SEDIMENT-SOURCE DATA FOR FOUR BASINS TRIBUTARY TO LAKE TAHOE, CALIFORNIA AND NEVADA AUGUST 1983-JUNE 1988

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CONVERSION FACTORS

For the convenience of readers who prefer inch-pound units to metric and International System (SI) units, the following conversion factors are provided:

Multiply	By	To obtain
cubic meter (m^3)	35.31	cubic foot
cubic meter per second (m^3/s)	35.31	cubic foot per second
gram (g)	0.0022	pound
grams per meter per annum [(g/m)/a]	0.116	ounce per foot per year
kilometer (km)	0.621	mile
megagram (Mg)	1.10	ton, short
megagram per cubic meter (Mg/m^3)	0.031	ton per cubic foot
meter (m)	3.28	foot
millimeter (mm)	0.039	inch
square kilometer (km^2)	0.386	square mile
square meter (m^2)	10.76	square foot

For temperature, degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) by using the formula:

$$\text{Temp } ^\circ\text{F} = 1.8 \text{ temp } ^\circ\text{C} + 32$$

DEFINITION OF TERMS

Water year: A water year is a 12-month period, October 1 through September 30, designated by the calendar year in which it ends. In this report, years are water years unless otherwise noted.

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

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ABSTRACT

This report presents data collected during a 5-year study of sediment sources in four drainage basins tributary to Lake Tahoe, California and Nevada: Blackwood Creek, General Creek, Edgewood Creek, and Logan House Creek. Data include changes in bank and bed positions at channel cross sections, results of stream-channel inventories, analyses of bank and bed material samples, tabulations of bed-material pebble counts, measured rates of hillslope erosion, dimensions of gullies, suspended-sediment data collected during synoptic snowmelt sampling, and physiographic data for the four study basins.

INTRODUCTION

The protection of water quality in Lake Tahoe, California and Nevada, depends, in part, on controlling delivery of suspended sediment by tributaries. Large variations in sediment yields have been observed among streams for which sediment records are available, but little is known about the processes that control the supply of sediment to Lake Tahoe tributaries. Effective management of lands in the Lake Tahoe basin to improve lake water quality requires an understanding of these processes and their importance within tributary drainage basins.

This report presents data collected during a 5-year study of sediment sources in four drainage basins tributary to Lake Tahoe (fig. 1). The four basins selected for the study are Blackwood Creek (figs. 2 and 3), General Creek (fig. 4), Edgewood Creek (figs. 5 and 6), and Logan House Creek (figs. 7 and 8). Data contained in this report include descriptions of the physiography, geology, erosional landforms, vegetation, streamflow, and suspended-sediment loads of the study basins (tables 1-4) and results of repeated surveys of stream-channel cross sections, inventories of selected characteristics of selected channel segments, analysis of channel bank and bed-material samples, and measurements of ground-surface lowering and surface erosion. Dimensions of gullies mapped in the Blackwood Creek and Edgewood Creek basins are also included. In addition, results of synoptic snowmelt sampling for water discharge and suspended sediment at selected sites within the Blackwood Creek basin are included. Data for the Blackwood Creek basin are given in tables 5-15, for the General Creek basin in tables 16-19, for the Edgewood Creek basin in tables 20-26, and for the Logan House Creek basin in tables 27-30.

This study was done by the U.S. Geological Survey in cooperation with the Tahoe Regional Planning Agency. Assistance in the field was provided by Julie H. Galton, Gerald L. Rockwell, Denis J. O'Halloran, James A. Howle, Jon Major, Andrea Holland, William Hoffman, Mark Cramer, and Cecily C.Y. Chang. Julie H. Galton and James R. Mullen assisted with data analysis.

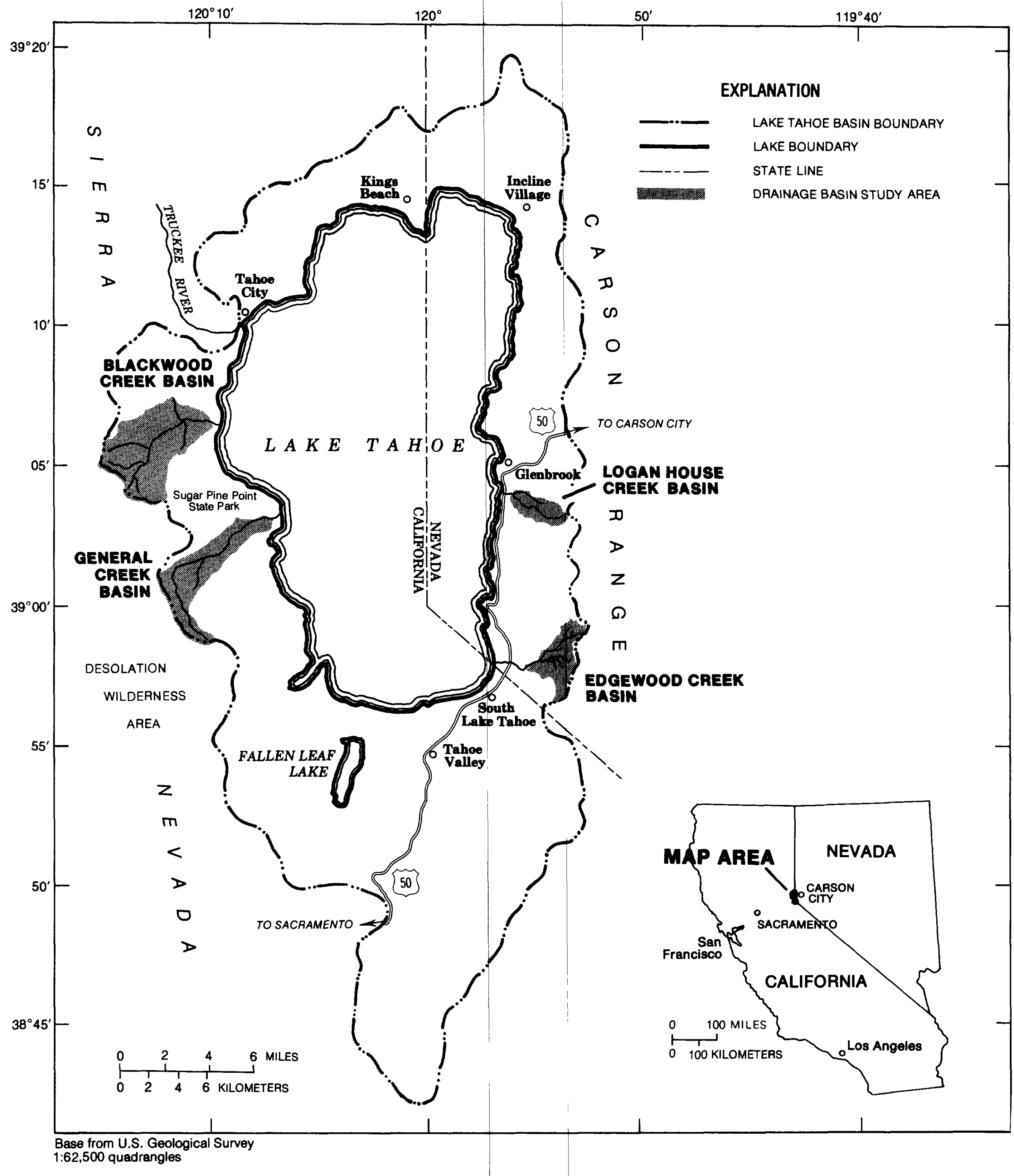

FIGURE 1. Location of study basins tributary to Lake Tahoe.

MEASUREMENTS OF SEDIMENT TRANSPORT AND STORAGE

BASIN DESCRIPTION

Basin physiographic characteristics (table 1) were determined from 1:24,000-scale U.S. Geological Survey topographic maps except where noted. Drainage areas are reported for the areas upstream of the gaging stations (Hunter, Mullen, and Simpson, 1988).

Areas used to calculate various basin characteristics described in this report were determined with the dot-grid method. This method involves placing a transparent grid over a map of the area and counting the number of squares, or "dots," that fall within the area of interest. The area is computed by multiplying the number of squares by the map-scale area represented by one "square."

Altitudes were determined from topographic maps. Contour intervals for these maps are 40 feet (12.2 meters), and precision of altitude determinations is 6.1 meters. Relief was calculated as the difference between the highest and lowest altitudes within each basin.

Hypsometric analysis index values were determined using the procedure described by Langbein and others (1947, p. 140) and Tatum (1963, p. 886, 888). The index values express a relation between basin height and basin area, and represent the relative height (actual basin height divided by total relief) at which the drainage area is divided into two equal parts.

Basin aspects were determined using the method described by Iwatsubo and others (1975). These numbers reflect the general orientation of the basins. Aspects are reported as true azimuths in degrees; 0 and 360 degrees represent north.

Average land-surface slopes were determined by the line-intersection method of Wentworth (1930). Slopes are reported in degrees relative to the horizontal.

Drainage densities were calculated as the total length of stream channels in each basin, divided by the basin area. Total channel lengths were measured from 1:24,000-scale topographic maps. Streams were measured along and upstream from channels shown as blue lines on 1:24,000-scale topographic maps, following successive crenulations in contour lines until crenulations became indistinct. These channels include ephemeral streams, which may not carry water during some years.

Main-channel lengths are those reported by Jorgensen and others (1978). Stream-channel gradients were determined by obtaining the altitudes of the highest and lowest points along the main stream channels, as

Table 1.—*Physiographic and geologic characteristics of the four study basins*

[Rock types expressed as percentage of total basin area, from mapping by Matthews and Burnett (1971): m, meter; mm, millimeter; km, kilometer, km^2, square kilometer]

Basin	Drainage area (km^2)	Mean altitude (m)	Relief (m)	Hypsometric analysis index	Aspect (degrees)	Land-surface slope (degrees)	Drainage density (km/km^2)	Main channel length (km)
Blackwood Creek	29.8	2,195	807	0.390	45	17.8	5.4	9.8
General Creek	19.3	2,195	760	.390	45	12.2	3.0	14.6
Edgewood Creek	8.3	2,195	1,025	.340	270	17.7	8.1	7.4
Logan House Creek	5.4	2,347	789	.570	293	15.0	4.4	3.5

Basin	Channel gradient (percent)	Average annual precipitation (mm)	Rock type: Glaciated granitic	Rock type: Decomposed granitic	Rock type: Volcanic	Rock type: Metamorphic	Rock type: Surficial
Blackwood Creek	4.7	1,397	0	0	50.3	10.3	39.4
General Creek	3.5	1,270	65.0	0	0	0	35.0
Edgewood Creek	10.0	584	0	94.0	0	0	6.0
Logan House Creek	14.0	635	0	69.0	0	31.0	0

Table 2.—*Erosional landforms in four study basins*

[Data expressed as percentage of total basin area, based on mapping by Deborah Harden, California State University, San Jose, California, written commun., 1985]

Basin	Debris slide	Possible debris slide	Debris flow	Possible debris flow	Rock fall	Active fan	Older fan	Snow avalanche	Talus
Blackwood Creek	0.003	0.004	0	0	0	0.001	0.01	0.003	0.03
General Creek	0	.001	0	.0009	0	0	0	0	.003
Edgewood Creek	.003	.003	0	.002	.003	0	0	0	.003
Logan House Creek	.001	0	.0007	0	0	0	0	0	0

reported by Jorgensen and others (1978), subtracting to obtain the differences in altitudes, and dividing the differences by the main channel lengths. Stream-channel gradients are therefore reported as percentages, in contrast to land-surface slopes, which are reported in degrees.

Average annual precipitation values were determined using the precipitation map of the Tahoe Regional Planning Agency (1971a). Precipitation values halfway between lines of equal precipitation were used to calculate area-weighted averages, by multiplying these values by the area between successive lines of equal precipitation, as determined with a dot grid.

Basin geology (table 1) was determined from the geologic map of Matthews and Burnett (1971). The area underlain by each rock type was determined with a dot grid. Five rock types were delineated: glaciated granitic, decomposed granitic, volcanic, metamorphic, and surficial (primarily morainal, outwash, and alluvial deposits).

Erosional landforms (table 2), including various types of landslides and talus fields, were mapped from aerial photographs and field checked (Deborah Harden, Department of Geology, California State University, San Jose, written commun., 1985). Aerial photographs were taken in 1977 at a scale of 1:24,000 for Blackwood and General Creeks and at a scale of 1:15,840 for Edgewood and Logan House Creeks. The area of each basin included in each erosional landform was determined with the dot-grid method. The same method was used to determine the percentages of each basin covered by four general vegetation types-- bare ground, riparian, brush, and coniferous forest (table 3)—shown on the vegetation map of the Tahoe Regional Planning Agency (1971b). Streamflow and suspended-sediment data for the study basins during 1984-87 are summarized in table 4.

CHANNELS

CHANNEL CROSS-SECTIONAL SURVEYS

Channel cross sections were established to determine changes in streambank and bed cross-sectional area due to bank erosion, bed scour, and fill. The cross sections were located along the main channels of each stream, and along several tributary streams in the Blackwood Creek and Edgewood Creek basins; they were located in groups of two or three at approximately equal intervals along the channels to document changes representative of each reach. Locations of cross-sectional groups for each basin are shown in figures 2, 4, 5, and 7. Within cross-sectional groups, individual cross sections were located at distances of two to three channel widths from adjacent cross sections.

Table 3.—*Vegetation cover in four study basins*

[Data expressed as percentage of total basin area, based on mapping by Tahoe Regional Planning Agency (1971b)]

Basin	Bare and alpine	Riparian	Brush	Forest
Blackwood Creek	16	5	7	72
General Creek	7	61	2	30
Edgewood Creek	3	1	0	96
Logan House Creek	0	16	9	75

Cross sections were monumented with lengths of metal fencepost or reinforcement rod (rebar). The elevation difference between the tops of the monuments was determined with a level and surveying rod. Compass bearings were taken from one monument to the other, and the distance between monuments was recorded; this allowed reestablishment of the cross section if one of the two monuments was lost. In addition, reference marks were established at most cross sections to provide a means of relocating monuments. Monuments were marked by drilling small holes into the fenceposts or twisting wire on the rebar to provide a consistent position for attaching the cloth tape during surveys.

Two methods were used to survey cross sections. At wide cross sections (generally wider than 25 m), a self-leveling level and rod were used to obtain elevations. A small bubble level was used to keep the rod vertical. Elevations were measured to the nearest 3 mm. Distances were read to the nearest 0.03 m with a cloth tape. At cross sections of lesser width, where sagging of the cloth tape was not significant, elevations were determined by holding the rod vertically against the cloth tape and reading the rod where it intersected the lower edge of the cloth tape. Precision of measurement for both distances and rod readings was 3 mm.

Cross-sectional data (tables 5, 16, 20, and 27) were entered into computer files and processed by a series of programs that converted the data from inch-pound into International System (SI) units, corrected horizontal distances for the differences between monument elevations (for the slope of the cloth tape), sorted the data, and plotted the most recent survey with the previous survey at the same cross section. Locations of upper and lower extents of banks were determined from these plots and from notes made during field work. Based on these locations, the changes in area between successive surveys for the left and right banks and bed were calculated with a computer-graphics program. Using these area changes, the rate of channel change between surveys was calculated by dividing by the bank height, for bank changes, or by horizontal distance, for bed changes.

CHANNEL INVENTORIES

Stream channels were inventoried (tables 6, 7, 17, 21, and 28) to determine the streambed areas, areas of eroding and stable streambanks, and volumes of sediment storage in the channels. Bank heights were measured with a surveying rod, channel widths and lengths with a rod or rangefinder, and dimensions of storage elements with a rod. Storage elements consisted of active, semiactive, and inactive channel bars; storage behind organic debris; and storage in the active channel above the thalweg (lowest point in streambed). The average depths or heights of these storage elements were determined by measuring the height of each storage element above the thalweg with a surveying rod. The percentages of each bank that appeared to be eroding, stable, or armored were visually estimated. Measurement precision for rod measurements was 0.03 m. For range-finder measurements, precision varied from 0.15 m at distances of 10 m to 1.5 m at distances of 50 m.

Channel inventories were completed in reaches of variable length. Each reach was defined as a length of channel in which the measured features were fairly uniform. Reaches ended where changes were apparent, or where visibility was limited by vegetation or channel meanders. The entire main channels of Blackwood and General Creeks were inventoried. In Edgewood Creek and Logan House Creek basins, slightly more than 30 percent of the main channels were inventoried. Selected reaches on several tributaries in Blackwood Creek basin also were inventoried. Inventoried reaches are shown in figures 2-8.

Table 4.—*Streamflow and sediment data for study basins, 1984-87*

[Data from Fogelman and others (1985), Hunter, Mullen, Simpson, and Grillo (1987, 1988), and Hunter, Mullen, and Simpson (1988). m^3/s, cubic meter per second; Mg, megagram]

Basin	Period of record (water year)		Mean daily streamflow (m^3/s)				Suspended sediment load (Mg)			
	Streamflow	Sediment	1984	1985	1986	1987	1984	1985	1986	1987
Blackwood Creek	1961-87	1975-87	1.58	0.74	1.60	0.44	1,290	355	6,300	161
General Creek	1980-87	1981-87	0.68	0.33	0.73	0.18	165	45.6	578	16.5
Edgewood Creek	1983-87	1983-87	0.10	0.06	0.08	0.05	52.7	28.4	69.7	10.3
Logan House Creek	1984-87	1984-87	0.03	0.02	0.03	0.01	3.86	2.60	6.99	1.52

BED AND BANK SAMPLING

Samples of streambank and bed material were collected at each cross section to determine the percentage by weight of bank and bed material with a grain diameter finer than 2 mm (tables 8, 9, 18, 22, and 29). An upper limit of 2 mm was used because it is the largest grain size that is normally transported as suspended sediment in the Lake Tahoe basin (Fogelman and others, 1985; Hunter, Mullen, Simpson, and Grillo, 1987, 1988; Hunter, Mullen, and Simpson, 1988; Mullen and others, 1989).

Bank samples were collected by driving metal cans horizontally into the banks until the cans were completely filled with material. Samples were transferred to canvas bags and transported for processing.

Bulk density of each sample was determined by oven drying the sample at about 65 °C for 24 hours, weighing the sample, and dividing the mass by the volume of the sample-collection can. Samples were placed on a 2-mm sieve, and mechanically shaken for 10-20 minutes. The percentage of sample finer than 2 mm was determined by dividing the mass of sediment passing through the 2-mm sieve by the mass of the total sample. The percentage of organic material was not determined.

When conditions permitted, bed-material samples were collected and processed in the same manner as bank samples, but this often was not possible because of large particle sizes and low-cohesion bed material. Under these conditions, bed-material bulk density was determined by scooping a small depression in exposed bed material, lining the depression with plastic sheeting, and filling the depression with water. The volume of added water was measured to give the volume of material excavated from the depression. The excavated material was placed in a plastic bucket and weighed with a spring scale. Bulk density (wet) then was calculated as the mass of excavated material divided by the volume of the excavated depression. This method was not entirely satisfactory, because volume determinations were somewhat subjective and because samples were not dried prior to weighing. For remote sites with coarse bed material, however, it appeared to be the only practical method. Excavated material was wet-sieved in the field to determine the percentage of bed sediment finer than 2 mm. The slight amount of water retained with the coarse fraction caused an undetermined underestimation of the percent of bed material finer than 2 mm.

Pebble counts (Wolman, 1954) were made of surface bed material at all sets of cross sections (tables 10, 19, 23, and 30). The pebble count is a method of assessing the representative size of coarse bed sediments (Guy and Norman, 1970, p. 52). The technique involves laying a grid over the streambed and measuring clast sizes at points on the grid. About 100 points were sampled for each count. Counts were made in both 1983 and 1984. Material finer than 2 mm was estimated by assessing texture by "feel."

HILLSLOPES

EROSION PINS

Erosion-pin arrays were established at various locations within the Blackwood Creek and Edgewood Creek basins (figs. 2 and 5) to determine rates of land-surface lowering by hillslope processes. Erosion-pin arrays were monumented with lengths of metal fence-posts or rebar driven into the ground in pairs. These pairs were installed along hillslope contours in sets of three pairs per site. The pairs were offset so that no pair was directly above another on a slope. The relative altitudes of erosion-pin monuments were established with a level and rod. Changes in land-surface altitude (tables 11 and 24) were measured by placing a specially fabricated aluminum bracket between the two monuments of each pair. This bracket was attached to the monuments at a consistent altitude relative to the tops of the monuments. A metal rod was dropped through each of the ten holes drilled across the length of the bracket, and the height of the rod that remained above the bracket after the rod had contacted the land surface was measured with a ruler. Measurement precision was 1 mm. Many of the monuments were resurveyed to check for possible changes in monument altitude due to frost heave or other causes; changes were found to be negligible. Changes in average rod height above the bracket represented changes in the average land-surface altitude between erosion-pin array monuments; decreases in rod height indicated lowering of the land surface. Average change for an erosion-pin array was considered positive if the net change was a decrease in rod height, that is, if the ground surface had been lowered between successive measurements.

EROSION BOXES

Erosion boxes were installed at most of the erosion-pin sites in Blackwood and Edgewood Creek basins to measure directly the rate of sediment transport on hill-slopes. Erosion-box sites are shown in figures 2 and 5. At sites S4 and S8 in both basins, two erosion boxes were installed (boxes S4a,b, and S8a,b). Numerous difficulties with these boxes, most notably vandalism, frost heaving, and crushing due to snow accumulation, necessitated trying several designs for the erosion boxes. All boxes were 0.3 m long and installed flush with the ground surface along hillslope contours. Boxes were of three types: uncovered galvanized steel, plywood-covered galvanized steel, and covered metal.

The uncovered boxes were not limited to any size range of sediment. However, because of the size of the slot between box and cover, the metal-covered boxes could accommodate only particles smaller than 20 mm and the plywood-covered boxes could accommodate only particles smaller than 40 mm. All boxes had small holes in their upslope sides to allow water to exit; on the uncovered and metal-covered boxes, the holes were screened with a 0.032-mm mesh. Plywood-covered boxes were not screened.

From 1985 to 1988, each erosion box was visited annually during the summer, and any accumulated sediment was removed and oven dried or air dried. Samples were weighed, placed on a 2-mm sieve, and mechanically shaken for 10-20 minutes. Sediment remaining on the sieve was weighed, and subtracted from the total sample mass. The hillslope-sediment-transport rate (table 12) was calculated as the mass of fine sediment (less than 2-mm grain diameter) collected in each box during approximately a 1-year period, divided by the length of the opening of the erosion box, in meters. Hillslope-sediment-transport rates therefore represent the mass of fine sediment transported downslope annually per meter of hillslope contour at each erosion-box site.

GULLIES

Many of the major gullies in parts of the Blackwood Creek and Edgewood Creek basins were mapped. Locations of gullies and areas mapped are shown in figures 3 and 6, and dimensions of gullies are given in tables 13, 14, and 26. Gullies were located in 1986-87 by walking roads, trails, and roadless areas. Gullies were considered to be any channel which had steep sides, a width/depth ratio of up to 3.0, a depth greater than 0.3 m, and seemingly active headward erosion or a clear association with disturbances, such as road drainage. Most gullies were too small to be visible on the aerial photographs and were located using field traverses. Gully location was noted on topographic maps by comparing features identified on aerial photographs with those visible on the ground, and occasionally by taking compass bearings on landmarks. Gully dimensions were measured with a range finder and surveying rod. Precisions are the same as those given for channel mapping.

SYNOPTIC SNOWMELT SAMPLING

During the spring of 1987, a program of synoptic snowmelt sampling was conducted in Blackwood Creek basin. The locations of miscellaneous sites used for synoptic snowmelt sampling are shown in figure 3. Sampling consisted of water-discharge measurements and concurrent collection of suspended sediment (table 15). Water-discharge measurements were made using standard current-meter measurement techniques as described by Rantz and others (1983). Suspended-sediment samples were collected using the equal-width increment method (U.S. Geological Survey, 1977).

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BLACKWOOD CREEK BASIN

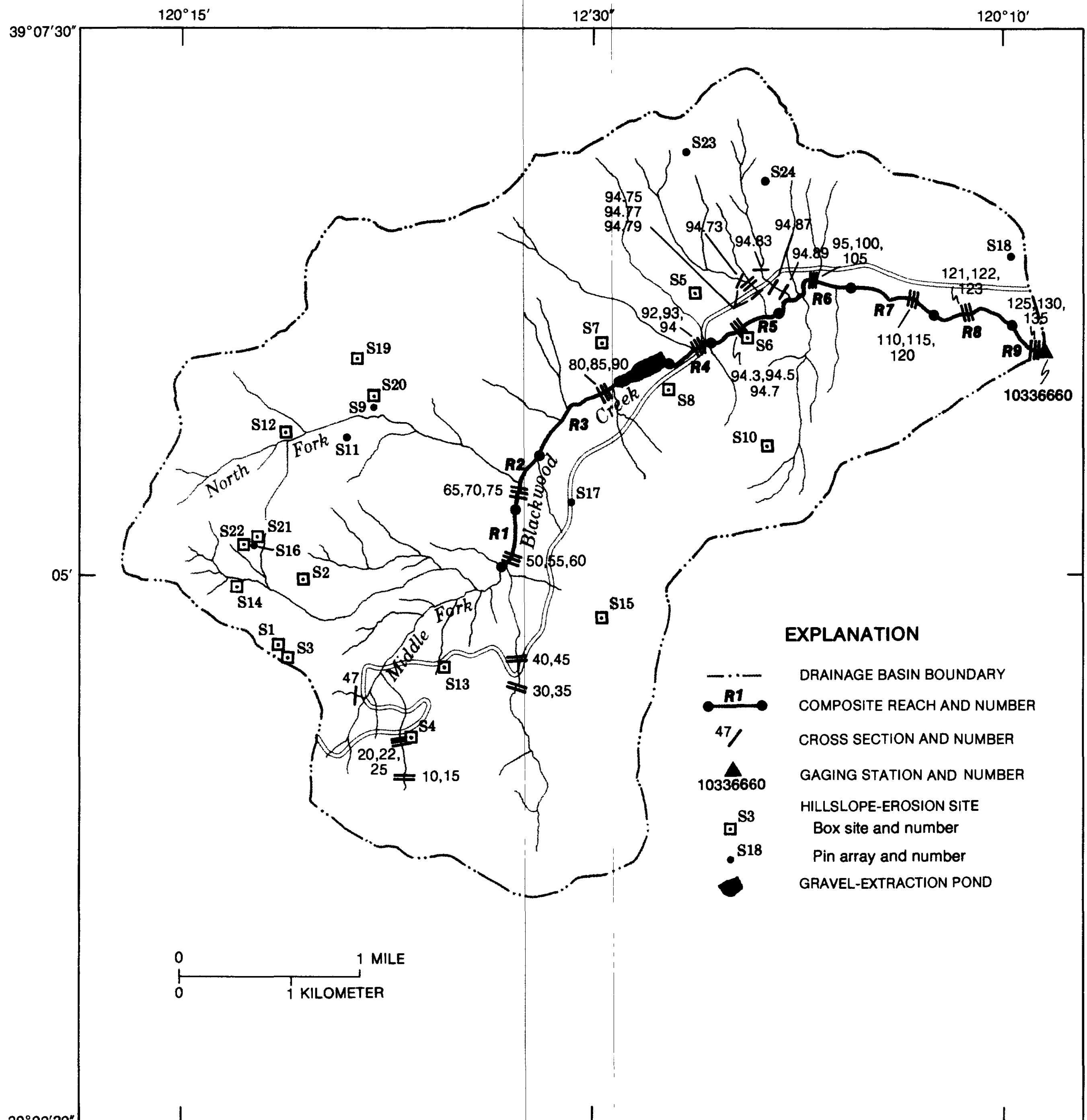

FIGURE 2. Location of composite reaches, channel cross sections, gaging station, and hillslope-erosion sites in Blackwood Creek basin.

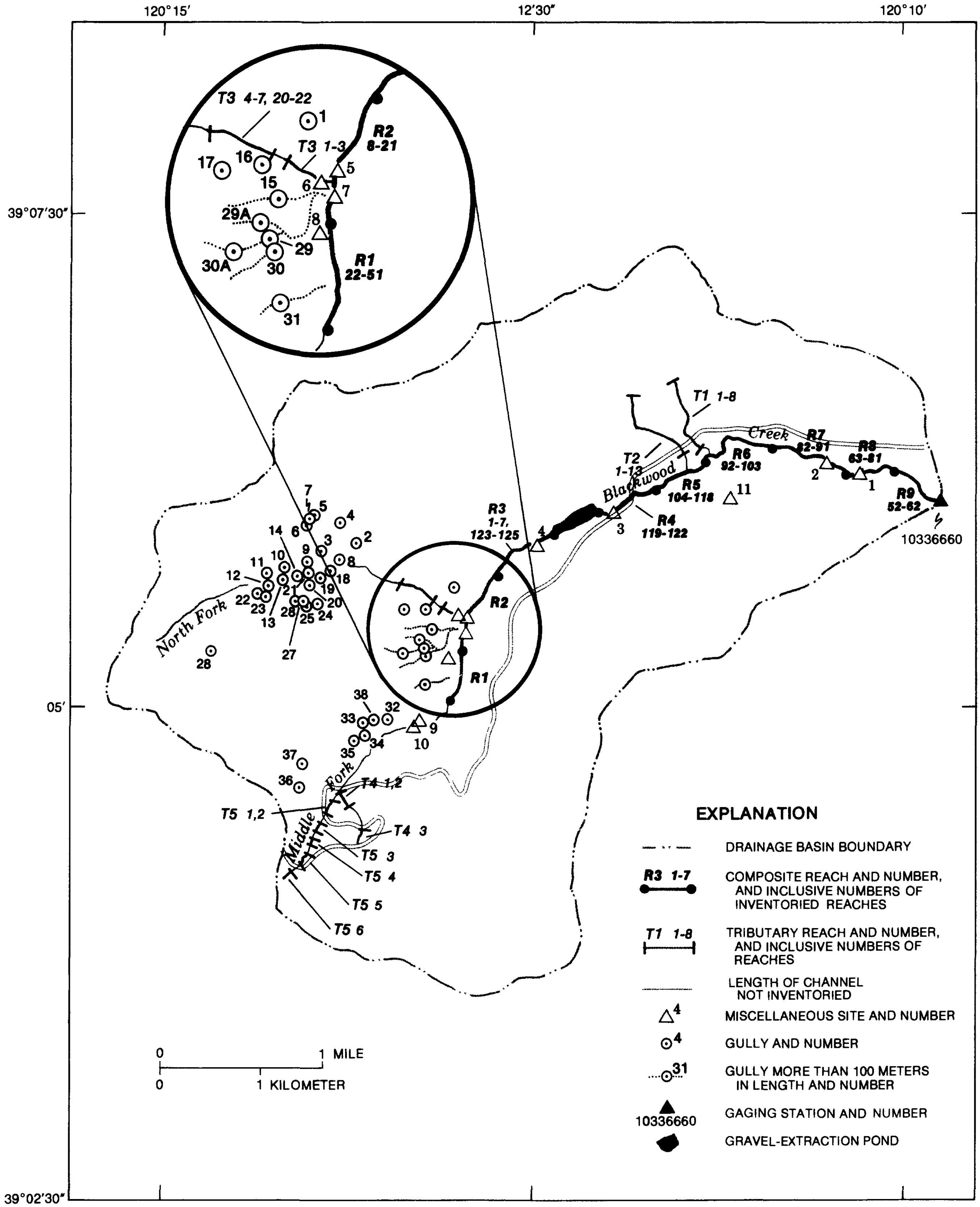

FIGURE 3. Location of composite reaches, tributary reaches, gullies, and miscellaneous sites used for synoptic snowmelt sampling in Blackwood Creek basin.

Table 5.—*Changes at channel cross sections, Blackwood Creek basin, 1983-87*

[Values represent average changes in horizontal position of left and right banks and vertical position of bed, in meters, between successive surveys made during summers of the indicated years. Positive numbers indicate bank retreat or bed scour. Total changes for the period 1984-86 are shown for cross sections not surveyed in 1985. —, no data available]

Cross section (fig. 2)	1983-84	1984-85	1985-86	1984-86	1986-87	Average annual
			Left bank			
10	0.008	0.005	0.070	—	-0.018	0.016
15	.076	-.071	.083	—	-.072	.004
20	-.031	—	—	0.021	-.027	-.009
22	.013	-.117	.023	—	.022	-.015
25	-.173	—	—	-.040	.021	-.048
30	.073	—	—	([1])	.122	.098
35	.136	.192	.170	—	-.225	.068
40	.026	—	—	.091	-.145	-.007
45	-.189	.108	.076	—	-.009	-.004
47	—	.101	-.053	—	.018	.022
50	-.086	—	—	.144	-.020	.010
55	-.089	-.078	-.013	—	-.087	-.067
60	-.022	([2])	([2])	-.018	-.080	-.030
65	—	—	—	-.032	.016	-.016
70	—	.113	.904	—	.063	.360
75	—	—	—	-.871	.341	-.176
80	.015	—	—	.113	.112	.060
85	.084	.121	-.017	—	.121	.077
90	.025	—	—	.074	.219	.080
92	.169	—	—	.098	-.025	.060
93	.071	-.012	-.005	—	.035	.022
94	—	—	—	.026	-.033	-.002
94.3	—	—	—	6.667	—	3.334
94.5	—	([1])	.156	—	.026	.091
94.7	—	—	—	-.023	.094	.023
94.73	—	—	—	—	([2])	([2])
94.75	—	—	—	—	-.011	-.011
94.77	—	—	—	—	-.163	-.163
94.79	—	—	—	—	.096	.096
94.83	—	—	—	—	.024	.024
94.87	—	—	—	—	-.038	-.038
94.89	—	—	—	—	([2])	([2])
95	—	—	—	0.312	-.034	.093
100	-.013	.030	.97	—	-.028	.240
105	.042	—	—	.302	-.001	.086
110	.086	-.094	-.082	—	.151	.015
115	.073	.103	.306	—	-.020	.116
120	.019	.175	2.827	—	.020	.760
121	—	—	—	.063	.015	.026
122	—	-.195	.233	—	-.076	-.013
123	—	—	—	.026	-.028	-.001
125	-.032	—	—	.080	-.010	.010
130	.460	-.062	.223	—	.008	.157
135	.074	—	—	.235	.004	.078

See footnotes at end of table.

Table 5.—*Changes at channel cross sections, Blackwood Creek basin, 1983-87*—Continued

Cross section (fig. 2)	1983-84	1984-85	1985-86	1984-86	1986-87	Average annual
			Right bank			
10	0.063	0.026	0	—	-0.003	0.022
15	.091	-.019	.018	—	.017	.027
20	-.184	—	.030	(2)	.023	-.044
22	-.112	-.144	-.245	—	.276	-.056
25	-.040	—	—	-0.416	.158	-.074
30	0	—	—	(1)	.039	.019
35	-.090	-.081	-.301	—	.373	-.025
40	.113	—	—	.012	.024	.037
45	-.026	.033	.012	—	0	.005
47	—	-.125	-.015	—	-.139	-.093
50	.063	—	—	-.123	.005	-.014
55	.044	-.006	.093	—	-.004	.032
60	.117	—	—	-.095	-.022	0
65	—	—	—	-.070	-.031	-.034
70	—	-.199	-.062	—	-.002	-.088
75	—	—	—	-.208	-.022	-.077
80	-.110	—	—	.656	.031	.144
85	.266	.083	.151	—	-.019	.120
90	-.162	—	—	2.925	-.006	.689
92	-.010	—	—	.003	.015	.002
93	—	—	.022	—	.011	.016
94	—	—	—	.082	-.002	.027
94.3	—	—	—	-.165	—	-.082
94.5	—	(1)	.451	—	.042	.247
94.7	—	—	—	-.015	.026	.004
94.73	—	—	—	—	(2)	(2)
94.75	—	—	—	—	.051	.051
94.77	—	—	—	—	(2)	(2)
94.79	—	—	—	—	.500	.500
94.83	—	—	—	—	.108	.108
94.87	—	—	—	—	.020	.020
94.89	—	—	—	—	(2)	(2)
95	—	—	—	.047	-.047	0
100	-.068	-.026	.073	—	-.014	-.009
105	-.091	—	—	.085	-.029	-.009
110	.081	.545	2.853	—	.026	.876
115	.057	.041	1.478	—	-.162	.354
120	.248	-.051	-.186	—	-.081	-.018
121	—	—	—	.189	-.006	.061
122	—	.020	.161	—	-.006	.058
123	—	—	—	-.288	-.003	-.097
125	-.123	—	—	.098	-.026	-.013
130	.106	-.042	-.085	—	.010	-.003
135	-.078	—	—	.093	.006	.005

See footnotes at end of table.

Table 5.—*Changes at channel cross sections, Blackwood Creek basin, 1983-87*—Continued

Cross section (fig. 2)	1983-84	1984-85	1985-86	1984-86	1986-87	Average annual
			Bed			
10	0.019	-0.007	0.028	—	-0.019	0.005
15	.069	-.030	.018	—	.024	.020
20	.127	—	—	-0.009	-.025	.023
22	.098	.017	-.021	—	-.002	.023
25	.011	—	—	-.045	.018	-.004
30	.021	([1])	([1])	([1])	.023	.022
35	-.001	-.023	.002	—	.022	0
40	.010	—	—	-.036	.025	0
45	-.032	.016	-.028	—	-.002	-.012
47	—	.010	-.024	—	-.021	-.012
50	-.013	—	—	.022	-.014	-.001
55	-.026	.006	.004	—	.076	.015
60	.026	—	—	-.064	.208	.043
65	—	—	—	.018	.004	.007
70	—	-.010	-.045	—	.023	-.011
75	—	—	—	-.011	-.115	-.042
80	.021	—	—	-.097	-.059	-.034
85	.007	-.001	-.034	—	.123	.024
90	-.023	—	—	-.457	-.079	-.140
92	.056	—	—	0	.010	.016
93	.008	.003	-.145	—	-.076	-.052
94	—	—	—	.024	-.006	.006
94.3	—	—	—	-.197	—	-.099
94.5	—	([1])	-.050	—	.010	-.020
94.7	—	—	—	.009	-.026	-.006
94.73	—	—	—	—	.013	.013
94.75	—	—	—	—	-.007	-.007
94.77	—	—	—	—	.021	.021
94.79	—	—	—	—	.076	.076
94.83	—	—	—	—	0	0
94.87	—	—	—	—	.023	.023
94.89	—	—	—	—	.007	.007
95	—	—	—	.451	.235	.228
100	0	.004	.045	—	-.061	-.003
105	.396	—	—	.122	.147	.166
110	-.047	-.026	-.035	—	-.052	-.040
115	.017	.037	-.058	—	—	-.001
120	-.036	-.030	-.195	—	.118	-.036
121	—	—	—	.038	-.168	-.043
122	—	-.006	.004	—	-.001	-.001
123	—	—	—	-.028	—	-.014
125	.018	—	—	.111	.079	.052
130	-.022	.002	-.006	—	—	-.009
135	-.006	—	—	.235	.182	.103

[1]Data missing.
[2]No bank defined.

Table 6.—*Channel-inventory results for selected reaches, Blackwood Creek, 1983-85*

[Data include measured volumes of stored sediment and estimated areas of eroding banks, stable banks, and active channel bed. Active channel storage and bars include sediment judged potentially available for transport each year. Semiactive bars include sediment stabilized by annual vegetation and are considered potentially available for transport by mean annual peak flows. Inactive bars consist of sediment stabilized by perennial vegetation or protected by armoring and are considered available for transport only by infrequent high flows. Organic debris consists of large woody material, which blocks the flow of water and collects sediment. m, meter; m^2, square meter; m^3, cubic meter]

Composite reach (fig. 2)	Inventoried reaches (fig. 3)	Composite reach length (m)	Volume of stored sediment (m^3)				Volume of sediment stored behind organic debris (m^3)	Estimated area (m^2)		
			Active channel	Active bars	Semiactive bars	Inactive bars		Eroding banks	Stable banks	Active bed
R1	22-51	417	459	213	392	264	108	378	296	3,180
R2	8-21	721	292	3,370	794	1,050	0	877	684	7,320
R3	123-125,1-7	819	38.6	5,010	1,430	0	0	1,460	484	11,100
R4	119-122	395	153	775	362	75.0	0	389	313	4,300
R5	104-118	942	243	1,500	323	0	55	1,510	288	10,400
R6	92-103	862	520	1,460	1,690	1,030	28.8	1,030	833	9,340
R7	82-91	743	658	2,690	998	0	1,100	613	471	11,300
R8	63-81	777	676	333	99.6	0	1,430	708	385	6,350
R9	52-62	645	356	817	238	0	0	949	444	5,780
Total		6,320	3,400	16,200	6,330	2,420	2,720	7,910	4,200	69,100

Table 7.--*Channel-inventory results for selected reaches, Blackwood Creek tributaries, 1986*

[Data include measured volumes of stored sediment and estimated areas of eroding banks, stable banks, and active channel bed. Active storage includes sediment judged potentially available for transport each year. Semiactive storage includes sediment stabilized by annual vegetation and organic debris and is considered potentially available for transport by mean annual peak flows. m, meter; m^2, square meter; m^3, cubic meter]

Tributary (fig. 3)	Inventoried reach (fig. 3)	Reach length (m)	Volume of stored sediment (m^3)		Estimated area (m^2)		
			Active storage	Semiactive storage	Eroding banks	Stable banks	Active bed
T5	1-2	137	24.7	5.1	79.0	104	557
T5	3	67.1	12.1	3.9	10.8	97.5	198
T5	4	76.2	.7	.8	33.0	27.4	218
T5	5	64.3	0	.4	5.4	67.1	157
T5	6	49.1	0	9.9	32.9	31.4	184
T4	1-2	130	13.1	8.4	41.6	151	432
T4	3	88.1	15.7	2.4	11.5	104	258
T3	1-3	157	44.6	19.3	304	87.7	903
	4-7, 20-22	290	54.8	11.3	110	417	1,700
T2	1-13	918	181	62.2	248	650	2,840
T1	1-8	626	11.4	31.0	342	121	1,180

Table 8.—*Bulk density and percentage of particles finer than 2 millimeters intermediate grain diameter for streambank and bed samples, Blackwood Creek main channel, 1985-87*

[Mg/m^3, megagram per cubic meter; mm, millimeter; --, no data available]

Cross-sectional group (fig. 2)	Bank material: Bulk density (Mg/m^3)	Bank material: Percentage finer than 2 mm	Bed material: Bulk density (Mg/m^3)	Bed material: Percentage finer than 2 mm
50, 55, 60	1.33	86	1.73	16
65, 70, 75	1.02	61	--	--
	.87	87	2.33	7
80, 85, 90	1.83	41	--	--
	.94	95	2.53	12
	--	7	--	--
	.94	95	--	--
92, 93, 94	--	28	--	--
	0.70	86	2.25	4
94.3, 94.5, 94.7	1.15	58	1.91	9
95, 100, 105	1.03	80	2.16	19
110, 115, 120	.70	99	2.19	21
	1.49	21	--	--
	.75	99	--	--
121, 122, 123	0.70	97	--	--
	--	--	1.96	29
125, 130, 135	1.94	21	1.80	14

Table 9.—*Bulk density and percentage of particles finer than 2 millimeters intermediate grain diameter for streambank and bed samples, Blackwood Creek tributaries, 1987*

[Mg/m^3, megagram per cubic meter; mm, millimeter; --, no data available]

Cross-sectional group (fig. 2)	Bank material: Bulk density (Mg/m^3)	Bank material: Percentage finer than 2 mm	Bed material: Bulk density (Mg/m^3)	Bed material: Percentage finer than 2 mm
10, 15	0.64	81	1.01	11
20, 22, 25	--	21	2.22	11
30, 35	--	42	1.87	10
94.73, 94.75, 94.77, 94.79	.91	76	--	--
94.83, 94.87, 94.89	.87	71	--	--

Table 10.—*Pebble-count data for bed material at cross-sectional groups, Blackwood Creek basin, 1983-84*

[Table shows percentage of bed material in size classes and total number of points for each count. < actual value is less than value shown, > actual value is greater than value shown]

Cross-sectional group (fig. 2)	Water year	Grain size, in millimeters										Total number of points
		<0.062	0.062-2	2-4	4-8	8-16	16-32	32-64	64-128	128-256	>256	
10, 15	1983	0	1	0	0	7	16	35	15	23	3	100
	1984	0	3	0	3	5	15	23	27	19	5	100
20, 22, 25	1983	0	0	1	1	6	15	11	19	24	24	101
	1984	0	0	0	0	5	7	17	19	32	20	100
50, 55, 60	1983	0	6	3	7	6	12	11	9	20	26	120
	1984	3	7	4	12	13	11	16	14	7	13	100
65, 70, 75	1984	1	4	1	1	6	12	28	27	15	6	105
80, 85, 90	1983	0	2	0	3	12	22	22	30	10	0	105
	1984	0	1	2	4	9	13	27	32	12	0	105
94.3, 94.5, 94.7	1984	0	6	1	2	15	37	36	2	1	0	100
95, 100, 105	1983	0	27	1	5	12	17	13	7	9	9	137
110, 115, 120	1984	8	10	0	3	18	24	25	11	1	0	100
125, 130, 135	1983	0	14	0	2	17	24	14	13	14	0	90

Table 11.—*Erosion-pin data for hillslope sites, Blackwood Creek basin, 1984-86*

[Average altitude changes are changes in land-surface altitude, in millimeters, between successive surveys made in the summer or autumn of the indicated years. Positive numbers represent a decrease in land-surface altitude. Aspect: N, north; S, south]

Erosion-pin array (fig. 2)	Number of pins	Average altitude change	Standard deviation	Maximum altitude change		Aspect	Hill-slope angle (degrees)	Ground cover
				Increase	Decrease			
				1984-85				
S1	50	9	8	-8	25	N	19	Bare
S2	30	-2	11	-25	18	S	19	Shrub
S3	30	2	7	-15	15	N	17	Bare
S4	30	-1	5	-7	19	N	19	Forest
S5	26	17	9	-1	49	S	29	Bare
S6	30	-4	17	-45	20	N	16	Forest
S7	30	2	17	-39	48	S	20	Bare
S8	30	-14	23	-70	16	N	13	Shrub
S9	30	-2	24	-107	29	S	25	Forest
S10	30	2	8	-14	31	N	26	Forest
S11	30	-2	4	-14	5	N	28	Forest
S12	30	-2	10	-31	24	S	28	Forest
S13	30	5	15	-15	57	N	23	Forest
S14	30	0	10	-18	22	N	32	Forest
S15	30	2	11	-23	26	N	17	Shrub
S16	30	1	5	-12	15	S	16	Forest
S17	30	-7	19	-96	14	N	15	Shrub
S18	30	-2	6	-16	10	S	14	Forest
S19	30	1	12	-33	24	S	13	Bare
S20	30	-2	16	-42	27	S	31	Shrub
S21	10	2	11	-15	28	S	13	Shrub
S22	20	0	8	-27	16	S	12	Shrub
S23	30	2	6	-12	16	S	23	Forest
S24	30	5	8	-10	28	S	27	Shrub
				1985-86				
S1	([1])	([1])	([1])	([1])	([1])	([1])	([1])	([1])
S2	30	0	13	-37	23	S	19	Shrub
S3	30	-2	7	-15	9	N	17	Bare
S4	30	0	4	-12	6	N	19	Forest
S5	26	-13	15	-62	20	S	29	Bare
S6	20	-1	4	-8	6	N	16	Forest
S7	30	0	20	-45	67	S	20	Bare
S8	30	5	23	-48	80	N	13	Shrub
S9	30	2	19	-26	89	S	25	Forest
S10	30	2	8	-14	31	N	26	Forest
S11	30	-1	4	-12	5	N	28	Forest
S12	30	1	10	-33	15	S	28	Forest
S13	30	2	7	-11	18	N	23	Forest
S14	30	-1	6	-13	12	N	32	Forest
S15	30	1	9	-17	28	N	17	Shrub
S16	30	-1	6	-21	12	S	16	Forest
S17	30	6	9	-7	34	N	15	Shrub
S18	([1])	([1])	([1])	([1])	([1])	([1])	([1])	Forest
S19	30	2	12	-22	19	S	13	Bare
S20	30	0	20	-59	32	S	31	Shrub
S21	10	9	12	-13	26	S	13	Shrub
S22	20	-3	14	-27	21	S	12	Shrub
S23	([1])	([1])	([1])	([1])	([1])	([1])	([1])	Forest
S24	30	-2	9	-25	12	S	27	Shrub

[1]Data missing.

Table 12.—*Erosion-box data for hillslope sites, Blackwood Creek basin, 1985-88*

[Data shown are amount of soil collected in erosion boxes during indicated years, and amount consisting of soil particles finer than 2 millimeters intermediate grain diameter. Also included are calculated rates of hillslope transport of particles finer than 2 millimeters per meter width of hillslope per annum. Percentages have been rounded. g, gram; mm, millimeter; (g/m)/a, gram per meter per annum]

Erosion-box site (fig. 2)	Total mass (g)	Percentage of particles finer than 2 mm	Mass finer than 2 mm (g)	Hillslope transport rate [(g/m)/a]
Water year 1985				
S1	43.5	20	8.7	28.5
S2	199.2	32	63.7	209.1
S4	3.5	73	2.5	8.4
S5	([1])	([1])	([1])	([1])
S8	2,118.9	54	1,144.2	3,754.0
S9	([1])	([1])	([1])	([1])
S10	.8	60	.5	1.6
S13	([1])	([1])	([1])	([1])
Average	473.2	48	243.9	800.3
Water year 1986				
S1	93.3	12	11.2	36.7
S2	147.8	46	68	223.1
S4	([1])	([1])	([1])	([1])
S5	974.2	39	379.9	1,246.5
S8	4,131.4	61	2,520.2	8,268.2
S9	81.4	7	5.7	18.7
S10	1.1	49	.5	1.8
S13	3.4	99	3.4	11.0
Average	776.1	45	427.00	1,400.9
Water year 1987				
S1	176.3	23	40.0	131.2
S2	137.9	26	35.7	117.1
S3	44.2	38	16.8	55.1
S4a	40.4	81	32.8	107.6
S4b	43.3	81	34.9	114.5
S5	1,762.4	50	878.5	2,882.2
S7	([1])	([1])	([1])	([1])
S8a	192.3	49	93.6	307.1
S8b	97.9	62	61.2	200.8
S10	0.9	100	0.9	3.0
Water year 1987—Continued				
S12	188.9	20	38.3	125.7
S13	8.4	88	7.4	24.3
S14	([1])	([1])	([1])	([1])
S15	19.0	70	13.2	43.3
S19	120.8	54	65.8	215.9
S20	12.5	65	8.1	26.6
S21	5,574.0	64	3,556.0	11,666.7
S22	5,455.4	64	3,486.0	11,437.0
Average	867.2	58	523.0	1,716.0
Water year 1988				
S1	80.3	25	20.4	66.9
S2	76.5	24	18.5	60.7
S3	83.6	5	4.2	13.8
S4a	1,171.9	46	535.6	1,757.2
S4b	([1])	([1])	([1])	([1])
S5	([1])	([1])	([1])	([1])
S7	524.3	45	233.8	767.1
S8a	650.8	49	318.4	1,044.6
S8b	95.6	15	14.0	45.9
S10	.4	100	.4	1.3
S12	271.1	27	73.5	241.1
S13	27.8	54	15.0	49.2
S14	9.5	21	2.0	6.6
S15	393.6	39	155.0	508.5
S19	5,566.9	24	1,350.4	4,430.5
S20	102.3	22	22.2	72.8
S21	4,572.5	49	2,233.4	7,327.4
S22	4,919.6	51	2,488.6	8,164.7
Average	1,159.0	37	468.0	1,535.0

[1] Data missing.

Table 13.—*Dimensions of gullies mapped, North Fork Blackwood Creek basin, 1986*

[m, meter; m^3, cubic meter]

Gully (fig. 3)	Length (m)	Average depth (m)	Average width (m)	Volume (m^3)
1	61.3	0.5	1.1	33
2	15.2	.3	.7	3
3	17.4	.1	.5	1
4	19.5	.1	1.4	3
5	7.3	.2	.7	1
6	64.3	.2	.9	10
7	30.5	.1	.7	3
8	123	.2	1.1	34
9	18.3	.1	1.0	2
10	11.6	.2	1.2	2
11	122	.3	1.2	45
11a	152	.3	1.2	57
11b	76.2	.2	1.3	18
12	14.0	.1	.9	2
13	12.2	.1	1.0	1
14	33.5	.2	.8	4
16	52.4	.7	1.6	57
17	6.1	.3	.8	2
18	29.0	.4	.9	10
19	32.6	.3	1.3	13
20	139	.8	1.7	181
21	8.5	.4	.9	3
22	13.1	.3	1.2	5
23	15.9	.3	1.4	6
24	10.7	.9	1.8	17
25	68.9	.4	.9	28
26	5.2	.2	.3	0
27	14.0	.3	.4	2
28	2.1	.2	1.1	1
Total				544

Table 14.—*Dimensions of gullies mapped, Middle Fork Blackwood Creek basin, 1986*

[m, meter; m^3, cubic meter]

Gully (fig. 3)	Length (m)	Average depth (m)	Average width (m)	Volume (m^3)
15	483	0.9	1.6	700
29	350	.6	2.3	513
29a	6.7	.3	1.6	3
30	460	.8	2.5	887
30a	61.3	.7	.8	34
31	37.8	.2	.8	7
32	38.4	.5	1.0	18
33	67.7	.2	1.0	14
34	117	.5	1.6	88
35	15.2	.4	4.7	28
36	10.7	.6	.9	5
37	20.1	.3	1.2	7
38	59.7	.3	.5	9
Total				2,313

Table 15.—*Streamflow and suspended-sediment concentrations and discharges at synoptic snowmelt sampling sites, Blackwood Creek basin, April 1987*

[mg/L, milligram per liter; m^3/s, cubic meter per second; Mg/d, megagram per day]

Site No. (fig. 3)	Site name	Date of sample	Time (hours)	Streamflow (m^3/s)	Sediment concentration (mg/L)	Sediment discharge (Mg/d)
1	Below debris	28	1500	3.31	25	7.16
			1700	3.79	37	12.10
			1900	3.88	63	21.10
		29	1745	3.54	42	12.90
			1958	3.82	43	14.20
2	At meadows	29	1510	3.68	25	7.96
			1725	4.02	45	15.70
3	Below ponds	28	1530	3.40	17	5.00
			1700	3.43	13	3.85
			1900	3.62	17	5.33
		29	1700	3.74	12	3.88
4	Above diversion ...	28	1720	3.20	15	4.15
			1905	3.43	12	3.56
5	Main channel below	28	1510	2.57	15	3.34
	North Fork		1740	2.92	17	4.29
6	North Fork	28	1345	.50	12	.51
7	Middle Fork	27	1810	1.50	226	29.20
8	Middle Fork gullies .	27	1955	.10	31	.26

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GENERAL CREEK BASIN

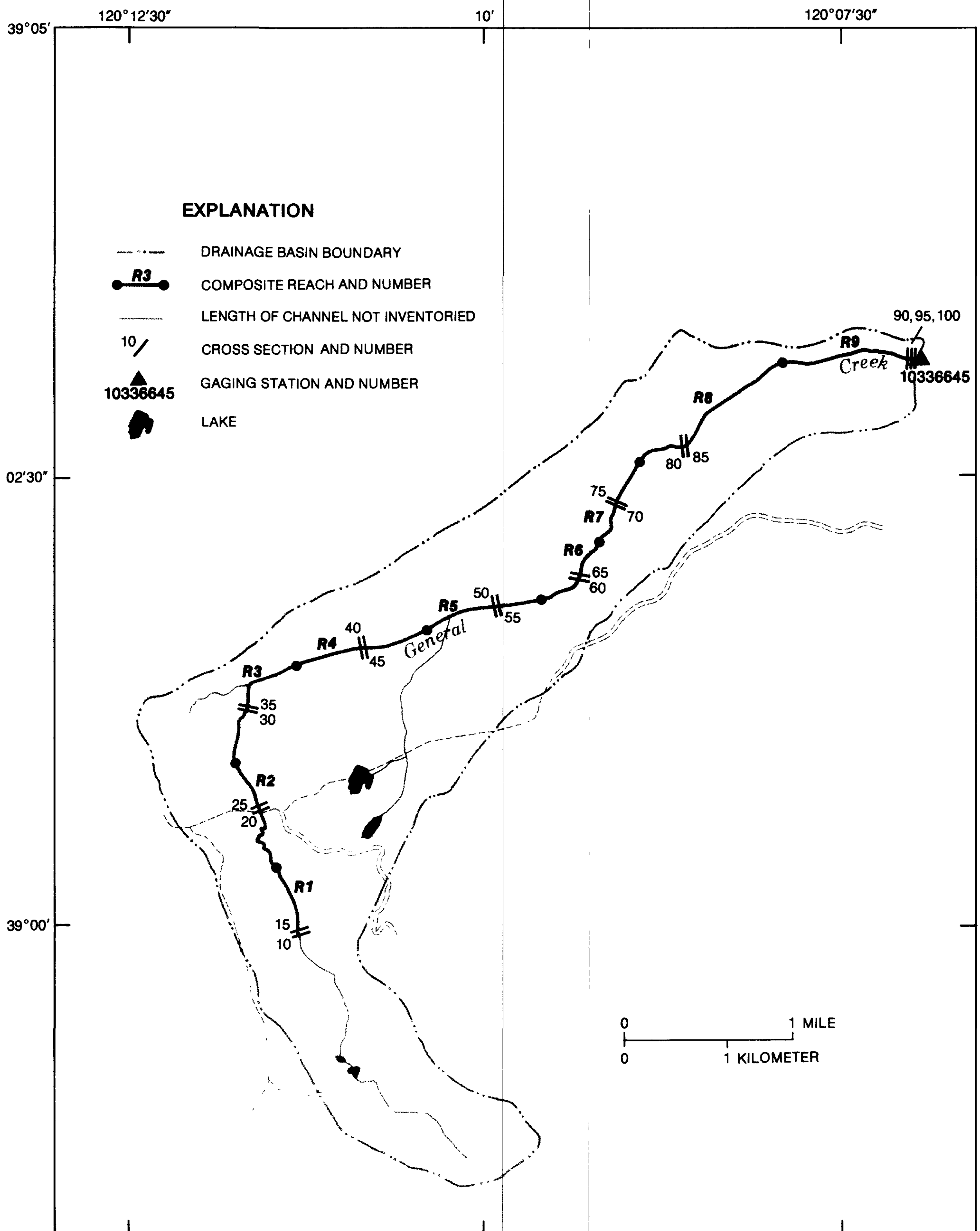

FIGURE 4. Location of composite reaches, channel cross sections, and gaging station in General Creek basin.

Table 16.—*Changes at channel cross sections, General Creek, 1983-87*

[Values represent average changes in horizontal position of left and right banks and vertical position of bed, in meters, between successive surveys made during summers of the indicated years. Positive numbers indicate bank retreat or bed scour. —, no data available]

Cross section (fig. 4)	1983-84	1984-85	1985-86	1986-87	Average annual
		Left bank			
10	—	-0.019	0.089	-0.004	0.022
15	—	.004	-.092	.024	-.021
20	-0.016	.018	—	.108	.037
25	-.049	.095	-.138	.099	.002
30	-.144	.248	—	([1])	.052
35	.112	-.054	.013	-.028	.011
40	.005	.086	-.001	-.118	-.007
45	0	-.082	—	([1])	-.041
50	.043	-.062	—	([1])	-.010
55a	.111	-.045	-.034	-.140	-.027
55b	-.079	.036	.002	-.095	-.034
60	-.022	.042	—	([1])	.010
65	.017	.046	-.013	.052	.026
70	.018	-.012	-.086	-.023	-.026
75	.024	.018	.080	-.074	.012
80	.687	—	—	([2])	.687
85	.025	.039	-.001	([2])	.021
90	-.103	.035	.078	-.030	-.005
95	.086	-.031	—	([1])	.028
100	.065	-.057	.092	-.054	.012
		Right bank			
10	—	0.005	0.003	0.016	0.008
15	—	-.067	0	-.028	-.032
20	0.129	-.285	.011	([1])	-.048
25	.051	-.185	—	([1])	-.067
30	-.142	.143	—	([1])	.001
35	-.210	.039	—	([1])	-.086
40	-.019	-.013	.040	.043	.013
45	.031	.014	.092	.019	.039
50	-.116	.044	.023	-.086	-.034
55a	-.050	.032	.034	-.049	-.008
55b	-.230	-.225	.288	-.232	-.010
60	.009	.055	-.064	-.092	-.023
65	.094	-.272	.202	.011	.009
70	.021	.023	.012	.326	.096
75	.060	-.060	-.034	.017	-.004
80	-.674	—	—	([2])	-.674
85	.098	.039	.188	([2])	.108
90	-.015	.021	.052	-.057	.002
95	.078	-.050	.048	.026	.026
100	-.082	.062	-.052	-.078	-.037

See footnotes at end of table.

Table 16.—*Changes at channel cross sections, General Creek, 1983-87*—Continued

Cross section (fig. 4)	1983-84	1984-85	1985-86	1986-87	Average annual
			Bed		
10	—	-0.047	0.072	0.005	0.010
15	—	-.010	.054	-.005	.013
20	0.036	-.013	.018	.032	.018
25	.007	-.020	.015	.015	.004
30	-.010	.064	-.090	0	-.009
35	-.012	.021	-.015	-.045	-.013
40	.016	-.012	-.014	.001	-.002
45	.003	.076	-.051	-.009	.005
50	.017	.008	-.034	-.019	-.007
55a	-.027	-.004	.023	-.014	-.005
55b	-.012	-.014	.013	-.003	-.004
60	.015	.004	.041	-.024	.009
65	-.022	-.007	.037	.003	.003
70	-.019	-.008	-.198	.008	-.054
75	-.004	.003	.021	-.006	.004
80	.082	—	—	([2])	.082
85	-.031	.002	-.075	([2])	-.035
90	.036	-.031	.002	.024	.008
95	.002	-.005	-.003	.010	.001
100	-.021	-.010	-.019	.010	-.010

[1]No bank defined.
[2]Data missing.

Table 17.—*Channel-inventory results for General Creek, 1985*

[Data include measured volumes of stored sediment and estimated areas of eroding banks, stable banks, and active channel bed. Active channel storage and bars include sediment judged potentially available for transport each year. Semiactive bars include sediment stabilized by annual vegetation and are considered potentially available for transport by mean annual peak flows. Inactive bars consist of sediment stabilized by perennial vegetation or protected by armoring and are considered available for transport only by infrequent high flows. Organic debris consists of large woody material, which blocks the flow of water and collects sediment. m, meter; m^2, square meter; m^3, cubic meter]

Composite reach (fig. 4)	Inventoried reaches (fig. 4)	Composite reach length (m)	Volume of stored sediment (m^3)				Volume of sediment stored behind organic debris (m^3)	Estimated area (m^2)		
			Active channel	Active bars	Semiactive bars	Inactive bars		Eroding banks	Stable banks	Active bed
R1	506-605	3,070	785	415	18.2	17.1	48.8	978	1,500	16,600
R2	453-505	1,350	346	88.5	2	0	24.6	117	478	7,330
R3	390-452	1,100	358	47.4	5.6	0	3.8	105	391	5,140
R4	292-389	1,240	512	402	.1	105	24.6	177	810	7,370
R5	250-291	1,100	452	528	73.7	4.43	21.3	360	540	6,420
R6	218-249	950	277	121	19.3	0	86.7	254	541	4,550
R7	112-217	1,420	207	87.2	0	0	781	553	756	6,050
R8	27-111	1,760	516	430	77.1	139	148	808	1,070	9,160
R9	1-26	800	287	293	14	0	137	664	346	4,870
Total		12,790	3,740	2,410	210	266	1,280	4,020	6,430	67,500

Table 18.—*Bulk density and percentage of particles finer than 2 millimeters intermediate grain diameter for streambank and bed samples, General Creek, 1987*

[Mg/m^3, megagram per cubic meter; mm, millimeter; --, no data available]

Cross-sectional group (fig. 4)	Bank material		Bed material	
	Bulk density (Mg/m^3)	Percentage finer than 2 mm	Bulk density (Mg/m^3)	Percentage finer than 2 mm
10, 15	0.66	96	1.49	32
20, 25	.84	97	1.05	88
30, 35	1.26	57	1.44	47
40, 45	--	17	2.31	7
50, 55	1.08	70	1.57	27
60, 65	.68	100	2.33	9
70, 75	.67	98	1.51	22
80, 85	--	66	2.19	5
90, 100	.95	98	2.01	51

Table 19.—*Pebble-count data for bed material at cross-sectional groups, General Creek, 1983-84*

[Table shows percentage of bed material in size classes and total number of points for each count. < actual value is less than value shown; > actual value is greater than value shown]

Cross-sectional group (fig. 4)	Water year	Grain size, in millimeters <0.062	0.062-2	2-4	4-8	8-16	16-32	32-64	64-128	128-256	>256	Total number of points
10, 15	1984	0	67	0	0	10	8	1	3	5	6	100
20, 25	1984	0	36	0	2	4	12	10	18	12	6	100
30, 35	1983	0	10	3	2	6	15	14	12	15	23	100
	1984	0	11	2	0	7	14	14	26	11	15	100
40, 45	1983	0	7	3	2	2	1	11	15	17	42	100
	1984	0	1	3	4	2	10	8	18	17	37	100
50, 55	1983	0	3	0	2	6	11	25	38	14	1	100
	1984	0	3	2	1	7	17	25	33	8	4	100
60, 65	1983	0	15	0	3	7	12	18	14	16	15	100
	1984	0	12	1	0	6	17	19	16	16	13	100
70, 75	1983	0	4	0	0	4	39	40	6	4	2	99
	1984	0	10	0	1	16	24	31	4	12	2	100
80, 85	1983	0	9	2	3	1	6	35	31	12	1	100
	1984	4	14	2	1	3	13	29	30	4	0	100
90, 100	1983	0	26	0	0	11	12	26	17	5	3	102

EDGEWOOD CREEK BASIN

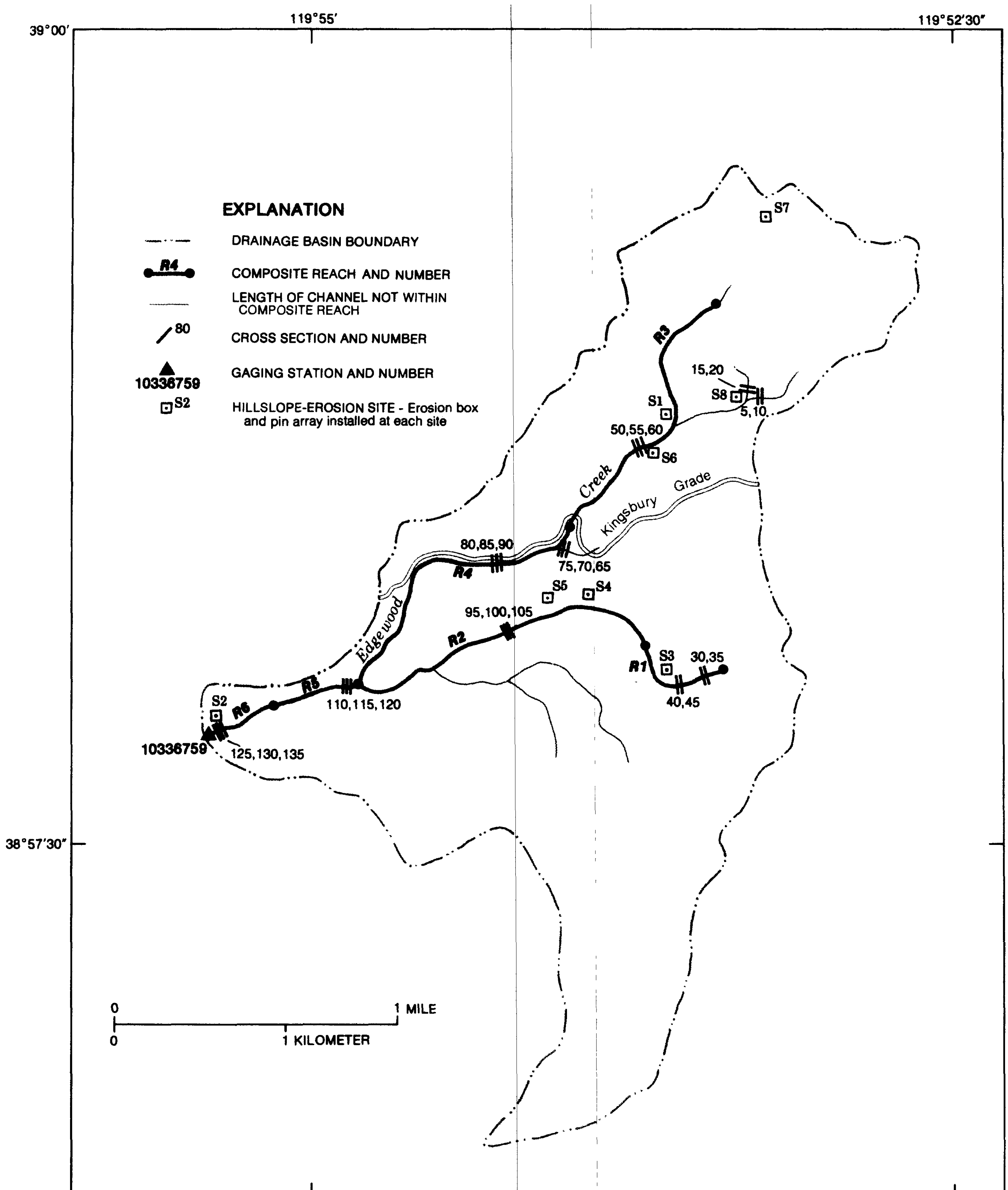

FIGURE 5. Location of composite reaches, channel cross sections, gaging station, and hillslope erosion sites in Edgewood Creek basin.

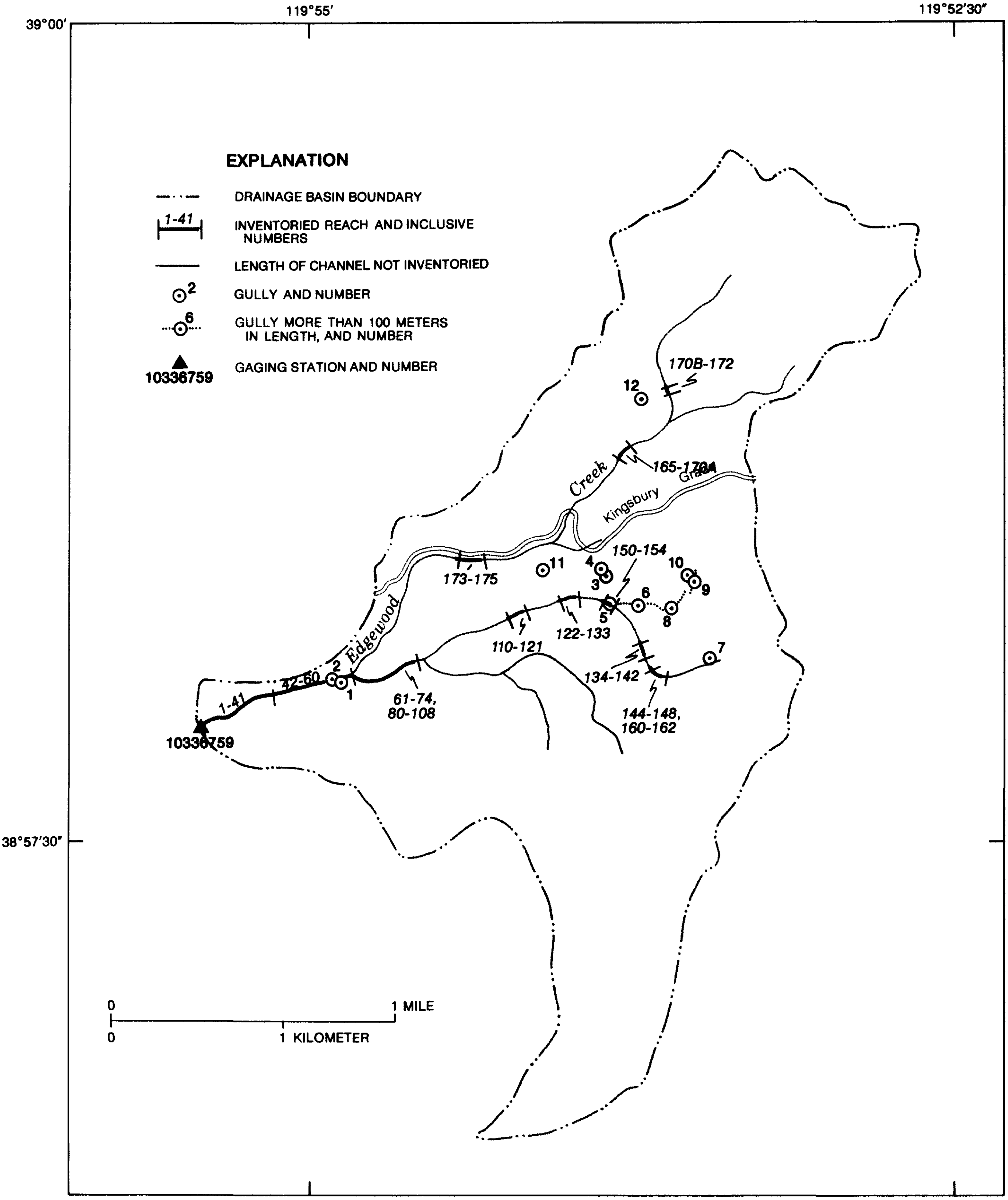

FIGURE 6. Location of inventoried reaches and gullies in Edgewood Creek basin.

Table 20.—*Changes at channel cross sections, Edgewood Creek basin, 1983-87*

[Values represent average changes in horizontal position of left and right banks and vertical position of bed, in meters, between successive surveys made during summers of the indicated years. Positive numbers indicate bank retreat or bed scour. —, no data available]

Cross section (fig. 5)	1983-84	1984-85	1985-86	1986-87	Average annual
			Left bank		
5	0.069	-0.020	-0.176	0.142	0.004
10	.286	.094	.002	.039	.105
15	.068	-.054	-.005	-.029	-.005
20	.066	-.066	-.079	.111	.008
30	-.034	.027	-.048	.067	.003
35	-.048	.037	-.018	.065	.009
40	.014	.043	.019	.014	.023
45	.058	.065	.024	.044	.048
50	.019	0	-.016	-.028	-.006
55	0	.067	-.016	-.014	.009
60	-.016	-.019	.006	.036	.002
65	.207	-.063	-.117	.157	.046
70	-.420	.050	.121	-.388	-.159
75	—	—	-.198	.152	-.023
80	.016	-.028	-.034	.030	-.004
85a	0	.036	-.045	.050	.010
85b	.056	-.286	-.034	-.101	-.091
90	-.230	-.347	.099	.051	-.107
95	0	.062	-.017	.023	.017
100	.037	.010	-.052	.033	.007
105	-.031	.058	.005	(1)	.011
110	-.064	.121	.006	.032	.024
115	.026	.006	.011	.044	.022
120	-.023	0	.039	-.041	-.006
125	.025	-.024	.024	.012	.009
130	.028	-.062	.011	.013	-.003
135	.016	.010	-.050	.031	.002
			Right bank		
5	0.024	-0.081	0.028	0.089	0.015
10	.126	-.048	.036	.008	.031
15	-.154	.044	.077	.008	-.006
20	-.127	.116	.121	-.041	.017
30	.031	-.059	.028	-.003	-.001
35	.019	-.667	.117	-.039	-.142
40	(1)	(1)	(1)	(1)	(1)
45	.068	.015	-.018	.035	.025
50	.015	.018	.078	(1)	.037
55	-.034	.090	.029	.005	.023
60	-.421	-.036	.045	.006	-.102
65	.257	-.101	.015	-.068	.026
70	.066	-.778	-.105	.436	-.095
75	—	—	.031	-.088	-.029

See footnotes at end of table.

Table 20.—*Changes at channel cross sections, Edgewood Creek basin, 1983-87*—Continued

Cross section (fig. 5)	1983-84	1984-85	1985-86	1986-87	Average annual
		Right bank—Continued			
80	-0.082	-0.032	-0.034	0.027	-0.030
85a	-.062	.033	.181	0	.038
85b	.020	-.159	-.039	-.024	-.051
90	-.023	.095	([1])	([1])	.036
95	.042	-.057	0	.035	.005
100	-.033	0	-.013	0	-.012
105	-.039	.030	-.012	-.019	-.010
110	.010	-.053	.006	-.009	-.011
115	.100	-.108	.064	-.023	.008
120	.242	.108	.027	([1])	.126
125	.018	.006	-.042	.058	.010
130	.026	.029	.008	.058	.030
135	-.038	-.010	.042	.012	.002
		Bed			
5	0.003	-0.016	-0.016	0.026	-0.001
10	-.203	-.011	.004	.004	-.051
15	-.074	.018	-.049	-.014	-.030
20	-.104	.030	-.034	-.079	-.047
30	-.007	.003	.019	.007	.005
35	.007	.049	.100	-.027	.032
40	.027	-.014	-.015	.018	.004
45	.075	-.005	.023	.002	.024
50	.034	-.006	.028	-.006	.013
55	.054	.033	.001	-.007	.020
60	-.079	-.001	.014	.011	-.014
65	.153	-.015	.029	-.043	.031
70	.309	-.070	-.070	-.020	.037
75	—	—	-.036	-.016	-.026
80	-.042	.001	.006	.002	-.008
85a	-.032	.027	.013	-.081	-.018
85b	-.027	-.032	-.031	-.005	-.024
90	-.044	-.006	.014	-.047	-.021
95	-.009	.042	.021	-.002	.013
100	-.063	.030	.013	-.002	-.005
105	.074	.054	-.027	-.024	.019
110	-.024	.021	-.002	.002	-.001
115	.043	-.033	-.005	-.115	-.028
120	-.026	-.010	.003	.006	-.007
125	-.009	-.001	-.005	-.001	-.004
130	-.054	-.047	.055	-.001	-.012
135	-.044	-.048	.090	-.060	-.015

[1]No bank defined.
[2]Data missing.

Table 21.—*Channel-inventory results for selected reaches, Edgewood Creek basin, 1986-87*

[Data include measured volumes of stored sediment and estimated areas of eroding banks, stable banks, and active channel bed. Active channel storage and bars include sediment judged to be potentially available for transport each year. Semiactive bars include sediment stabilized by annual vegetation and are considered potentially available for transport by mean annual peak flows. Inactive bars consist of sediment stabilized by perennial vegetation or protected by armoring and are considered available for transport only by infrequent high flows. Organic debris consists of large woody material, which blocks the flow of water and collects sediment. m, meter; m^2, square meter; m^3, cubic meter]

Composite reach (fig. 5)	Inventoried reaches (fig. 6)	Composite reach length (m)	Volume of stored sediment (m^3): Active channel	Active bars	Semiactive bars	Inactive bars	Volume of sediment stored behind organic debris (m^3)	Estimated area (m^2): Eroding banks	Stable banks	Active bed
R1	134-142, 144-148, 160-162	198	11.8	1.0	0.8	0	15.2	64.1	52.0	255
R2	61-74, 80-108, 110-133, 150-154	717	44.9	.7	1.8	0	65.0	253	165	947
R3	165-172	141	4.8	0	0	0	8.1	38.5	40.2	221
R4	173-175	132	6.9	.1	0	0	1.3	46.7	106	142
R5	42-60	470	84.8	.1	.6	1.0	19.8	444	210	1,250
R6	1-41	508	37.6	15.0	20.0	0	5.2	390	133	950

Table 22.—*Bulk density and percentage of particles finer than 2 millimeters intermediate grain diameter for streambank and bed samples, Edgewood Creek basin, 1987*

[Mg/m^3, megagram per cubic meter; mm, millimeter; --, no data available]

Cross-sectional group (fig. 5)	Bank material: Bulk density (Mg/m^3)	Bank material: Percentage finer than 2 mm	Bed material: Bulk density (Mg/m^3)	Bed material: Percentage finer than 2 mm
30, 35	1.01	98	1.50	70
95, 100, 105	.48	95	.81	99
50, 55, 60	.45	99	.72	93
65, 70, 75	--	--	1.11	65
80, 85, 90	.80	91	1.17	95
110, 115, 120	.69	70	--	38
125, 130, 135	.57	90	--	93

Table 23.—*Pebble-count data for bed material at cross-sectional groups, Edgewood Creek basin, 1983-84*

[Table shows percentage of bed material in size classes and total number of points for each count. < actual value is less than value shown; > actual value is greater than value shown]

Cross-sectional group (fig. 5)	Water year	Grain size, in millimeters <0.062	0.062-2	2-4	4-8	8-16	16-32	32-64	64-128	128-256	>256	Total number of points
40, 45	1983	7	48	19	13	11	2	0	0	0	0	100
	1984	11	30	12	19	26	2	0	0	0	0	100
50, 55, 60	1983	58	37	3	1	1	0	0	0	0	0	101
	1984	47	36	7	9	0	0	1	0	0	0	100
80, 85, 90	1983	9	49	13	12	7	3	6	2	0	0	101
110	1983	3	50	0	0	0	5	30	13	0	0	40
	1984	32	17	0	20	5	10	10	5	0	0	40
115	1983	0	45	0	0	0	10	13	3	17	13	40
	1984	5	28	0	3	7	13	15	7	13	10	40
120	1983	0	32	3	17	20	13	10	0	0	5	40
	1984	17	3	5	23	17	20	7	3	0	5	40
125, 130, 135	1983	0	62	2	18	11	5	1	1	0	0	100
	1984	4	43	28	23	1	1	0	0	0	0	100

Table 24.—*Erosion-pin data for hillslope sites, Edgewood Creek basin, 1984-86*

[Average altitude changes are changes in land-surface altitude, in millimeters, between successive surveys made in the summer or autumn of the indicated years. Positive numbers represent a decrease in land-surface altitude, that is, net erosion. Aspect: N, north; S, south. --, no data available]

Erosion-pin array (fig. 5)	Number of pins	Average altitude change	Standard deviation	Maximum altitude change Increase	Decrease	Aspect	Hillslope angle (degrees)	Ground cover
				1984-85				
S1	50	9	8	-8	25	S	20	Forest
S2	30	-2	11	-25	18	S	19	Forest
S3	30	6	9	-7	32	S	23	Bare
S4	30	7	7	-7	30	S	22	Forest
S5	30	10	13	-9	47	S	23	Forest
S6	30	5	9	-17	22	N	21	Forest
S7	30	2	20	-31	94	S	25	Shrub
S8	30	12	11	-18	40	--	--	--
				1985-86				
S1	50	3	9	-23	17	S	20	Forest
S2	30	-9	11	-46	13	S	19	Forest
S3	30	6	18	-21	64	S	23	Bare
S4	30	-2	12	-36	22	S	22	Forest
S5	30	1	10	-22	19	S	23	Forest
S6	30	6	18	-22	69	N	21	Forest
S7	30	29	29	-78	77	S	25	Shrub
S8	30	-2	17	-38	55	--	--	--

Table 25.—*Erosion-box data for hillslope sites, Edgewood Creek basin, 1985-88*

[Data shown are amount of soil collected in erosion boxes during indicated years, and amount consisting of soil particles finer than 2 millimeters intermediate grain diameter. Also listed are calculated rates of hillslope transport of particles finer than 2 millimeters per meter width of hillslope per annum. Percentages have been rounded. g, gram; mm, millimeter; (g/m)/a, gram per meter per annum]

Erosion-box site (fig. 5)	Total mass (g)	Percentage of particles finer than 2 mm	Mass finer than 2 mm (g)	Hillslope transport rate [(g/m)/a]
Water year 1985				
S6	3.8	88	([1])	([1])
S8	76.0	81	([1])	([1])
Water year 1986				
S3	139.6	52	72.5	238
S4a	80.8	51	41.2	135
S5	34.3	62	21.2	70
S7	49.0	83	40.7	133
S8a	9.0	87	7.8	26
S8b	6.3	95	6.0	20
Water year 1987				
S1	363.8	48	173.9	571
S2	0	([1])	0	0
S3	45.4	52	23.6	77
S4a	215.2	51	108.8	357
S4b	116.6	51	59.7	196
S5	163.7	51	85.0	279
Water year 1988				
S1	3.2	81	2.6	8.5
S3	37.2	37	13.7	44.9
S4a	213.0	57	121.4	398
S5	35.1	56	19.6	64.3
S7	499.0	79	392.1	1,290

[1]Data missing.

Table 26.—*Dimensions of gullies mapped, Edgewood Creek basin, 1987*

[m, meter; m^3, cubic meter]

Gully (fig. 6)	Length (m)	Average depth (m)	Average width (m)	Volume (m^3)
1	6.4	0.4	0.3	1
2	27.4	.5	.2	4
3	57.9	.9	.2	10
4	36.6	.9	.2	8
5	7.9	1.6	.6	7
6	79.6	2.7	.7	153
7	50.3	1.2	.3	18
8	142	1.2	.3	50
9	51.8	1.7	.5	46
10	8.8	.9	.3	2
11	14.3	2.9	.3	13
12	17.1	1.6	.3	9
Total				321

LOGAN HOUSE CREEK BASIN

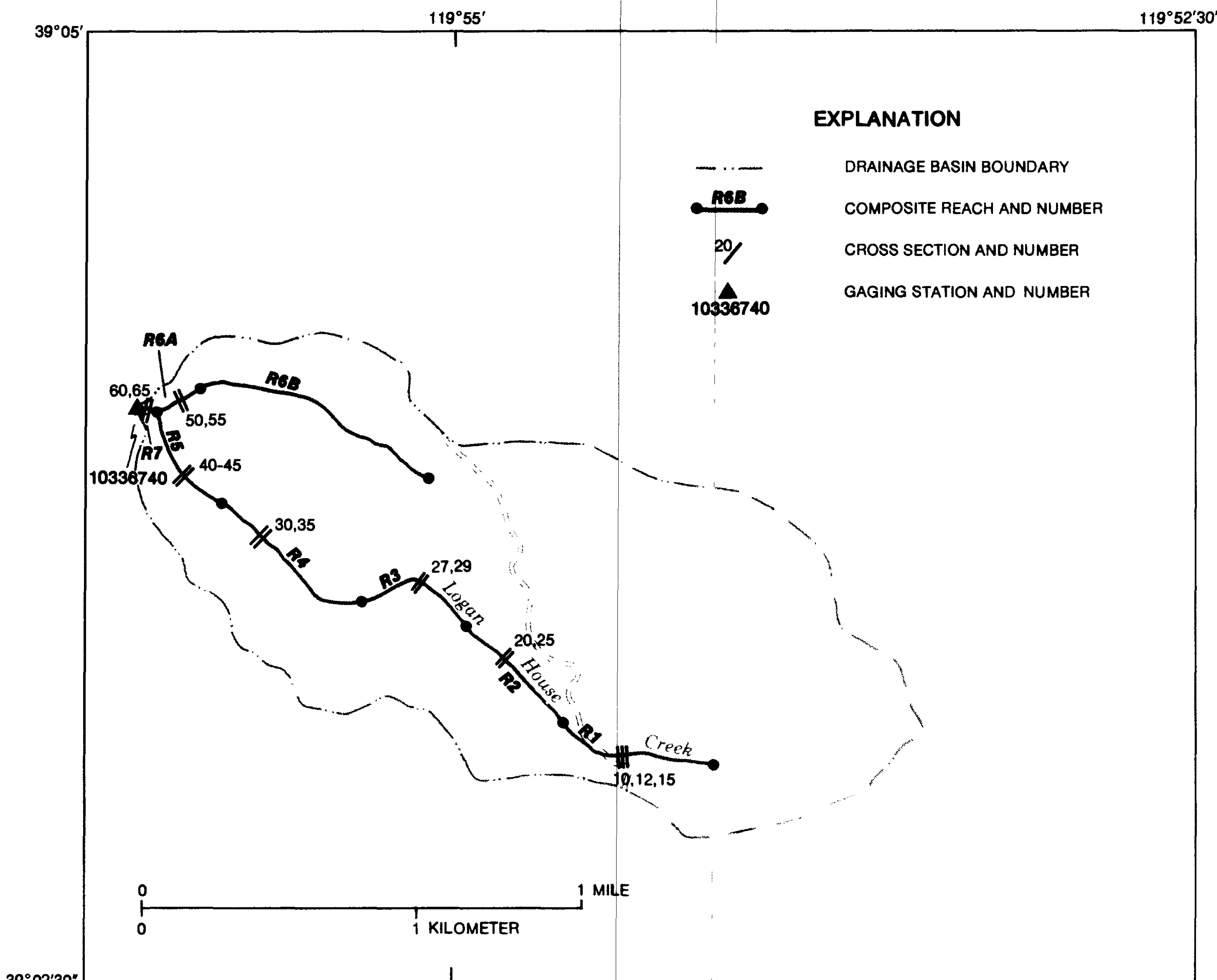

FIGURE 7. Location of composite reaches and channel cross sections in Logan House Creek basin.

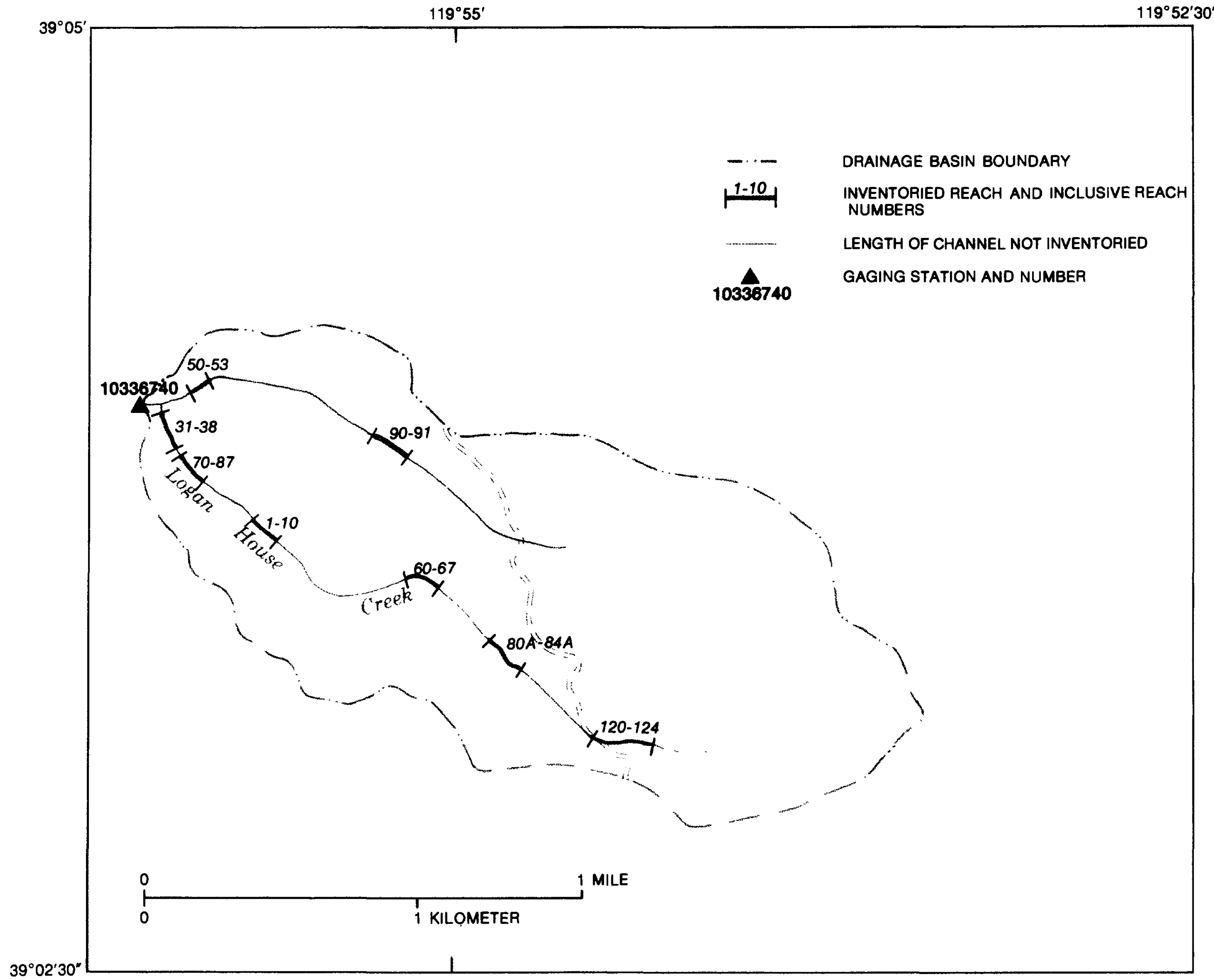

FIGURE 8. Location of inventoried reaches and gaging station in Logan House Creek basin.

Table 27.—*Changes at channel cross sections, Logan House Creek basin, 1983-87*

[Values represent average changes in horizontal position of left and right banks and vertical position of bed, in meters, between successive surveys made during summers of the indicated years. Positive numbers indicate bank retreat or bed scour. —, no data available]

Cross section (fig. 7)	1983-84	1984-85	1985-86	1986-87	Average annual
			Left bank		
10	0.005	0.005	-0.029	0.061	0.010
12	.001	-.002	-.052	0	-.013
15	0	-.001	-.020	.022	0
20	-.015	-.016	-.036	.021	-.012
25	.010	-.020	-.020	.040	.003
27	—	-.007	-.012	0	-.006
29	—	-.015	—	.007	-.004
30	-.010	-.002	-.008	.015	-.001
35	.021	-.038	-.029	.044	-.001
40	.026	-.008	-.142	.027	-.024
45	.003	.010	-.078	.051	-.004
50	-.001	.009	-.054	.261	.054
55	.008	.020	-.079	.044	-.002
60	.010	-.013	.006	-.020	-.004
65	.002	.012	-.038	.004	-.005
			Right bank		
10	-0.008	-0.011	-0.094	-0.008	-0.030
12	.003	-.020	.020	.006	.002
15	0	.001	.016	.034	.013
20	-.007	.003	-.031	-.031	-.016
25	.006	-.006	.021	-.044	-.006
27	—	-.009	.018	.008	.006
29	—	-.008	—	-.055	-.032
30	.001	.001	.012	0	.004
35	0	-.004	.042	-.014	.006
40	-.006	.002	-.019	-.130	-.038
45	-.011	-.003	-.002	0	-.004
50	.020	-.009	-.001	-.001	.002
55	-.021	-.002	.026	-.005	-.001
60	-.001	.028	.032	-.030	.007
65	.050	-.020	.017	-.038	.002

Table 27.—*Changes at channel cross sections, Logan House Creek basin, 1983-87*--Continued

Cross section (fig. 7)	1983-84	1984-85	1985-86	1986-87	Average annual
			Bed		
10	-0.001	0.044	-0.026	0.005	0.006
12	-.001	.011	.022	-.029	.001
15	-.001	-.004	-.002	-.012	-.005
20	.017	-.019	-.002	-.045	-.012
25	.069	-.077	.014	-.016	-.003
27	—	.001	-.003	-.003	-.002
29	—	-.020	—	-.018	-.019
30	-.007	-.008	.020	-.002	.001
35	-.006	.007	-.005	.010	.002
40	-.040	-.027	-.009	-.024	-.025
45	.019	-.017	-.004	.003	0
50	-.009	-.015	-.178	-.178	-.095
55	.023	.017	.048	-.013	.019
60	.019	.018	-.039	-.018	-.005

Table 28.—*Channel-inventory results for selected reaches, Logan House Creek basin, 1987*

[Data include measured volumes of stored sediment and estimated areas of eroding banks, stable banks, and active channel bed. Active channel storage and bars include sediment judged potentially available for transport each year. Semiactive bars include sediment stabilized by annual vegetation and are considered potentially available for transport by mean annual peak flows. Inactive bars consist of sediment stabilized by perennial vegetation or protected by armoring and are considered available for transport only by infrequent high flows. Organic debris consists of large woody material, which blocks the flow of water and collects sediment. m, meter; m^2, square meter; m^3, cubic meter]

Composite reach (fig. 7)	Inventoried reaches (fig. 8)	Composite reach length (m)	Volume of stored sediment (m^3)				Volume of sediment stored behind organic debris (m^3)	Estimated area (m^2)		
			Active channel	Active bars	Semiactive bars	Inactive bars		Eroding banks	Stable banks	Active bed
R1	120-124	220	1.3	0.1	0	0	1.6	68.6	21.4	170
R2	80a-84a	213	7.3	0	0	0	1.2	43.5	29.2	150
R3	60-67	203	4.5	0	0	0	8.4	50.5	53.7	197
R4	1-10	229	4.1	.3	.1	0	11.0	72.6	35.3	204
R5	70-87	279	4.2	.6	.2	0	14.0	91.7	17.0	290
R6a	50-53	106	13.3	0	0	0	9.2	79.9	58.7	115
R6b	90-91	201	7.9	1.0	4.1	0	4.8	59.1	32.4	264
R7	31-38	202	6.1	.9	0	.7	14.5	84.2	42.0	205

Table 29.—*Bulk density and percentage of particles finer than 2 millimeters intermediate grain diameter for streambank and bed samples, Logan House Creek basin, 1987*

[Mg/m^3, megagram per cubic meter; mm, millimeter; --, no data available]

Cross-sectional group (fig. 7)	Bank material		Bed material	
	Bulk density (Mg/m^3)	Percentage finer than 2 mm	Bulk density (Mg/m^3)	Percentage finer than 2 mm
10, 12, 15	0.18	89	--	22
20, 25	.21	99	1.57	54
27, 29	.17	100	1.60	40
30, 35	.34	99	1.70	35
40, 45	.15	92	1.84	25
50, 55	.96	88	1.63	24
60, 65	.80	79	1.57	37

Table 30.—*Pebble-count data for bed material at cross-sectional groups, Logan House Creek basin, 1983-84*

[Table shows percentage of bed material in size classes and total number of points for each count. < actual value is less than value shown; > actual value is greater than value shown]

Cross-sectional group (fig. 7)	Water year	Grain size, in millimeters										Total number of points
		<0.062	0.062-2	2-4	4-8	8-16	16-32	32-64	64-128	128-256	>256	
10, 12, 15	1983	0	2	3	2	6	24	30	27	6	0	100
	1984	0	0	0	0	12	33	34	19	2	0	100
20, 25	1983	18	43	6	19	13	1	0	0	0	0	100
	1984	21	52	1	7	18	1	0	0	0	0	100
27, 29	1984	0	67	3	8	8	3	4	6	1	0	100
30, 35	1983	0	2	3	14	14	22	32	11	2	0	100
	1984	4	2	6	9	23	23	29	3	1	0	100
40, 45	1983	0	4	0	2	11	12	19	31	15	6	100
	1984	4	3	3	10	15	14	14	24	8	5	100
50, 55	1983	1	12	0	2	22	31	25	8	0	0	101
	1984	0	29	2	3	15	22	22	7	0	0	100
60, 65	1983	0	7	2	9	20	18	15	18	7	4	100
	1984	1	21	4	4	11	13	20	20	3	3	100