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Roughness Characteristics of Natural Channels

By HARRY H. BARNES, JR.

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Color photographs and descriptive data for 50 stream channels for which roughness coefficients have been determined

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12–3455. Rock Creek Canal near Darby, Mont.

Gage location.—Lat 46°04′40″, long 114°12′40″, in SW¼ sec. 28, T. 4 N., R. 21 W., on downstream side of footbridge, 0.25 mile downstream from diversion dam, 1.5 miles downstream from Como Lake, and 4 miles northwest of Darby. Section 1 is about 0.25 mile upstream from gage.

Date of flood.—Sept. 23, 1948.

Gage height.—3.34 ft at gage; 15.33 ft at section 1.

Peak discharge.—138 cfs.

Computed roughness coefficient.—Manning $n = 0.060$.

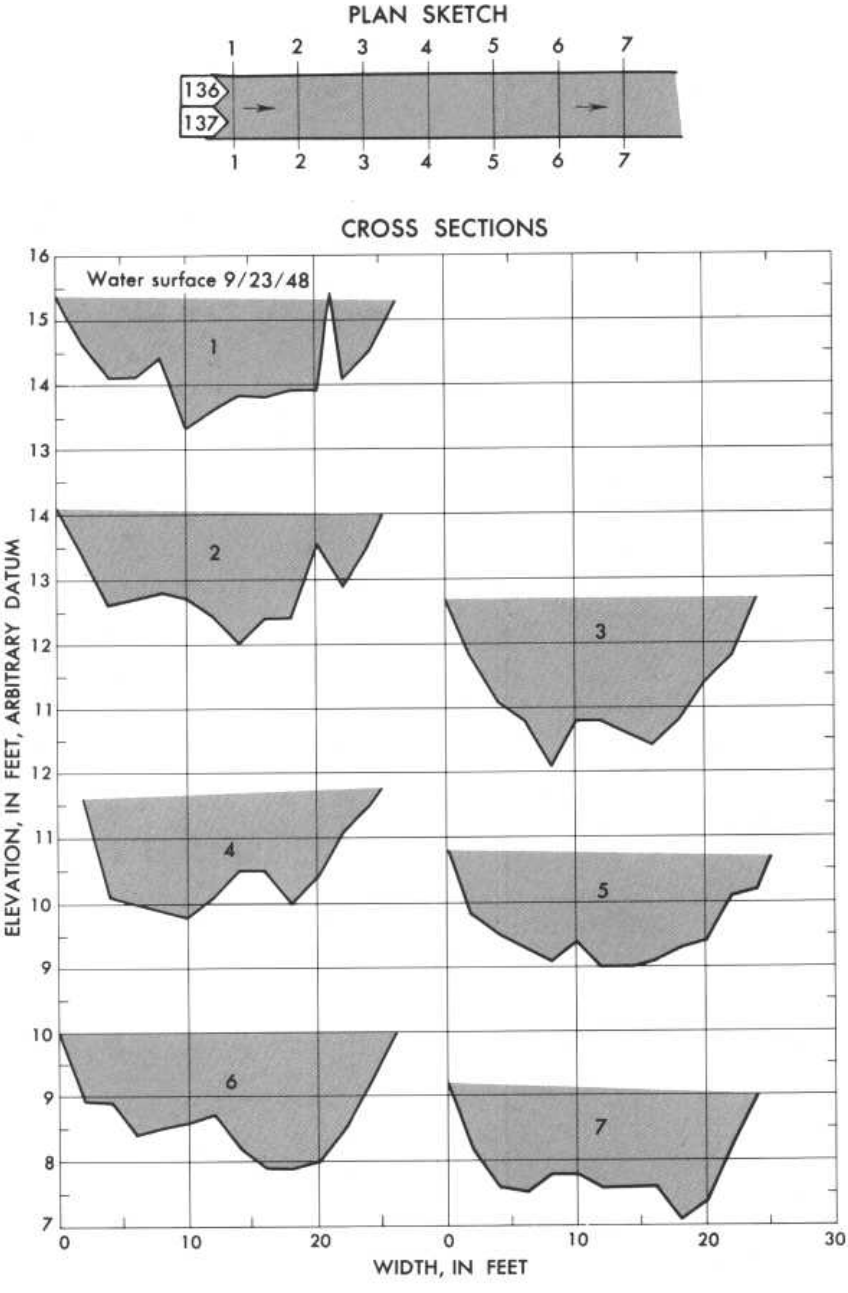
Description of channel.—Bed and bank consist of boulders; $d_{50} =$ 210 mm, $d_{84} = 375$ mm.

Reach properties

Section	Area (sq ft)	Top width (ft)	Mean depth (ft)	Hydraulic radius (ft)	Mean velocity (ft per sec)	Length (ft) between sections	Fall (ft) between sections
1	30	26	1.15	1.07	4.60	.....	.....
2	31	25	1.24	1.19	4.45	45	1.25
3	39	24	1.62	1.56	3.54	50	1.36
4	30	25	1.20	1.25	4.60	50	1.02
5	32	25	1.28	1.28	4.31	50	.93
6	37	26	1.42	1.37	3.73	50	.78
7	32	24	1.33	1.28	4.31	50	.85

Notes.—

$n = 0.060$

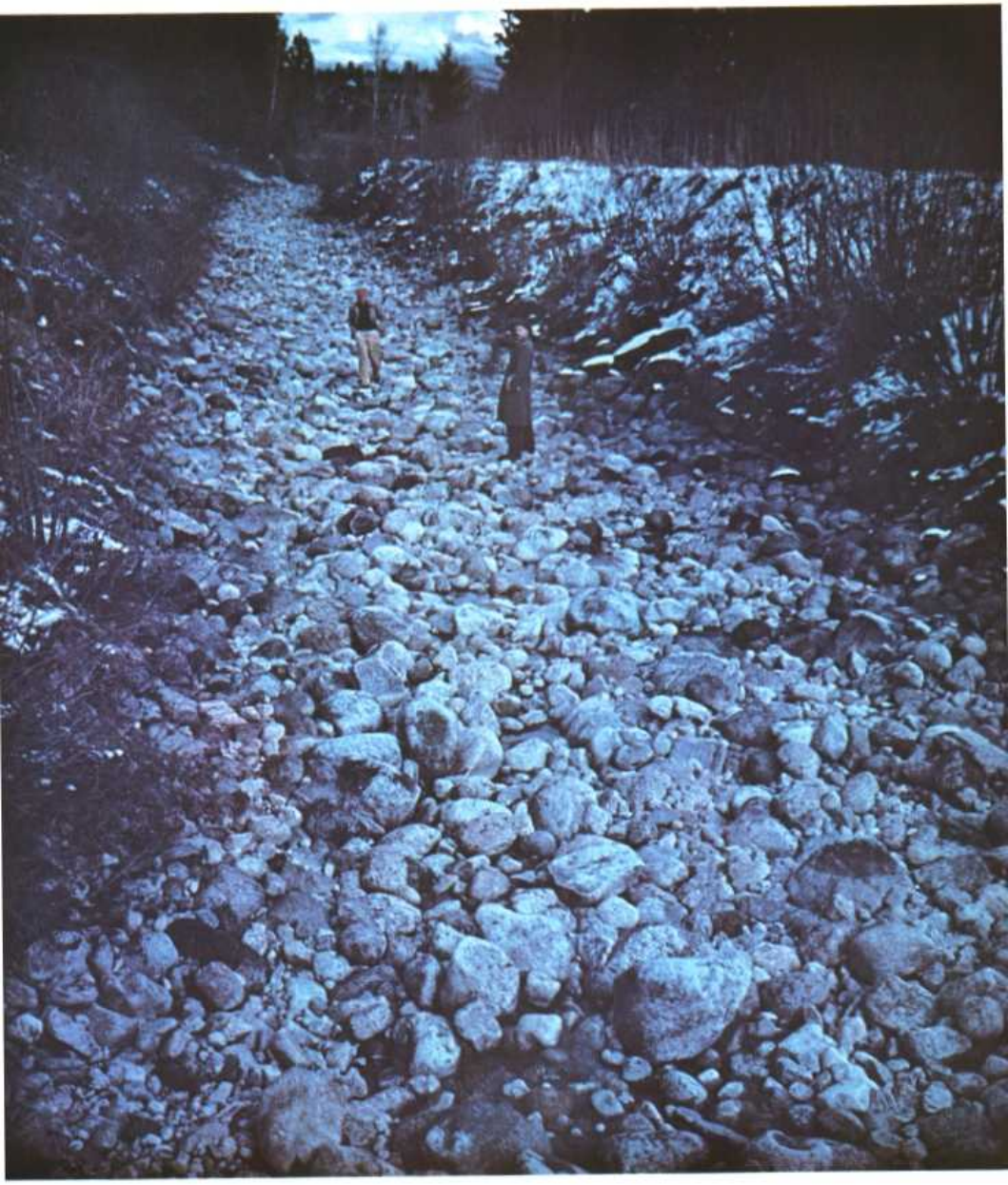


Plan sketch and cross sections, Rock Creek Canal near Darby, Mont.

$n = 0.060$

No. 136 downstream from above section 1,
Rock Creek Canal near Darby, Mont.

$n = 0.060$



No. 137 downstream from above section 1,
Rock Creek Canal near Darby, Mont.

11–2645. Merced River at Happy Isles Bridge, near Yosemite, Calif.

Gage location.—Lat 37°43′54″, long 119°33′28″, on right bank 10 ft downstream from Happy Isles Bridge, 0.4 mile downstream from Illilouette Creek, and 2 miles southeast of Yosemite National Park Headquarters, Mariposa County. Section 1 is about 1,000 ft downstream from gage.

Drainage area.—181 sq mi.

Date of flood.—May 17, 1950.

Gage height.—6.06 ft at gage; 97.40 ft (different datum) at section 1.

Peak discharge.—1,950 cfs.

Computed roughness coefficient.—Manning $n = 0.065$.

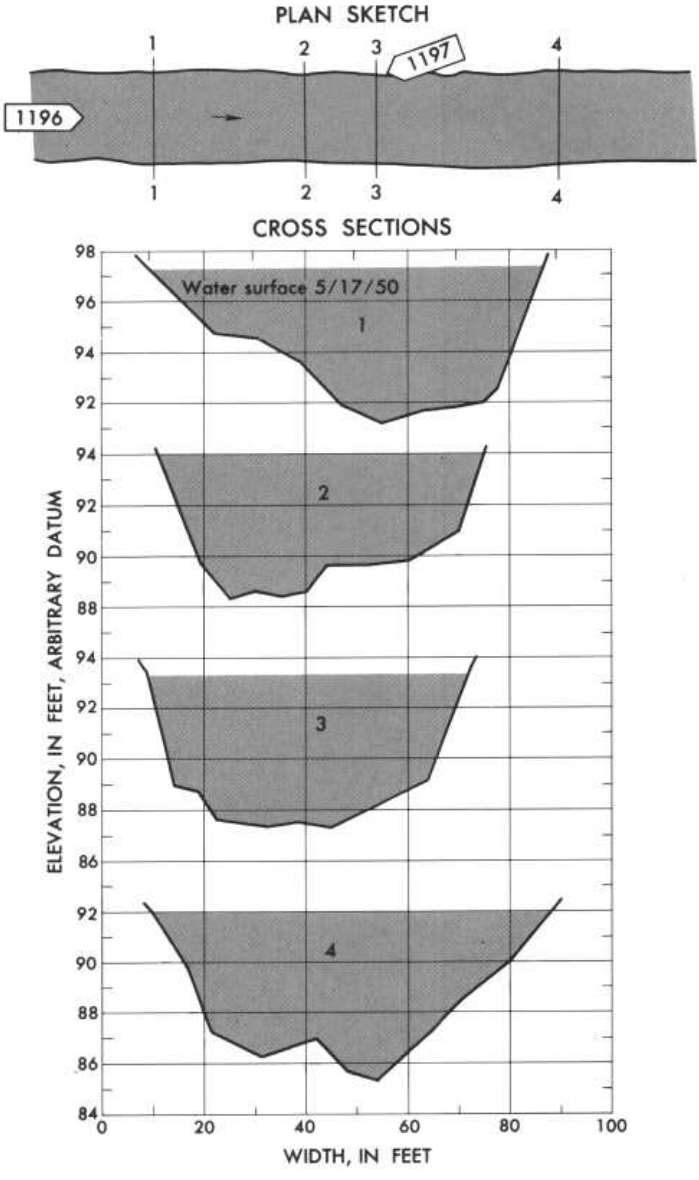
Description of channel.—Fairly straight channel is composed of boulders with trees along top of banks; $d_{50} = 253$ mm, $d_{84} = 550$ mm.

Reach properties

Section	Area (sq ft)	Top width (ft)	Mean depth (ft)	Hydraulic radius (ft)	Mean velocity (ft per sec)	Length (ft) between sections	Fall (ft) between sections
1	308	78	4.0	3.90	6.33	.....	.....
2	263	64	4.1	3.98	7.41	200	3.40
3	309	63	4.9	4.68	6.31	40	.50
4	327	78	4.2	4.09	5.96	180	1.55

Notes.—

$n = 0.065$



Plan sketch and cross sections, Merced River at Happy Isles Bridge, near Yosemite, Calif.

$n = 0.065$

No. 1196 downstream from above section 1, Merced River at Happy Isles Bridge, near Yosemite, Calif.

$n = 0.065$

No. 1197 upstream from right bank at section 3, Merced River at Happy Isles Bridge, near Yosemite, Calif.

3-3020. Pond Creek near Louisville, Ky.

Gage location.—Lat 38°07′11″, long 85°47′45″, on downstream side of bridge on Manslick Road, 0.4 mile south of Third Street Road, 0.6 mile downstream from Bee Lick Creek, and 2.4 miles south of Louisville City Limits, Jefferson County. Section 1 is about 550 ft upstream from gage.

Drainage area.—64.0 sq mi.

Date of flood.—Feb. 14, 1950.

Gage height.—15.00 ft at gage; 15.1 ft at section 1.

Peak discharge.—1,480 cfs.

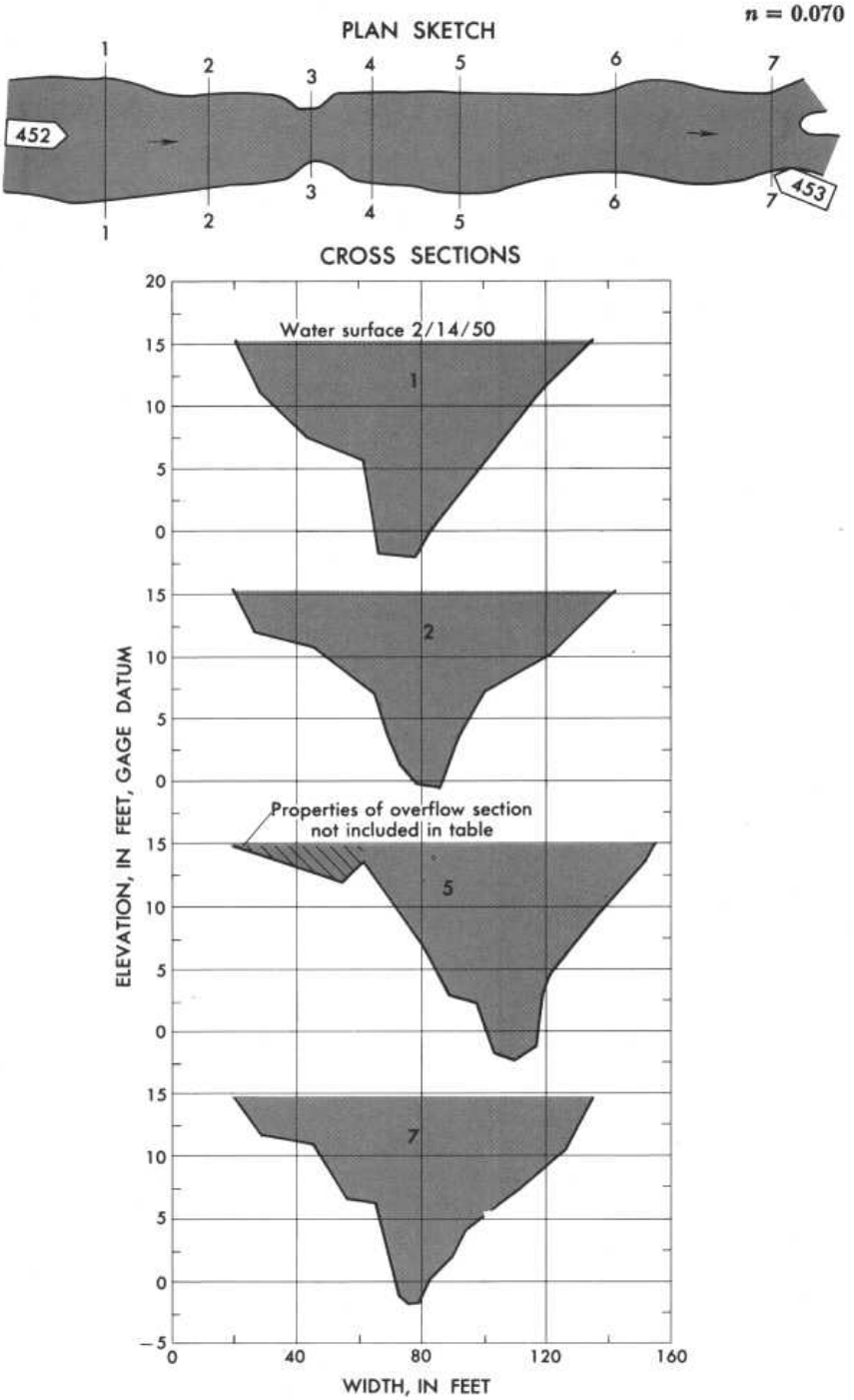
Computed roughness coefficient.—Manning $n = 0.070$.

Description of channel.—Bed is fine sand and silt. Banks are irregular with fairly heavy growth of 2- to 8-inch trees on the banks above low water, particularly on the left bank. Reach sections 1, 2, 5, 6, 7 used to determine roughness coefficient. Bridge abutments form constriction at section 3.

Reach properties

Section	Area (sq ft)	Top width (ft)	Mean depth (ft)	Hydraulic radius (ft)	Mean velocity (ft per sec)	Length (ft) between sections	Fall (ft) between sections
1	888	115	7.7	7.10	1.67	.....	.....
2	830	122	6.8	6.48	1.78	90	0.05
3	591	52	11.4	8.23	2.50	95	.10
4	837	116	7.2	6.80	1.77	45	.02
5	818	94	8.7	8.06	1.81	79	.05
6	791	107	7.4	7.00	1.87	156	.10
7	854	115	7.4	7.00	1.73	147	.07

Notes.—



Plan sketch and cross sections, Pond Creek near Louisville, Ky.

$n = 0.070$

No. 452 downstream from above section 1,
Pond Creek near Louisville, Ky.

$n = 0.070$

No. 453 upstream from right bank at section 7,
Pond Creek near Louisville, Ky.

12–3215. Boundary Creek near Porthill, Idaho

Gage location.—Lat 48°59′50″, long 116°34′05″, in SW¼ sec. 11, T. 65 N., R. 2 W., on left bank near mouth of canyon, 0.2 mile south of international boundary, and 3 miles west of Porthill. Section 1 is 413 ft upstream from gage.

Drainage area.—97 sq mi, approximately.

Date of flood.—May 28, 1948.

Gage height.—5.34 ft at gage; 13.60 ft at section 1.

Peak discharge.—2,530 cfs.

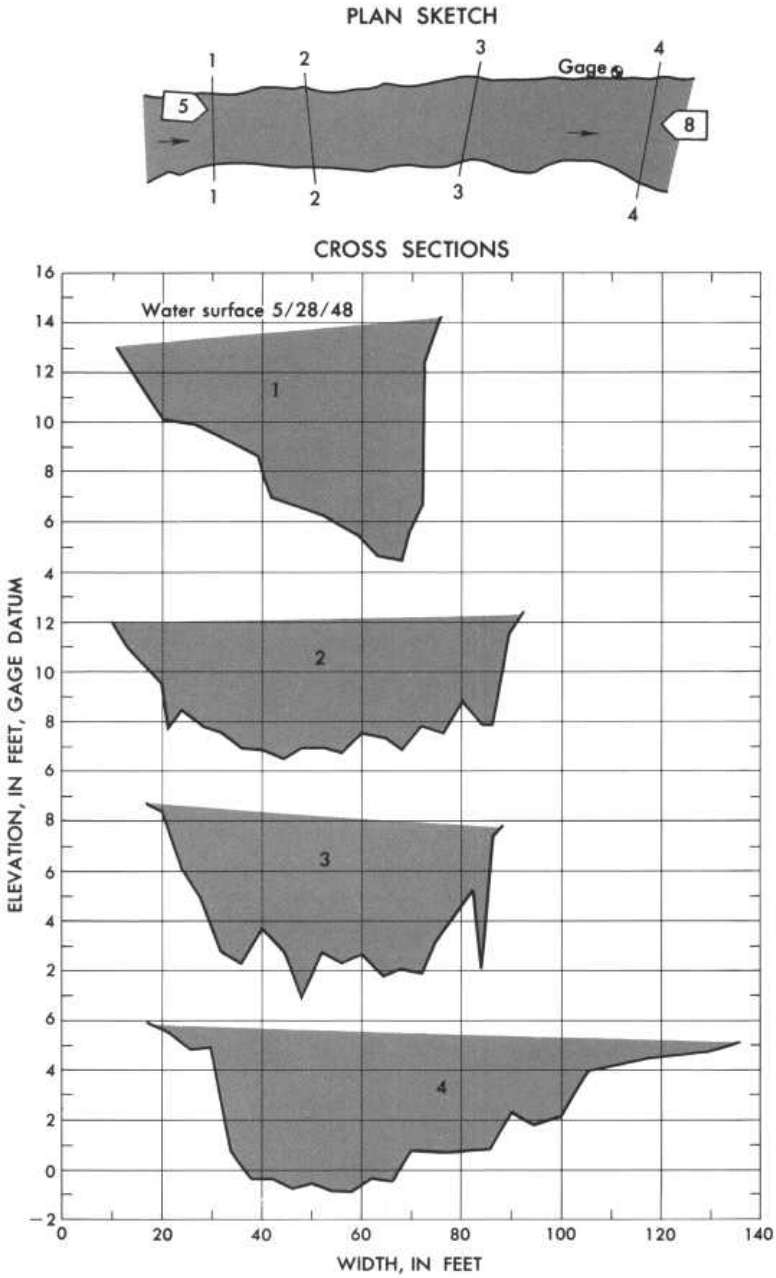
Computed roughness coefficient.—Manning $n = 0.073$.

Description of channel.—Bed consists of boulders; $d_{50} = 210$ mm, $d_{84} = 375$ mm. Banks are composed of boulders and have trees and brush along top.

Reach properties

Section	Area (sq ft)	Top width (ft)	Mean depth (ft)	Hydraulic radius (ft)	Mean velocity (ft per sec)	Length (ft) between sections	Fall (ft) between sections
1	351	64	5.48	4.87	7.21	.....	.....
2	338	82	4.12	3.93	7.49	94	1.45
3	327	71	4.61	4.09	7.74	163	3.95
4	400	118	3.39	3.30	6.32	177	2.70

Notes.—



Plan sketch and cross sections, Boundary Creek near Porthill, Idaho.

$n = 0.073$

No. 5 downstream from left bank above section 1,
Boundary Creek near Porthill, Idaho.

$n = 0.073$

No. 8 upstream from below section 4,
Boundary Creek near Porthill, Idaho.

12–3450. Rock Creek near Darby, Mont.

Gage location.—Lat 46°04′10″, long 114°13′20″, in SE¼SE¼ sec. 29, T. 4 N., R. 21 W., on left bank 0.6 mile downstream from Como Lake, 0.7 mile upstream from Rock Creek Canal, and 4 miles northwest of Darby. Section 1 is about 0.25 mile upstream from gage.

Drainage area.—55.4 sq mi.

Date of flood.—May 27, 1948.

Gage height.—5.78 ft at gage; 23.85 ft at section 1.

Peak discharge.—1,500 cfs.

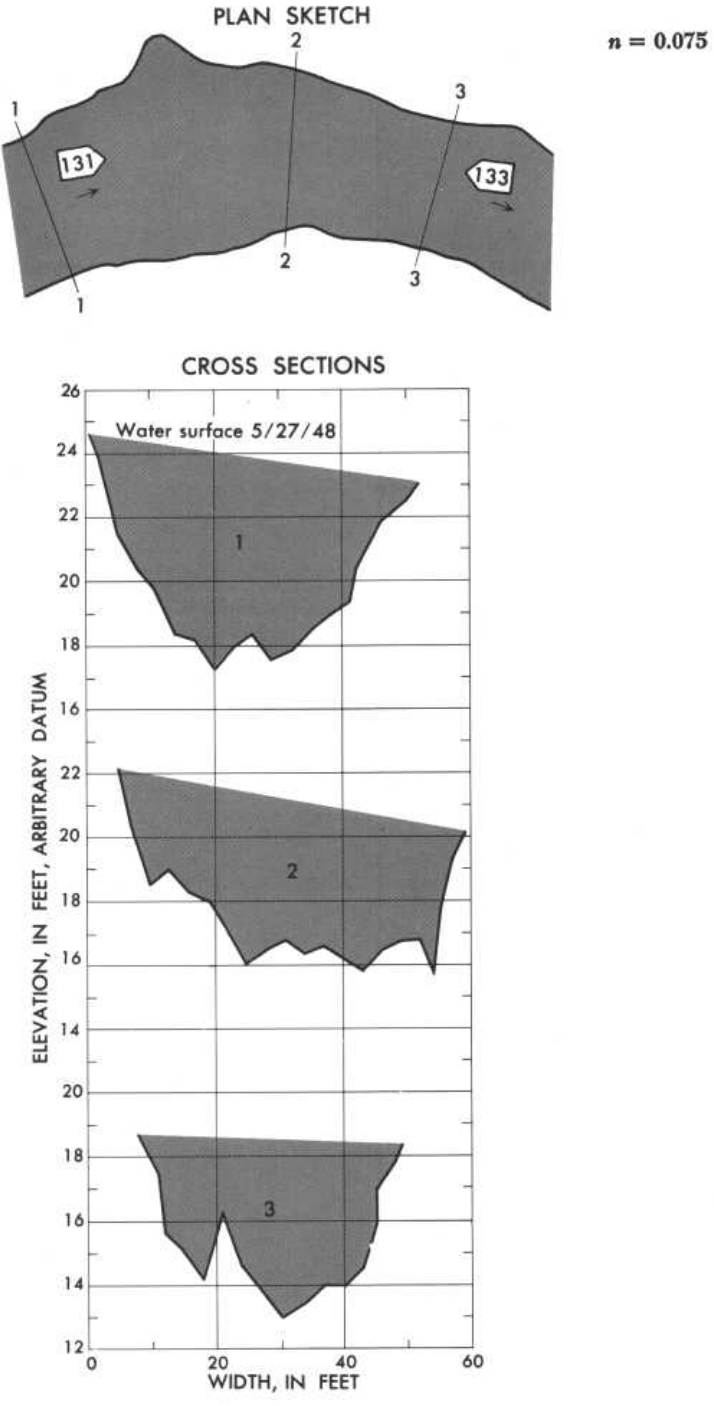
Computed roughness coefficient.—Manning $n = 0.075$.

Description of channel.—Bed consists of boulders; $d_{50} = 220$ mm, $d_{84} = 415$ mm. Banks are composed of boulders and have trees and brush.

Reach properties

Section	Area (sq ft)	Top width (ft)	Mean depth (ft)	Hydraulic radius (ft)	Mean velocity (ft per sec)	Length (ft) between sections	Fall (ft) between sections
1	214	51	4.20	3.96	7.01	.....	.....
2	203	54	3.76	3.50	7.39	79	2.65
3	134	43	3.12	2.91	11.19	47	2.45

Notes.—



Plan sketch and cross sections, Rock Creek near Darby, Mont.

$n = 0.075$

No. 131 downstream from above section 2,
Rock Creek near Darby, Mont.

$n = 0.075$

No. 133, upstream from below section 3,
Rock Creek near Darby, Mont.

SELECTED REFERENCES

Bailey, J. F., and Ray, H. A., 1966, Definition of stage-discharge relation in natural channels by step-backwater analysis: U.S. Geol. Survey Water-Supply Paper 1869–A, 24 p.

Benson, M. A., and Dalrymple, Tate, 1966, General field and office procedures for indirect discharge measurements: U.S. Geol. Survey Techniques Water-Resources Inv., book 3, chap. A1 (in press).

Bodhaine, G. L., 1966, Measurement of peak discharge at culverts by indirect methods: U.S. Geol. Survey Techniques Water-Resourves Inv., book 3, chap. A3 (in press).

Dalrymple, Tate, and Benson, M. A., 1966, Measurement of peak discharge by the slope-area method: U.S. Geol. Survey Techniques Water-Resources Inv., book 3, chap. A2 (in press).

Houk, I. E., 1918, Calculation of flow in open channels: Miami Conservancy Dist. Tech. Repts., pt. 4, 283 p.

Hulsing, Harry, 1966, Measurement of peak discharge at dams by indirect methods: U.S. Geol. Survey Techniques Water-Resources Inv., book 3, chap. A5 (in press).

Matthai, H. F., 1966, Measurement of peak discharge at width contractions by indirect methods: U.S. Geol. Survey Techniques Water-Resources Inv., book 3, chap. A4 (in press).

Ramser, C. E., 1929, Flow of water in drainage channels: U.S. Dept. Agriculture Tech. Bull. 129, 102 p.

Scobey, F. C., 1933, Flow of water in flumes: U.S. Dept. Agriculture Tech. Bull. 393, 99 p.

———1939, The flow of water in irrigation and similar canals: U.S. Dept. Agriculture Tech. Bull. 652, 79 p.

Simons, D. B., and Richardson, E. V., 1962, The effect of bed roughness on depth-discharge relations in alluvial channels: U.S. Geol. Survey Water-Supply Paper 1498–E, 26 p.

Wolman, M. G., 1954, A method of sampling coarse river-bed material: Am. Geophys. Union Trans., v. 35, p. 951.

Woodward, S. M., and Posey, C. J., 1941, Hydraulics of steady flow in open channels: John Wiley & Sons, 151 p.

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