FLOOD ON THE VIRGIN RIVER, JANUARY 1989, IN UTAH, ARIZONA, AND NEVADA

By Darrell D. Carlson and David F. Meyer

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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
acre	4,047	square meter
acre-foot (acre-ft)	1,233	cubic meter
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
cubic yard (yd^3)	0.7646	cubic meter
foot (ft)	0.3048	meter
foot per second (ft/s)	0.3048	meter per second
inch (in.)	25.4	millimeter
mile (mi)	1.609	kilometer
square mile (mi^2)	2.59	square kilometer

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.

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By D.D. Carlson and D.F. Meyer

ABSTRACT

The impoundment of water in Quail Creek Reservoir in southwestern Utah began in April 1985. The drainage area for the reservoir is 78.4 square miles, including Quail Creek and Leeds Creek watersheds. Water also is diverted from the Virgin River above Hurricane, Utah, to supplement the filling of the reservoir.

A dike, which is one of the structures impounding water in Quail Creek Reservoir, failed on January 1, 1989. This failure resulted in the release of about 25,000 acre-feet of water into the Virgin River near Hurricane, Utah.

Flooding occurred along the Virgin River flood plain in Utah, Arizona, and Nevada. The previous maximum discharge of record was exceeded at three U.S. Geological Survey streamflow-gaging stations, and the flood discharges exceeded the theoretical 100-year flood discharges. Peak discharge estimates ranged from 60,000 to 66,000 cubic feet per second at the three streamflow-gaging stations.

Damage to roads, bridges, agricultural land, livestock, irrigation structures, businesses, and residences totaled more than $12 million. The greatest damage was to agricultural and public-works facilities. Washington County, which is in southwestern Utah, was declared a disaster area by President George Bush.

INTRODUCTION

Water from Quail Creek drains into the Virgin River in southwestern Utah (pl. 1, fig. 1) and eventually flows into the Colorado River through the Overton Arm of Lake Mead. The impoundment of water in Quail Creek Reservoir began in 1985. Reservoir structures include a dam on Quail Creek and a separate dike in a topographically low area about 0.5 mi west of the dam.

Uses of Quail Creek Reservoir water include municipal and industrial supply, irrigation, power generation, and recreation. Flooding caused by failure of the dike on January 1, 1989, seriously affected 89 mi of the Virgin River valley in Utah, Arizona, and Nevada.

Purpose and Scope

The purpose of this report is to document the January 1, 1989, flood in the Virgin River Basin that was caused by failure of a dike in Quail Creek Reservoir in Utah. The report discusses characteristics of, and damages caused by, this flood, and includes information on the history of past floods in the Virgin River Basin.

Acknowledgments

The authors wish to acknowledge the assistance given by personnel of several agencies in the preparation of this report. Louis Ramirez of the Federal Emergency Management Agency provided damage data, and Matthew Linden of the Utah Department of Natural Resources, Division of Water Rights, provided photographs and construction data for the dike.

Description of Quail Creek Reservoir

Quail Creek Reservoir in southwestern Utah (pl. 1) is owned and operated by the Washington County Water Conservancy District. Construction of the reservoir began in November 1983. The reservoir dike construction was completed in April 1984, and the dam, about 0.5 mi east of the dike, was completed in January 1985. Impoundment of water in the reservoir began in April 1985 (James and others, 1989).

The dike was a zoned earth embankment constructed on the Shnabkaib Member of the Moenkopi Formation (Triassic), which contains abundant gypsum deposits (James and others, 1989). The dike and dam crest altitude is 2,995 ft. The dam has an uncontrolled spillway with a crest altitude of 2,985 ft. The storage capacity of the reservoir at the spillway crest is 40,352 acre-ft (fig. 2). The surface area of the reservoir is 590 acres at the spillway crest altitude, and the average depth is about 68 ft.

Quail Creek and Leeds Creek contribute runoff to the reservoir. The total drainage area of the reservoir is 78.4 mi^2. Water also is diverted from the Virgin River

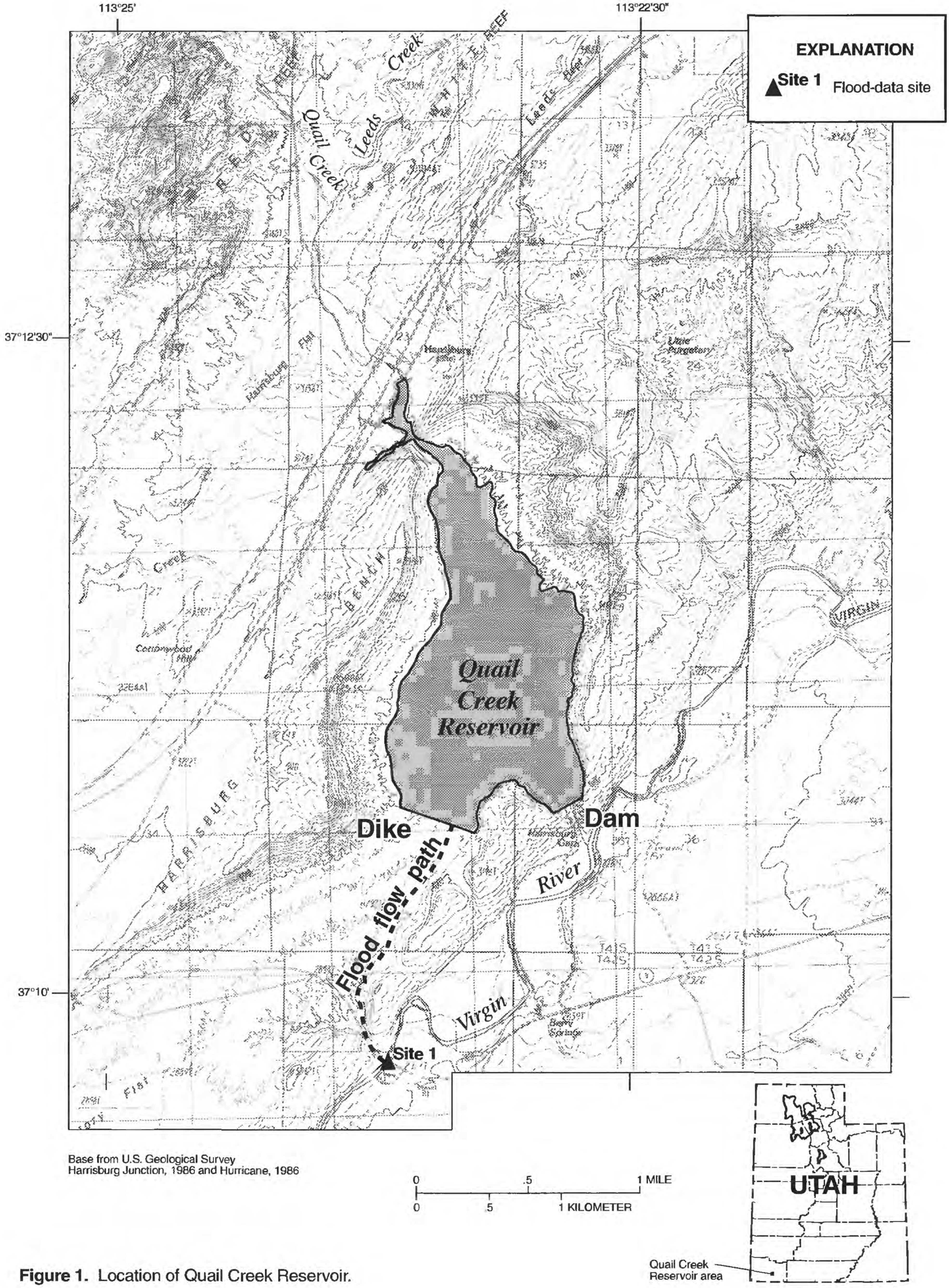

Figure 1. Location of Quail Creek Reservoir.

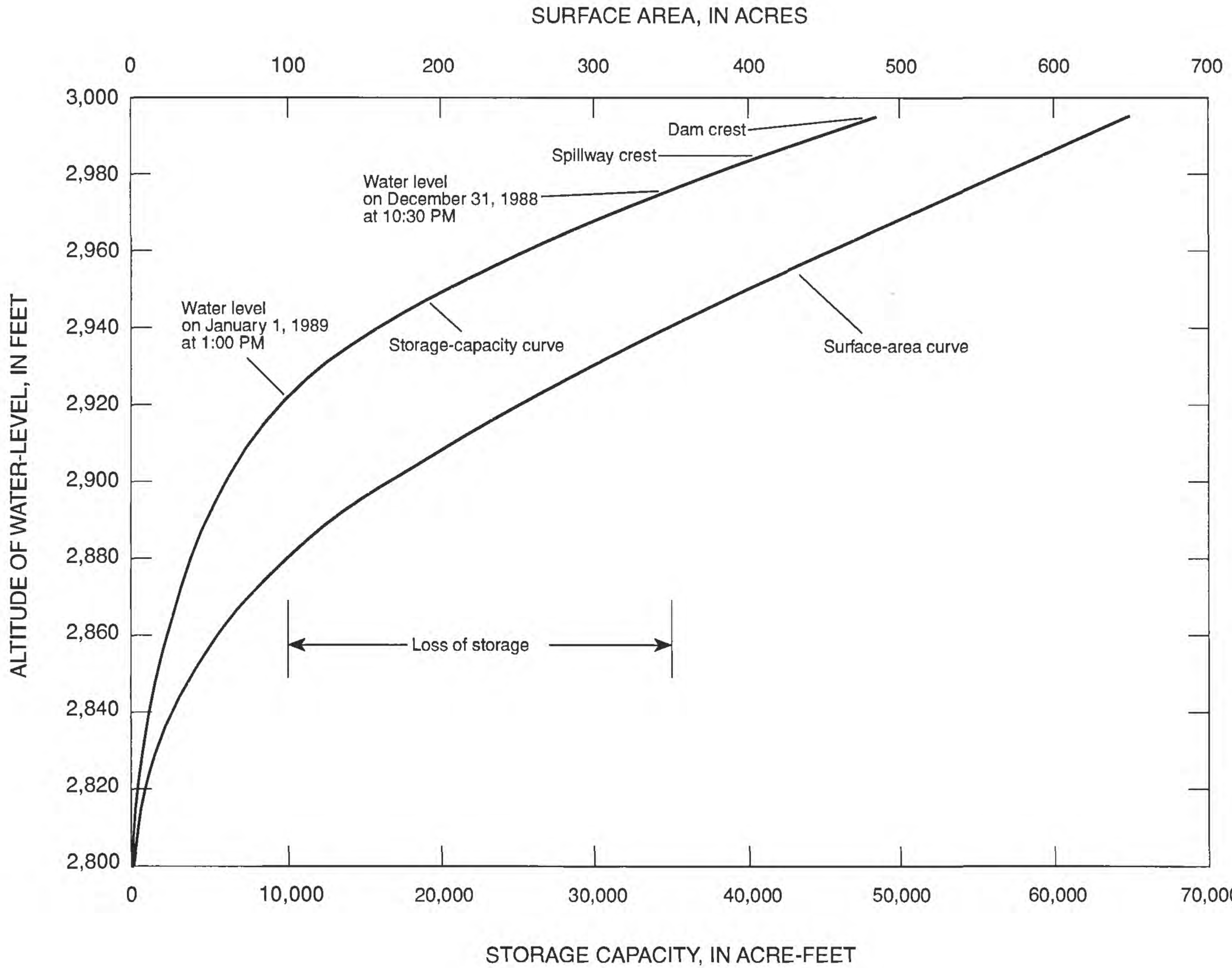

Figure 2. Surface-area and storage-capacity curves for Quail Creek Reservoir in southwestern Utah.

through a pipeline to the reservoir; the diversion dam is about 2 mi upstream from Hurricane, Utah (pl. 1).

Maximum dike height is about 80 ft, with a crest width of 20 ft and a length of nearly 2,000 ft. A typical cross section of the dike near the area of the breach is shown in figure 3, which was drawn from data in James and others (1989, figs. 2-5).

Description of the Breach of the Dike

Quail Creek Reservoir storage was about 35,000 acre-ft at a water-surface altitude of 2,976 ft on December 31, 1988. Seepage increased noticeably throughout the day, mainly at one location. Seepage through the dike began to substantially increase at 8:20 p.m. The leakage was estimated to be nearly 70 ft^3/s about 10:30 p.m., at which time the flow changed from a vertical to a horizontal direction and began to deteriorate the toe of the dike. A large part of the dike embankment sloughed in near the downstream toe of the dike between 11:00 p.m. and 11:30 p.m. As material was eroded, the embankment continued to slough in until the dike breached completely at about 12:30 a.m. on January 1, 1989.

The breach was estimated to be 140 ft wide and 80 ft deep (fig. 4). Land-surface altitude upstream of the breach was about 2,928 ft (fig. 3). Water was bypassing the 2,928-ft land-surface altitude on the right side because a small earthen dike was constructed in this area (fig. 5). Reservoir storage was about 10,000 acre-ft at an altitude of 2,922 ft; therefore, about 25,000 acre-ft of water spilled through the breach. Flow through the breach stopped about 1:00 p.m. on January 1, 1989 (James and others, 1989).

The path the water took after the dike breached is shown in figures 5, 6, and 7. The water entered the Virgin River at the Utah State Highway 9 bridge crossing (fig. 1, site 1). Top soil was completely removed between the dike and the confluence with the Virgin River (fig. 6). In addition, it is estimated that about 75,000 yd^3 of material were removed from the dike at the breach. Most of this material was deposited in the Virgin River channel at the Utah State Highway 9 bridge crossing (figs. 8 and 9).

Determination of Peak Discharge

The sudden breaching of the Quail Creek Reservoir dike did not allow sufficient time to obtain current-meter measurements of the flood; therefore, indirect discharge measurements were made after the flood peak had passed. Indirect discharge measurements are computed using established hydraulic principles based on channel geometry and the slope of the water surface within a given reach of a river (Benson and Dalrymple, 1967). Azimuth-stadia surveys of the channel geometry and high-water marks provide the data needed to theoretically compute discharge.

Indirect measurement methods were used to compute peak discharge at all sites on the Virgin River. Hydraulic conditions at three sites were not considered favorable for this type of measurement, so computations of peak discharge are considered to be estimates at site 1, Virgin River near Hurricane, Utah; site 3, Virgin River near Bloomington, Utah; and site 5, Virgin River near Mesquite, Arizona.

FLOOD OF JANUARY 1, 1989

The flood of January 1, 1989, along the Virgin River flood plain was caused by the failure of the Quail Creek Reservoir dike. The theoretical 100-year flood discharge was exceeded at three U.S. Geological Survey streamflow-gaging stations in the Virgin River Basin (table 1) during this flood.

The floodwater traveled about 1 mi before entering the Virgin River at the Utah State Highway 9 bridge crossing. The floodwater entered the Virgin River at an angle of about 90 degrees and destroyed the right approach to the bridge. The left bank of the Virgin River at the Utah State Highway 9 bridge crossing consists of a high vertical bank made up of volcanic rock (fig. 8). Sediment deposition at the highway crossing (fig. 9) indicates that this bank dissipated a large quantity of the energy associated with the translatory wave.

The floodwater diverged both upstream and downstream in the Virgin River. The slope in this reach of the Virgin River is about 20 ft/mi. The depth of water 1.5 mi downstream of the Utah State Highway 9 bridge crossing where the indirect measurement data was collected averaged 35 ft. Transferring this depth upstream to the bridge crossing, the effects of the flood would extend about 1.75 mi upstream of the Utah State Highway 9 bridge. The width of the channel upstream of the bridge averages 2,000 ft in this reach. The volume of water that filled the channel upstream of the bridge was estimated to be about 6,000 acre-ft. Channel storage between the bridge and the site of the indirect measurement, 1.5 mi downstream, was estimated to be 4,000 acre-ft using an average depth of 35 ft and an average width of 700 ft.

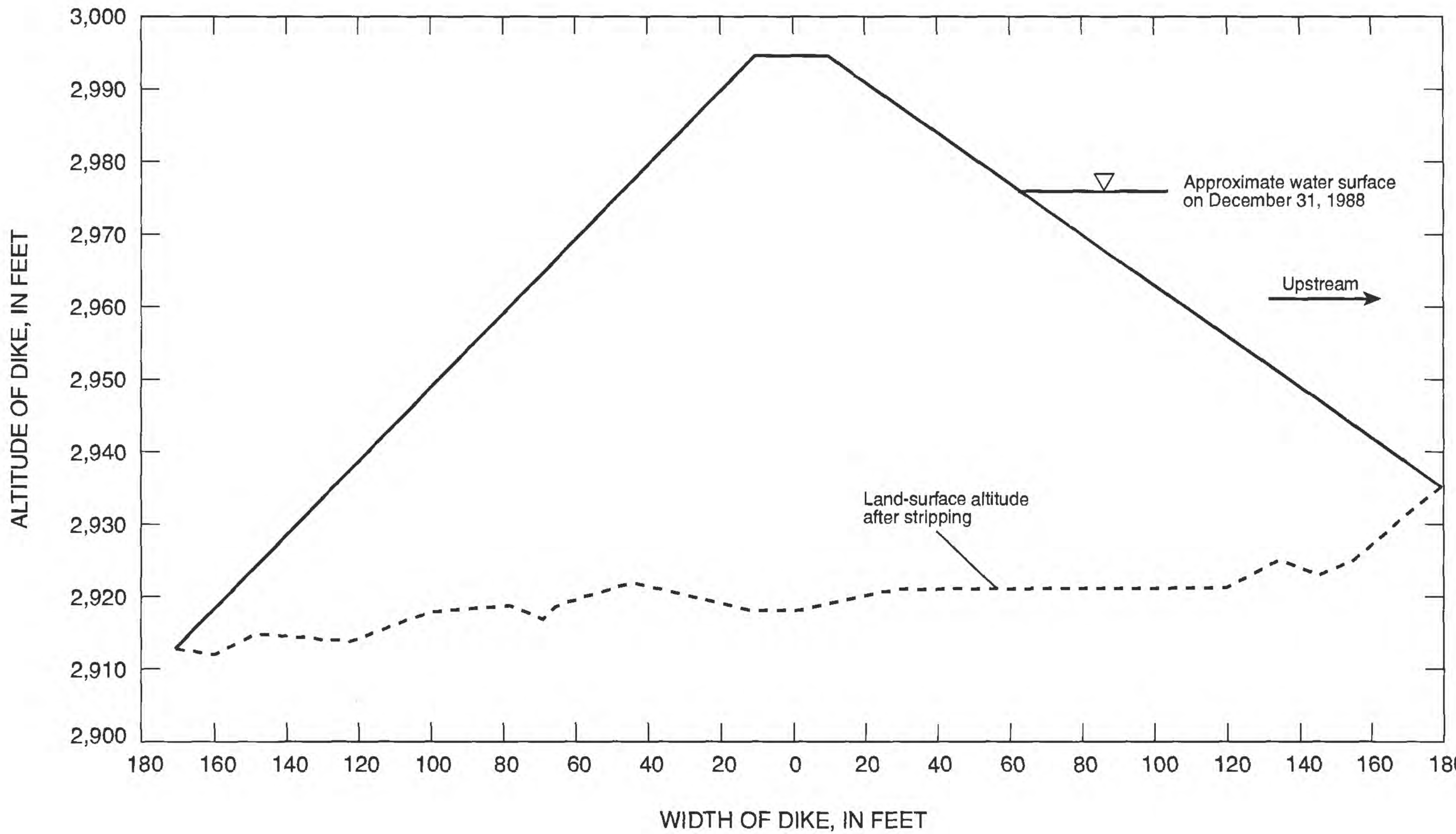

Figure 3. Cross section of Quail Creek Reservoir dike near area of breach, before dike failure.

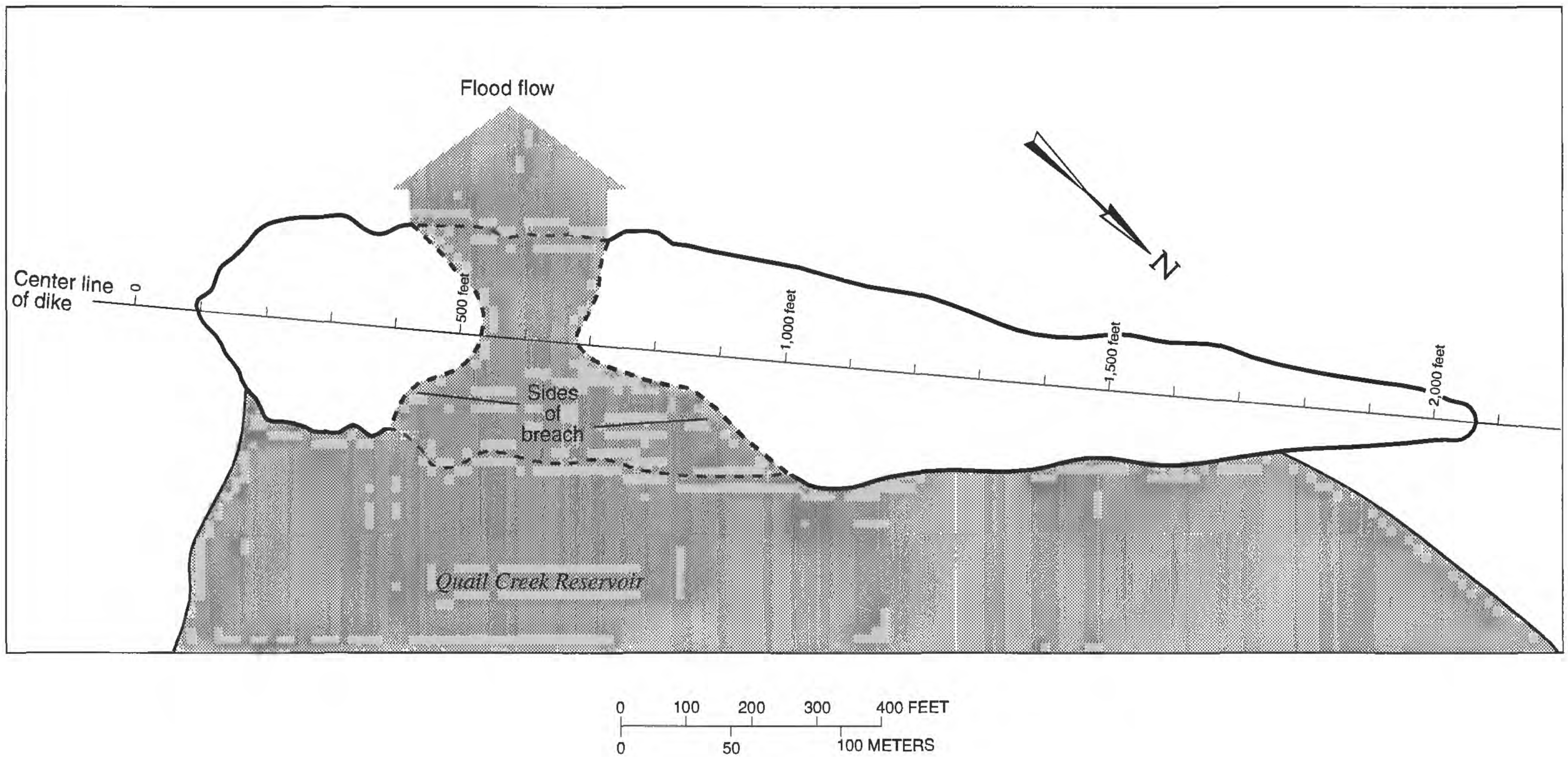

Figure 4. Plan view of Quail Creek Reservoir dike.

Figure 5. Quail Creek Reservoir dike after failure. (Photograph from the Utah Department of Natural Resources, Division of Water Rights.)

Figure 6. Upstream view of the breach in the Quail Creek Reservoir dike near Hurricane, Utah, January 1990.

Figure 7. Upstream view from Utah State Highway 9 of the floodwater path between the breach in the dike and Utah State Highway 9 near Hurricane, Utah.

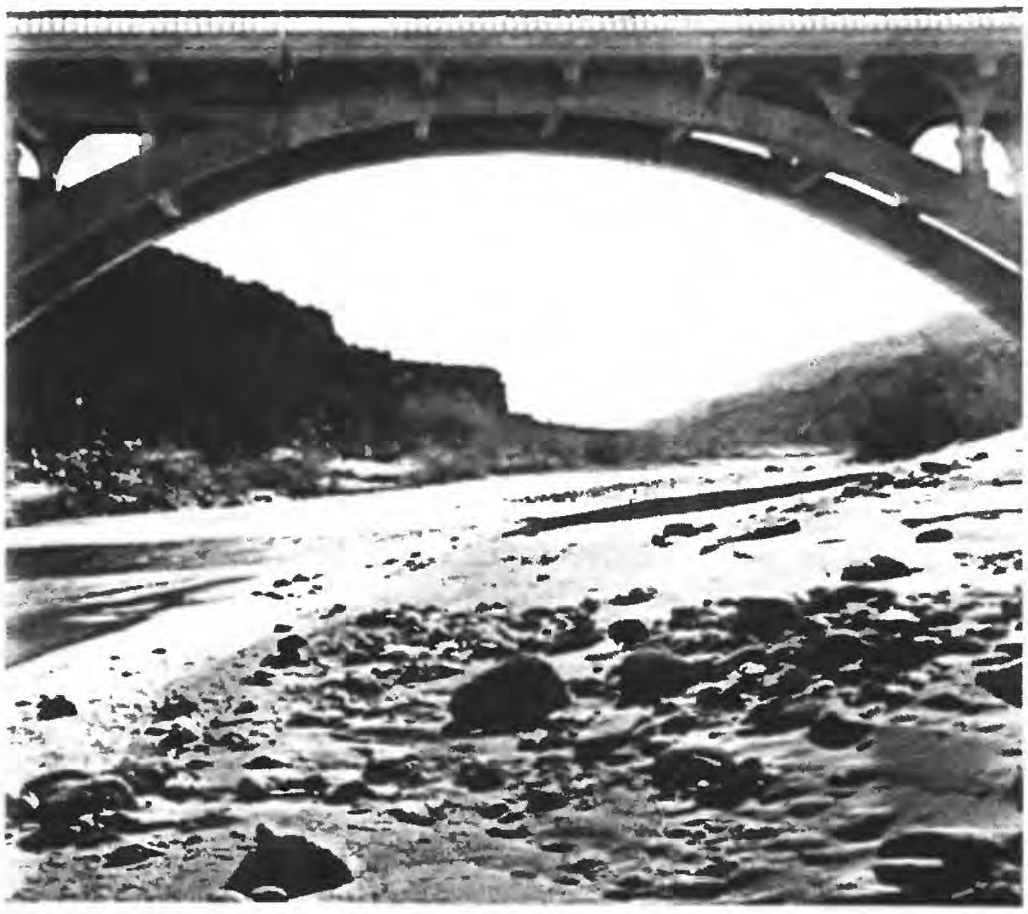

Figure 8. Downstream view of the Utah State Highway 9 bridge across the Virgin River near Hurricane, Utah, before the dike failure.

Figure 9. Downstream view of the Utah State Highway 9 bridge across the Virgin River near Hurricane, Utah, after the dike failure.

Table 1. Summary of flood stages and discharges of January 1989 flood on the Virgin River

[—, no data; >, greater than]

Station number	Station name (site number)	Period of record, water year	Maximum flood previously known: Date	Maximum flood previously known: Gage height (feet)	Maximum flood previously known: Discharge (cubic feet per second)	Flood of January 1989: Date	Flood of January 1989: Gage height (feet)	Flood of January 1989: Discharge (cubic feet per second)	Recurrence interval (years)
09408150	Virgin River near Hurricane, Utah (1)	1967-88	12-06-66	17.34	20,100	01-01-89	—	[1]66,000	>100
09413000	Santa Clara River at St. George, Utah (2)	1951-56, 1984-88	08-24-55	10.02	4,200	01-01-89	10.49	—	—
09413200	Virgin River near Bloomington, Utah (3)	1978-88	03-05-78	—	17,000	01-01-89	25.48	[1]60,000	>100
09415000	Virgin River at Littlefield, Arizona (4)	1930-88	12-06-66	15.66	35,200	01-01-89	—	61,000	>100
—	Virgin River at Mesquite, Arizona (5)	—	—	—	—	—	—	[1]43,000	—

[1]Estimated.

Peak discharge at site 1, Virgin River near Hurricane, Utah, was estimated to be 66,000 ft^3/s (table 1 and fig. 10), about double the discharge for a 100-year flood. This discharge was measured indirectly using the slope-area method of determining peak discharge (Dalrymple and Benson, 1967). The site selected for determining peak discharge was about 1.5 mi downstream from the Utah State Highway 9 bridge and about 2.5 mi downstream from the Quail Creek Reservoir dike. Virgin River discharge just prior to the dike failure was about 100 ft^3/s.

The flood caused backwater effects in tributary streams as it progressed downstream. Backwater was noted at a streamflow-gaging station on the Santa Clara River (site 2), a tributary to the Virgin River 0.75 mi upstream from its mouth and 15.9 mi downstream from the Quail Creek Reservoir dike. Peak gage height for Santa Clara River at St. George, Utah (table 1), was 10.49 ft on January 1, 1989 (fig. 11). The peak gage height resulted from backwater from the Virgin River flood and occurred about 5:30 a.m. This height exceeds the previous maximum gage height, 10.02 ft on August 24, 1955.

Peak discharge at the next downstream streamflow-gaging station, site 3, Virgin River near Bloomington, Utah, was estimated to be 60,000 ft^3/s (table 1 and fig. 12). This discharge was more than 1.5 times the 100-year flood discharge for this site, which is just upstream from the bridge on Interstate Highway 15 and about 16.3 mi downstream from the dike. The flood began about 4:00 a.m. at this site and lasted about 6 hours. The slope-conveyance method was used to estimate the discharge (Benson and Dalrymple, 1967, p. 28).

A slope-area indirect measurement was made in the Virgin River Gorge, a narrow canyon formed where the Virgin River cuts through the Beaver Dam Mountains in northwestern Arizona. The site is in a straight, narrow reach, 43.4 mi downstream from the Quail Creek Reservoir dike. A peak discharge of 61,000 ft^3/s was computed at the site; measurement accuracy rated fair. Depths ranged from 21.8 to 29.7 ft, and computed

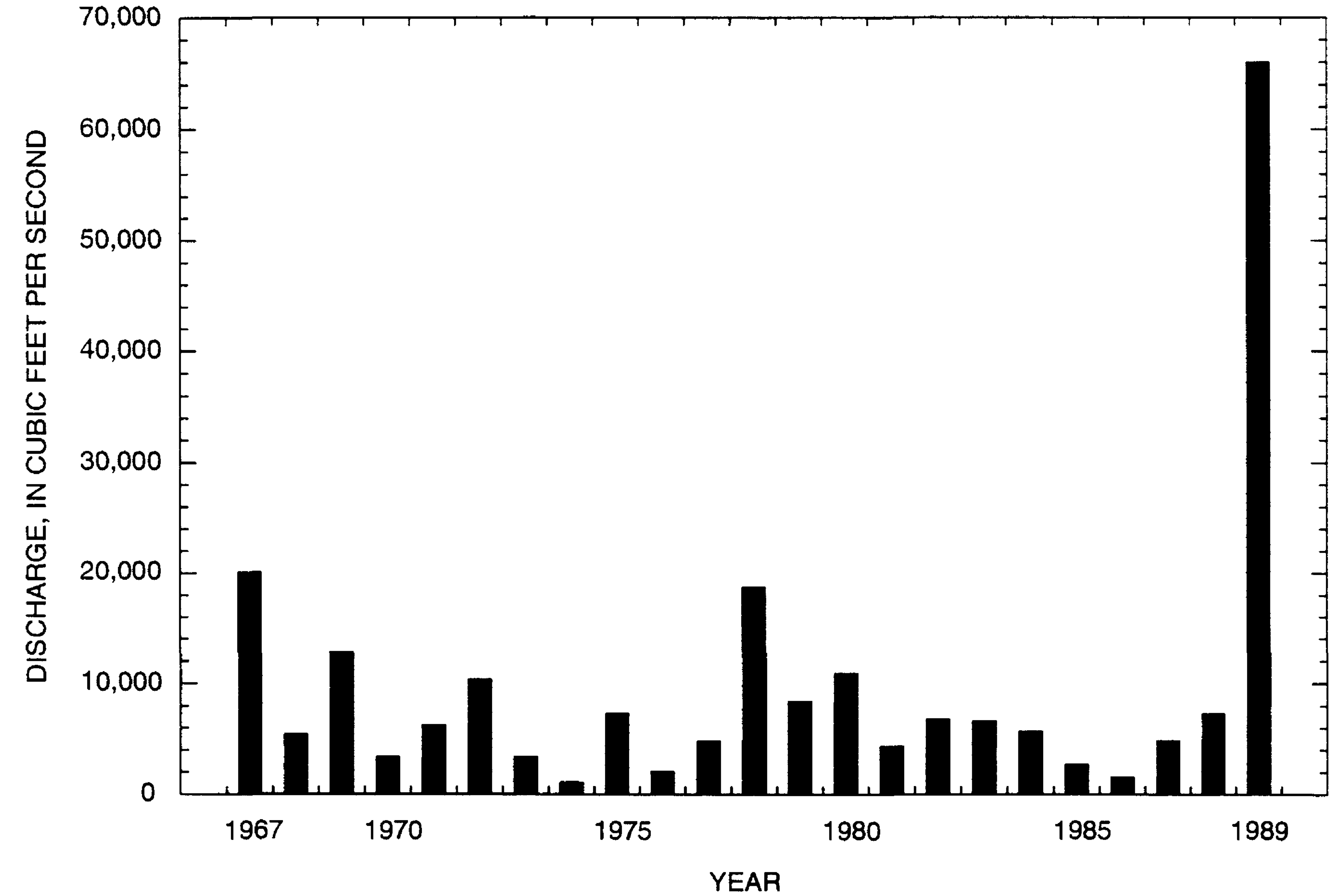

Figure 10. Annual peak discharges for Virgin River near Hurricane, Utah (site 1), 1967-89.

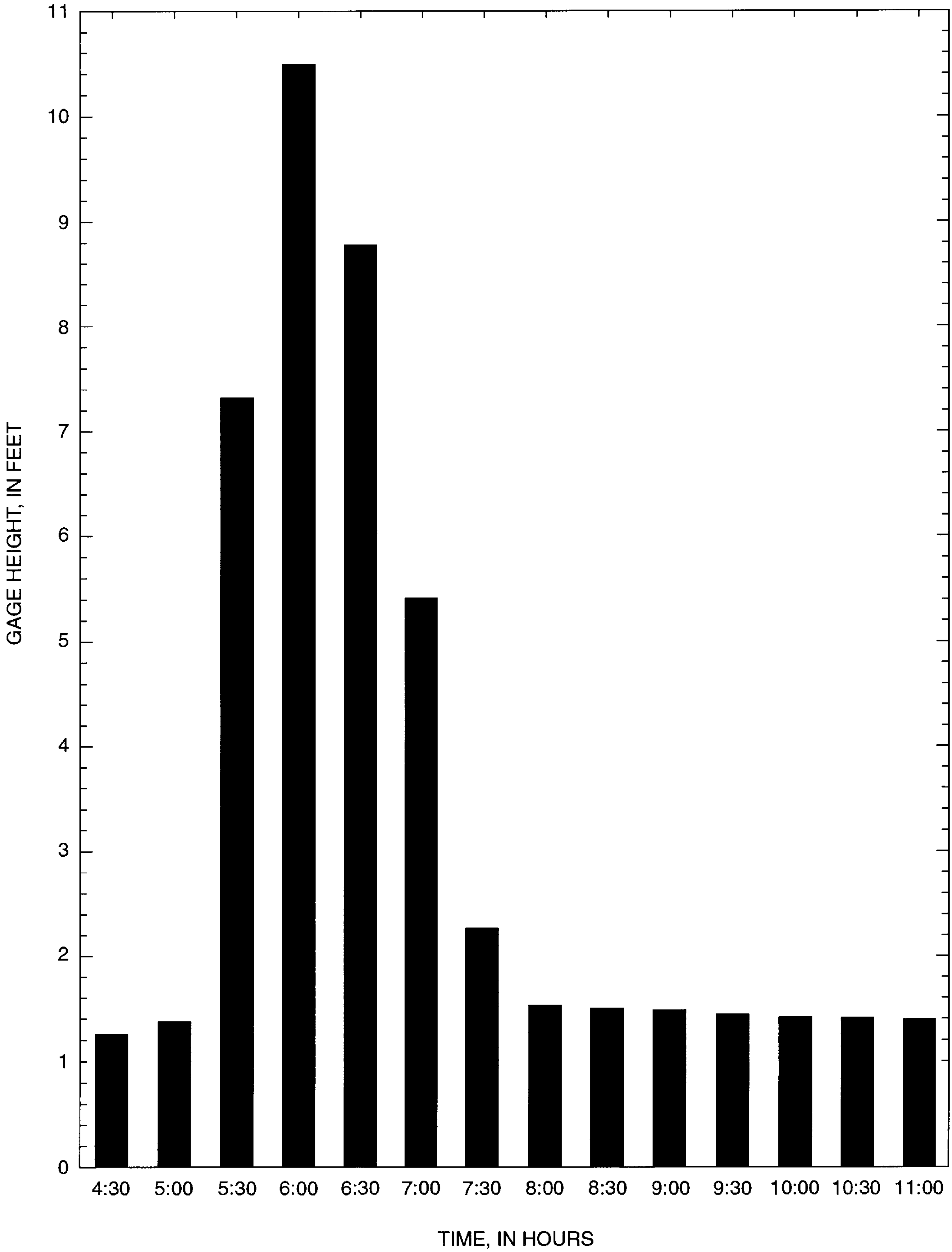

Figure 11. Stage hydrograph for Santa Clara River at St. George, Utah (site 2), on morning of January 1, 1989.

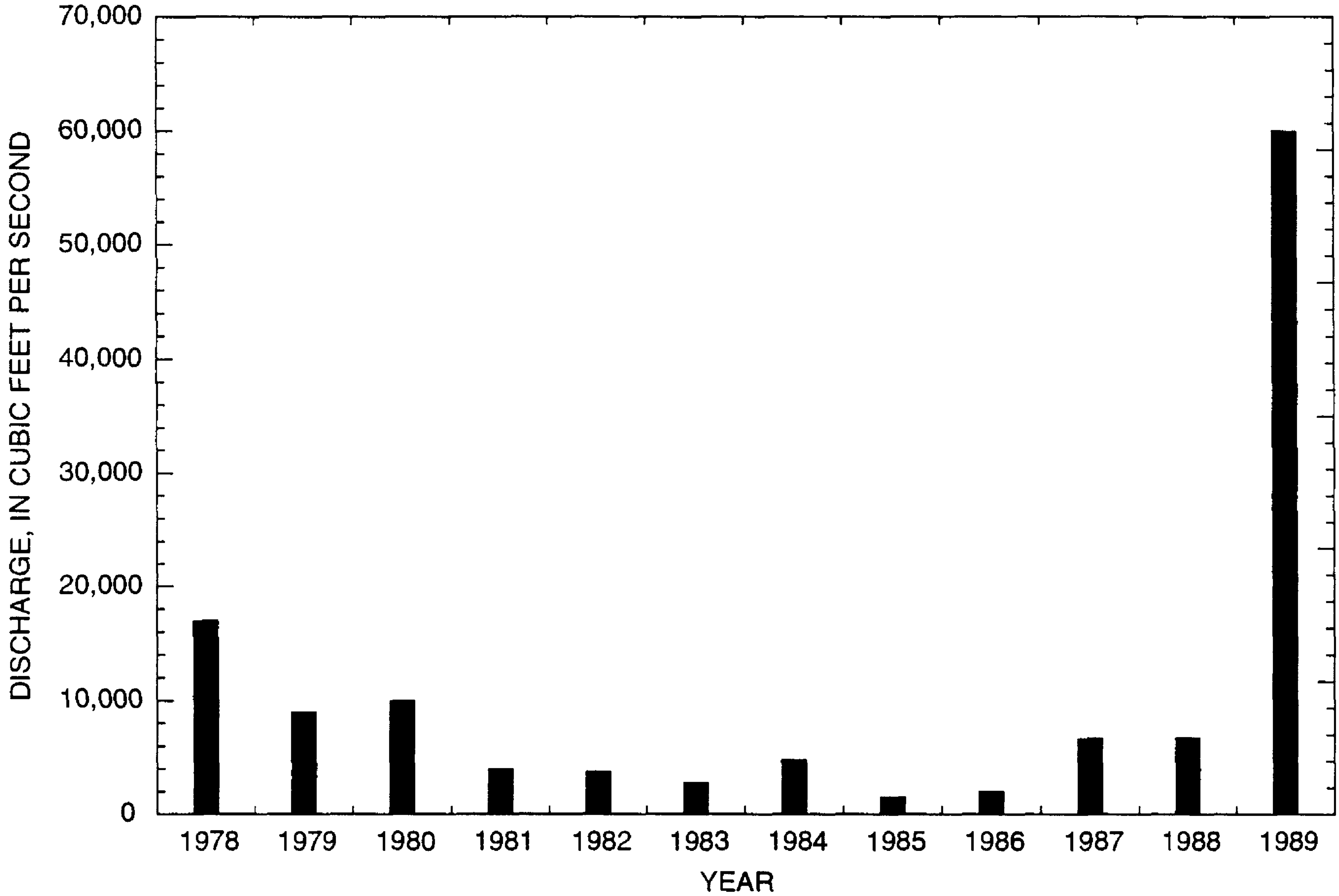

Figure 12. Annual peak discharge for Virgin River near Bloomington, Utah (site 3), 1978-89.

average velocities ranged from 17.6 to 18.1 ft/s. This measurement was used to help confirm peak discharge at the Littlefield, Arizona, streamflow-gaging station 51.0 mi downstream from the Quail Creek Reservoir dike. Extrapolation of the area-discharge relation from earlier discharge measurements at the Littlefield site indicates that the discharge was about 61,000 ft^3/s (table 1 and fig. 13), and the average velocity was 11.2 ft/s.

The initial flood wave arrived at site 4, Virgin River at Littlefield, Arizona, between 8:00 and 8:15 a.m. Pacific standard time. The gage was recording river stage every 15 minutes and made a normal recording at 8:00 a.m., but the manometer-orifice line was damaged by the flood prior to the 8:15 a.m. recording. A local resident and former U.S. Geological Survey observer reported that the initial flood wave was preceded by about 1/2 mi of debris without a substantial increase in river stage. River stage rose for about 1/2 hour, and the river remained near peak stage for 1 1/2 to 2 hours (Eddie Jones, Littlefield, Arizona, oral commun., 1989). At site 5, the Nevada Highway 170 bridge in Mesquite, Nevada, 65.7 mi downstream from the Quail Creek Reservoir dike, a slope-conveyance (Benson and Dalrymple, 1967, p. 28) estimate indicates that peak discharge was about 43,000 ft^3/s.

The stage of Lake Mead rose 0.13 ft on January 2, 1989, but Lake Mead normally experiences stage fluctuations caused by variations in inflow, outflow, and evaporation. The mouth of the Virgin River is about 89 mi downstream from the Quail Creek Reservoir dike (the location of the mouth varies with lake stage). Hoover Dam, where Lake Mead stage data are collected, is about 54 mi downstream from the mouth of the Virgin River.

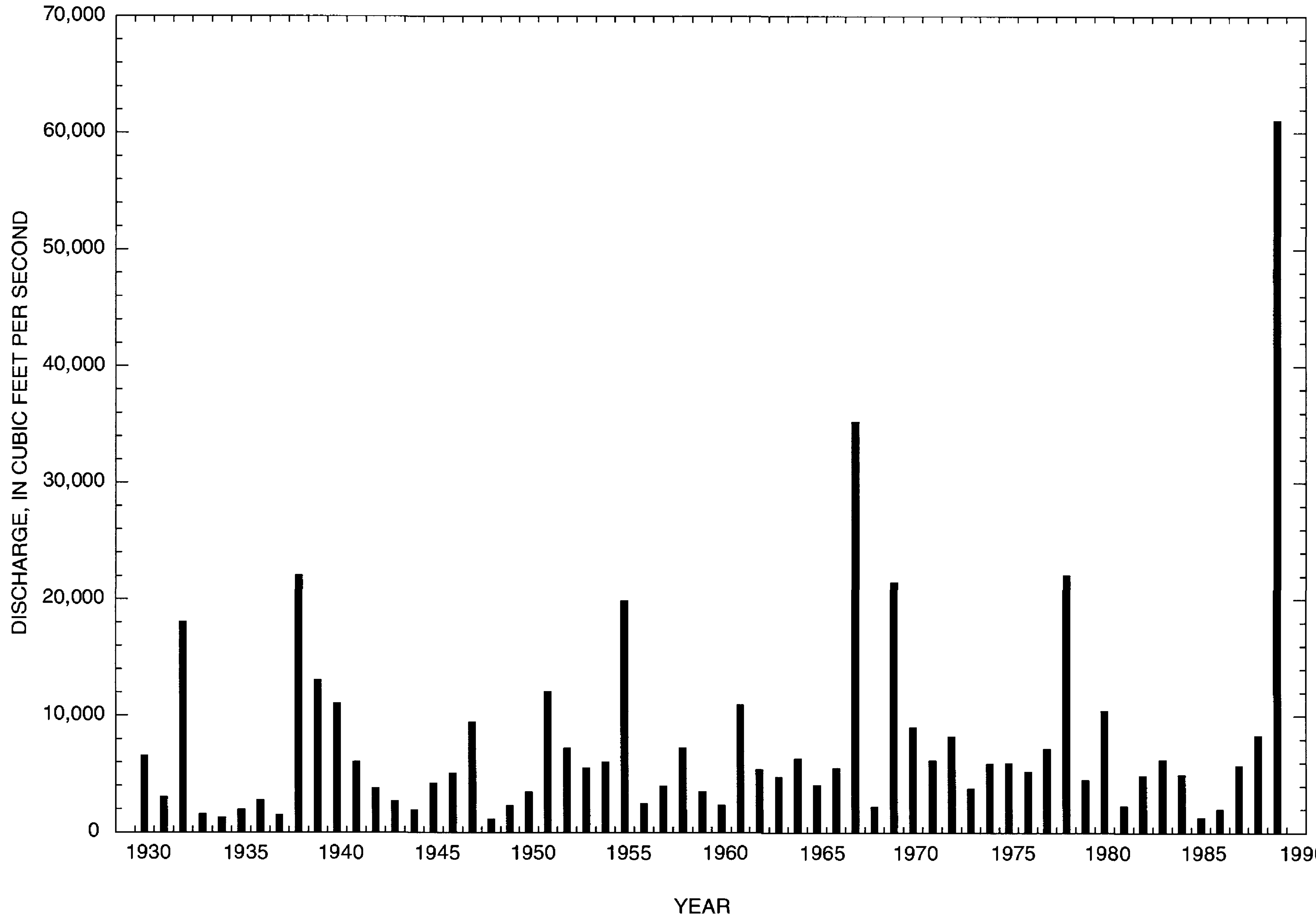

Figure 13. Annual peak discharge for Virgin River at Littlefield, Arizona (site 4), 1930-89.

Sedimentation

Sedimentation, including erosion, headcutting, channel degradation, deposition, and other physical processes, was readily evident in the first 50 miles of the Virgin River downstream from the failed dike and was present, but less evident, all the way to the river's mouth. No quantitative sediment data were collected during this event.

The topsoil was completely eroded between the dike and the Utah State Highway 9 bridge where the flood entered the Virgin River (fig. 6). Most of this topsoil, along with the eroded dike material, was deposited at the Utah State Highway 9 bridge crossing over the Virgin River and blocked a large part of the bridge opening (fig. 9).

The main channel of the Virgin River was unable to contain the flood; therefore, the floodwater was forced out onto the flood plain. The velocity of the water decreased across the flood plain, causing sediment to be deposited (fig. 14).

Headcutting also occurred during this flood. The headcut near the Washington Fields diversion dam was about 10 ft deep (fig. 15).

Erosion of roadbeds from Hurricane, Utah, to Bloomington, Utah, occurred during this flood (fig. 16). Some degradation of the Virgin River channel occurred at the Man-of-War bridge. The scour at this bridge was severe enough to expose the piles under two of the piers.

The flood redistributed bed material, but net sedimentation was negligible in the Virgin River Gorge. A local resident reported that sand and gravel bars were altered and moved by the flood and that debris and riparian vegetation were eroded. The low-water channels were similar in size and shape before and after the flood (James Miller, Virgin River Canyon Recreation Area, oral commun., 1989).

Downstream from the Virgin River Gorge, at the Littlefield streamflow-gaging station (site 4), discharge measurements made before and after the flood indicate that the channel filled about 0.10 ft, with mostly sand. The flood plain at Littlefield had areas of aggradation and degradation. Flood-plain deposits from the flood were more than 10 ft thick in backwater areas, but where floodwater overflowed the channel on the outside of meander bends, several feet of scour was indicated by erosion of an A-frame cableway foundation. Medium- to fine-grained sand dunes that had average amplitudes of about 3 ft and average lengths of about 50 ft were deposited on the flood plain here.

An irrigation ditch occupied the right bank (outside bank of the meander) at the Littlefield gage prior to January 1, 1989. Photographs of the gage taken following the flood of December 6, 1966, indicate that at that time a pipe or aqueduct existed along the right bank. Fill was placed along this bank between 1966 and 1987 about 25 ft from the bank and about 25 ft high. The January 1, 1989, flood eroded about 20 ft of this fill at the gage (fig. 17), including beam-and-cable bank protection along the irrigation ditch.

Downstream from Littlefield, Nevada, vertical scour and bank erosion became progressively less severe. At Mesquite, Nevada, banks without vegetation are rare, and where they are present, tree roots indicate that no more than 10 ft of bank erosion occurred during the January 1, 1989, flood. Near-channel flood-plain deposits decrease in thickness downstream from about 1 ft at Mesquite to about 0.3 ft near the mouth of the Virgin River.

Flood Damage

President George Bush declared Washington County in Utah a disaster area on January 31, 1989, qualifying the area for Federal funds. Flood damage estimates were compiled by several State and Federal agencies and were made available by the Federal Emergency Management Agency (John Swanson, written commun., 1989). Substantial losses were incurred because of damage to private, public, and agricultural facilities. Estimated damage in Utah, Arizona, and Nevada from the January 1989 flood totaled more than $12 million and is listed in table 2. The greatest damage was to agricultural and public-works facilities.

Businesses and residences in the towns of St. George and Bloomington, Utah, incurred substantial damage. About 30 homes in Bloomington, Utah, sustained some degree of flood damage. Fifty-eight apartments were affected by floodwater in St. George, Utah. Cost for flood-related damages to private-sector property in St. George and other communities was estimated to be nearly $1.5 million.

Damage to public property also was substantial. The Utah State Highway 9 bridge near Hurricane (fig. 9) had to be replaced, and the approach roadway to the bridge was washed out (fig. 18). The River Road bridge near St. George, Utah, was completely washed out (fig. 19). The Interstate Highway 15 bridge near St. George

Figure 14. Deposition of sediment on an agricultural field near Washington, Utah, January 1990.

Figure 15. Headcutting near the Washington Fields diversion dam near Washington, Utah, January 1990.

Figure 16. Erosion to downstream side of roadbed at approach to River Road bridge near St. George, Utah, January 1990.

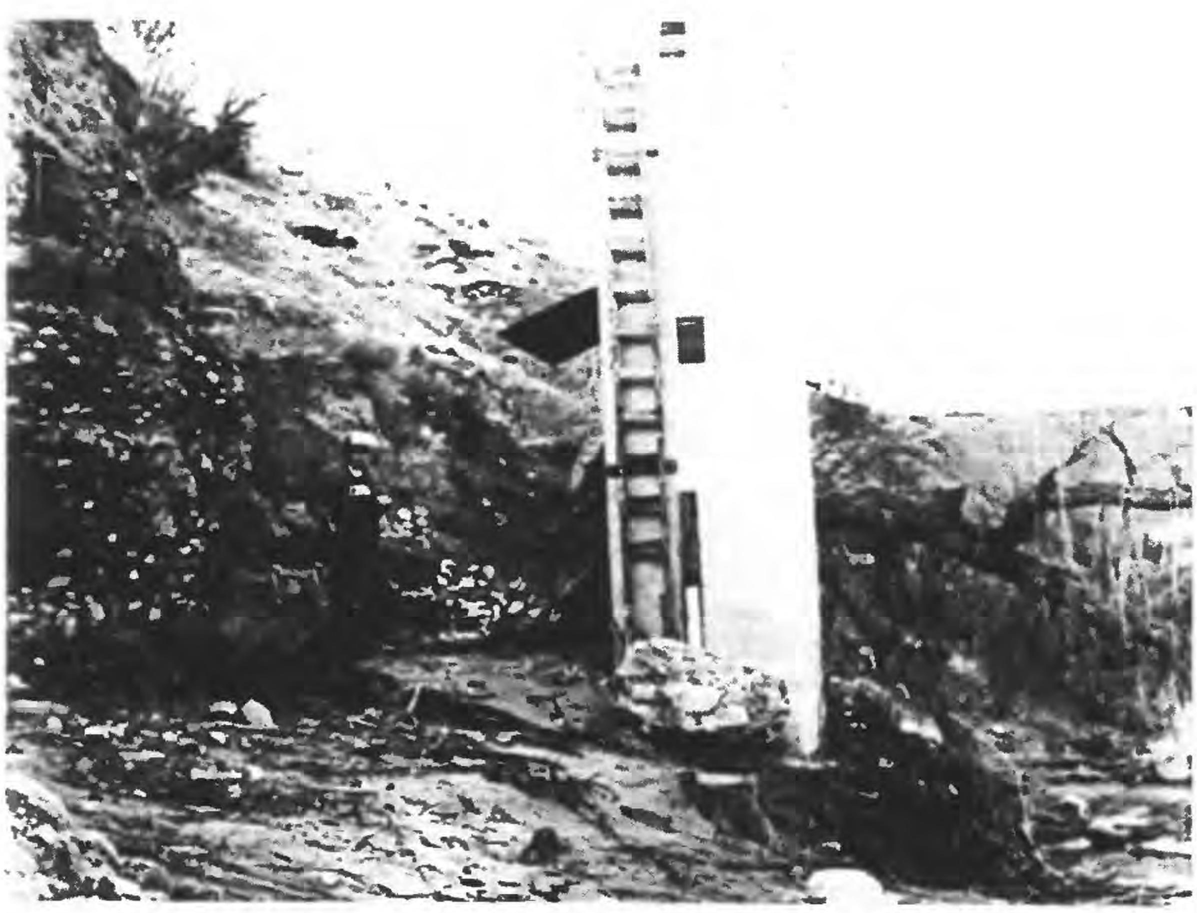

Figure 17. Eroded right bank of the Virgin River at site 5, Virgin River at Littlefield, Arizona, January 1990.

Table 2. Summary of flood damage in Utah, Arizona, and Nevada

[*, indicates some damage occurred but was not quantified]

Type of damage	Utah	Arizona	Nevada
Private damage:			
Residential	$ 848,000	$81,000	0
Business	589,500	0	0
Subtotal	1,437,500	81,000	0
Agricultural damage:			
Equipment	670,000	0	0
Crop loss	1,110,000	*	*
Livestock loss	70,000	*	*
Miscellaneous	250,000	*	[1]$90,000
Subtotal	2,100,000	[2]30,000	90,000
Public damage:			
Road systems	3,121,000	0	0
Public utilities	347,700	*	0
Debris removal	12,500	0	0
Protective measures	110,100	*	0
Water-control facilities	5,257,400	[3]0	[3]35,000
Miscellaneous	12,100	12,000	0
Subtotal	8,860,800	12,000	35,000
Total	12,398,300	123,000	125,000

[1] Pierre, Labarry, Agricultural Stabilization and Conservation Service, oral commun. (1989).
[2] Estimated damage, Steve Cassady, [U.S.] Soil Conservation Service, oral commun. (1989).
[3] Many of the irrigation works that serve Nevada have their headworks in Arizona; these are included with Nevada damage.

and the Man-of-War bridge at Bloomington, Utah, were damaged. The Washington Fields diversion dam was completely destroyed (fig. 20). This diversion dam was relocated to the present site in January 1891 after a pile dam about 5 mi downstream was swept away by the floods of January 1889 (Reid, 1964). The present site was selected in 1889 to allow the natural constriction in the flood plain to form part of the dam (fig. 21). A solid rock ledge creates part of this constriction on the north side of the Virgin River. Irrigation utilities in Utah incurred losses amounting to more than $5 million, including the estimated cost to repair the dike, add a more extensive cutoff trench for the dike, and repair other irrigation utilities.

The agricultural community sustained damage to crops, equipment, and livestock. About 450 acres of farmland sustained crop damage. Livestock losses included 130 pigs and 40 mature cows. The total estimate for agricultural damages in Utah was more than $2 million.

The flood plain in Arizona and Nevada is much less developed than in Utah, and damage in these states was substantially less (table 2). Two houses in Littlefield were inundated; one was destroyed, and the other was damaged but repairable. Agricultural fields (mainly alfalfa and pasture) were inundated, buried, and eroded by the flood (fig. 14). Fences were damaged and an unknown, but minor, number of livestock were drowned. Irrigation utilities serving Mesquite, Riverside, and Bunkerville, Nevada, were destroyed both at the headworks in Arizona, and along canals inundated or eroded by the flood.

Comparison of January 1, 1989, Flood with Historical Area Floods

The relation between the January 1989 flood discharge and greatest known flood discharge in the same area is shown in figure 22. This figure relates discharge to the corresponding drainage area, and the curve defines the limit of the largest documented floods.

Figure 18. Upstream view of the washout of approach to Utah State Highway 9 bridge near Hurricane, Utah, January 1990.

Figure 19. Upstream view of flood damage to River Road bridge near St. George, Utah. January 1990.

Figure 20. Flood damage to Washington Fields diversion dam near Washington, Utah, January 1990.

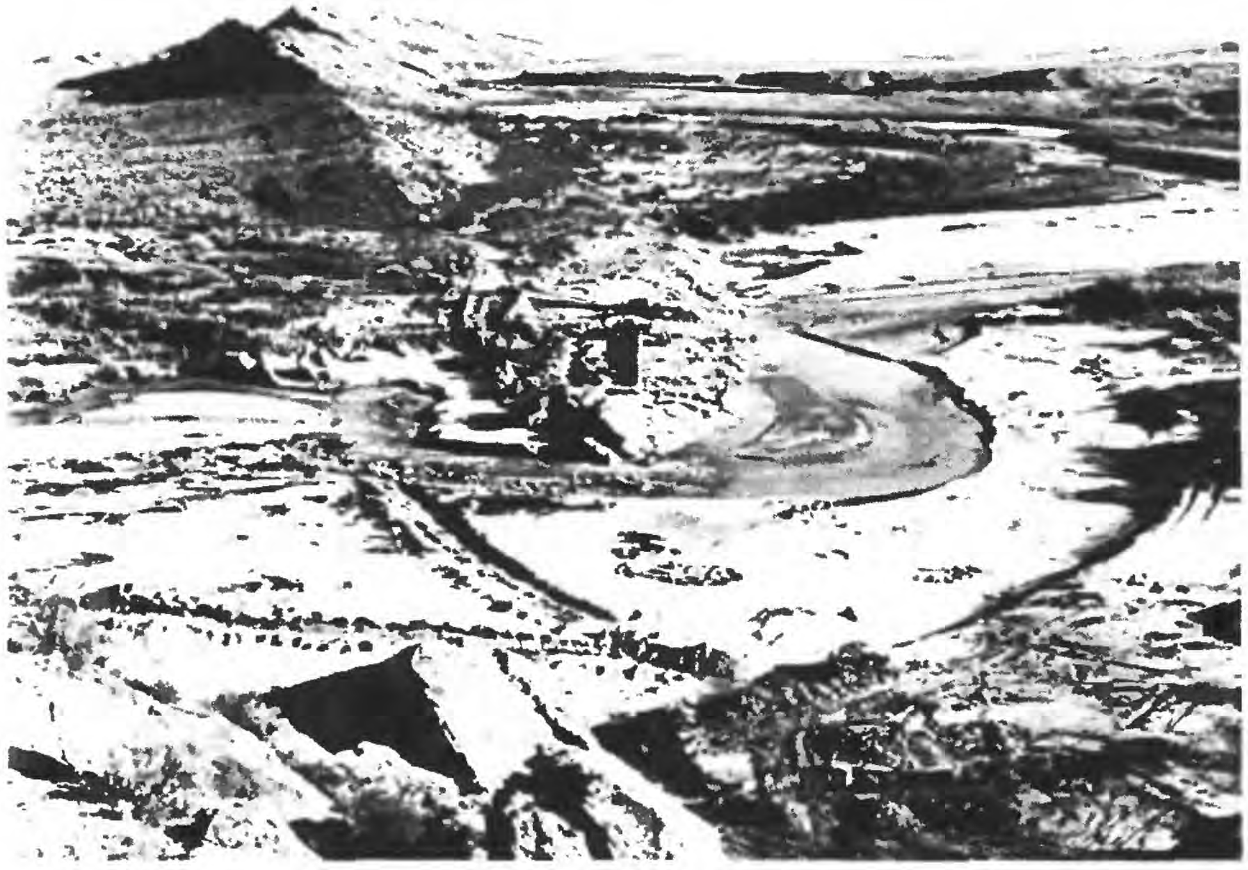

Figure 21. Upstream view of Washington Fields diversion dam and natural constriction in Virgin River flood plain, Utah, January 1990.

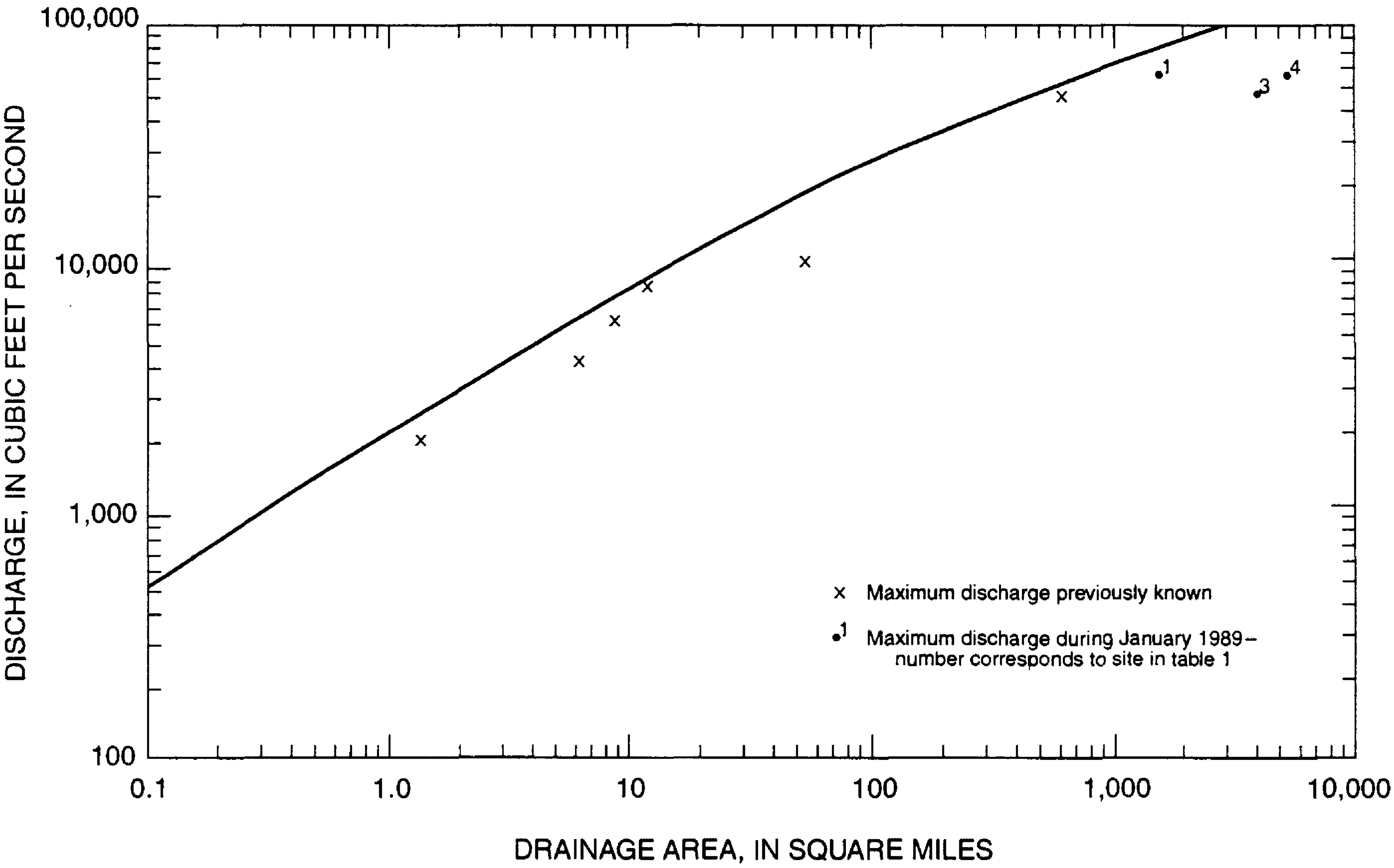

Figure 22. Relation of January 1989 peak discharge with maximum known flood peaks in the Virgin River Basin area.

Floods resulting from unusual conditions such as ice jams or dam breaks were not used to develop this figure (Crippen and Bue, 1977), which is presented here only to give the reader an idea of the historical flooding that has occurred in this general area. The January 1, 1989, flood can be compared with other floods caused by dam failures (Costa, 1985).

The first reported major flooding of the Virgin River occurred during December 25, 1861, to January 8, 1862, along the Virgin and Santa Clara Rivers (Reid, 1964). Most of the towns and irrigation diversions along the Virgin River were damaged or destroyed (Larson, 1957). Another flood of unknown magnitude destroyed irrigation diversions during December 1889 (Larson, 1957).

A flood occurred March 3, 1938, that had a peak discharge of 22,000 ft^3/s, measured at Littlefield, Arizona. No other gages were in operation at that time.

The largest flood for which discharge measurements or estimates exist occurred on December 6, 1966. This flood resulted from an intense rainfall that affected Utah, Nevada, and California (Butler and Mundorff, 1970). Peak discharge was 20,100 ft^3/s measured near Hurricane, Utah, and 35,200 ft^3/s measured at Littlefield, Arizona. The recurrence interval for these discharges ranges from 30 years at the Hurricane site to 60 years at the Littlefield site.

A series of storms during early March 1978 produced floodflow throughout the Virgin River Basin. The Virgin River peaked at a discharge of 18,700 ft^3/s at Hurricane, Utah, on March 5; 17,000 ft^3/s at Bloomington, Utah, on March 5; and 22,000 ft^3/s at Littlefield, Arizona, on March 2.

These previous floods were natural occurrences resulting from rainfall or snowmelt runoff. No peaks were augmented by dams breaching or similar occurrences. Annual peak discharge prior to the January 1, 1989, flood for streamflow-gaging stations in the Virgin River Basin is shown in figures 10, 12, and 13.

SUMMARY

Flooding along the Virgin River flood plain during January 1989 was caused by a breach in the Quail Creek Reservoir dike on January 1, 1989. About 25,000 acre-feet of water discharged into the Virgin River near Hurricane, Utah. Peak discharges exceeded the previous maximums and the theoretical 100-year flood discharges at three U.S. Geological Survey streamflow-gaging stations on the Virgin River.

Severe flooding occurred in Utah, Arizona, and Nevada that resulted in damage to residences, businesses, agricultural equipment, crops, livestock, roads, bridges, and irrigation structures. The greatest damage was to agricultural and public-works facilities. Total damage was estimated to be more than $12 million. Washington County, which is in southwestern Utah, was declared a disaster area by President George Bush.

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