rainfall totals during storms.

During the afternoon and evening of May 17, a warm front associated with a mid-latitude cyclone centered over Lake Superior moved northeast across Ohio and brought scattered thunderstorms to the region. In Richland County nearly 1.5 in. of rain fell during the passage of this storm, while areas of Hocking County recorded 0.6 in. (National Oceanic and Atmospheric Administration, 2004a). These storms were isolated; much of the State did not receive any precipitation.

On the morning of May 18, the mid-latitude cyclone that was centered over Lake Superior moved northeast into northeastern Canada. By late evening on May 18, the cold front associated with the mid-latitude cyclone began to move southeast across Ohio before stalling out over central Ohio during the early morning of May 19. This stationary front remained over Ohio until the late evening of May 19. Precipitation formed along the stationary front, with 0.1–0.5 in. of rain falling on most of northwestern Ohio during the 48-hour period of May 18–19. During the same period, much of central and southeastern Ohio received 1.5–2.5 in., with parts of Hocking County receiving more than 3.5 in. of rain (National Oceanic and Atmospheric Administration, 2004a).

In the early morning of May 20, the warm air that was south of the stationary front over Ohio on May 19 began to move north. In the wake of this passing warm front, Ohio received little precipitation. This warm front was associated with another mid-latitude cyclone that had formed over northern Minnesota. As this mid-latitude cyclone advanced eastward into Canada, its associated cold front stretched across Lake Erie, just north of Ohio.

Three different rounds of severe thunderstorms swept across Ohio during a 24-hour period from May 21 to May 22. The first round of thunderstorms occurred in the early morning of May 21 as the cold front moved southward and stalled out over northern Ohio. A line of severe thunderstorms spawned by this stalled cold front moved across central and northern Ohio between 2:00 a.m. and 5:00 a.m. The second round of thunderstorms occurred in the afternoon of May 21 between 4:00 p.m. and 8:00 p.m. This line of severe thunderstorms formed along the stalled front and moved southeast from Michigan across Ohio. The third round of thunderstorms occurred on May 22 between 2:00 a.m. and 5:00 a.m. This line of severe thunderstorms again formed along the stalled front and moved eastward from Michigan, across Lake Erie, and into northeastern Ohio. The southwestern half of the State received 0–0.5 in. of rain, and much of the northeastern half of the State received 1.0–3.0 in. during the 48-hour period of May 21–22. Parts of Summit, Cuyahoga, and Portage Counties received more than 3.5 in. in this 48-hour period (National Oceanic and Atmospheric Administration, 2004a).

---

4 “Normal” refers to the average value for the period 1951–2000 (Cashell and Kirk, 2004 a,b).

5 Moisture convergence is defined as a measure of the degree to which moist air is converging into a given area.

6 A mid-latitude cyclone is defined as a low pressure system characterized by the presence of frontal boundaries. Also called an extratropical cyclone.
Figure 2. Regionally averaged monthly total precipitation and percentage of normal precipitation for the 10 climatic regions of Ohio for A, March and B, April 2004 (modified from Cashell and Kirk, 2004 a,b; “normal” refers to the average value for the period 1951–2000).
Scattered thunderstorms in the late evening of May 23 brought less than 1.0 in. of rain to parts of northern and eastern Ohio (National Oceanic and Atmospheric Administration, 2004a). In the morning of May 24, the frontal system that had stalled out over northern Ohio moved northward, and the unstable air that had been over Ohio for 3 days was replaced by warm, stable air.

During the 7-day period from May 17–23, 2004, rainfall was spread across the State with more than 5 in. of rain falling in parts of central, eastern, northeastern, and northwestern Ohio (fig. 3). Woodsfield, in Monroe County, received the most rainfall for the State during this 7-day period with 5.70 in. of rain. Rainfall intensities and recurrence intervals for selected National Weather Service (NWS) sites from this storm are listed in table 1. The time period used in table 1 is variable in order to show the most intense period of rainfall at the selected rain-gage sites.

**General Description of the May 18–25, 2004, Flood**

The following sections present information about the flooding that resulted from the May 17–23, 2004, storms. This section focuses on streamflow and stage at selected USGS streamgages in the affected counties (fig. 4). The omission from this report of any rivers or communities that experienced flooding is not a reflection of the severity of the flooding or the impact on those communities but rather is due to a lack of available streamflow data.

**Areal Distribution**

The counties listed in table 2 were declared Federal disaster areas (FEMA–1519–DR) as a result of the flooding of May 18–25, 2004. Table 2 also lists the areas affected by flooding and the streams that caused the flooding. Locations of USGS streamgages and streams in the areas that were flooded are shown in figures 5–8.

**Flood Stages, Streamflows, and Recurrence Intervals**

USGS streamgage records were examined to determine the gages where notable flooding occurred. The peak streamflows determined for those gages were compared to the recurrence intervals for streamflows that are reported in Koltun and others (2006). For streamgages that did not have sufficient record to compute a reliable recurrence-interval estimate and so are not reported in Koltun and others (2006), recurrence intervals were estimated by use of Ohio StreamStats (U.S. Geological Survey, 2007). Table 3 lists the peak stage, peak streamflow, and recurrence-interval range for selected USGS streamgages for May 18–25, 2004. For those stations on regulated rivers, a recurrence interval is not given. Record peak streamflow occurred at the streamgage on Leatherwood Creek (station 03141870). However, the period of record for this station is relatively short. The 100–500 year recurrence interval estimated for Schocalog Run at Copley Junction (station 03115973) and the 50–100 year recurrence interval estimated for Yellow Creek at Botzum (station 04206220) were the two largest recurrence intervals estimated for USGS streamgages for May 18–June 21, 2004. Of the 29 gages for which an estimated recurrence-interval range was computed, 8 of the gages had estimated recurrence-interval ranges of less than 2 years and 13 of the gages had estimated recurrence-interval ranges of 2–5 years. Whereas this indicates that these were small events, more widespread damage assessments indicate that a majority of the flooding occurred on ungaged streams.
Figure 3. Isohyetal map of 7-day rainfall totals in Ohio for May 17–23, 2004. Based on data collected at 138 rain gages throughout Ohio (National Oceanic and Atmospheric Administration, 2004a).
Table 1. Precipitation totals and recurrence intervals for selected National Weather Service rain gages in Ohio for May 17–23, 2004. Station locations are shown on figure 3.

[Data from National Oceanic and Atmospheric Administration, 2004a]

<table>
<thead>
<tr>
<th>Station name</th>
<th>County</th>
<th>Dates (2004)</th>
<th>Period (days)</th>
<th>Precipitation (inches)</th>
<th>Recurrence interval (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woodsfield 2 N</td>
<td>Monroe</td>
<td>May 19–22</td>
<td>4</td>
<td>5.70</td>
<td>25–50</td>
</tr>
<tr>
<td>Coshocton AGRI RS STA</td>
<td>Coshocton</td>
<td>May 18–21</td>
<td>4</td>
<td>5.20</td>
<td>10–25</td>
</tr>
<tr>
<td>Upper Sandusky</td>
<td>Wyandot</td>
<td>May 19–22</td>
<td>4</td>
<td>5.10</td>
<td>10–25</td>
</tr>
<tr>
<td>Ravenna 2 S</td>
<td>Portage</td>
<td>May 19–22</td>
<td>4</td>
<td>5.08</td>
<td>10–25</td>
</tr>
<tr>
<td>Oberlin</td>
<td>Lorain</td>
<td>May 19–22</td>
<td>4</td>
<td>4.59</td>
<td>10–25</td>
</tr>
<tr>
<td>Enterprise</td>
<td>Hocking</td>
<td>May 17–20</td>
<td>4</td>
<td>4.24</td>
<td>5–10</td>
</tr>
</tbody>
</table>

EXPLANATION

Streamgage and number

Figure 4. Locations of selected U.S. Geological Survey streamgages that are referred to in this report.
<table>
<thead>
<tr>
<th>County</th>
<th>Stream(s)</th>
<th>Areas</th>
<th>Figure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athens</td>
<td>West Branch Sunday Creek</td>
<td>Glouster</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Sunday Creek</td>
<td>Glouster, Trimble, and Jacksonville</td>
<td>5</td>
</tr>
<tr>
<td>Carroll</td>
<td></td>
<td>Data not available</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dellroy to Carrollton</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Columbiana</td>
<td>Middle Fork Little Beaver Creek</td>
<td>Lisbon</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>North Fork Little Beaver Creek</td>
<td>Negley</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Leslie Run</td>
<td>Negley, East Palestine</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Brush Run</td>
<td>Negley</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>East Fork Little Beaver Creek</td>
<td>Leetonia and Washingtonville</td>
<td>7</td>
</tr>
<tr>
<td>Cuyahoga</td>
<td>Cuyahoga River</td>
<td>Valley View</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Big Creek</td>
<td>Parma</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Rocky River</td>
<td>widespread</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>East Branch Rocky River</td>
<td>North Royalton</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Baldwin Creek</td>
<td>North Royalton</td>
<td>8</td>
</tr>
<tr>
<td>Guernsey</td>
<td>Miller Creek</td>
<td>Cumberland</td>
<td>6</td>
</tr>
<tr>
<td>Hocking</td>
<td>Monday Creek</td>
<td>Carbon Hill</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Hocking River</td>
<td>Logan</td>
<td>5</td>
</tr>
<tr>
<td>Lorain</td>
<td>West Branch Black River</td>
<td>Wellington, Lagrange, and Oberlin</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>East Branch Black River</td>
<td>Grafton</td>
<td>8</td>
</tr>
<tr>
<td>Mahoning</td>
<td>Yellow Creek</td>
<td>Poland</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Mahoning River</td>
<td>Youngstown and Mill Creek Park</td>
<td>7</td>
</tr>
<tr>
<td>Medina</td>
<td>Chippewa Creek</td>
<td>Gloria Glens Park</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>East Branch Rocky River</td>
<td>Widespread</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>West Branch Rocky River</td>
<td>Widespread</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Plum Creek</td>
<td>Brunswick</td>
<td>8</td>
</tr>
<tr>
<td>Noble</td>
<td>West Fork Duck Creek</td>
<td>Caldwell and Belle Valley</td>
<td>6</td>
</tr>
<tr>
<td>Perry</td>
<td>West Branch Sunday Creek</td>
<td>Hemlock</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Sunday Creek</td>
<td>Corning</td>
<td>5</td>
</tr>
<tr>
<td>Portage</td>
<td>West Branch Mahoning River</td>
<td>Ravenna</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Cuyahoga River</td>
<td>Kent</td>
<td>8</td>
</tr>
<tr>
<td>Summit</td>
<td>Wolf Creek</td>
<td>Barberton, Copley, and Norton</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Pigeon Creek</td>
<td>Copley</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Schocalog Run</td>
<td>Copley</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Cuyahoga River</td>
<td>Cuyahoga Falls and Stow</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Mud Brook</td>
<td>Stow</td>
<td>8</td>
</tr>
<tr>
<td>Tuscarawas</td>
<td>Huff Run</td>
<td>Mineral City</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Tuscarawas River</td>
<td>Northeast of New Philadelphia</td>
<td>6</td>
</tr>
</tbody>
</table>
Figure 5. Selected areas of southeastern Ohio affected by flooding during May 18–25, 2004.
Figure 6. Selected areas of eastern Ohio affected by flooding during May 18–25, 2004.
Figure 7. Selected areas of northeastern Ohio affected by flooding during May 18–25, 2004.
EXPLANATION

03159500

▲ Streamgage and number

○ City or village

Figure 8. Selected areas of northern Ohio affected by flooding during May 18–25, 2004.
Table 3. Peak stages, peak streamflows, and estimated recurrence-interval ranges at selected USGS streamgages in Ohio, May 18–25, 2004.

<table>
<thead>
<tr>
<th>Permanent station number</th>
<th>Stream and place of determination</th>
<th>Drainage area (mi²)</th>
<th>Gage datum (ft)</th>
<th>Period of systematic record (water years)</th>
<th>Maximum prior to May 18</th>
<th>Maximum during May 18–25</th>
<th>Estimated recurrence-interval range (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water year</td>
<td>Stage (ft)</td>
<td>Streamflow (ft³/s)</td>
<td>Date</td>
</tr>
<tr>
<td>03121850</td>
<td>Huff Run at Mineral City</td>
<td>12.3</td>
<td>886.98</td>
<td>9</td>
<td>2000</td>
<td>5.16</td>
<td>1,090</td>
</tr>
<tr>
<td>03122500</td>
<td>Tuscarawas River below Dover Dam near Dover</td>
<td>1,405</td>
<td>861.51</td>
<td>84</td>
<td>1913</td>
<td>23.5</td>
<td>62,000</td>
</tr>
<tr>
<td>03141870</td>
<td>Leatherwood Creek near Kipling</td>
<td>69.5</td>
<td>795.78</td>
<td>6</td>
<td>2002</td>
<td>12.06</td>
<td>1,240</td>
</tr>
<tr>
<td>03157000</td>
<td>Clear Creek near Rockbridge</td>
<td>89</td>
<td>760.13</td>
<td>67</td>
<td>1948</td>
<td>17.68</td>
<td>16,000</td>
</tr>
<tr>
<td>03157500</td>
<td>Hocking River at Enterprise</td>
<td>459</td>
<td>723.58</td>
<td>76</td>
<td>1964</td>
<td>21.31</td>
<td>26,000</td>
</tr>
<tr>
<td>03158200</td>
<td>Monday Creek at Doanville</td>
<td>114</td>
<td>650</td>
<td>9</td>
<td>1998</td>
<td>19.42</td>
<td>5,130</td>
</tr>
<tr>
<td>03159500</td>
<td>Hocking River at Athens</td>
<td>943</td>
<td>611.26</td>
<td>94</td>
<td>1907</td>
<td>27.00</td>
<td>50,000</td>
</tr>
<tr>
<td>03110000</td>
<td>Yellow Creek near Hammondsville</td>
<td>147</td>
<td>692.10</td>
<td>66</td>
<td>1952</td>
<td>12.17</td>
<td>9,580</td>
</tr>
<tr>
<td>03111500</td>
<td>Short Creek near Dillonvale</td>
<td>123</td>
<td>676.10</td>
<td>65</td>
<td>1990</td>
<td>12.27</td>
<td>8,200</td>
</tr>
<tr>
<td>03092090</td>
<td>West Branch Mahoning River near Ravenna</td>
<td>21.8</td>
<td>1,011.80</td>
<td>41</td>
<td>2003</td>
<td>10.76</td>
<td>4,810</td>
</tr>
<tr>
<td>03093000</td>
<td>Eagle Creek at Phalanx Station</td>
<td>97.6</td>
<td>887.14</td>
<td>77</td>
<td>1959</td>
<td>13.12</td>
<td>6,700</td>
</tr>
<tr>
<td>03097550</td>
<td>Mahoning River at Ohio Edison Power Plant at Niles</td>
<td>854</td>
<td>843.08</td>
<td>19</td>
<td>2003</td>
<td>15.42</td>
<td>13,000</td>
</tr>
</tbody>
</table>
Table 3. Peak stages, peak streamflows, and estimated recurrence-interval ranges at selected USGS streamgages in Ohio, May 18–25, 2004.—Continued

<table>
<thead>
<tr>
<th>Permanent station number</th>
<th>Stream and place of determination</th>
<th>Drainage area (mi²)</th>
<th>Gage datum (ft)</th>
<th>Period of systematic record (water years)a</th>
<th>Maximum prior to May 18</th>
<th>Maximum during May 18–25</th>
<th>Estimated recurrence-interval range (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>03098600</td>
<td>Mahoning River below West Ave at Youngstown</td>
<td>978</td>
<td>824.10b</td>
<td>19</td>
<td>2003</td>
<td>17.49</td>
<td>15,800</td>
</tr>
<tr>
<td>03115400</td>
<td>Little Muskingum River at Bloomfield</td>
<td>210</td>
<td>645.99b</td>
<td>32</td>
<td>1998</td>
<td>30.78</td>
<td>32,300</td>
</tr>
<tr>
<td>03115973</td>
<td>Schocalog Run at Copley Junction</td>
<td>3.65</td>
<td>994b</td>
<td>15</td>
<td>2003</td>
<td>13.64</td>
<td>275</td>
</tr>
<tr>
<td>03117500</td>
<td>Sandy Creek at Waynesburg</td>
<td>253</td>
<td>955.00b</td>
<td>68</td>
<td>1959</td>
<td>10.05</td>
<td>15,000</td>
</tr>
<tr>
<td>03118000</td>
<td>Middle Branch Nimishillen Creek at Canton</td>
<td>43.1</td>
<td>1,046.60b</td>
<td>66</td>
<td>1959</td>
<td>6.50d</td>
<td>2,470</td>
</tr>
<tr>
<td>03118500</td>
<td>Nimishillen Creek at North Industry</td>
<td>175</td>
<td>976.72c</td>
<td>85</td>
<td>2003</td>
<td>14.18</td>
<td>9,310</td>
</tr>
<tr>
<td>03121850</td>
<td>Huff Run at Mineral City</td>
<td>12.3</td>
<td>886.98b</td>
<td>9</td>
<td>2000</td>
<td>5.16</td>
<td>1,090</td>
</tr>
<tr>
<td>03124500</td>
<td>Sugar Creek at Strasburg</td>
<td>311</td>
<td>896.24b</td>
<td>53</td>
<td>1935</td>
<td>12.70</td>
<td>19,700</td>
</tr>
<tr>
<td>03129000</td>
<td>Tuscarawas River at Newcomerstown</td>
<td>2,443</td>
<td>780.00b</td>
<td>84</td>
<td>1913</td>
<td>21.50</td>
<td>83,000</td>
</tr>
<tr>
<td>03150000</td>
<td>Muskingum River at McConnelsville</td>
<td>7,422</td>
<td>650.31c</td>
<td>79</td>
<td>1913</td>
<td>33.50</td>
<td>270,000</td>
</tr>
<tr>
<td>04199500</td>
<td>Vermilion River near Vermilion</td>
<td>262</td>
<td>595.14b</td>
<td>38</td>
<td>1969</td>
<td>17.14</td>
<td>40,800</td>
</tr>
<tr>
<td>04200500</td>
<td>Black River at Elyria</td>
<td>396</td>
<td>620.83b</td>
<td>62</td>
<td>1959</td>
<td>22.90</td>
<td>24,000</td>
</tr>
</tbody>
</table>
Table 3. Peak stages, peak streamflows, and estimated recurrence-interval ranges at selected USGS streamgages in Ohio, May 18–25, 2004.—Continued

[mi², square miles; ft, feet (above gage datum); ft³/s, cubic feet per second; <, less than; N/A, not available; thick lines separate dates of maximum peak]

<table>
<thead>
<tr>
<th>Permanent station number</th>
<th>Stream and place of determination</th>
<th>Drainage area (mi²)</th>
<th>Gage datum (ft)</th>
<th>Period of systematic record (water years)</th>
<th>Maximum prior to May 18</th>
<th>Maximum during May 18–25</th>
<th>Estimated recurrence-interval range (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water year</td>
<td>Stage (ft)</td>
<td>Streamflow (ft³/s)</td>
<td>Date</td>
</tr>
<tr>
<td>04201500</td>
<td>Rocky River near Berea</td>
<td>267</td>
<td>649.90b</td>
<td>75</td>
<td>1959</td>
<td>14.10</td>
<td>21,400</td>
</tr>
<tr>
<td>04206000</td>
<td>Cuyahoga River at Old Portage</td>
<td>404</td>
<td>740.11b</td>
<td>83</td>
<td>1959</td>
<td>11.54</td>
<td>6,500</td>
</tr>
<tr>
<td>04206043</td>
<td>Mud Brook at Cuyahoga Falls</td>
<td>25.6</td>
<td>953.78b</td>
<td>5</td>
<td>2003</td>
<td>12.93</td>
<td>1,120</td>
</tr>
<tr>
<td>04206212</td>
<td>North Fork at Bath Center</td>
<td>5.58</td>
<td>950b</td>
<td>15</td>
<td>1992</td>
<td>12.93</td>
<td>885</td>
</tr>
<tr>
<td>04206220</td>
<td>Yellow Creek at Botzum</td>
<td>30.7</td>
<td>760b</td>
<td>15</td>
<td>2003</td>
<td>19.53</td>
<td>2,960</td>
</tr>
<tr>
<td>04207200</td>
<td>Tinkers Creek at Bedford</td>
<td>83.9</td>
<td>876.18b</td>
<td>44</td>
<td>1969</td>
<td>10.10</td>
<td>7,220</td>
</tr>
<tr>
<td>04208000</td>
<td>Cuyahoga River at Independence</td>
<td>707</td>
<td>583.57b</td>
<td>77</td>
<td>1959</td>
<td>22.41</td>
<td>24,800</td>
</tr>
<tr>
<td>03094000</td>
<td>Mahoning River at Leavittsburg</td>
<td>575</td>
<td>871.25b</td>
<td>67</td>
<td>1959</td>
<td>19.37</td>
<td>20,300</td>
</tr>
<tr>
<td>03109500</td>
<td>Little Beaver Creek near East Liverpool</td>
<td>496</td>
<td>702.77b</td>
<td>92</td>
<td>1941</td>
<td>17.40</td>
<td>25,000</td>
</tr>
<tr>
<td>03142000</td>
<td>Wills Creek at Cambridge</td>
<td>406</td>
<td>772.34b</td>
<td>72</td>
<td>1998</td>
<td>26.91</td>
<td>11,400</td>
</tr>
<tr>
<td>03117000</td>
<td>Tuscarawas River at Massillon</td>
<td>518</td>
<td>916.00b</td>
<td>68</td>
<td>1969</td>
<td>16.43</td>
<td>10,700</td>
</tr>
<tr>
<td>04202000</td>
<td>Cuyahoga River at Hiram Rapids</td>
<td>151</td>
<td>1,087.46b</td>
<td>70</td>
<td>1959</td>
<td>8.11</td>
<td>3,670</td>
</tr>
</tbody>
</table>
Table 3. Peak stages, peak streamflows, and estimated recurrence-interval ranges at selected USGS streamgages in Ohio, May 18–25, 2004.—Continued

[mi², square miles; ft, feet (above gage datum); ft³/s, cubic feet per second; <, less than; N/A, not available; thick lines separate dates of maximum peak]

<table>
<thead>
<tr>
<th>Permanent station number</th>
<th>Stream and place of determination</th>
<th>Drainage area (mi²)</th>
<th>Gage datum (ft)</th>
<th>Period of systematic record (water years)ᵃ</th>
<th>Maximum prior to May 18</th>
<th>Maximum during May 18–25</th>
<th>Estimated recurrence-interval range (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>03091500 Mahoning River at Pricetown</td>
<td>273</td>
<td>905.00⁰</td>
<td>77</td>
<td>1937 15.01 6,770 May 25 7.21 2,170 N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ᵃ A water year is a 12-month period from October 1 through September 30 and is designated by the calendar year in which it ends.
ᵇ NGVD 29.
ᶜ Based on frequency estimates from Ohio StreamStats (U.S. Geological Survey, 2007).
ᵈ Based on weighted estimates from Koltun and others (2006).
ᵉ COE 1912.
ᶠ From topographic map.
ᵍ A peak stage of 6.63 ft occurred in water year 2003 but is associated with a peak discharge of only 1,630 ft³/s.
ʰ A peak stage of 13.29 ft occurred in water year 1979 but is associated with a peak discharge of only 6,230 ft³/s.
June 9, 2004, Flood

Storms on June 9, 2004, led to localized flooding on that date in northeastern Ohio. These storms affected northeastern Ohio following a wet April and the second wettest May (fig. 2B) on record for the State (Cashell and Kirk, 2004c) for 122 years preceding this event. These wet conditions likely contributed to the severity of the flooding that resulted from the June 9 storms.

Storms of June 9, 2004

On June 9, 2004, a cold front associated with an occluded mid-latitude cyclone centered over northeastern Canada moved slowly southward over the southern Great Lakes. With southwest winds bringing moisture-laden air into the region, moisture convergence over Ohio was high. In the late afternoon and early evening of June 9, a line of severe thunderstorms formed along the cold front and swept across northeastern Ohio. Isolated thunderstorms brought intense rainfall to central and southern Cuyahoga County, northern Medina County, and southwestern Geauga County. Figure 9 shows the 6-hour precipitation totals for June 9 from 3:00 p.m. to 9:00 p.m. based on data from the Northeast Ohio Regional Sewer District (NEORSD) and NWS rain-gage sites. Southeastern Cuyahoga County received the most rain, with 2.23 in. falling in Oakwood for this 6-hour period. Rainfall intensities and recurrence intervals for selected NEORSD sites from this storm are listed in table 4. The time period used in table 4 is variable in order to show the most intense period of rainfall at the selected rain-gage sites.

General Description of the June 9, 2004, Flood

The following sections present information about the flooding that resulted from the June 9, 2004, storms. This section will focus on streamflow and stage at selected USGS streamgages in the affected counties (fig. 4). The omission from this report of any rivers or communities that experienced flooding is not a reflection of the severity of the flooding or the impact on those communities but rather is due to a lack of available streamflow data.

Areal Distribution

Cuyahoga, Geauga, and Medina Counties were declared Federal disaster areas (FEMA–1519–DR) as a result of the flooding on June 9, 2004. Table 5 lists the areas affected by flooding and the streams that caused the flooding. Locations of USGS streamgages and streams in the flooded areas are shown in figure 10.

Flood Stages, Streamflows, and Recurrence Intervals

USGS streamgage records were examined to determine which streams were most affected by these storms. The peak streamflows for these streams were compared to the recurrence intervals for streamflows reported in Koltun and others (2006). Table 6 lists the peak stage, peak streamflow, and recurrence interval for selected USGS streamgages for June 9, 2004. Because of the localized nature of this storm, flooding occurred mostly on small streams and creeks and had less impact on the larger streams in the region that are gaged by the USGS.

June 11–18, 2004, Flood

Storms between June 11 and 17, 2004, led to flooding in central and eastern Ohio from June 11 to 18, 2004. These storms crossed east-central, central, and west-central Ohio following a wet April and the second-wettest May (fig. 2B) on record for the State (Cashell and Kirk, 2004c). These wet conditions likely contributed to the severity of the flooding that resulted from the June 9 storms.

---

7 Occluded means that the mid-latitude cyclone is in the final phase of its life cycle. An occluded front marks the boundary between two polar air masses.
Figure 9. Isohyetal map of 6-hour rainfall totals from 3:00 p.m. to 9:00 p.m. on June 9, 2004. Based on data collected at 31 rain gages throughout northeast Ohio (Thomas Knight, Northeast Ohio Regional Sewer District, written commun., 2007; National Oceanic and Atmospheric Administration, 2004b).
Table 4.  Precipitation totals and recurrence intervals for selected Northeast Ohio Regional Sewer District rain gages in Cuyahoga County, Ohio, on June 9, 2004. Station locations are shown on figure 9.

[Data from the Northeast Ohio Regional Sewer District (Thomas Knight, written commun., 2007)]

<table>
<thead>
<tr>
<th>Station name and location</th>
<th>Time</th>
<th>Period (minutes)</th>
<th>Precipitation (inches)</th>
<th>Recurrence interval¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROA – Oakwood</td>
<td>17:40–18:40</td>
<td>60</td>
<td>1.83</td>
<td>10–25</td>
</tr>
<tr>
<td>RMN – Moreland Hills</td>
<td>17:25–18:25</td>
<td>60</td>
<td>1.93</td>
<td>10–25</td>
</tr>
<tr>
<td>RIN - Independence</td>
<td>17:35–18:05</td>
<td>30</td>
<td>1.29</td>
<td>5–10</td>
</tr>
</tbody>
</table>


Table 5.  Areas and streams affected by flooding on June 9, 2004.

[Data from Angel and others, 2004b]

<table>
<thead>
<tr>
<th>County</th>
<th>Stream(s)</th>
<th>Areas</th>
<th>Figure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cuyahoga</td>
<td>East Branch Rocky River and its tributaries</td>
<td>North Royalton</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Baldwin Creek</td>
<td>North Royalton</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Chippewa Creek</td>
<td>Brecksville, Broadview Heights</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Data no available</td>
<td>Moreland Hills, Solon, Strongsville</td>
<td>10</td>
</tr>
<tr>
<td>Geauga</td>
<td>Data no available</td>
<td>Southwestern part of county</td>
<td>10</td>
</tr>
<tr>
<td>Medina</td>
<td>West Branch Rocky River, East Branch Rocky River</td>
<td>Northern part of county</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 6.  Peak stages, peak streamflows, and estimated recurrence-interval ranges at selected USGS streamgages in Cuyahoga County, Ohio, June 9, 2004.

[mi², square miles; ft, feet (above gage datum); ft³/s, cubic feet per second; <, less than]

<table>
<thead>
<tr>
<th>Permanent station number</th>
<th>Stream and place of determination</th>
<th>Drainage area (mi²)</th>
<th>Gage datum (ft) (NGVD 29)</th>
<th>Period of systematic record (water years)¹</th>
<th>Maximum prior to June 9</th>
<th>Maximum during June 9</th>
<th>Estimated recurrence-interval range (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>04207200</td>
<td>Tinkers Creek at Bedford</td>
<td>83.9</td>
<td>876.18</td>
<td>44</td>
<td>Water year²</td>
<td>Stage (ft)</td>
<td>Streamflow (ft³/s)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1969</td>
<td>10.10</td>
<td>7,220</td>
</tr>
<tr>
<td>04208000</td>
<td>Cuyahoga River at Independence</td>
<td>707</td>
<td>583.57</td>
<td>77</td>
<td>1959</td>
<td>22.41</td>
<td>24,800</td>
</tr>
</tbody>
</table>

¹A water year is a 12-month period from October 1 through September 30 and is designated by the calendar year in which it ends.

²Based on weighted estimates from Koltun and others (2006).
Figure 10. Selected areas of northern Ohio affected by flooding on June 9, 2004.
For the period from June 11 to 17, 2004, an upper-level trough was positioned west of Ohio, allowing the air over the region to rise, which resulted in increased thunderstorm development. Moisture convergence during this time period was also high over the Midwest, providing the moisture needed for large thunderstorms to develop. As this trough moved over and past Ohio on June 18, 2004, thunderstorm development in the region was inhibited by the descending air behind the trough.

On June 11, 2004, a stationary front was located over central Ohio. Thunderstorms formed along this stationary front and moved across central Ohio, resulting in 2–3 in. of rain in parts of Darke, Preble, Miami, Greene, Montgomery, Franklin, Coshocton, Muskingum, Perry, and Athens Counties. Columbus, in Franklin County, received 2.89 in. of rain from this storm (National Oceanic and Atmospheric Administration, 2004b).

On the morning of June 12, 2004, with a stationary front still spread across Illinois, Indiana, and southern Ohio, a cluster of thunderstorms moved over Ohio from the northwest to the southeast, dumping 1–2.5 in. of rain on much of northwestern, central, and southeastern Ohio. Parts of Monroe County received 2.5 in. from this storm (National Oceanic and Atmospheric Administration, 2004b).

On the evening of June 13 and the early morning of June 14, 2004, a mid-latitude cyclone was located over northern Michigan. Ahead of a slow-moving cold front associated with this mid-latitude cyclone, a squall line formed over northeastern Indiana and moved southwest across Ohio. This line of severe storms brought 1–2 in. of rain to central and northwestern Ohio, and more than 2 in. of rain fell in parts of Delaware and Richland Counties (National Oceanic and Atmospheric Administration, 2004b).

As the mid-latitude cyclone moved northeastward into Canada, its associated cold front stalled northwest of Ohio. On the evening of June 14 and early morning of June 15, 2004, another squall line formed over northern Indiana ahead of the stalled cold front and moved eastward across northern Ohio. On the afternoon of June 15, 2004, a cluster of thunderstorms formed along this cold front as it began to move southward over Ohio. These thunderstorms crossed Ohio between June 14 and 15, 2004, and dropped 1–3 in. of rain on much of northern Ohio, with more than 4 in. of rain falling in parts of Carroll and Stark Counties (National Oceanic and Atmospheric Administration, 2004b).

On the morning of June 16, 2004, the mid-latitude cyclone over northern Canada dissipated, and the frontal boundary over Ohio lifted. On the evening of June 16, a warm front associated with a mid-latitude cyclone over Iowa moved northward across Ohio. Thunderstorms formed along this warm front, bringing 0.5–2 in. of rain to parts of western and eastern Ohio. A total of 2.13 in. of rain fell on Cambridge in Guernsey County during this storm (National Oceanic and Atmospheric Administration, 2004b).

Storms that moved across Ohio during this week-long period from June 11 to 17, 2004, brought more than 7 in. of rain to parts of Logan, Delaware, Tuscarawas, and Carroll Counties (fig. 11). Figure 11 was created from NWS data (National Oceanic and Atmospheric Administration, 2004b) collected at 141 rain gages throughout Ohio. Rainfall intensities and recurrence intervals for selected NWS sites from this storm are listed in table 7.

### General Description of the June 11–18, 2004, Flood

The following sections present information about the flooding from June 11 to 18, 2004, that resulted from storms during that period. This section focuses on streamflow and stage at selected USGS streamgages in the affected counties (fig. 4). The omission from this report of any rivers or communities that experienced flooding is not a reflection of the severity of the flooding or the impact on those communities but rather is due to a lack of available streamflow data.

### Areal Distribution

The counties listed in table 8 were declared Federal disaster areas (FEMA–1519–DR) as a result of flooding from June 11 to 18, 2004. Table 8 also lists the areas affected by flooding and the streams that caused the flooding. Locations of USGS streamgages and streams in the areas flooded are shown in figures 12–15.

---

1. An upper-level trough is defined as an elongated region of low pressure at high levels in the atmosphere.
2. A squall line is defined as a linear band of severe thunderstorms that often forms ahead of or along a cold front.
Figure 11. Isohyetal map of 7-day rainfall totals in Ohio for June 11–17, 2004. Based on data collected at 141 rain gages throughout Ohio (National Oceanic and Atmospheric Administration, 2004b).
Table 7. Precipitation totals and recurrence intervals for selected National Weather Service rain gages in Ohio for June 11–17, 2004. Station locations shown on figure 11.

[Data from National Oceanic and Atmospheric Administration, 2004b]

<table>
<thead>
<tr>
<th>Station name</th>
<th>County</th>
<th>Period (days)</th>
<th>Precipitation (inches)</th>
<th>Recurrence interval (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leesville Lake</td>
<td>Carroll</td>
<td>7</td>
<td>7.80</td>
<td>50–100</td>
</tr>
<tr>
<td>Delaware Lake</td>
<td>Delaware</td>
<td>7</td>
<td>7.70</td>
<td>50–100</td>
</tr>
<tr>
<td>New Philadelphia</td>
<td>Tuscarawas</td>
<td>7</td>
<td>7.59</td>
<td>50–100</td>
</tr>
<tr>
<td>Bellefontaine</td>
<td>Logan</td>
<td>7</td>
<td>7.18</td>
<td>25–50</td>
</tr>
<tr>
<td>Wooster Exp Stn</td>
<td>Wayne</td>
<td>7</td>
<td>6.18</td>
<td>10–25</td>
</tr>
<tr>
<td>Louisville</td>
<td>Stark</td>
<td>7</td>
<td>5.84</td>
<td>10–25</td>
</tr>
</tbody>
</table>


Table 8. Areas and streams affected by flooding during June 11–18, 2004.

[Data from Angel and others, 2004b]

<table>
<thead>
<tr>
<th>County</th>
<th>Stream(s)</th>
<th>Areas</th>
<th>Figure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carroll</td>
<td>Sandy Creek</td>
<td>Malvern, Carrollton and Dellroy</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Data not available</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Columbiana</td>
<td>Sandy Creek</td>
<td>East Rochester, East Palestine, Lisbon, and New Waterford</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Data not available</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Crawford</td>
<td>Sandusky River and its tributaries</td>
<td>Bucyrus, Crestline, and Galion</td>
<td>13</td>
</tr>
<tr>
<td>Delaware</td>
<td>Olentangy River</td>
<td>Delaware and Powell</td>
<td>14</td>
</tr>
<tr>
<td>Guernsey</td>
<td>Wills Creek</td>
<td>Byesville and Guernsey</td>
<td>12</td>
</tr>
<tr>
<td>Harrison</td>
<td>Data not available</td>
<td>Bowerston and Deersville</td>
<td>12</td>
</tr>
<tr>
<td>Holmes</td>
<td>Salt Creek</td>
<td>Northern part of county</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Killbuck Creek</td>
<td>Killbuck</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Walnut Creek</td>
<td>Widespread</td>
<td>12</td>
</tr>
<tr>
<td>Knox</td>
<td>Data not available</td>
<td>Countywide</td>
<td>15</td>
</tr>
<tr>
<td>Licking</td>
<td>Data not available</td>
<td>Johnstown</td>
<td>15</td>
</tr>
<tr>
<td>Logan</td>
<td>Bokengehalas Creek</td>
<td>Bellefontaine</td>
<td>14</td>
</tr>
<tr>
<td>Noble</td>
<td>Data not available</td>
<td>Sarahsville</td>
<td>12</td>
</tr>
<tr>
<td>Richland</td>
<td>Black Fork Mohican River and it tributaries</td>
<td>Charles Mill Lake Park and Shelby</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Data not available</td>
<td>Plymouth</td>
<td>15</td>
</tr>
<tr>
<td>Stark</td>
<td>Sugar Creek</td>
<td>Beach City</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Data not available</td>
<td>Wilmot</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Nimishillen Creek</td>
<td>Louisville and North Industry</td>
<td>12</td>
</tr>
<tr>
<td>Tuscarawas</td>
<td>Tuscarawas River</td>
<td>New Philadelphia and Port Washington</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Walnut Creek</td>
<td>Dundee</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Stone Creek</td>
<td>Widespread</td>
<td>12</td>
</tr>
</tbody>
</table>
Figure 12. Selected areas of eastern Ohio affected by flooding during June 11–17, 2004.
Figure 13. Selected areas of north-central Ohio affected by flooding during June 11–17, 2004.
EXPLANATION

Base from U.S. Geological Survey
digital data, variously scaled,
State Plane Ohio South

Figure 14. Selected areas of southwestern, western, and central Ohio affected by flooding during June 11–17, 2004.
EXPLANATION

▲ Streamgage and number
○ City or village

Figure 15. Selected areas of east-central Ohio affected by flooding during June 11–17, 2004.
Flood Stages, Streamflows, and Recurrence Intervals

USGS streamgage records were examined to determine which streams were most affected by these storms. The peak streamflows for these streams were compared to the recurrence intervals for streamflows that are reported in Koltun and others (2006). For streamgages that did not have sufficient record to compute a reliable recurrence-interval estimate and so are not reported in Koltun and others (2006), recurrence intervals were estimated by use of Ohio StreamStats (U.S. Geological Survey, 2007). Table 9 lists the peak stage, peak streamflow, and recurrence-interval range for selected USGS streamgages for June 11–18, 2004. For those stations on regulated rivers, a recurrence interval is not given. Record peak streamflow occurred on the Kokosing River near Lucerne (station 03136175) and Mad River at West Liberty (station 03266560). However, these two stations have a relatively short period of record. Of the 25 streamgages for which an estimated recurrence-interval range was computed, 13 had estimated recurrence-interval ranges of less than 2 years and 8 had estimated recurrence-interval ranges of 2–5 years. Although these estimated recurrence-interval ranges indicate that these were small floods, more widespread damage assessments indicate that a majority of the flooding occurred on ungaged streams.

Flood and Storm Damages Associated with FEMA-1519-DR

Although it was not possible to determine an exact value of the damages caused by the flooding, Ohio EMA was able to obtain some estimates of the extent of the damage. According to the Ohio EMA (Kay Phillips, written commun., 2007) flooding for the period May 18–June 21, 2004, resulted in two deaths and damage to or destruction of 3,529 private properties. Damages to public property were estimated to be $16.7 million. FEMA approved nearly $32.5 million of assistance to aid in the repair of both public and private properties. The Small Business Administration approved an additional $11 million in loans to aid with repair of local businesses affected by the flooding.

Tables 10 and 11 list the extent of the damages to private and public property. Table 10 lists the estimated damages incurred to private property (Individual Assistance). Table 11 indicates estimated damages to public properties such as city and county buildings, roadways, vehicles, certain utilities, and other publicly owned property.

[mi², square miles; ft, feet (above gage datum); ft³/s, cubic feet per second; <, less than; N/A, not available; thick lines separate dates of maximum peak]

<table>
<thead>
<tr>
<th>Permanent station number</th>
<th>Stream and place of determination</th>
<th>Drainage area (mi²)</th>
<th>Gage datum (ft)</th>
<th>Period of systematic record (water years)*</th>
<th>Maximum prior to June 11</th>
<th>Maximum during June 11–18</th>
<th>Estimated recurrence-interval range (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>03121850</td>
<td>Huff Run at Mineral City</td>
<td>12.3</td>
<td>886.98b</td>
<td>9</td>
<td>2000 5.16 1,090</td>
<td>June 11 3.06 153</td>
<td>&lt;2c</td>
</tr>
<tr>
<td>03115400</td>
<td>Little Muskingum River at Bloomfield</td>
<td>210</td>
<td>645.99b</td>
<td>32</td>
<td>1998 30.78 32,300</td>
<td>June 12 17.15 4,420</td>
<td>&lt;2d</td>
</tr>
<tr>
<td>03110000</td>
<td>Yellow Creek near Hammondsville</td>
<td>147</td>
<td>692.10b</td>
<td>66</td>
<td>1952 12.17 9,580</td>
<td>June 14 6.71 2,580</td>
<td>&lt;2d</td>
</tr>
<tr>
<td>03111500</td>
<td>Short Creek near Dillonvale</td>
<td>123</td>
<td>676.10b</td>
<td>65</td>
<td>1990 12.27 8,200</td>
<td>June 14 5.89 1,590</td>
<td>&lt;2d</td>
</tr>
<tr>
<td>03121850</td>
<td>Huff Run at Mineral City</td>
<td>12.3</td>
<td>886.98b</td>
<td>9</td>
<td>2000 5.16 1,090</td>
<td>June 14 3.27 204</td>
<td>&lt;2c</td>
</tr>
<tr>
<td>0313175</td>
<td>Kokosing River near Lucerne</td>
<td>59.5</td>
<td>1,065c</td>
<td>5</td>
<td>2002 8.26 1,430</td>
<td>June 14 8.35 1,550</td>
<td>&lt;2c</td>
</tr>
<tr>
<td>03136500</td>
<td>Kokosing River at Mount Vernon</td>
<td>202</td>
<td>984.16b</td>
<td>53</td>
<td>1959 18.19 38,000</td>
<td>June 14 8.23 2,670</td>
<td>&lt;2d</td>
</tr>
<tr>
<td>03146500</td>
<td>Licking River near Newark</td>
<td>537</td>
<td>779.02b</td>
<td>66</td>
<td>1959 20.30 45,000</td>
<td>June 14 12.38 12,500</td>
<td>2–5d</td>
</tr>
<tr>
<td>03220000</td>
<td>Mill Creek near Bellepoint</td>
<td>178</td>
<td>865.14f</td>
<td>64</td>
<td>1997 14.45 21,800</td>
<td>June 14 7.74 3,820</td>
<td>&lt;2d</td>
</tr>
<tr>
<td>03228300</td>
<td>Big Walnut Creek at Sunbury</td>
<td>101</td>
<td>945b</td>
<td>17</td>
<td>1997 11.20 6,700</td>
<td>June 14 11.23 6,300</td>
<td>10–25d</td>
</tr>
<tr>
<td>03228750</td>
<td>Alum Creek near Kilbourne</td>
<td>64.9</td>
<td>900.99p</td>
<td>13</td>
<td>1975 12.05 4,850</td>
<td>June 14 8.98 3,060</td>
<td>2–5d</td>
</tr>
<tr>
<td>03260706</td>
<td>Bokengehalas Creek at De Graff</td>
<td>40.4</td>
<td>977.38b</td>
<td>14</td>
<td>2003 6.80 925</td>
<td>June 14 5.99 749</td>
<td>&lt;2c</td>
</tr>
<tr>
<td>03266560</td>
<td>Mad River at West Liberty</td>
<td>36.6</td>
<td>1,078.00p</td>
<td>10</td>
<td>1997 8.43 1,200</td>
<td>June 14 8.73 1,640</td>
<td>2–5c</td>
</tr>
<tr>
<td>04196000</td>
<td>Sandusky River near Bucyrus</td>
<td>88.8</td>
<td>955.04b</td>
<td>52</td>
<td>1959 11.90 13,500</td>
<td>June 14 9.5 4,230</td>
<td>5–10d</td>
</tr>
<tr>
<td>03109500</td>
<td>Little Beaver Creek near East Liverpool</td>
<td>496</td>
<td>702.77f</td>
<td>92</td>
<td>1941 17.40 25,000</td>
<td>June 15 9.73 6,550</td>
<td>&lt;2d</td>
</tr>
<tr>
<td>03117500</td>
<td>Sandy Creek at Waynesburg</td>
<td>253</td>
<td>955.00e</td>
<td>68</td>
<td>1959 10.05 15,000</td>
<td>June 15 8.24 5,110</td>
<td>5–10d</td>
</tr>
<tr>
<td>03118000</td>
<td>Middle Branch Nimishillen Creek at Canton</td>
<td>43.1</td>
<td>1,046.60e</td>
<td>66</td>
<td>1959 6.50e 2,470</td>
<td>June 15 5.21 529</td>
<td>&lt;2d</td>
</tr>
<tr>
<td>03118500</td>
<td>Nimishillen Creek at North Industry</td>
<td>175</td>
<td>976.72f</td>
<td>85</td>
<td>2003 14.18 9,310</td>
<td>June 15 11.46 6,480</td>
<td>25–50d</td>
</tr>
<tr>
<td>03221000</td>
<td>Scioto River below O’Shaughnessy Dam near Dublin</td>
<td>980</td>
<td>775.00e</td>
<td>86</td>
<td>1913 24.60 74,500</td>
<td>June 15 11.86 14,000</td>
<td>2–5d</td>
</tr>
</tbody>
</table>
Table 9. Peak stages, peak streamflows, and estimated recurrence-interval ranges at selected USGS streamgages in Ohio, June 11–18, 2004.—Continued

[mi², square miles; ft, feet (above gage datum); ft³/s, cubic feet per second; <, less than; N/A, not available; thick lines separate dates of maximum peak]

<table>
<thead>
<tr>
<th>Permanent station number</th>
<th>Stream and place of determination</th>
<th>Drainage area (mi²)</th>
<th>Gage datum (ft)</th>
<th>Period of systematic record (water years)a</th>
<th>Maximum prior to June 11</th>
<th>Maximum during June 11–18</th>
<th>Estimated recurrence-interval range (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>03228750</td>
<td>Alum Creek near Kilbourne</td>
<td>64.9</td>
<td>900.99b</td>
<td>13</td>
<td>1975</td>
<td>12.05</td>
<td>4,850</td>
</tr>
<tr>
<td>03219500</td>
<td>Scioto River near Prospect</td>
<td>567</td>
<td>886.90b</td>
<td>93</td>
<td>1913</td>
<td>21.10</td>
<td>27,000</td>
</tr>
<tr>
<td>04196500</td>
<td>Sandusky River near Upper Sandusky</td>
<td>298</td>
<td>792.25p</td>
<td>65</td>
<td>1959</td>
<td>15.00</td>
<td>10,000</td>
</tr>
<tr>
<td>03121850</td>
<td>Huff Run at Mineral City</td>
<td>12.3</td>
<td>886.98b</td>
<td>9</td>
<td>2000</td>
<td>5.16</td>
<td>1,090</td>
</tr>
<tr>
<td>03124500</td>
<td>Sugar Creek at Strasburg</td>
<td>311</td>
<td>896.24f</td>
<td>53</td>
<td>1935</td>
<td>12.70</td>
<td>19,700</td>
</tr>
<tr>
<td>03139000</td>
<td>Killbuck Creek at Killbuck</td>
<td>464</td>
<td>788.05p</td>
<td>76</td>
<td>1969</td>
<td>26.40</td>
<td>47,500</td>
</tr>
<tr>
<td>03228805</td>
<td>Alum Creek at Africa</td>
<td>221</td>
<td>822.00p</td>
<td>44</td>
<td>1963</td>
<td>14.20</td>
<td>6,460</td>
</tr>
</tbody>
</table>

a A water year is a 12-month period from October 1 through September 30 and is designated by the calendar year in which it ends.
b NGVD 29.
c Based on frequency estimates from Ohio StreamStats (U.S. Geological Survey, 2007).
d Based on weighted estimates from Koltun and others (2006).
e From topographic map.
f COE 1912.
g A peak stage of 11.86 ft occurred in water year 1991 but is associated with a peak discharge of 5,690 ft³/s.
h A peak stage of 6.63 ft occurred in water year 2003 but is associated with a peak discharge of 1,630 ft³/s.
i A peak stage of 27.74 ft occurred in water year 1979 but is associated with a peak discharge of 2,150 ft³/s.
### Table 10. Damage estimates for Individual Assistance associated with Federal Emergency Management Agency disaster declaration FEMA–1519–DR.

[Source: Kay Phillips, Ohio Emergency Management Agency, written commun., 2007]

<table>
<thead>
<tr>
<th>County</th>
<th>Structures damaged¹</th>
<th>Structures destroyed²</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athens</td>
<td>132</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Carroll</td>
<td>19</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Columbiana</td>
<td>80</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Crawford</td>
<td>144</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cuyahoga</td>
<td>1,079</td>
<td>16</td>
<td>0</td>
</tr>
<tr>
<td>Delaware</td>
<td>154</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Geauga</td>
<td>13</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Guernsey</td>
<td>28</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Harrison</td>
<td>139</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Hocking</td>
<td>21</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Holmes</td>
<td>445</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Licking</td>
<td>43</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Logan</td>
<td>88</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lorain</td>
<td>406</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Mahoning</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Medina</td>
<td>345</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Noble</td>
<td>15</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Perry</td>
<td>57</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Portage</td>
<td>46</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Richland</td>
<td>44</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Stark</td>
<td>12</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Summit</td>
<td>130</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tuscarawas</td>
<td>56</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

¹Properties that received damage considered to be repairable.
²Properties that were considered to be a total loss.

### Table 11. Damage estimates for Public Assistance associated with Federal Emergency Management Agency disaster declaration FEMA–1519–DR.

[Source: Kay Phillips, Ohio Emergency Management Agency, written commun., 2007]

<table>
<thead>
<tr>
<th>County</th>
<th>Estimated damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athens</td>
<td>$72,000</td>
</tr>
<tr>
<td>Carroll</td>
<td>$126,800</td>
</tr>
<tr>
<td>Columbiana</td>
<td>$2,531,668</td>
</tr>
<tr>
<td>Cuyahoga</td>
<td>$3,572,100</td>
</tr>
<tr>
<td>Delaware</td>
<td>$301,989</td>
</tr>
<tr>
<td>Guernsey</td>
<td>$951,109</td>
</tr>
<tr>
<td>Harrison</td>
<td>$2,061,426</td>
</tr>
<tr>
<td>Hocking</td>
<td>$156,581</td>
</tr>
<tr>
<td>Holmes</td>
<td>$643,000</td>
</tr>
<tr>
<td>Jefferson</td>
<td>$319,425</td>
</tr>
<tr>
<td>Knox</td>
<td>$772,841</td>
</tr>
<tr>
<td>Lorain</td>
<td>$236,700</td>
</tr>
<tr>
<td>Medina</td>
<td>$394,500</td>
</tr>
<tr>
<td>Noble</td>
<td>$237,700</td>
</tr>
<tr>
<td>Perry</td>
<td>$776,700</td>
</tr>
<tr>
<td>Portage</td>
<td>$699,136</td>
</tr>
<tr>
<td>Summit</td>
<td>$2,194,427</td>
</tr>
<tr>
<td>Tuscarawas</td>
<td>$682,500</td>
</tr>
</tbody>
</table>
Summary

The passage of several severe thunderstorms over Ohio between May 17 and May 23, on June 9, and between June 11 and June 17, 2004, resulted in flooding and widespread damage throughout much of central and eastern Ohio between May 18 and June 21. From May 17 through May 23, rain was widespread across eastern and central Ohio, with parts of Monroe County receiving more than 5.5 in. of rain from May 19 to May 22. Storms on June 9 were localized to parts of Cuyahoga County, with nearly 2 in. of rain falling in Moreland Hills during a 1-hour period. From June 11 through June 17, rain was widespread across eastern and central Ohio, with nearly 8 in. of rain falling in parts of Carroll County during this 7-day period.

The largest estimated flood-recurrence intervals at USGS streamgages for May 18–June 21, 2004, occurred in Summit County, where a 100–500 year flood occurred on Schocalog Run at Copley Junction (station 03115973) and a 50–100 year flood occurred on Yellow Creek at Botzum (station 04206220). Record peak streamflow occurred at three streamgages. Estimated recurrence intervals associated with peak flows during this month-long period were variable, and in many areas flooding is assumed to have occurred on ungaged streams.

In all, 25 counties in central and eastern Ohio were declared Federal disaster areas (FEMA–1519–DR) as a result of the storms and flooding between May 18 and June 21, 2004. Two storm- or flood-related fatalities were reported, and an economic impact of more than $43 million is estimated by the Ohio EMA.

Acknowledgments

Special thanks are extended to Kay Phillips of Ohio EMA for her help in providing damage estimates for the counties affected by this flood. Thanks also to Jeff Smith of the Ohio Geographically Referenced Information Program (OGRIP) for providing Ohio Statewide Imagery Program (OSIP) data used to make certain figures in this report.

References Cited


National Oceanic and Atmospheric Administration, 2004b, Hourly precipitation data, Ohio, June 2004: v. 54, no. 6, 22 p.


This page is intentionally blank.