Flood Characteristics of the Wassuk Range Near Hawthorne, Nevada

INTRODUCTION

Floods are among the most frequent and costly natural disasters in terms of human hardship and economic loss. In July 1992, for example, flooding of several drainages near Hawthorne, Nevada, caused road closures and damage to homes and businesses (Hughes, 1992).

In the 1960's, the U.S. Geological Survey (USGS) recognized the need for reliable quantitative information to predict magnitudes and frequencies of flooding, and initiated a nationwide investigative program of monitoring peak discharges. As part of this program, the USGS, in cooperation with the Nevada Department of Transportation (NDOT), designed and implemented a stream-gaging network.

In Nevada, the network consists of crest-stage gages and miscellaneous sites. A crest-stage gage is a permanent device that registers the peak stage of streamflow at a site during the time interval between inspections. Peak-discharge data primarily were derived at these gage sites through indirect (after-the-flood) measurements using the slope-area method (Dalrymple and Benson, 1976). However, most drainages are not monitored using a gage due to the dominantly ephemeral and uncertain character of streamflow throughout the State. Peak-discharge data also were determined at these ungaged miscellaneous sites using the slope-area method.

The statewide network has nearly 4 decades of peak-discharge measurements. These data are reviewed for notable hydrologic characteristics and trends. For example, the Wassuk Range, a discrete geographical area, has experienced several severe floods. This fact sheet presents select data and information pertaining to these floods.

WASSUK RANGE FLOODS

The Wassuk Range, in western Mineral County, is a north-northwest trending mountain range (Fig. 1). A review of Nevada streamflow data shows that the east-facing slope of the range is an active area of flooding. The Wassuk Range has had many floods from 1965 to 1998 that impacted U.S. Highway 95 between Schurz and Hawthorne, and Nevada State Route 359 between Hawthorne and the Nevada-California state line (Fig. 1; Table 1). Along the Wassuk Range front, peak-discharge data were collected at one crest-stage-gage site (site 4; Fig. 1) and at 22 ungaged sites (sites 1-3 and 5-23). The floods of July 1965 on Dutch and Little Squaw Creeks (sites 7 and 14, respectively) deposited rock and mud on highways, and caused $40,000 damage to a ranch. The July 10, 1975, flood in Copper Canyon (sites 5 and 6) damaged U.S. Highway 95 and the U.S. Bureau of Land Management campground on the shore of Walker Lake. The July 30, 1984, flood on Corey Creek (sites 10, 11, and 12) blocked U.S. Highway 395, endangered Hawthorne's water supply, and damaged several Hawthorne homes and businesses (Hughes, 1984). During the June 3, 1998, flood on House Creek (sites 8 and 9), water flowed over and debris was deposited on U.S. Highway 95, which resulted in a short delay for motorists (Hughes, 1998).

Flood Frequencies and Magnitudes

Severe thunderstorms are common in the Wassuk Range, mainly during late spring through early autumn. Some of these storms impact a single, small drainage; others impact several drainages or basins. The east-facing mountain front is rugged and steep; overall relief spans 7,300 feet from the surface of Walker Lake (altitude about 3,900 feet) to the top of Mt. Grant (altitude greater than 11,200 feet). Evidence of severe flooding along mountain-front drainages near Copper Canyon (sites 5 and 6) includes steep alluvial fans strewn with boulders. This evidence emphasizes the hazardous potential of floods from the mountain-front drainages.

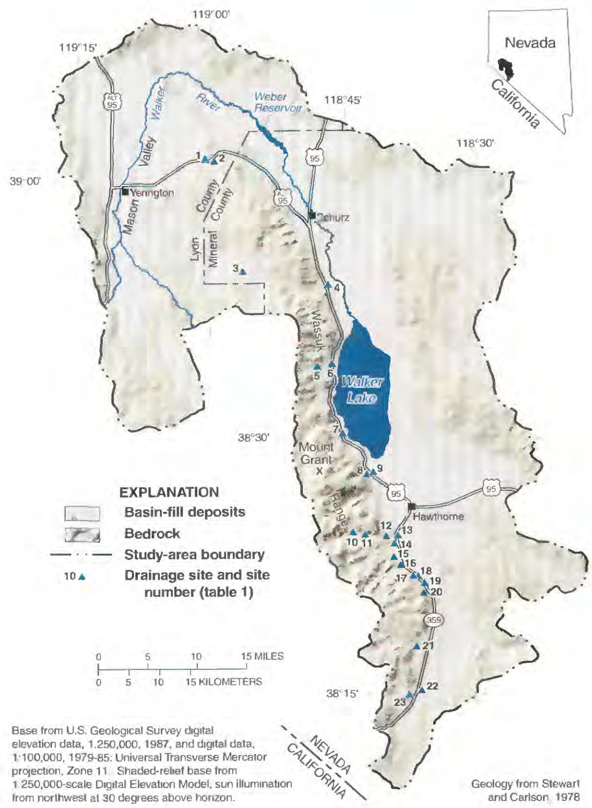

Figure 1. Geographic setting and hydrologic features of the Wassuk Range, Nevada.

Development of a regional flood-frequency relation that will accurately predict magnitudes and frequencies of future floods, requires a long-term data base that contains an adequate number and range of peak discharges from within the region (Thomas and others, 1994, p. 45). Accuracies of predictions for specific drainages within the region are enhanced when the relation is supplemented with peak-discharge data from the subject drainages. For example, the flood-frequency analysis for Corey Creek (site 13; Fig. 1, Table 1) was updated (Buch-Pedersen and others, 1999) using peak discharges from 1977 and 1984 collected under this cooperative program. This analysis indicates that the flood characteristics of Corey Creek are similar to flood characteristics of many southern Nevada streams. Similar to the study area, major floods in southern Nevada are caused primarily by severe summer thunderstorms. A comparison of observed peak discharges collected from this study and the 100-year peak discharges as determined from regional flood-frequency relations (Thomas and others, 1994) for the Wassuk Range area and southern Nevada are listed in table 1.

Hydraulic-Flow Processes

Accurate characterization of hydraulic-flow processes is important during data collection from the ephemeral drainages of the Wassuk Range. Variations in the flow processes are caused mainly by the character and content of sediment entrained in the flow. Water-dominated (Newtonian) flows essentially have no yield or shear strength and contain relatively low sediment concentrations. However, non-Newtonian, debris-dominated flows (debris flows) contain much larger quantities of entrained sediment (about 70 to 90 percent by

Table 1. Flood data for sites in the Wassuk Range near Hawthorne, Nevada

[Abbreviations: ft^3/s, cubic feet per second; ft^2, square feet; e, estimated; ND, not determined when debris-flow process; --, no data]

Drainage site number (Fig. 1)	Drainage site name	Drainage area, in square miles	Observed peak discharge			Hydraulic-flow process	100-year peak discharge (ft^3/s)	
			Date	Magnitude (ft^3/s)	Cross-sectional area (ft^2)		Wassuk Range area[1]	Southern Nevada[2]
1	Wassuk Range tributary No. 1	0.80	May 26, 1981	ND	154	debris flow	230	730
2	Wassuk Range tributary No. 2	5.64	May 26, 1981	ND	130	debris flow	1,110	2,800
3	Pumpkin Hollow tributary	22	July 31,1965	750	106	unknown	1,630	7,170
4	Reese River Canyon	14	July 31, 1965	1,870	248	unknown	2,260	5,250
5	Copper Canyon	4.31	July 10, 1975	ND	360	debris flow	470	2,330
6	Copper Canyon	5.0	July 28, 1982	ND	223	debris flow	630	2,580
			Aug. 1990	ND	142	debris flow		
7	Dutch Creek	5.0	July 31 1965	4,000	110	unknown	370	2,580
8	House Creek	2.59	June 3, 1998	ND	28	debris flow	220	1,640
9	House Creek	2.86	June 3, 1998	ND	13	debris flow	260	1,760
10	Corey Creek tributary	.2	July 30, 1984	4,000	196	unknown	40	280
11	Corey Creek	6.82	Aug. 21, 1977	2,180	165	Newtonian	420	3,200
			July 30, 1984	100	18	Newtonian		
12	Corey Creek	19.3	July 30, 1984	11,800	589	Newtonian	1,130	6,550
13	Corey Creek	21.8	Aug. 21, 1977	194	28	Newtonian	1,190	7,130
14	Little Squaw Creek	11	July 16, 1965	3,930	240	Newtonian	570	4,450
			July 30, 1984	600	75	unknown		
15	North Canyon	6.77	Aug. 15, 1965	3,210	206	unknown	480	3,180
16	Alum Creek	5.77	Aug. 15, 1965	2,910	150	unknown	410	2,850
			July 30, 1984	e200	--	unknown		
			July 11, 1992	e100	--	unknown		
			Sept. 1997	ND	22	debris flow		
17	Willow Canyon	3.34	July 11,1992	ND	75	debris flow	300	1,950
18	Cottonwood Creek tributary No. 1	.5	July 11,1992	ND	65	debris flow	80	530
19	Cottonwood Creek tributary No. 2	.35	Aug. 7, 1983	ND	18	debris flow	60	410
20	Cottonwood Creek tributary No. 3	1.3	Aug. 7, 1983	50	10	unknown	150	1,020
21	Powell Canyon	15.8	July 30,1984	e1,000	--	unknown	750	5,710
22	Box Canyon	6	Aug. 21, 1977	ND	--	debris flow	380	2,930
23	Whisky Flat tributary	1.02	July 23, 1998	250	22	Newtonian	100	870

[1] Estimated by methods of Thomas and others (1994), Wassuk Range in flood region 5.

[2] Estimated by methods of Thomas and others (1994), Southern Nevada in flood region 10.

weight) and have measurable shear strength and plasticity (Costa, 1988, p. 113-114). Newtonian flows have limited velocity and small mobilized particles; subsequently, these flows have destructive potential. In contrast, debris flows can have greater velocities and can mobilize larger particles, and thus potentially are more destructive. Also, for a given storm, resultant debris flows often have larger peak discharges and greater flood volumes because of sediment-bulking characteristics. Thus, an understanding of the probable hydraulic-flow processes of floods for given drainages is essential to meaningful predictions of flood-hazard potential.

Because the geohydrologic characteristics of the Wassuk Range commonly cause sediment-laden flows, hydraulic-flow processes dominant in floods were tentatively characterized. Processes were characterized from eyewitness accounts and evidence collected during post-flood surveys. A majority of the floods documented in the Wassuk Range area exhibited strong evidence of debris-flow characteristics (Table 1). For example, the July 11, 1992, floods of Alum Creek, Willow Canyon, and Cottonwood Creek tributary No. 1 (sites 16-18; Fig. 1) deposited between 6,000 and 10,000 cubic yards of sediment up to 10 feet deep in some places (Warejcka, 1992).

The slope-area method (Dalrymple and Benson, 1976) was used to determine peak discharge at the Newtonian flow sites within the study area. This method assumes relatively low sediment concentrations, stable channel bottom, and uniform flow characteristics of Newtonian flows. However, debris flows typically are non-uniform, have unstable channel bottoms, and can contain large concentrations of sediment. Thus, peak-discharge data cannot be determined using the slope-area method.

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—Glen W. Hess and Patrick A. Glancy

For further information contact:

Public Information Assistant
GS-W-NVpublic-info@usgs.gov
(775) 887-7649

U.S. Geological Survey
333 W. Nye Lane
Carson City, NV 89706