Estimated Flood Flows in the Lake Tahoe Basin, California and Nevada

Introduction

Lake Tahoe, the largest alpine lake in North America, covers about 192 square miles (mi^2) of the 506-mi^2 Lake Tahoe Basin, which straddles the border between California and Nevada (Fig. 1). In cooperation with the Nevada Department of Transportation (NDOT), the U.S. Geological Survey (USGS) estimates the flood frequencies of the streams that enter the lake. Information about potential flooding of these streams is used by NDOT in the design and construction of roads and highways in the Nevada portion of the basin. The stream-monitoring network in the Lake Tahoe Basin is part of the Lake Tahoe Interagency Monitoring Program (LTIMP), which combines the monitoring and research efforts of various Federal, State, and regional agencies, including both USGS and NDOT.

The altitude in the basin varies from 6,223 feet (ft) at the lake's natural rim to over 10,000 ft along the basin's crest. Precipitation ranges from 40 inches per year (in/yr) on the eastern side to 90 in/yr on the western side (Crippen and Pavelka, 1970). Most of the precipitation comes during the winter months as snow. Precipitation that falls from June through September accounts for less than 20 percent of the annual total.

Methods

The estimated magnitude of peak flows at 50- and 100-year recurrence intervals was determined for 46 sites in 21 watersheds that cover about 177 mi^2 of the Lake Tahoe Basin (Fig. 1; Table 1). The drainage areas of the 46 sites range in size from 0.63 mi^2 at Eagle Rock Creek near Stateline, Nev., (site 40) to 54.0 mi^2 at Upper Truckee River at South Lake Tahoe, Calif. (site 4). Expected peak flows were determined using five methods (refer to Table 1 footnotes for the method used to estimate discharge at each site).

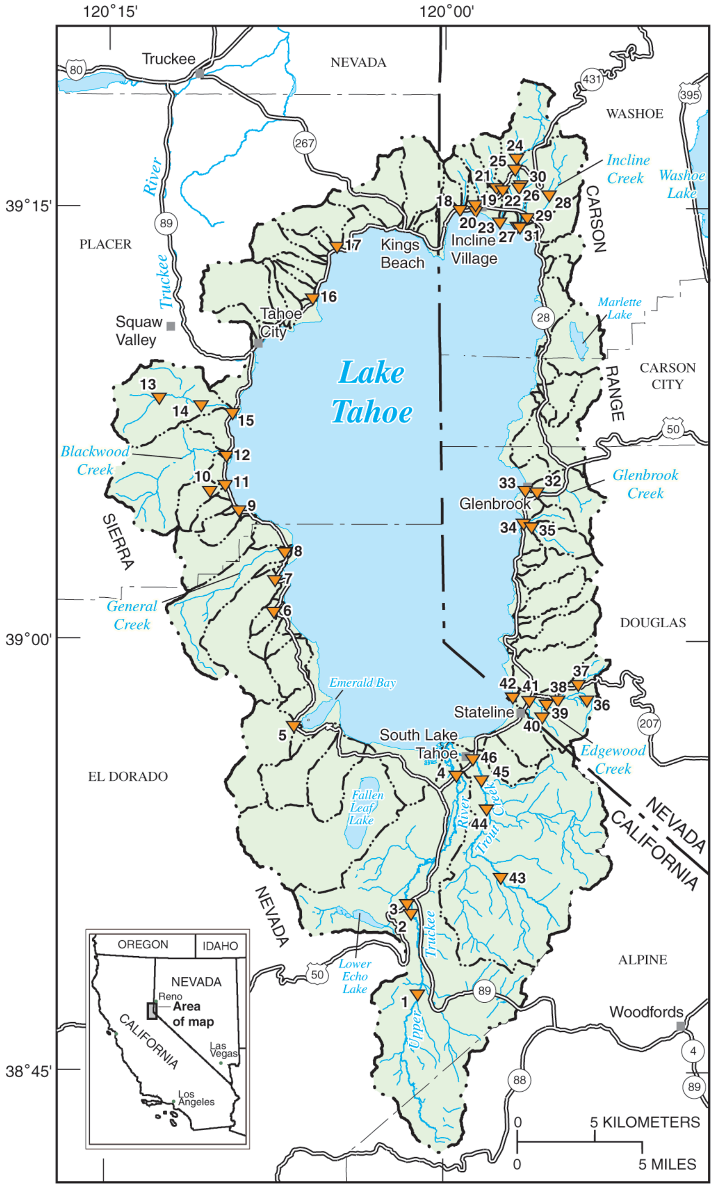
Method 1 uses a USGS computer model (W.O. Thomas and others, U.S. Geological Survey, written commun., 1998) that is based on statistical flood-frequency analysis of annual peak-flow records according to the U.S. Interagency Advisory Committee on Water Data (1982) guidelines. This method employs the Pearson Type III distribution with log transformation of the data as the base method for flood-flow frequency. Method 2 is a variation of method 1 in which historic peaks are considered (W.O. Thomas and others, U.S. Geological Survey, written commun., 1998). This option modifies the length of the historic return period. Method 3 is a two-station comparison as presented in U.S. Interagency Advisory Committee on Water Data (1982) guidelines. This method is used to adjust the logarithmic mean and standard deviation of a short record on the basis of a regression analysis with a nearby long-term record.

Because methods 1–3 use annual peaks to determine the estimated peak discharge, better estimates are obtained by incorporating more years of data. The range in the period of record for the 20 sites at which these methods were used ranged from 10 years at seven sites to 40 years at two sites, with an average period of record of 18 years. The years for which data were collected at each site are listed in Table 1.

Method 4 estimates the magnitude of peak-flood discharge as a generalized least-square regression equation determined for the eastern Sierra (Thomas and others, 1997, p. 45). This equation uses drainage area, mean basin elevation, and latitude of the site in decimal degrees. In this method the period of record is not important.

Method 5 is an equation presented in Thomas and others (1997, p. 14) that was used to determine flood-frequency relations at sites near gaged sites on the same stream. This equation is based on the relation of the discharge at the gaged site and the drainage area of the two sites. Ideally, the drainage-area ratio should be approximately between 0.5 and 1.5. In methods 4 and 5 the period of record for the 24 sites ranged from 2 years at four sites to 15 years at one site, with an average period of record of 7 years. At sites 41 and 42 peak flows were not determined because these sites are affected by regulation.

The peak flows published in this report vary from -24 to 9 percent of the values published in Rowe and others (1998). These differences in estimated peak values can be explained either by the additional three years of data or by the methods used for this analysis.



Base from U.S. Geological Survey digital data, 1:24,000 and 1:100,000,1969–85.
Universal Transverse Mercator projection, Zone 11

EXPLANATION

Boundary of Lake Tahoe Basin
Boundary of subbasin
10 Gaging station and site number (see table 1)

Figure 1. Geographic setting, hydrologic basins, and selected gaging stations in the Lake Tahoe Basin, California and Nevada

Table 1. Information for USGS sites in the Lake Tahoe Basin, California and Nevada

[Abbreviations: mi^2, square miles; ft^3/s, cubic feet per second]

Gaging station			Period of record, water years	Drainage area (mi^2)	50-year peak discharge[a] (ft^3/s)	100-year peak discharge[b] (ft^3/s)	Largest recorded flood peak	
Site no. (fig. 1)	Number	Name					Date	Magnitude (ft^3/s)
1	10336580	Upper Truckee River at South Upper Truckee Road near Meyers, Calif.	1991–2000	14.2	1,280[c]	1,530[c]	January 2, 1997	2,010
2	10336600	Upper Truckee River near Meyers, Calif.	1961–86	33.2	2,530[d]	3,010[d]	February 1, 1963	2,550
3	103366092	Upper Truckee River at U.S. Highway 50 above Meyers, Calif.	1991–2000	39.3	2,890[c]	3,450[c]	January 2, 1997	5,120
4	10336610	Upper Truckee River at South Lake Tahoe, Calif.	1972–74, 1978, 1980–2000	54.0	3,650[d]	4,560[d]	January 2, 1997	5,480
5	10336630	Eagle Creek near Camp Richardson, Calif.	1972–73	6.59	398[e]	514[e]	November 12, 1973	343
6	10336635	Lake Tahoe tributary near Meeks Bay, Calif.	1963–73	.66	53[f]	70[f]	January 31, 1963	43
7	10336640	Meeks Creek at Meeks Bay, Calif.	1972–75	8.11	530[e]	700[e]	November 12, 1973	526
8	10336645	General Creek near Meeks Bay, Calif.	1980–2000	7.39	930[d]	1,120[d]	January 2, 1997	797
9	10336650	Quail Lake Creek at Homewood, Calif.	1972–74	1.48	150[e]	207[e]	May 14, 1973	24
10	10336655	Madden Creek near Homewood, Calif.	1972–73	1.67	146[e]	195[e]	May 17, 1973	43
11	10336658	Madden Creek at Homewood, Calif.	1972–73	2.04	178[e]	240[e]	May 17, 1973	86
12	10336660	Blackwood Creek near Tahoe City, Calif.	1961–2000	11.1	2,070[d]	2,710[d]	January 1, 1997	2,940
13	10336674	Ward Creek below confluence near Tahoe City, Calif.	1992–2000	4.84	1,260[c]	1,660[c]	January 1, 1997	1,220
14	10336675	Ward Creek at Stanford Rock Trail Crossing near Tahoe City, Calif.	1992–2000	9.18	2,110[c]	2,780[c]	January 1, 1997	2,370
15	10336676	Ward Creek at Highway 89 near Tahoe Pines, Calif.	1973–2000	9.73	2,210[d]	2,910[d]	January 1, 1997	2,530
16	10336684	Dollar Creek near Tahoe City, Calif.	1973–74	1.07	133[e]	190[e]	April 27, 1973	32
17	10336686	Carnelian Creek at Carnelian Bay, Calif.	1999–2000	2.93	290[e]	390[e]	May 22, 1999	32
18	10336688	First Creek near Crystal Bay, Nev.	1970–74, 1991–2000	1.07	45[f]	57[f]	September 26, 1972	22
19	10336690	Second Creek near Crystal Bay, Nev.	1970–74	1.33	122[e]	162[e]	May 18, 1970	16
20	10336691	Second Creek at Lakeshore Drive near Crystal Bay, Nev.	1991–2000	1.35	125[e]	165[e]	May 31, 1995	7
21	10336692	Wood Creek above Jennifer Street near Incline Village, Nev.	1991–2000	1.30	59[f]	72[f]	May 1997	29
22	10336693	Wood Creek near Crystal Bay, Nev.	1967–78	1.69	66[f]	78[f]	May 1969	40
23	10336694	Wood Creek at mouth near Crystal Bay, Nev.	1970–74, 1991–2000	1.97	75[c]	88[c]	June 26, 1995	43
24	103366958	Third Creek below unnamed tributary near Incline Village, Nev.	1991–2000	4.32	146[c]	168[c]	June 4, 1996	59
25	10336696	Third Creek at Incline Village, Nev.	1970–74	4.41	149[c]	171[c]	June 19, 1971	120
26	103366965	Third Creek at Village Boulevard at Incline Village, Nev.	1991–2000	4.48	151[c]	173[c]	June 26, 1995	60
27	10336698	Third Creek near Crystal Bay, Nev.	1970–73, 1975, 1978–2000	6.02	191[f]	219[f]	June 18, 1982	150
28	103366993	Incline Creek above Tyrol Village near Incline Village, Nev.	1991–2000	2.85	107[f]	130[f]	June 26, 1995; January 2, 1997	52
29	103366995	Incline Creek at Highway 28 at Incline Village, Nev.	1990–2000	4.54	144[c]	177[c]	January 2, 1997	143
30	103366997	Incline Creek tributary at Country Club Drive at Incline Village, Nev.	1991–2000	1.01	43[c]	53[c]	June 26, 1995	11
31	10336700	Incline Creek near Crystal Bay, Nev.	1970–75, 1988–2000	6.69	197[f]	242[f]	January 2, 1997	179
32	10336725	Glenbrook Creek at old Highway 50 at Glenbrook, Nev.	1991–2000	3.75	139[c]	204[c]	January 2, 1997	70
33	10336730	Glenbrook Creek at Glenbrook, Nev.	1972–75, 1988–2000	4.11	150[f]	221[f]	January 2, 1997	144
34	10336735	North Logan House Creek near Glenbrook, Nev.	1991–2000	1.08	32[f]	41[f]	January 2, 1997	16
35	10336740	Logan House Creek near Glenbrook, Nev.	1984–2000	2.09	20[f]	23[f]	January 2, 1997; June 12, 1998	12
36	10336750	Edgewood Creek below South Benjamin Drive near Daggett Pass, Nev.	1991–2000	.73	46[f]	66[f]	January 1997	28
37	10336756	Edgewood Creek tributary near Daggett Pass, Nev.	1991–2000	.80	33[f]	47[f]	January 2, 1997	6
38	103367585	Edgewood Creek at Palisade Drive near Kingsbury, Nev.	1991–2000	3.13	114[f]	153[f]	August 14, 1991	57
39	10336759	Edgewood Creek near Stateline, Nev.	1983–87	3.20	116[c]	156[c]	May 27, 1983	24
40	103367592	Eagle Rock Creek near Stateline, Nev.	1990–2000	.63	57[e]	76[e]	January 2, 1997	4
41	10336760	Edgewood Creek at Stateline, Nev.	1993–2000	5.61	—[g]	—[g]	January 2, 1997	136
42	10336765	Edgewood Creek at Lake Tahoe near Stateline, Nev.	1989–92	6.57	—[g]	—[g]	March 4, 1991; October 26, 1991	27
43	10336770	Trout Creek at U.S. Forest Service Road 12N01 near Meyers, Calif.	1991–2000	7.41	216[h]	249[h]	June 27, 1995	166
44	10336775	Trout Creek at Pioneer Trail near South Lake Tahoe, Calif.	1989, 1991–2000	23.1	442[c]	542[c]	January 2, 1997	525
45	10336780	Trout Creek near Tahoe Valley, Calif.	1961–2000	36.7	638[d]	783[d]	February 1, 1963; January 2, 1997	535
46	10336790	Trout Creek at South Lake Tahoe, Calif.	1972–74	40.4	691[c]	848[c]	May 31, 1973	190

a. The 50-year peak discharge is theoretical and statistically has a 2-percent chance of occurring in any given year.
b. The 100-year peak discharge is theoretical and statistically has a 1-percent chance of occurring in any given year.
c. Method 5; estimated by methods of Thomas and others (1997, p. 45) using nearby gaging station on the same stream.
d. Method 2; determined from U.S. Interagency Advisory Committee on Water Data (1982) guidelines, considering historic peaks.
e. Method 4; estimated by methods of Thomas and others (1997, p. 45) using the regression equation for the Eastern Sierra.
f. Method 1; determined from U.S. Interagency Advisory Committee on Water Data (1982) guidelines.
g. Affected by regulation; value not determined.
h. Method 3; determined from U.S. Interagency Advisory Committee on Water Data (1982) guidelines for two-station comparison.

Observed Floods

Table 1 also provides the largest recorded flood peak at each site. During 1997, 31 stream-monitoring sites were in operation, 21 of these sites recorded their largest flood peak as a result of the widespread flooding that occurred on January 1 and 2, 1997, the result of a rain-on-snow event (Hunrichs and others, 1998; and Rowe and others, 1998). For many of the other sites, the largest recorded flood was the result of either convective or frontal rainstorms that occurred during the spring or summer months.

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