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RUNOFF VOLUME-DURATION-PROBABILITY ANALYSES
for
SELECTED WATERSHEDS
in
ARIZONA



Prepared by the Central Technical Unit
Hydrology Branch, Soil Conservation Service
United States Department of Agriculture
(FOR IN-SERVICE USE ONLY)

April 1965

Acknowledgment

This report was prepared by the Central Technical Unit, Hydrology Branch, Engineering Division, S.C.S. for in-Service use only. The high flow summaries used for the computations were prepared and furnished by the U.S. Geological Survey under a cooperative agreement.

RUNOFF VOLUME-DURATION-PROBABILITY ANALYSES

for

SELECTED WATERSHEDS

INTRODUCTION

The volume-duration-probability (VDP) analyses relate the annual maximum 1, 3, 7, 15, 30, 60, 90, 120, 183, and 274-day streamflow from selected watersheds to a percent chance. The annual maximum streamflow data for the various durations were furnished to the SCS by the U.S. Geological Survey through a Memorandum of Understanding initiated in 1961. The Central Technical Unit, through electronic data processing (EDP), estimated the probability of the annual maximum volumes for each duration.

The main use for these analyses is to determine the proper balance between detention storage and principal spillway capacity which will pass floods through floodwater retarding structures without using the emergency spillway, on the average, more frequently than specified in SCS standards. It was initiated to assist in complying with criteria set forth in Engineering Memorandum-27 (Rev.).

The computed output data are presented in tabular form, including certain statistics which were part of the analyses, and in graphical form with the high flow runoff volume in inches plotted at each of the durations analyzed. Each graph presents this relationship for the 1 and 4 percent probabilities which are those most commonly used in the design of floodwater retarding storage. The probable maximum runoff volume in inches (for convenience indicated as 0.0 percent chance) and the 50 percent chance are also shown in contrast with the two commonly used.

Data furnished by U. S. Geological Survey

As previously mentioned, the USGS provided the annual (water year) high flow volumes for the 1, 3, 7, 15, 30, 60, 90, 120, 183 and 274-day durations for those stream gage records requested by CTU. In preparing the request for data, CTU examined published stream gage records and selected stations in accordance with the following general provisions:

1. Drainage areas were less than 1000 square miles with a few exceptions.
2. Stations were omitted which were known to have had excessive diversion or stream regulation above the gage.
3. Station records which were obviously too short to reflect a reasonable estimate were omitted.

The CTU also examined the raw input data received from USGS to establish the period of record to be analyzed. In some cases a portion of the total period of record was excluded. Diversions or other regulatory structures have been installed above some stations in recent years. Those years in which the streamflow has been regulated have been omitted from the station analysis. Such exceptions are noted under "Period of Record" or "Remarks" in the following summaries. Furthermore, a base period of record has been extracted from the total record, representing a period common to a majority of the stations for comparison. Thus the common base period is being analyzed on as many stations as practical to permit a regional analysis of stations for most any choice of grouping.

Outliers

An outlier as considered here is an event which is probably foreign to the sample being analyzed. It is assumed that in a longer period of record the event might not be designated (identified) as an outlier. It is something which is not always known for certain. The remarks on each station tabulation identifies the durations and years for which the data were judged to be outliers.

An abbreviated method for inspecting the ordered data for outliers was used for these analyses. The upper and lower portions of the curves were inspected for one or more of the ordered values. Usually, the one day was plotted for all computed and observed values in order to check the fit of the computed curve to the observed data. When this fit was questionable, other durations were plotted for comparison of trend within the family of 10 curves.

Logarithmic Normal, No. 31,376, Codex Book Company probability paper was utilized for summarizing the data, except where the above graphs indicated

the data belonged to the Log Extreme Value or other distributions. A review of the station record and the date of the outlier event will often reveal the circumstances which support a conclusion of why it is nonrepresentative of the sample.

Zero Probability

The volume for "zero probability" in the tables and charts is not the maximum probable volume. The probability distributions are truncated at selected reduced-variate values in published U-value tables. The Central Technical Unit used U-value "Tables of the Incomplete Γ -function" by Karl Pearson¹ for the zero probability in the analyses. The maximum reduced-variate value for the Pearson tables is approximately 5.250.

Computer Analyses

The analyses are made possible through the utilization of electronic data processing. The CTU used a program described in FAP for IBM 7090 equipment for processing the data. It performs all the statistical computations required for obtaining the maximum annual volume of flow at each selected percent chance for 10 durations ranging from 1 through 274-days.

The Two-Parameter Gamma distribution applied to most of the cases in computing the 0-99 percent chance events. Otherwise the Log Normal distribution was used for those cases in which the gamma statistic was greater than 51.

The data and computed events have been plotted on log normal probability paper. The Gamma distribution plots as a concave downward curve. As the gamma statistic increases the curve approaches a straight line and a Log Normal distribution.

The computer input and output are on file in the CTU office. The file data includes, in addition to that shown in the following tabulations:

1. Original input ordered data in cfs per day and identified by the year of occurrence.
2. Logarithms to base 10 of each item of the input data.

^{1/} H. M. Stationery Office, London, 1922.

Effect of Durations Restricted Within a Fixed Year and Day

The high flow input data supplied by USGS establish the maximum runoff periods on (1) a water year basis and (2) on a calendar day basis. Although it isn't practical to analyze the data in any other way than by using a fixed period for a year, such as the water year from October 1 through September 30, greater volumes would likely show up for the longer (274-, 183-day, etc.) durations if beginning and ending dates could be chosen at will for the maximum period. For example a greater 274-day volume may have occurred between July 1, 1963 and March 30, 1964 than any 274-day period eligible for selection within either the 1963 or 1964 water year.

For this reason the following summaries show a lesser amount for the longer durations, being confined to the water year, than that which might actually be experienced for any unrestricted period.

In somewhat the same manner the volumes for the 1-day duration are confined to 24 hours in a fixed clock period. In many cases a greater 24-hour volume would overlap into the daily fixed period from either the previous or the subsequent day. The 3-day, 7-day, etc. may be similarly affected but to a much lesser and rapidly diminishing degree.

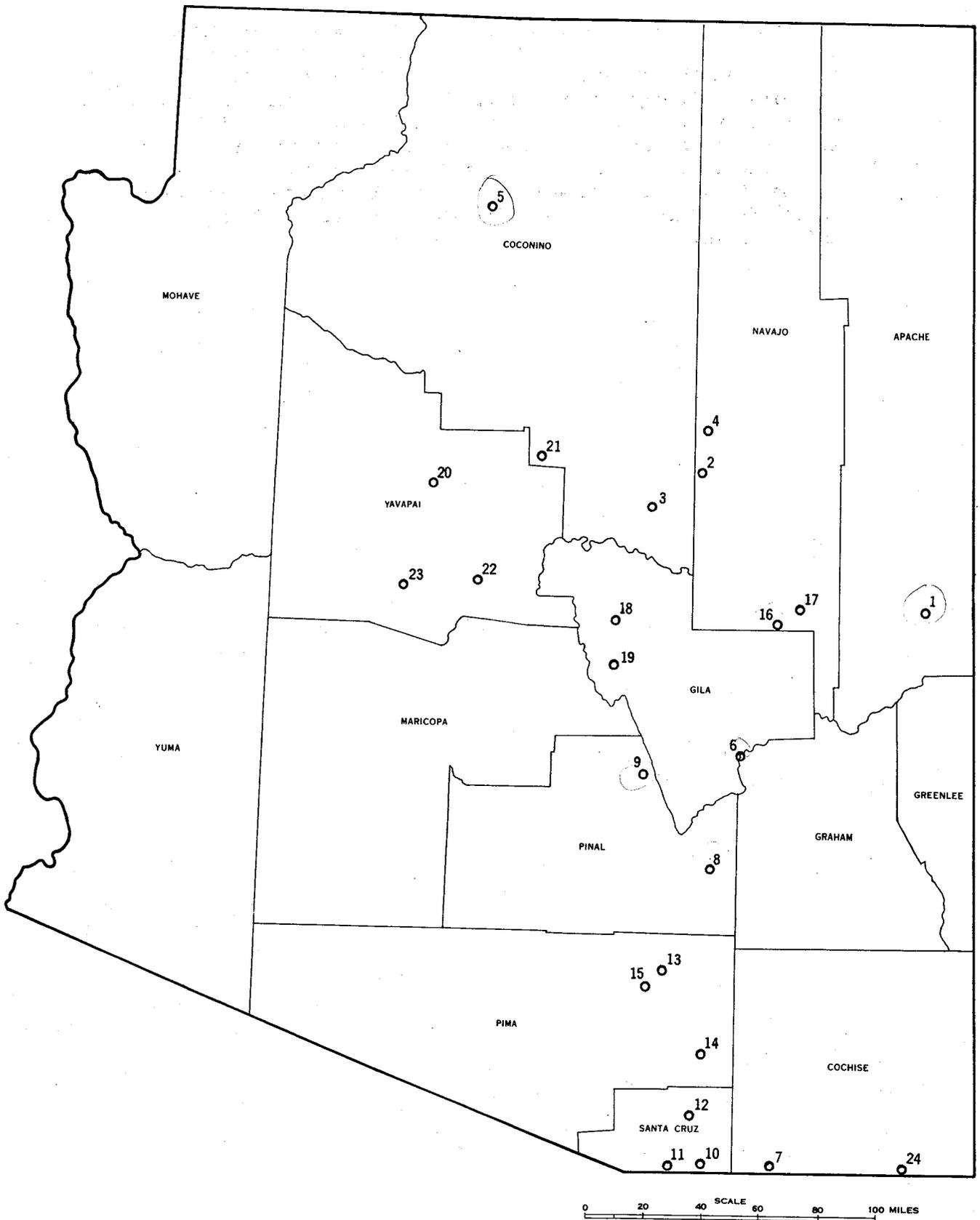
Effect of Watershed Size

The range in watershed size, from a few square miles to about 1000 square miles, prevents a direct comparison of volumes of flow. The 1-day volume summary for a 1000 square mile watershed is comparatively smaller than that for a 5 square mile watershed because of difference in runoff lag time between them. Only a fraction of the 1-day runoff from the smaller watershed is contained in the 1-day measured runoff for its larger, 1000 square mile counterpart. Its volume may be distributed between and contained as a portion of several consecutive daily measurements. The greater prevalence of partial storm coverage over the larger watersheds further complicates a comparison of volume between them. Until sometime in the distant future when adequate data are available for small watershed, empirical methods will continue to be required to transpose the measured results from large watersheds into the existing void of the small ones and for the most part are necessary in using the following summaries to plan and design small upstream water control structures.

Scope of Application

As stated in the introduction, the high flow tabulations are primarily for determining or authenticating other methods of determining the proper balance between detention storage and principal spillway capacities on flood water retarding structures. Their derivation from high flow input data almost restricts them to this primary use. Low flow and flow duration data were developed concurrently by USGS on these same stations in providing SCS with high flow data, and can be analyzed similarly to the VDP analysis to determine the probability of yield, sustained flows, etc.

ARIZONA

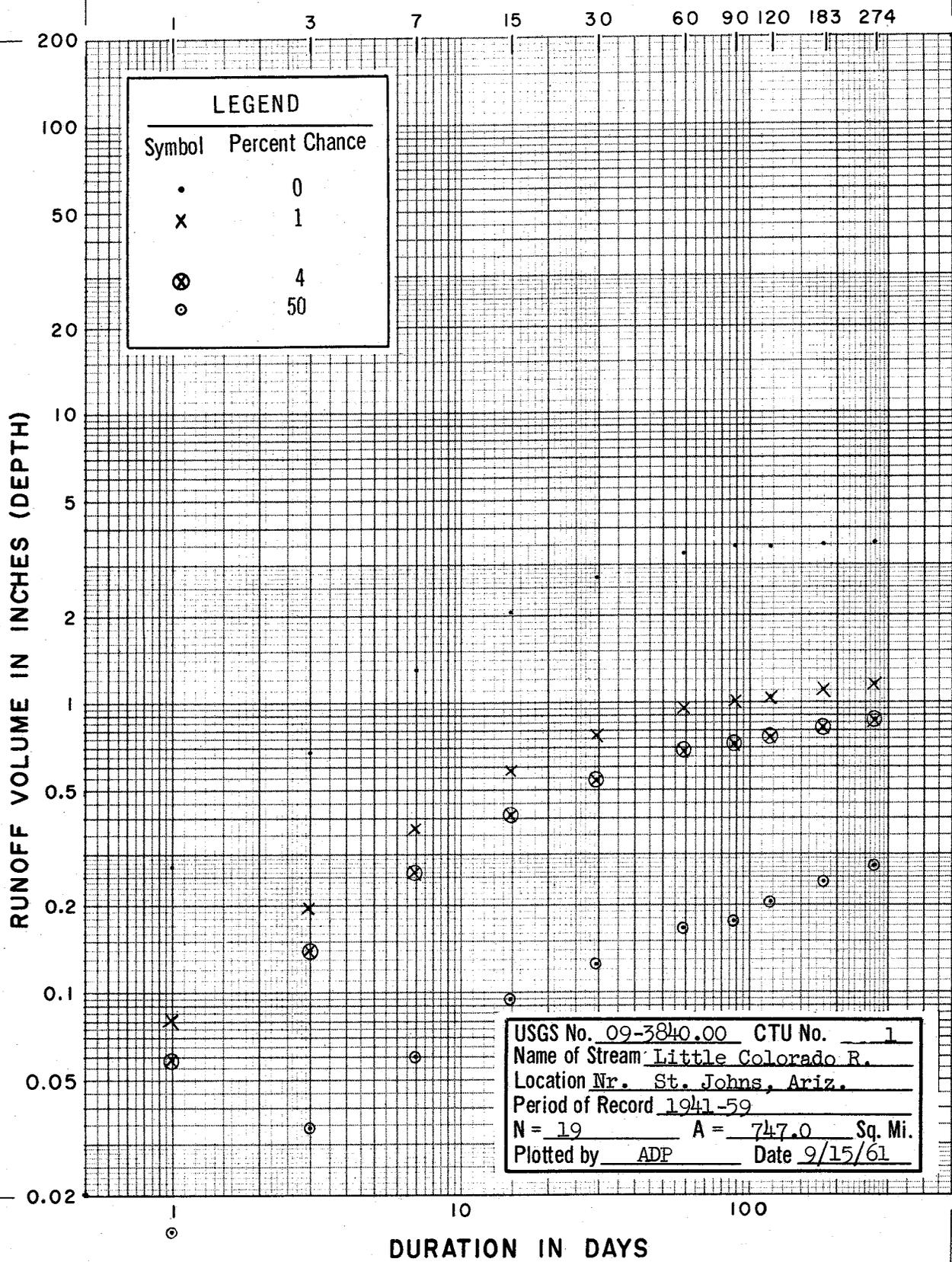


Central Technical Unit Number and Location of Stream Gages Included
in Volume - Duration - Probability Analyses

TABLE OF CONTENTS FOR SELECTED STATIONS IN ARIZONA

CTU No.	USGS No.	Drainage Area Sq. Mi.	Period of Record	Subset	Location of Stream Gage
1	09-3840.00	747.0	1941-59 ✓		Little Colorado R. nr. St. Johns
2	09-3975.00	275.0	1948-59		Chevelon Fk. below Wildcat Canyon nr. Winslow
3	09-3980.00	1010.0	1930~59*	1942-59	Chevelon Fork nr. Winslow
4	09-3985.00	321.0	1948-59		Clear Creek near Winslow
5	09-4030.00	98.4	1924-59	1942-59	Bright Angle Creek nr. Grand Canyon
6	09-4685.00	1027.0	1930~60	1942-59	San Carlos River near Peridot
7	09-4705.00	741.0	1936~60 ✓		San Pedro River at Palominas
8	09-4730.00	538.0	1920~42		Aravaipa Creek near Feldman
9	09-4785.00	144.0	1949-58		Queen Creek near Superior
10	09-4800.00	82.2	1950-60		Santa Cruz River near Lochiel
11	09-4805.00	533.0	1931~60 ✓	1942~60	Santa Cruz River near Nogales
12	09-4815.00	209.0	1931~60	1942-60	Sonoita Creek near Patagonia
13	09-4840.00	35.5	1933~60	1942~60	Sabino Creek near Tucson
14	09-4850.00	44.8	1953~60		Rincon Creek near Tucson
15	09-4860.00	918.0	1914~60	1942-60	Rillito Creek near Tucson
16	09-4943.00	237.0	1954-59		Carrizo Creek near Showlow
17	09-4945.00	57.0	1953-59		Corduroy Creek near Showlow
18	09-4990.00	675.0	1942-60 ✓		Tonto Cr. above Gun Cr. nr. Roosevelt
19	09-4995.00	841.0	1914-40 ✓		Tonto Creek near Roosevelt
20	09-5030.00	39.0	1933~47		Granite Creek near Prescott
21	09-5045.00	357.0	1941~59		Oak Creek near Cornville
22	09-5125.00	588.0	1941~60		Agua Fria River near Mayer
23	09-5155.00	417.0	1947~60		Hassayampa River near Wickenburg
24	09-5375.00	1023.0	1919-59		Whitewater Draw near Douglas

* Throughout this publication, this symbol (~) indicates a discontinuous period of record.



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

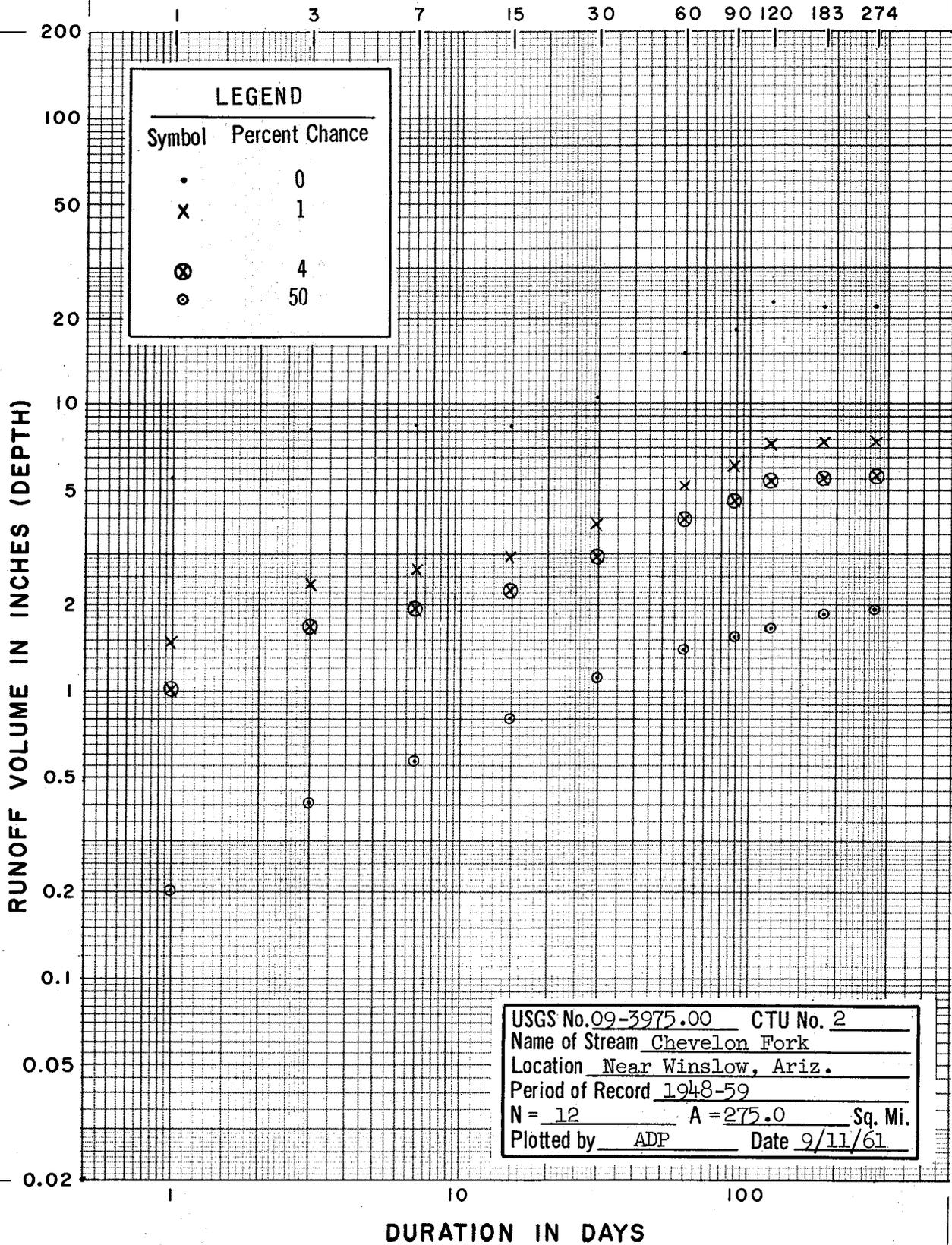
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Little Colorado River Gage Location above Lyman Res. near St. Johns, Arizona
 USGS No. 09-3840 CTU No. 1 Drainage Area 747 Sq. Mi.
 Period of Record 1941-1959 Date 9/15/61 N = 19 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	.2699	.6726	1.296	2.060	2.719	3.287	3.473	3.444	3.522	3.561
0.2	.1054	.2590	.4901	.7793	1.028	1.266	1.337	1.365	1.434	1.484
1	.0798	.1950	.3662	.5822	.7683	.9527	1.007	1.0404	1.105	1.153
2	.0688	.1673	.3127	.4971	.6560	.8173	.8636	.8995	.9613	1.010
4	.0575	.1390	.2587	.4113	.5428	.6794	.7179	.7554	.8154	.8628
10	.0425	.1018	.1873	.2978	.3930	.4975	.5257	.5637	.6174	.6620
20	.0308	.0731	.1327	.2110	.2784	.3570	.3772	.4137	.4615	.5028
50	.0148	.0339	.0595	.0945	.1248	.1658	.1752	.2044	.2401	.2725
80	.0058	.0126	.0207	.0330	.0435	.0616	.0651	.0837	.1059	.1274
95	.0018	.0036	.0052	.0083	.0110	.0174	.0183	.0279	.0390	.0507
99	.0005	.0009	.0011	.0018	.0023	.0043	.0046	.0079	.0133	.0198
Y	1.296	1.162	1.105	1.106	1.130	1.175	1.247	1.361	1.565	1.777
σ	.01520	.03926	.07561	.1202	.1569	.1907	.1955	.1930	.1902	.1855
σ/Y	.0173	.0423	.0795	.1264	.1668	.2067	.2184	.2251	.2380	.2473

Remarks:



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

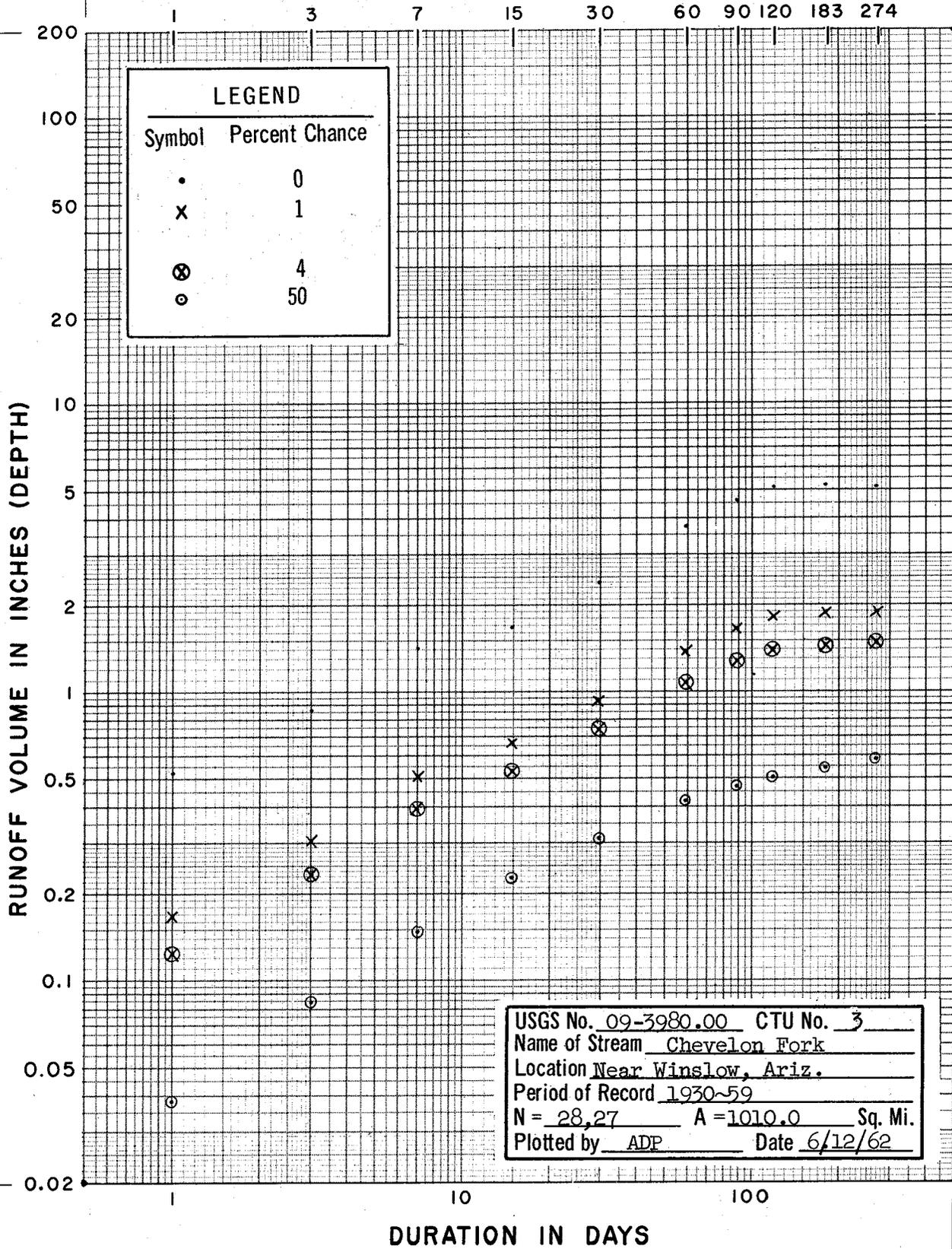
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Chevelon Fork Gage Location below Wildcat Canyon, near Winslow, Arizona
 USGS No. 09-3975 CTU No. 2 Drainage Area 275 Sq. Mi.
 Period of Record 1948-1959 Date 9/11/61 N = 12 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	5.531	8.101	8.383	8.293	10.47	15.03	18.24	22.86	21.87	21.92
0.2	2.007	3.120	3.412	3.700	4.747	6.606	7.797	9.413	9.347	9.430
1	1.473	2.348	2.629	2.934	3.800	5.221	6.116	7.285	7.332	7.428
2	1.245	2.015	2.288	2.594	3.376	4.607	5.376	6.358	6.445	6.541
4	1.017	1.675	1.940	2.246	2.943	3.980	4.620	5.415	5.539	5.636
10	.7174	1.226	1.469	1.767	2.344	3.117	3.586	4.128	4.299	4.395
20	.4930	.8799	1.098	1.383	1.858	2.428	2.760	3.112	3.308	3.403
50	.2021	.4086	.5715	.8064	1.120	1.398	1.547	1.654	1.854	1.933
80	.0591	.1518	.2520	.4215	.6134	.7171	.7596	.7517	.9106	.9714
95	.0125	.0428	.0929	.1943	.3023	.3227	.3231	.2897	.3874	.4258
99	.00192	.0107	.0317	.0879	.1452	.1425	.1355	.1065	.1624	.1829
Y	.8919	1.155	1.592	2.313	2.566	2.212	2.004	1.737	2.025	2.062
B	.3385	.4742	.4488	.4069	.4954	.7433	.9208	1.188	1.098	1.098
B√Y	.3197	.5095	.5664	.6189	.7935	1.105	1.303	1.566	1.562	1.577

Remarks: A questionable value in 1952, small Gamma, large Beta and small sample size in the 120-day duration creates non-representative values for the upper and lower parts of the computed points. A similar situation is present in the upper points of the 7-day duration.



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

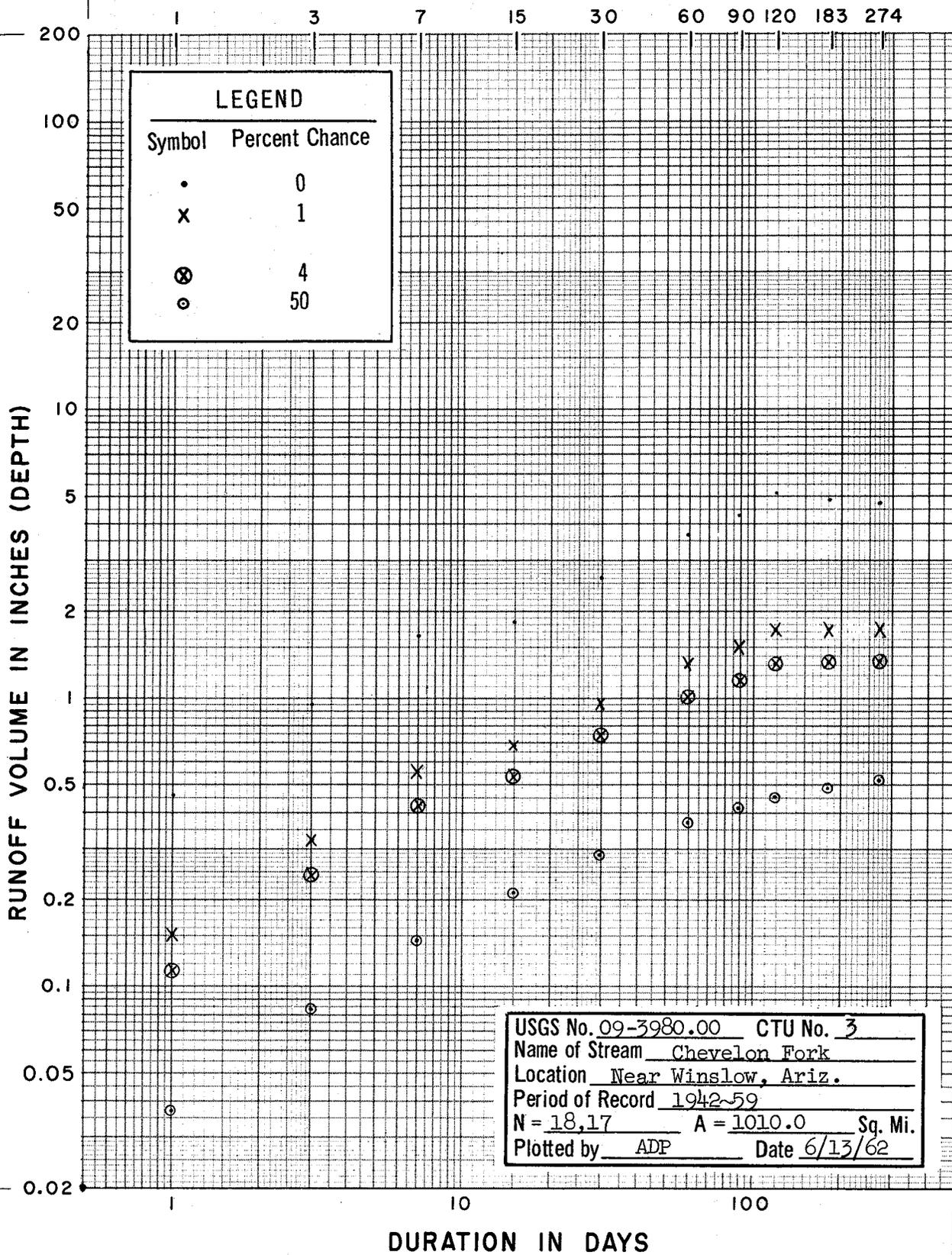
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Chevelon Fork Gage Location near Winslow, Arizona
 USGS No. 09-3980 CTU No. 3 Drainage Area 1010 Sq. Mi.
 Period of Record 1930-1959 Date 6/12/62 N = 27,28 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	.5250	.8699	1.434	1.699	2.443	3.829	4.703	5.214	5.292	5.209
0.2	.2161	.3881	.6446	.8204	1.158	1.720	2.114	2.326	2.379	2.382
1	.1673	.3078	.5145	.6711	.9437	1.405	1.682	1.845	1.899	1.917
2	.1460	.2721	.4564	.6039	.8471	1.250	1.489	1.631	1.685	1.709
4	.1243	.2356	.3969	.5342	.7471	1.091	1.293	1.412	1.465	1.495
10	.0948	.1853	.3150	.4366	.6078	.8725	1.022	1.111	1.163	1.199
20	.0714	.1451	.2487	.3559	.4927	.6942	.8034	.8696	.9180	.9574
50	.0380	.0846	.1483	.2306	.3150	.4227	.4738	.5070	.5475	.5881
80	.0173	.0442	.0801	.1386	.1861	.2344	.2518	.2650	.2956	.3300
95	.00665	.0204	.0386	.0784	.1027	.1178	.1188	.1222	.1424	.1690
99	.00245	.00922	.0182	.0442	.0564	.0579	.0548	.0553	.0672	.0847
γ	1.656	2.301	2.545	3.450	3.349	2.737	2.424	2.295	2.515	2.773
β	.02794	.04280	.06758	.07317	.1052	.1766	.2271	.2569	.2509	.2365
$\beta\sqrt{\gamma}$	.03596	.06492	.1078	.1359	.1924	.2923	.3536	.3891	.3979	.3976

Remarks: 1952 appeared as a high outlier in the 1 and 3-day durations and was omitted from these durations.
 A questionable value in 1952, small Gamma and large Beta in the 120-day duration creates non-representative values for the computed points. Similar inconsistencies are present for the 183 and 274-day durations.



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

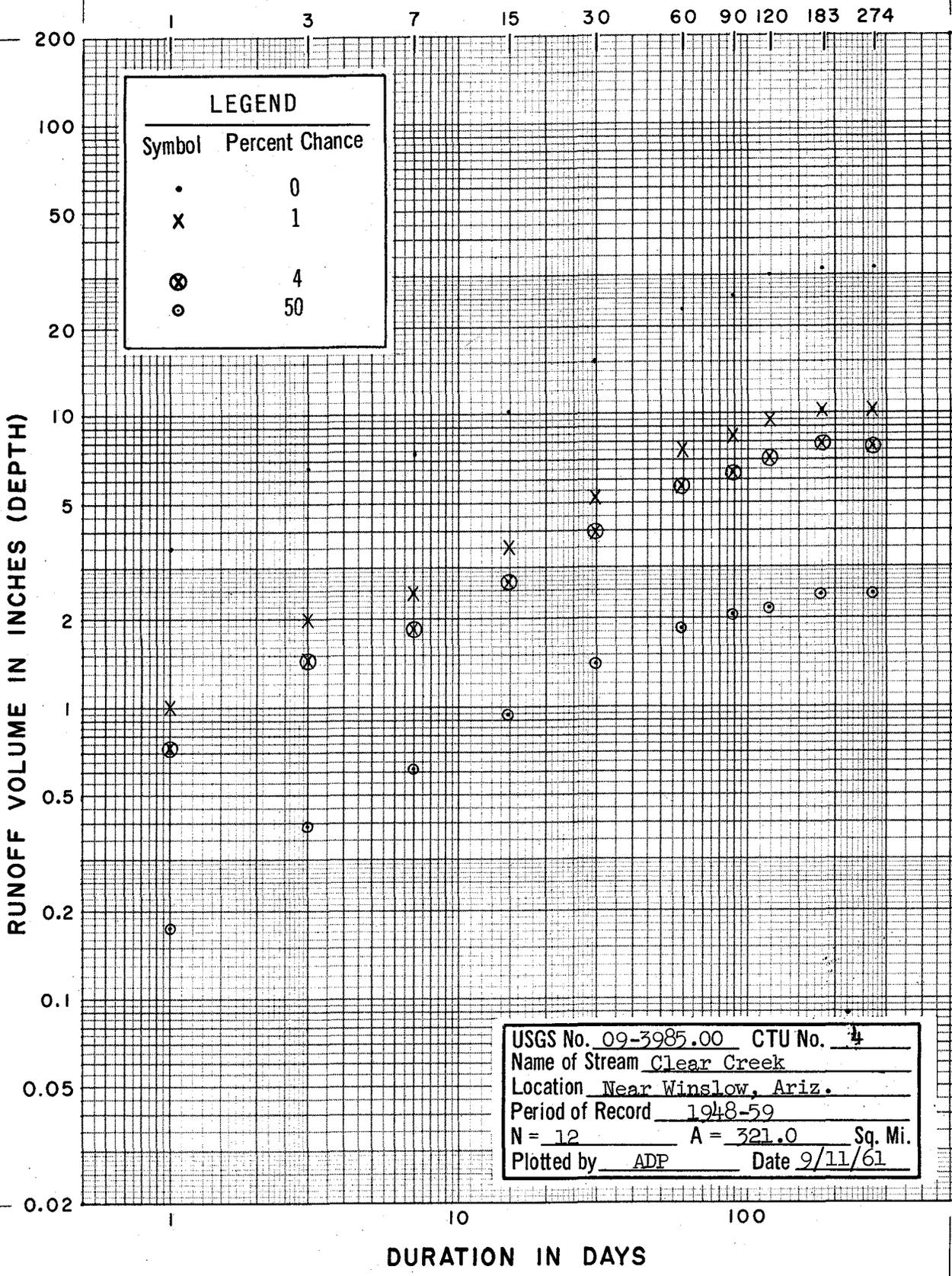
Name of Stream Chevelon Fork Gage Location near Winslow, Arizona
 USGS No. 09-3980 CTU No. 3 Drainage Area 1010 Sq. Mi.
 Period of Record 1912-1959 Date 6/13/62 N = 17,18 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	.4595	.9488	1.653	1.844	2.628	3.702	4.303	5.165	4.870	4.749
0.2	.1939	.4082	.7111	.8504	1.181	1.664	1.920	2.222	2.189	2.133
1	.1514	.3215	.5601	.6862	.9639	1.324	1.522	1.750	1.742	1.742
2	.1328	.2831	.4933	.6127	.8579	1.172	1.346	1.541	1.542	1.550
4	.1138	.2440	.4250	.5368	.7490	1.018	1.165	1.328	1.339	1.354
10	.0879	.1902	.3314	.4319	.5988	.8042	.9168	1.036	1.058	1.082
20	.0672	.1473	.2566	.3461	.4764	.6324	.7177	.8019	.8319	.8609
50	.0371	.0837	.1458	.2144	.2901	.3730	.4184	.4556	.4906	.5242
80	.0178	.0420	.0733	.1217	.1609	.1982	.2187	.2289	.2607	.2907
95	.00731	.0184	.0321	.0634	.0808	.0935	.1008	.1003	.1230	.1461
99	.00298	.00792	.0138	.0323	.0397	.0431	.0456	.0431	.0568	.0718
γ	1.884	2.068	2.144	2.943	2.741	2.422	2.255	2.055	2.411	2.702
β	.02358	.04746	.08122	.08269	.1212	.1789	.2138	.2592	.2358	.2205
$\beta\sqrt{\gamma}$	.03236	.06826	.1189	.1418	.2006	.2784	.3211	.3716	.3661	.3625

Remarks: 1952 appeared as a high outlier and was omitted from the 1 and 3-day durations.

A questionable value in 1952, small Gamma and large Beta in the 120-day duration creates non-representative values for the computed points. Similar inconsistencies are present for the 183 and 274-day durations.



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

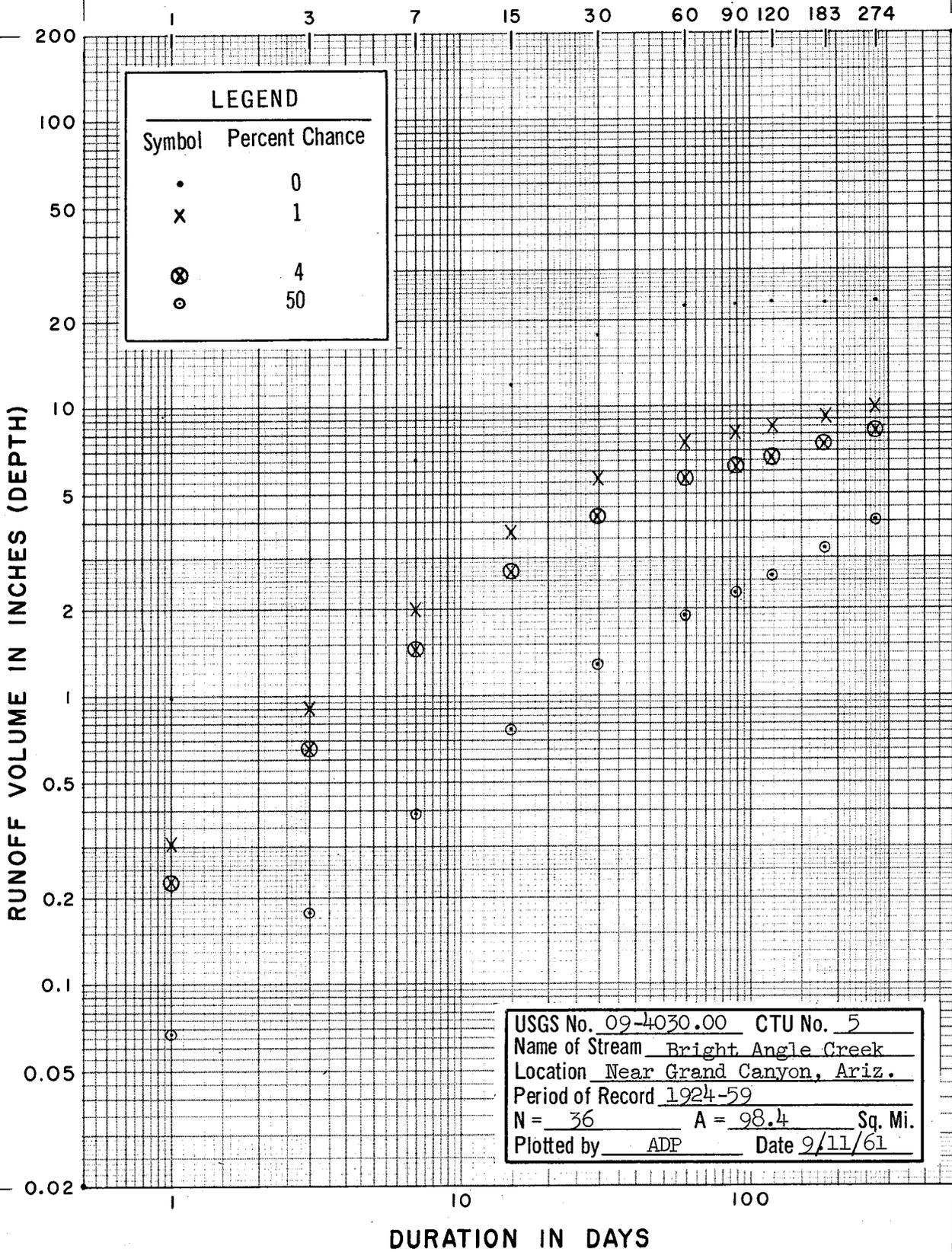
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Clear Creek Gage Location below Willow Creek near Winslow, Arizona
 USGS No. 09-3985 CTU No. 4 Drainage Area 321 Sq. Mi.
 Period of Record 1948-1959 Date 9/11/61 N = 12 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	3.460	6.588	7.287	10.18	15.18	23.02	25.59	30.11	31.75	31.91
0.2	1.333	2.611	3.115	4.476	6.671	9.711	10.80	12.39	13.23	13.30
1	1.003	1.990	2.443	3.538	5.273	7.585	8.432	9.592	10.28	10.34
2	.8604	1.721	2.148	3.122	4.653	6.653	7.395	8.372	9.001	9.046
4	.7153	1.445	1.846	2.697	4.020	5.703	6.339	7.130	7.914	7.732
10	.5238	1.078	1.432	2.112	3.148	4.401	4.892	5.435	5.903	5.932
20	.3758	.7914	1.102	1.645	2.452	3.365	3.741	4.097	4.483	4.505
50	.1745	.3910	.6178	.9472	1.412	1.858	2.065	2.177	2.430	2.442
80	.0648	.1602	.3035	.4860	.7243	.8899	.9893	.9898	1.136	1.141
95	.0183	.0534	.1291	.2186	.3259	.3663	.4073	.3815	.4520	.4543
99	.0046	.0151	.0541	.0966	.1440	.1491	.1658	.1402	.1764	.1773
Y	1.189	1.421	2.028	2.210	2.242	1.909	1.852	1.701	1.810	1.824
β	.1995	.3613	.3654	.5037	.7451	1.173	1.324	1.581	1.638	1.641
β√Y	.2176	.4306	.5205	.7488	1.116	1.621	1.802	2.062	2.205	2.216

Remarks:



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

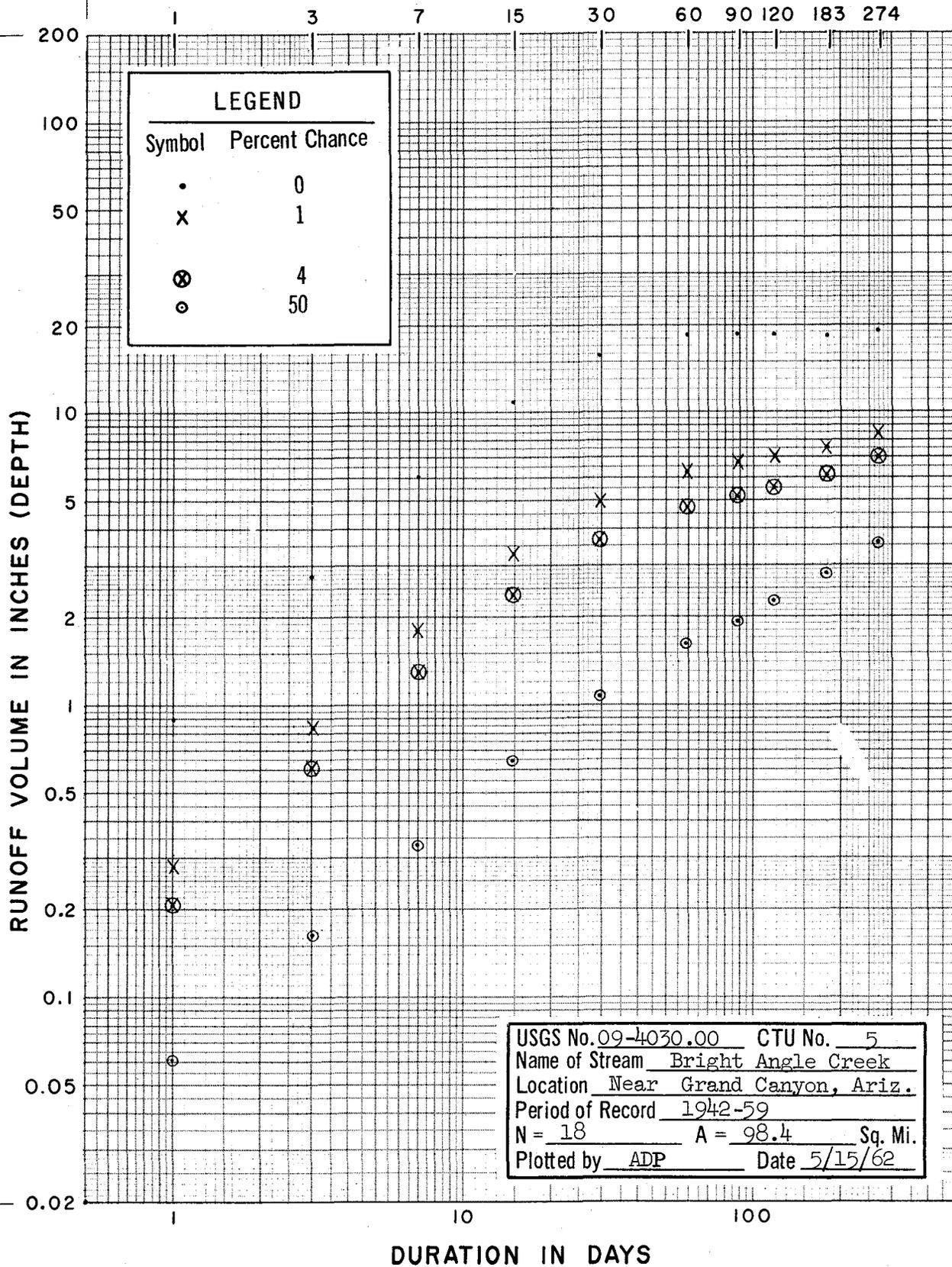
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Bright Angle Creek Gage Location near Grand Canyon, Arizona
 USGS No. 09-4030 CTU No. 5 Drainage Area 98.4 Sq. Mi.
 Period of Record 1924-1959 Date 9/11/61 N = 36 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	.9783	2.999	6.597	11.97	17.86	22.50	22.68	23.21	23.03	23.41
0.2	.3982	1.188	2.614	4.821	7.351	9.616	10.19	10.61	11.25	12.01
1	.3068	.9059	1.993	3.696	5.689	7.543	8.111	8.545	9.238	9.882
2	.2670	.7832	1.723	3.206	4.965	6.630	7.181	7.616	8.331	9.195
4	.2265	.6578	1.447	2.707	4.229	5.698	6.233	6.663	7.389	8.272
10	.1715	.4908	1.080	2.035	3.224	4.422	4.926	5.343	6.068	6.962
20	.1282	.3602	.7925	1.509	2.430	3.404	3.874	4.267	4.970	5.861
50	.0667	.1780	.3915	.7663	1.291	1.908	2.285	2.621	3.259	4.087
80	.0294	.0729	.1604	.3265	.5870	.9369	1.214	1.471	1.992	2.715
95	.0108	.0243	.0535	.1149	.2263	.3985	.5729	.7531	1.150	1.738
99	.0037	.0069	.0151	.0351	.0832	.1671	.2643	.3774	.6633	1.128
γ	1.572	1.426	1.404	1.472	1.667	2.025	2.428	2.827	3.730	5.116
β	.05271	.1641	.3639	.6579	.9473	1.129	1.095	1.054	.9620	.8558
$\beta\sqrt{\gamma}$	.0661	.1960	.4312	.7982	1.223	1.607	1.705	1.772	1.858	1.935

Remarks: Durations greater than the 90-day are non-representative for the upper part of the computed points.



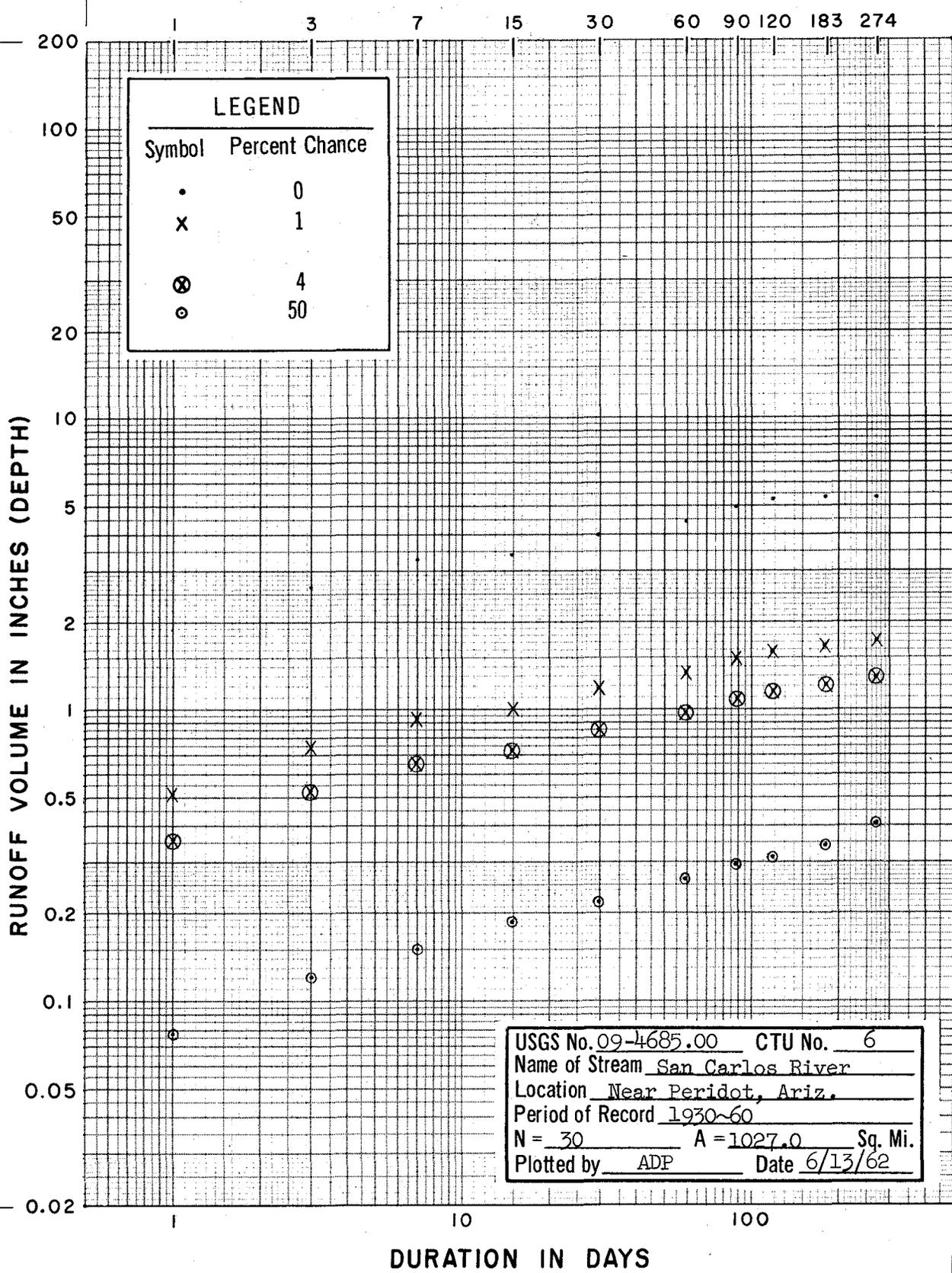
VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Bright Angle Creek Gage Location near Grand Canyon, Arizona
 USGS No. 09-4030 CTU No. 5 Drainage Area 98.4 Sq. Mi.
 Period of Record 1942-1959 Date 5/15/62 N = 18 Years

% Probability (Greater than)	Runoff Volume in Inches (Depth)									
	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	.8871	2.767	6.092	10.92	15.94	18.62	18.80	18.70	18.55	19.31
0.2	.3611	1.096	2.378	4.327	6.490	8.009	8.452	8.711	9.206	10.05
1	.2782	.8359	1.802	3.299	5.000	6.308	6.746	7.064	7.623	8.491
2	.2421	.7227	1.552	2.852	4.351	5.555	5.984	6.325	6.910	7.781
4	.2054	.6069	1.297	2.395	3.691	4.787	5.204	5.560	6.165	7.037
10	.1555	.4528	.9594	1.787	2.795	3.733	4.130	4.499	5.114	5.978
20	.1162	.3324	.6962	1.312	2.089	2.890	3.260	3.626	4.237	5.083
50	.0605	.1642	.3343	.6481	1.087	1.642	1.945	2.284	2.850	3.624
80	.0267	.0673	.1308	.2655	.4794	.8250	1.050	1.324	1.805	2.477
95	.00983	.0224	.0406	.0885	.1767	.3616	.5060	.7119	1.089	1.640
99	.00336	.00633	.0109	.0250	.0603	.1554	.2388	.3770	.6604	1.106
Y	1.575	1.359	1.340	1.412	1.609	2.070	2.547	3.059	4.194	5.784
B	.04774	.1551	.3373	.6008	.8495	.9307	.8855	.8290	.7364	.6636
B \sqrt{Y}	.05994	.1808	.3905	.7137	1.077	1.339	1.413	1.450	1.508	1.596

Remarks: Durations greater than the 90-day are non-representative for the upper part of the computed points.



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

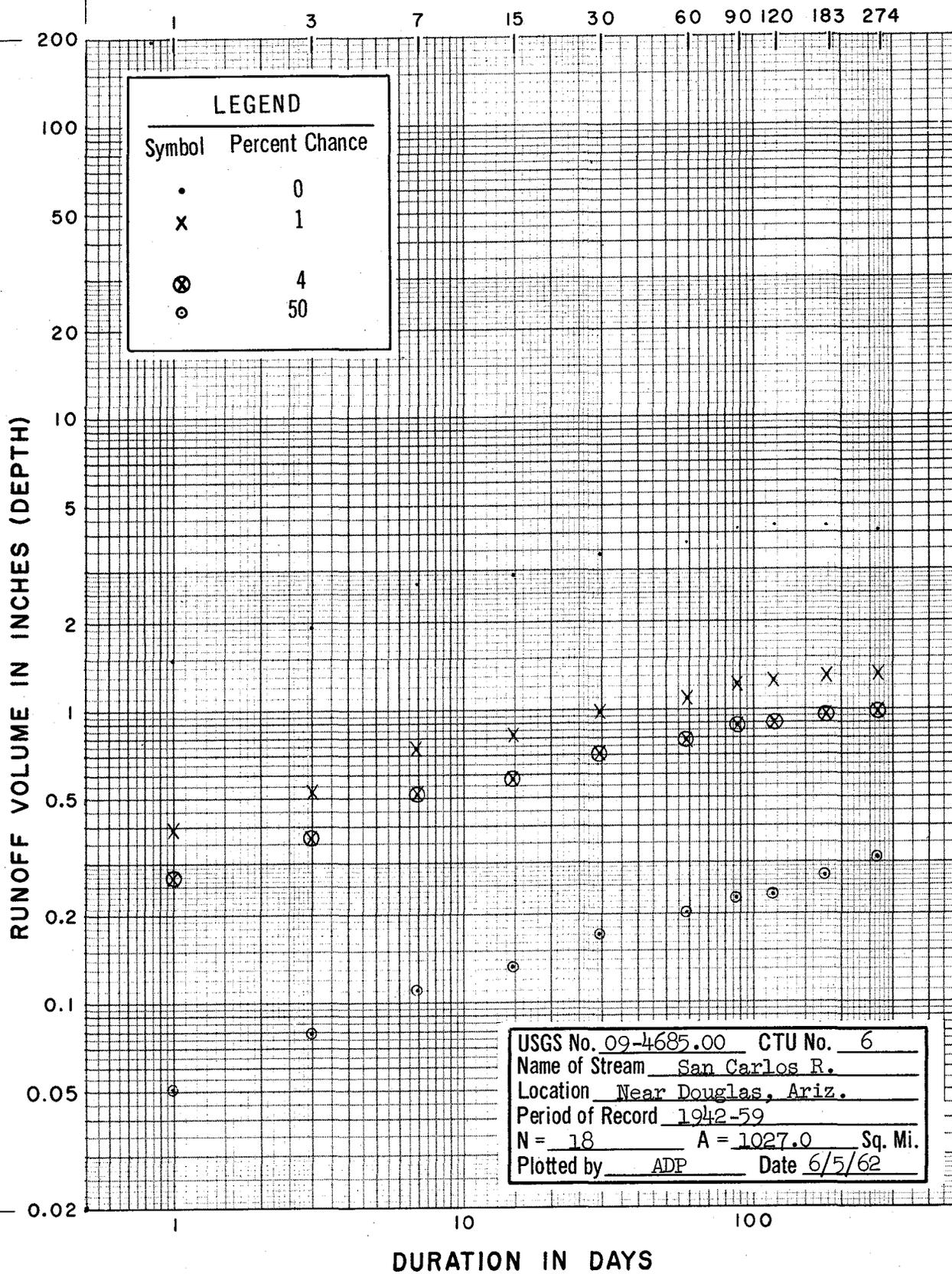
Name of Stream San Carlos River Gage Location near Peridot, Arizona
 USGS No. 09-4685 CTU No. 6 Drainage Area 1027 Sq. Mi.
 Period of Record 1930-1960 Date 6/13/62 N = 30 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	1.863	2.631	3.264	3.386	3.965	4.406	4.933	5.213	5.314	5.281
0.2	.6853	.9951	1.235	1.322	1.548	1.746	1.955	2.066	2.140	2.201
1	.5078	.7434	.9224	1.002	1.173	1.331	1.490	1.575	1.641	1.711
2	.4315	.6348	.7876	.8629	1.010	1.151	1.288	1.362	1.423	1.497
4	.3551	.5252	.6516	.7209	.8441	.9665	1.082	1.144	1.201	1.280
10	.2539	.3803	.4718	.5333	.6245	.7212	.8074	.8532	.9034	.9818
20	.1775	.2694	.3342	.3870	.4532	.5294	.5926	.6263	.6696	.7456
50	.0764	.1207	.1498	.1858	.2176	.2615	.2928	.3094	.3401	.4042
80	.0246	.0421	.0523	.0727	.0851	.1071	.1199	.1268	.1449	.1889
95	.00573	.0107	.0132	.0226	.0264	.0357	.0400	.0423	.0510	.0752
99	.00110	.00226	.00280	.00608	.00712	.0101	.0113	.0119	.0156	.0293
Y	.9935	1.081	1.115	1.252	1.304	1.399	1.362	1.360	1.520	1.787
B	.1106	.1552	.1896	.1940	.2225	.2435	.2763	.2922	.2874	.2743
B/Y	.1103	.1614	.2003	.2171	.2542	.2880	.3224	.3407	.3543	.3668

Remarks: 1941 appeared as a high outlier and was omitted from all durations.

Low Gamma and a high Beta in the 120-day duration leads to non-representative values in the upper part of the computed points. Similar inconsistencies are present in the 183 and 274-day durations.



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

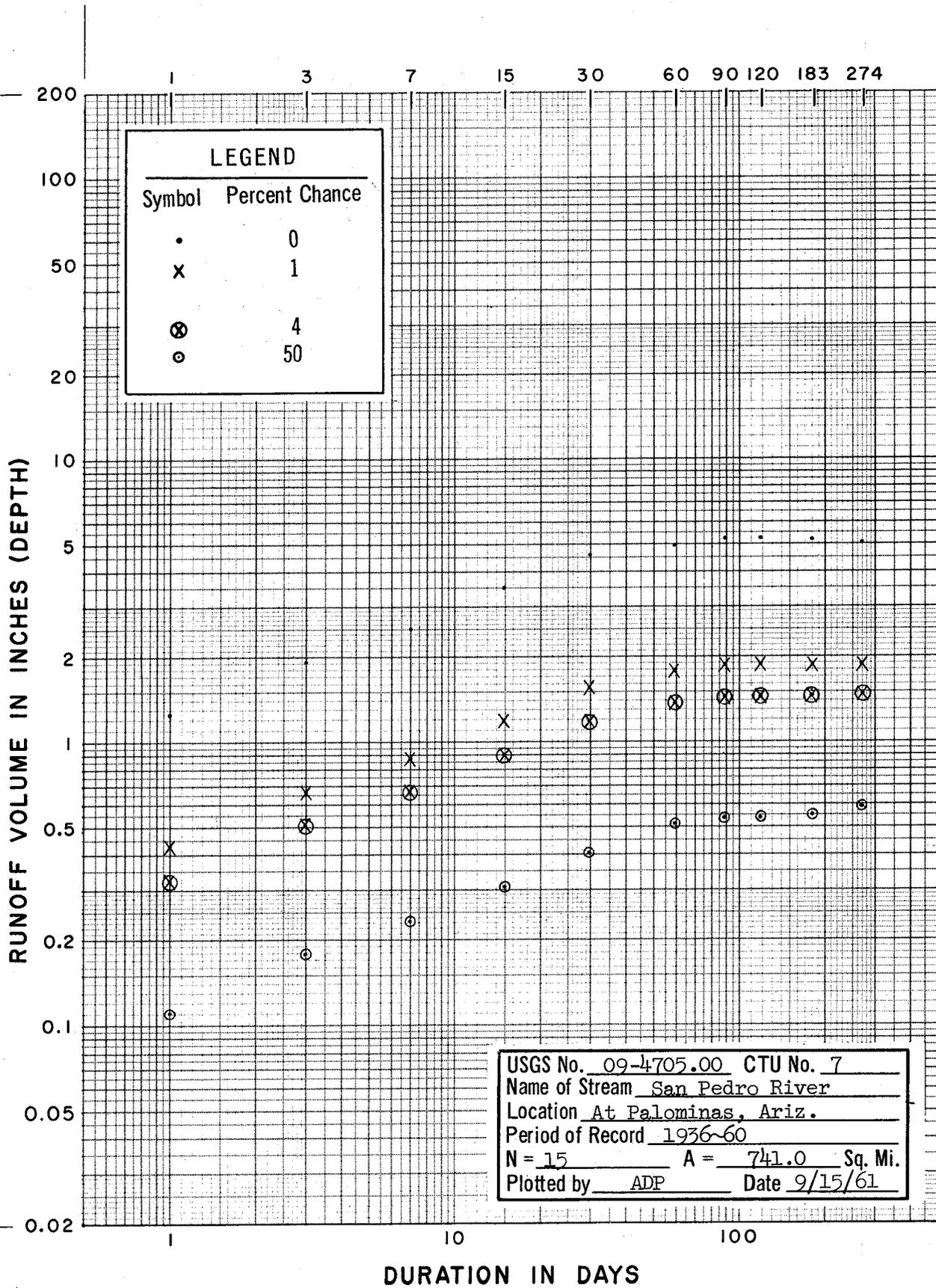
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream San Carlos River Gage Location near Peridot, Arizona
 USGS No. 09-4685 CTU No. 6 Drainage Area 1027 Sq. Mi.
 Period of Record 1942-1959 Date 6/5/62 N = 18 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	1.490	1.931	2.717	2.911	3.403	3.708	4.154	4.262	4.237	4.089
0.2	.5346	.7102	.9991	1.101	1.311	1.448	1.622	1.664	1.706	1.704
1	.3905	.5263	.7403	.8226	.9863	1.097	1.229	1.261	1.308	1.324
2	.3288	.4472	.6290	.7024	.8462	.9448	1.058	1.086	1.135	1.159
4	.2675	.3680	.5175	.5811	.7034	.7893	.8843	.9072	.9579	.9907
10	.1873	.2632	.3702	.4208	.5151	.5840	.6543	.6712	.7203	.7601
20	.1274	.1840	.2588	.2981	.3696	.4238	.4748	.4871	.5339	.5804
50	.0507	.0792	.1114	.1336	.1716	.2035	.2279	.2338	.2712	.3129
80	.0141	.0255	.0358	.0466	.0638	.0796	.0892	.0915	.1155	.1462
95	.00288	.00594	.00836	.0118	.0180	.0247	.0277	.0284	.0407	.0582
99	.000423	.00114	.00161	.00250	.00449	.00666	.00746	.00765	.0124	.0227
γ	.8713	1.047	.9789	1.101	1.175	1.321	1.285	1.309	1.463	1.766
B	.09070	.1117	.1625	.1702	.1974	.2067	.2349	.2388	.2335	.2136
B/γ	.08466	.1143	.1608	.1786	.2140	.2377	.2663	.2732	.2825	.2840

Remarks: Low Gamma and a high Beta in the 120-day duration leads to non-representative values in the upper part of the computed points. Similar inconsistencies are present in the 183 and 274-day durations.



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

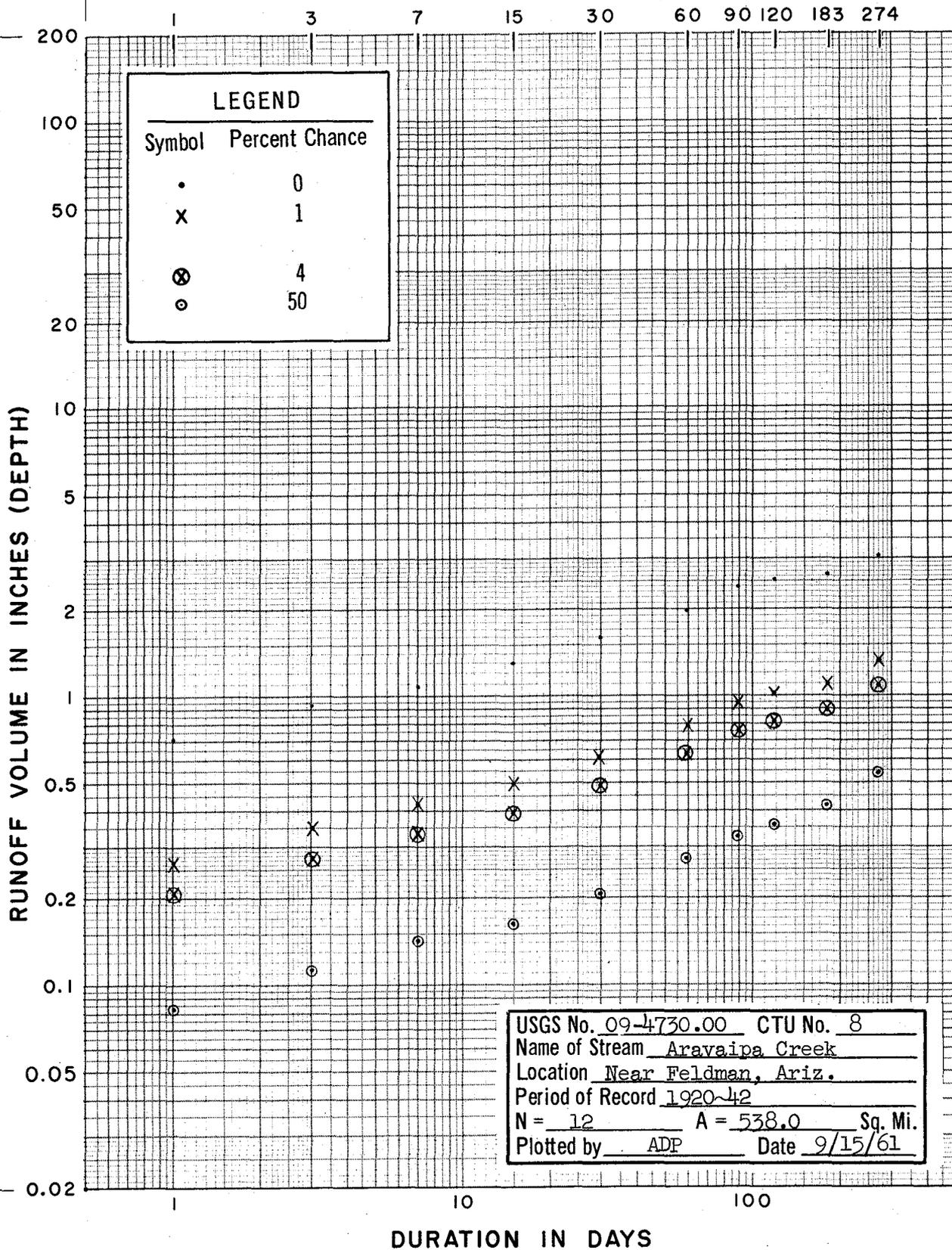
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream San Pedro River Gage Location at Palominas, Arizona
 USGS No. 09-4705 CTU No. 7 Drainage Area 741.0 Sq. Mi.
 Period of Record 1936-1960 Date 9/15/61 N = 15 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	1.247	1.912	2.501	3.490	4.588	4.945	5.194	5.220	5.163	5.052
0.2	.5364	.8405	1.099	1.502	1.974	2.223	2.335	2.347	2.340	2.330
1	.4225	.6643	.8689	1.183	1.555	1.775	1.864	1.873	1.873	1.880
2	.3721	.5862	.7667	1.042	1.369	1.574	1.653	1.662	1.664	1.679
4	.3206	.5064	.6624	.8974	1.180	1.369	1.438	1.445	1.451	1.471
10	.2499	.3966	.5188	.6998	.9200	1.086	1.141	1.147	1.155	1.183
20	.1936	.3089	.4040	.5419	.7124	.8577	.9009	.9055	.9156	.9481
50	.1100	.1779	.2326	.3078	.4047	.5116	.5373	.5401	.5522	.5876
80	.0553	.0912	.1194	.1547	.2033	.2762	.2901	.2916	.3023	.3334
95	.0242	.0411	.0537	.0678	.0891	.1331	.1398	.1405	.1490	.1737
99	.0104	.0181	.0237	.0291	.0383	.0628	.0660	.0663	.0716	.0886
Y	2.111	2.193	2.176	2.128	2.122	2.472	2.461	2.478	2.567	2.860
B	.06176	.09493	.1246	.1721	.2266	.2365	.2489	.2494	.2441	.2298
B \sqrt{Y}	.0897	.1406	.1839	.2511	.3301	.3718	.3905	.3925	.3911	.3886

Remarks: Gammas, the shape statistics, are non-representative for all durations for this period of record.
 Inconsistencies developed in durations greater than the 120-day.



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

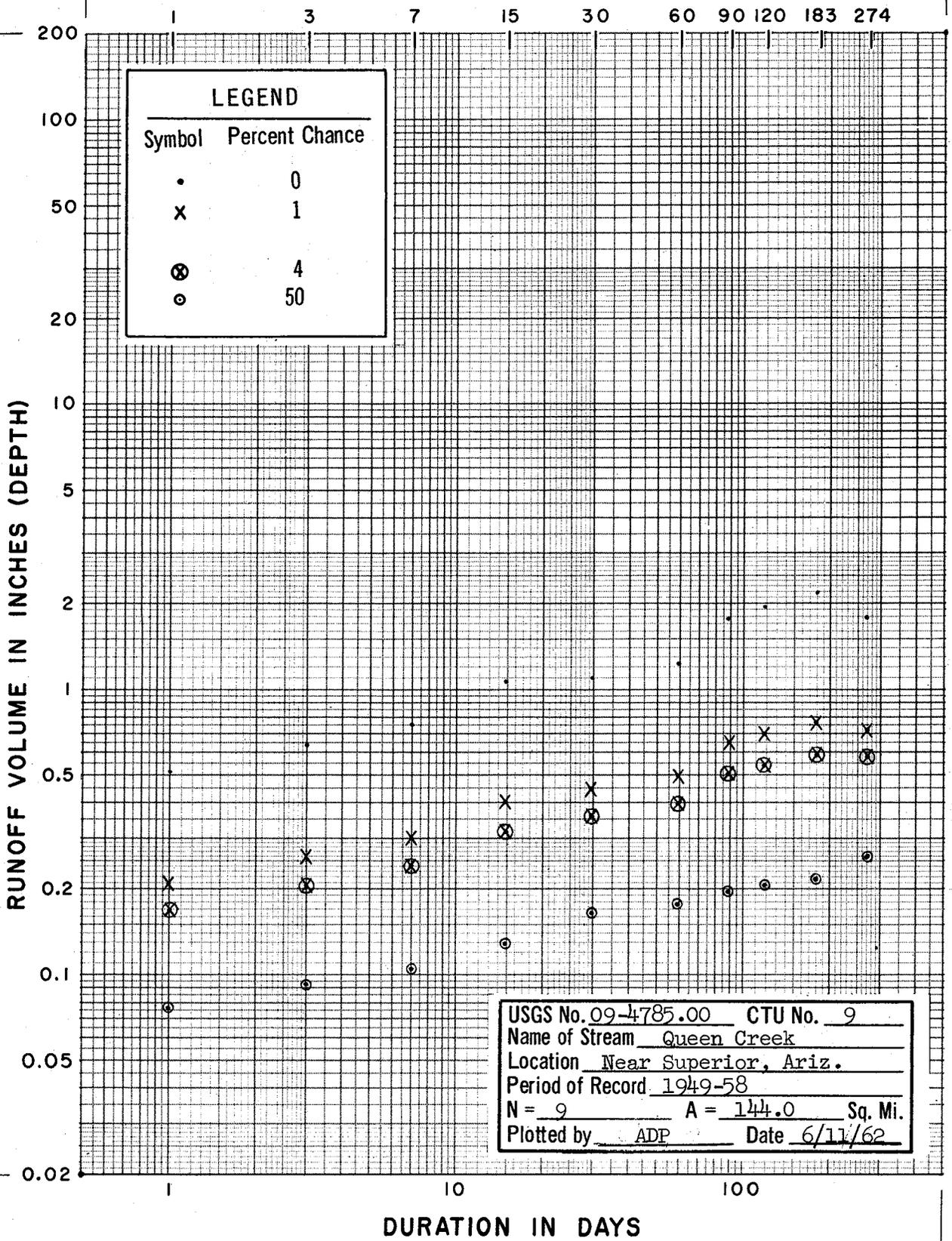
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Aravaipa Creek Gage Location near Feldman, Arizona
 USGS No. 09-4730 CTU No. 8 Drainage Area 538 Sq. Mi.
 Period of Record 1920-1942 Date 9/15/61 N = 12 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	.7137	.9365	1.090	1.315	1.619	1.996	2.426	2.566	2.678	3.096
0.2	.3292	.4362	.5215	.6175	.7677	.9734	1.172	1.253	1.334	1.593
1	.2656	.3537	.4258	.5020	.6254	.7978	.9585	1.029	1.108	1.337
2	.2372	.3167	.3827	.4500	.5614	.7187	.8626	.9277	1.006	1.221
4	.2078	.2784	.3380	.3963	.4951	.6366	.7630	.8228	.8995	1.099
10	.1672	.2253	.2756	.3216	.4028	.5216	.6236	.6757	.7489	.9261
20	.1340	.1816	.2240	.2599	.3265	.4262	.5083	.5535	.6228	.7810
50	.0830	.1143	.1442	.1649	.2087	.2779	.3294	.3629	.4228	.5466
80	.0471	.0663	.0860	.0965	.1233	.1684	.1980	.2218	.2708	.3647
95	.0245	.0356	.0481	.0526	.0681	.0963	.1120	.1281	.1659	.2347
99	.0125	.0189	.0267	.0283	.0374	.0549	.0631	.0739	.1025	.1533
Y	2.875	3.093	3.351	3.237	3.258	3.566	3.528	3.674	4.390	5.248
B	.03237	.04222	.04726	.05707	.07065	.08525	.1033	.1080	.1039	.1117
B√Y	.0549	.0726	.0865	.1027	.1275	.1610	.1941	.2069	.2177	.2559

Remarks:



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

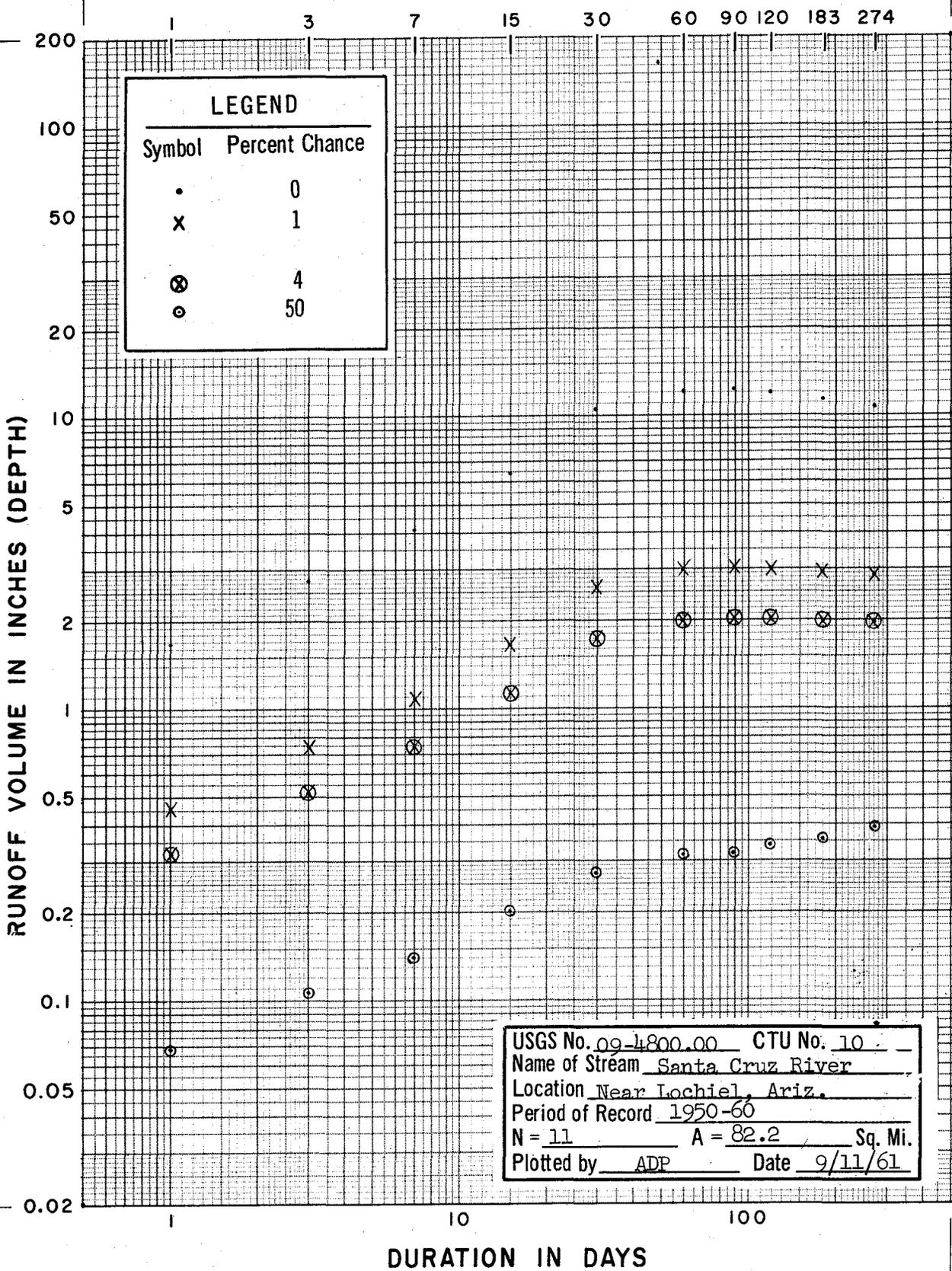
Name of Stream Queen Creek Gage Location at Whitlow Damsite near Superior, Arizona
 USGS No. 09-4785 CTU No. 9 Drainage Area 144 Sq. Mi.
 Period of Record 1949-1958 Date 6/11/62 N = 9 years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	.5146	.6386	.7552	1.073	1.104	1.240	1.787	1.952	2.195	1.796
0.2	.2525	.3128	.3682	.5030	.5425	.6064	.8164	.8782	.9722	.8795
1	.2084	.2578	.3018	.4068	.4485	.4988	.6554	.7030	.7735	.7247
2	.1886	.2330	.2719	.3638	.4061	.4504	.5834	.6246	.6849	.6551
4	.1679	.2071	.2408	.3193	.3620	.4000	.5093	.5445	.5945	.5824
10	.1387	.1709	.1973	.2576	.2998	.3292	.4072	.4336	.4698	.4804
20	.1144	.1406	.1612	.2071	.2478	.2703	.3240	.3437	.3694	.3953
50	.0762	.0932	.1051	.1294	.1658	.1782	.1972	.2073	.2179	.2619
80	.0476	.0578	.0637	.0742	.1043	.1098	.1094	.1135	.1158	.1626
95	.0283	.0340	.0364	.0393	.0625	.0640	.0550	.0559	.0546	.0957
99	.0168	.0201	.0208	.0204	.0376	.0374	.0270	.0269	.0252	.0566
Y	3.978	3.884	3.574	3.003	4.134	3.816	2.744	2.604	2.404	3.926
B	.02081	.02613	.03223	.04638	.04380	.05121	.08311	.09099	.1048	.07310
B \sqrt{Y}	.04151	.05150	.06093	.08379	.08904	.10003	.1364	.1468	.1626	.1448

Remarks: 1954 appears as a high outlier and is omitted from all durations.

The period of record is short and inadequate for estimation of representative statistics (use only as an approximation).



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

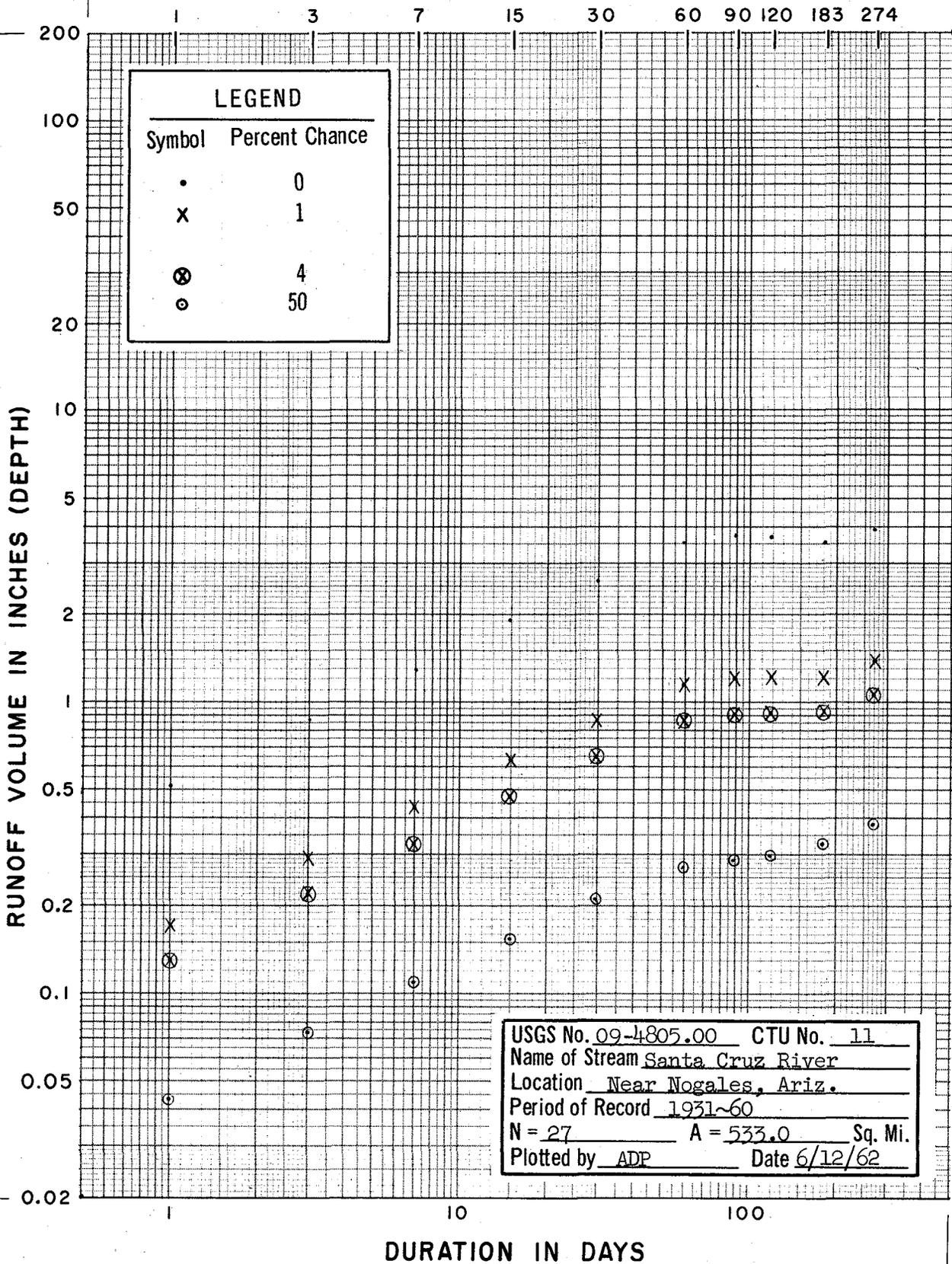
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Santa Cruz River Gage Location near Lochiel, Arizona
 USGS No. 09-4800 CTU No. 10 Drainage Area 82.2 Sq. Mi.
 Period of Record 1950-1960 Date 9/11/61 N = 11 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	1.653	2.739	4.104	6.383	10.47	12.02	12.19	11.82	11.24	10.59
0.2	.6078	1.000	1.473	2.267	3.595	4.127	4.187	4.112	3.990	3.844
1	.4504	.7379	1.076	1.647	2.580	2.963	3.006	2.971	2.899	2.822
2	.3827	.6253	.9057	1.382	2.149	2.467	2.503	2.484	2.432	2.384
4	.3149	.5128	.7369	1.119	1.722	1.977	2.006	2.001	1.970	1.948
10	.2252	.3643	.5158	.7763	1.170	1.343	1.363	1.375	1.367	1.374
20	.1575	.2528	.3510	.5221	.7656	.8790	.8918	.9127	.9190	.9442
50	.0678	.1064	.1397	.2008	.2717	.3120	.3165	.3378	.3534	.3870
80	.0219	.0327	.0387	.0524	.0612	.0703	.0713	.0822	.0923	.1133
95	.0051	.0070	.0079	.0100	.0106	.0121	.0123	.0148	.0176	.0239
99	.0010	.0012	.0013	.0014	.0015	.0016	.0018	.0019	.0025	.0037
y	.9950	.9301	.8764	.7913	.6941	.7125	.7385	.7597	.8154	.8987
B	.09801	.1661	.2491	.4009	.6683	.7574	.7549	.7367	.6951	.6458
B√y	.0978	.1602	.2332	.3566	.5568	.6393	.6486	.6423	.6277	.6123

Remarks: The period of record is short and inadequate for estimation of representative statistics (use only as an approximation).



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

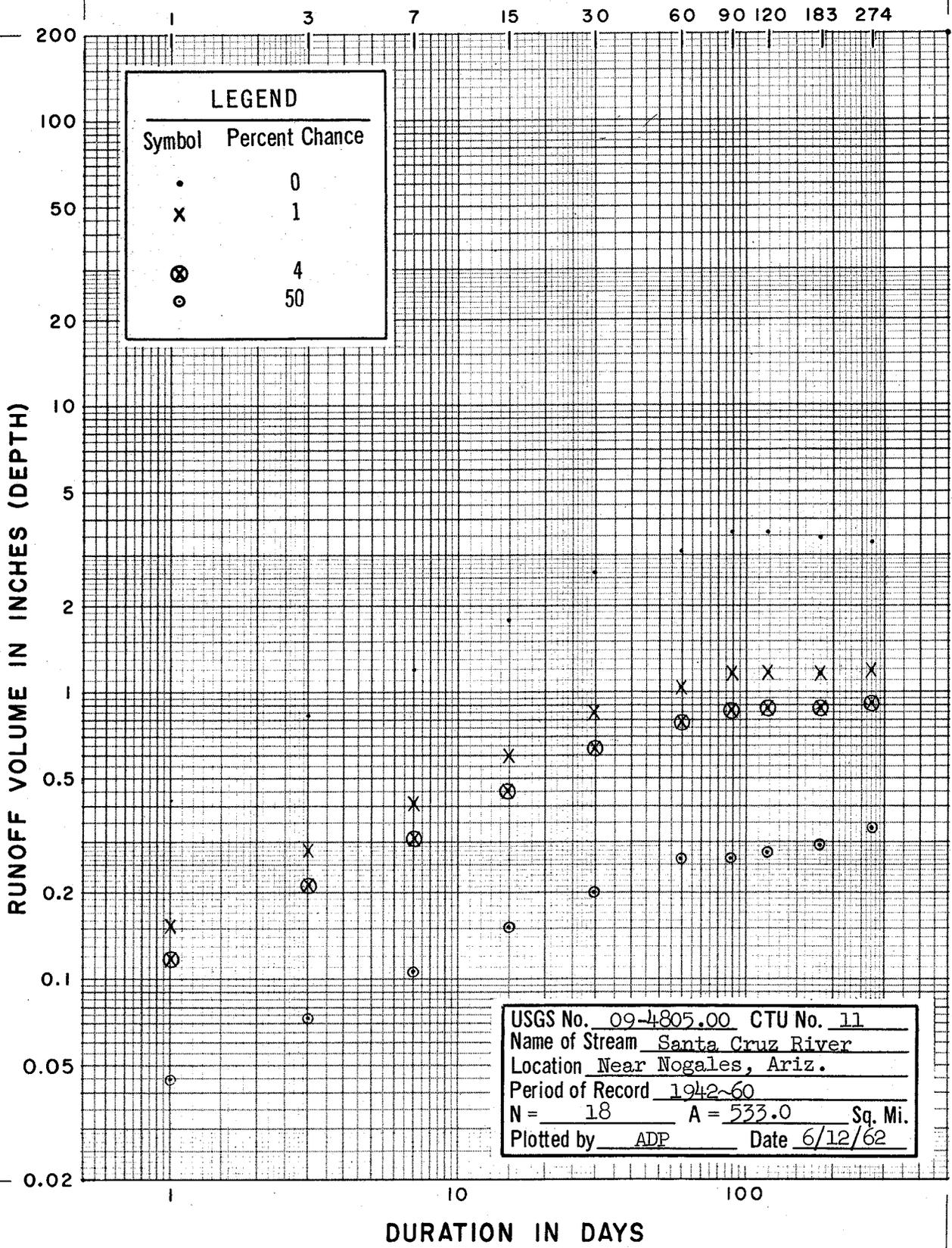
Name of Stream Santa Cruz River Gage Location near Nogales, Arizona
 USGS No. 09-4805 CTU No. 11 Drainage Area 533 Sq. Mi.
 Period of Record 1931 ~ 1960 Date 6/12/62 N = 27 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	.5070	.8651	1.290	1.913	2.620	3.546	3.729	3.686	3.500	3.911
0.2	.2167	.3698	.5512	.8070	1.105	1.477	1.554	1.555	1.538	1.745
1	.1700	.2901	.4324	.6303	.8634	1.148	1.208	1.215	1.216	1.384
2	.1494	.2550	.3801	.5528	.7573	1.005	1.057	1.065	1.073	1.223
4	.1284	.2191	.3267	.4739	.6492	.8591	.9034	.9132	.9269	1.059
10	.0997	.1701	.2535	.3657	.5010	.6592	.6932	.7047	.7259	.8333
20	.0767	.1309	.1951	.2797	.3851	.5006	.5264	.5389	.5653	.6523
50	.0430	.0733	.1093	.1544	.2115	.2713	.2853	.2975	.3255	.3803
80	.0211	.0360	.0537	.0740	.1013	.1268	.1333	.1425	.1670	.1988
95	.00898	.0153	.0228	.0304	.0417	.0505	.0531	.0587	.0751	.0916
99	.00377	.00643	.00958	.0124	.0170	.0197	.0207	.0239	.0332	.0414
γ	1.978	2.027	1.976	1.903	1.928	1.804	1.837	1.895	2.161	2.281
β	.02575	.04340	.06552	.09764	.1329	.1833	.1911	.1886	.1750	.1933
$\beta\sqrt{\gamma}$	.03621	.06179	.09212	.1347	.1845	.2462	.2589	.2596	.2573	.2919

Remarks: 1955 appears as a high outlier in all durations and is omitted.

Durations greater than the 90-day are non-representative for the upper parts of the computed points.



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

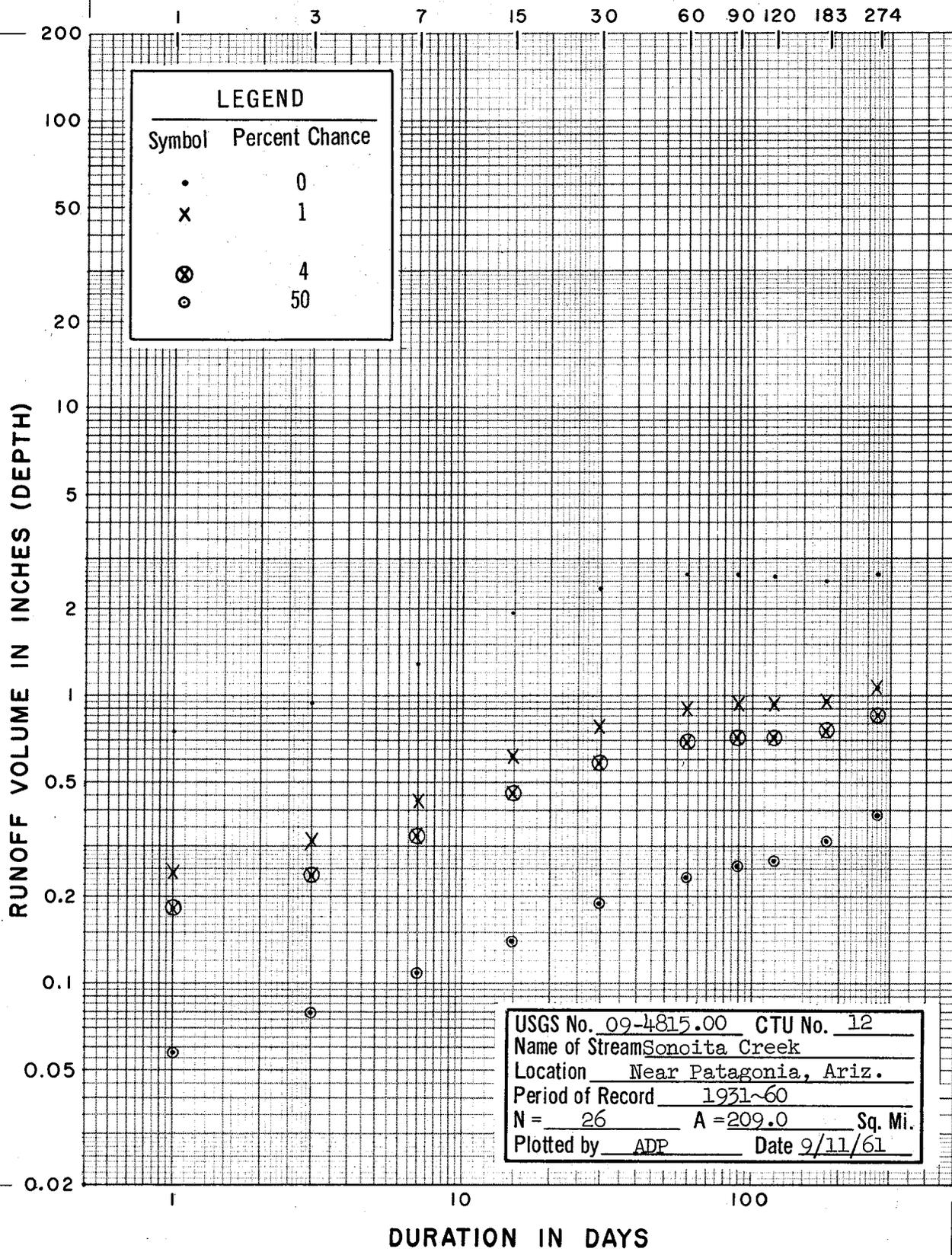
Name of Stream Santa Cruz River Gage Location near Nogales, Arizona
 USGS No. 09-4805 CTU No. 11 Drainage Area 533 Sq. Mi.
 Period of Record 1942-1960 Date 6/12/62 N = 18 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	.4201	.8368	1.220	1.813	2.654	3.135	3.675	3.650	3.491	3.365
0.2	.1904	.3600	.5251	.7751	1.106	1.340	1.513	1.521	1.492	1.513
1	.1524	.2836	.4136	.6080	.8595	1.051	1.171	1.182	1.170	1.204
2	.1354	.2497	.3642	.5344	.7522	.9238	1.022	1.035	1.029	1.043
4	.1180	.2152	.3138	.4593	.6429	.7940	.8705	.8844	.8842	.9251
10	.0940	.1678	.2447	.3565	.4933	.6162	.6636	.6786	.6862	.7310
20	.0745	.1299	.1895	.2743	.3746	.4742	.5002	.5153	.5281	.5749
50	.0449	.0738	.1076	.1538	.2031	.2658	.2658	.2793	.2960	.3391
80	.0246	.0371	.0541	.0755	.0949	.1305	.1208	.1305	.1454	.1802
95	.0121	.0163	.0237	.0321	.0378	.0555	.0466	.0520	.0618	.0850
99	.00582	.00698	.0102	.0135	.0147	.0233	.0171	.0203	.0259	.0392
Y	2.577	2.148	2.100	1.957	1.843	1.970	1.744	1.773	2.026	2.369
B	.01983	.04110	.06060	.09259	.1357	.1595	.1906	.1904	.1752	.1644
B \sqrt{Y}	.03182	.06020	.08780	.1295	.1843	.2239	.2517	.2535	.2493	.2530

Remarks: 1955 appears as a high outlier and is omitted from all durations.

Durations greater than the 90-day are non-representative for the upper parts of the computed points.



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

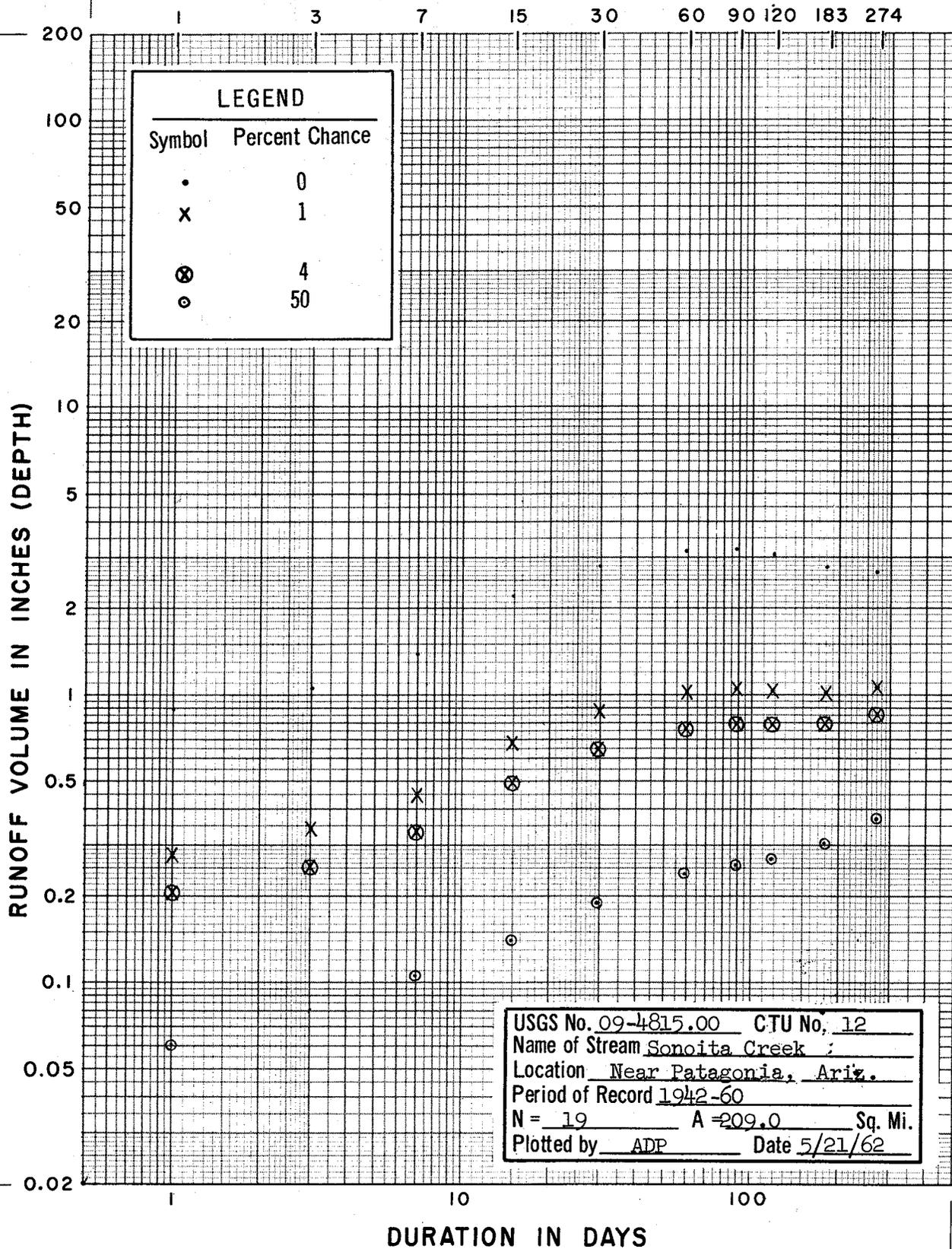
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Sonoita Creek Gage Location near Patagonia, Arizona
 USGS No. 09-4815 CTU No. 12 Drainage Area 209 Sq. Mi.
 Period of Record 1931~1960 Date 9/11/61 N = 26 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	.7488	.9352	1.285	1.943	2.363	2.651	2.625	2.580	2.499	2.628
0.2	.3120	.3997	.5493	.8001	.9969	1.1404	1.171	1.160	1.174	1.287
1	.2425	.3136	.4309	.6192	.7786	.8982	.9288	.9260	.9541	1.061
2	.2122	.2756	.3788	.5404	.6829	.7910	.8210	.8214	.8554	.9586
4	.1814	.2369	.3255	.4603	.5854	.6816	.7109	.7143	.7533	.8523
10	.1392	.1838	.2526	.3509	.4518	.5315	.5593	.5669	.6112	.7031
20	.1057	.1415	.1944	.2645	.3454	.4115	.4378	.4476	.4941	.5785
50	.0573	.0793	.1090	.1406	.1907	.2338	.2553	.2669	.3135	.3833
80	.0268	.0389	.0535	.0639	.0914	.1175	.1334	.1441	.1835	.2380
95	.0107	.0166	.0228	.0246	.0376	.0515	.0615	.0695	.0999	.1401
99	.0042	.0069	.0095	.0091	.0153	.0221	.0278	.0328	.0539	.0826
Y	1.837	2.043	1.977	1.704	1.877	2.138	2.318	2.505	3.197	3.977
B	.03841	.04676	.06528	.1019	.1215	.1304	.1287	.1226	.1091	.1063
B√Y	.0520	.0668	.0918	.1331	.1664	.1907	.1959	.1940	.1952	.2119

Remarks: Durations greater than the 90-day are non-representative for the upper parts of the computed points.



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

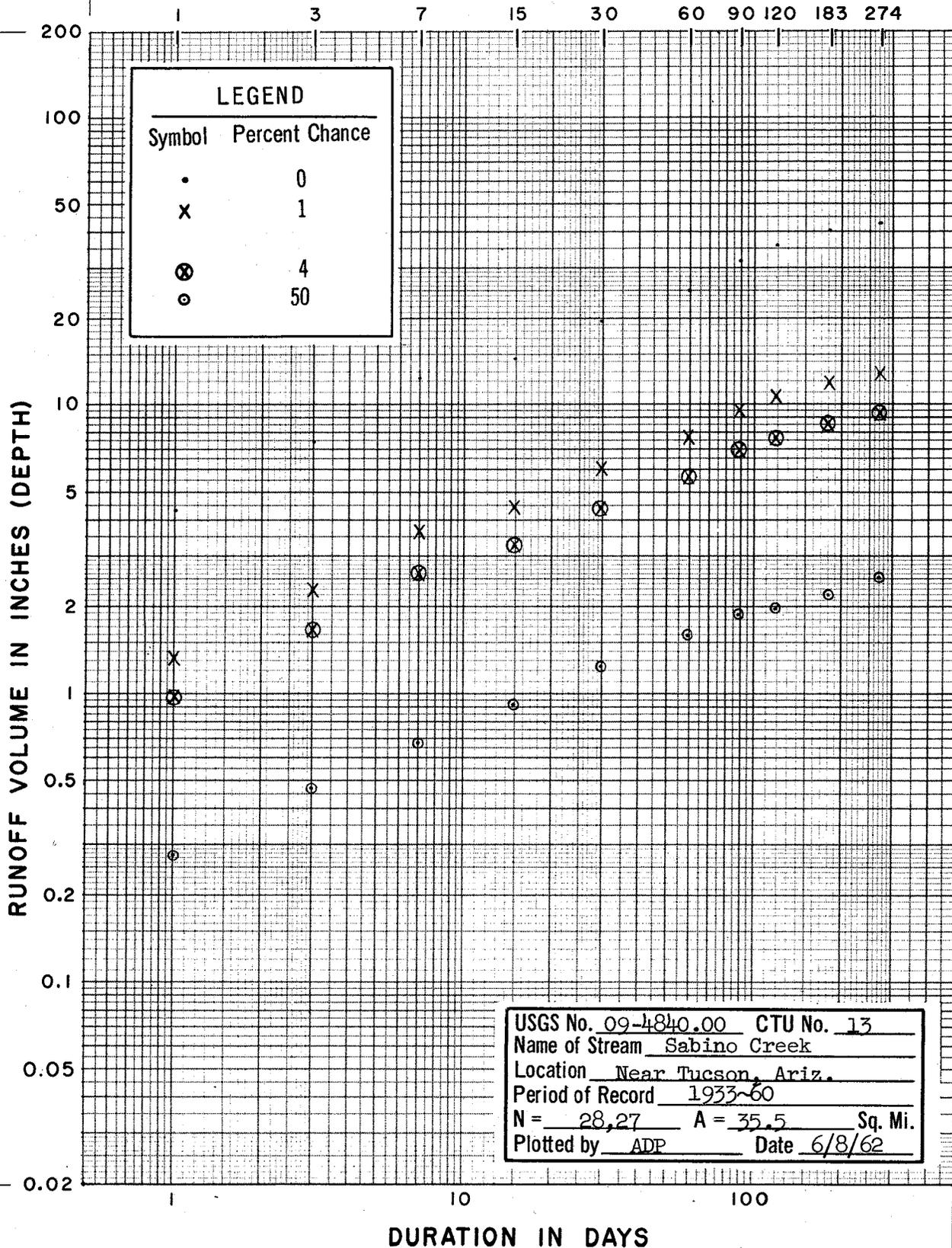
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Sonoita Creek Gage Location near Patagonia, Arizona
 USGS No. 09-4815 CTU No. 12 Drainage Area 209 Sq. Mi.
 Period of Record 1942-1960 Date 5/21/62 N = 19 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	.8814	1.047	1.382	2.203	2.803	3.146	3.181	3.057	2.765	2.663
0.2	.3588	.4362	.5758	.9400	1.141	1.311	1.342	1.315	1.242	1.298
1	.2764	.3391	.4476	.6802	.8790	1.019	1.048	1.036	1.014	1.064
2	.2405	.2968	.3917	.5900	.7650	.8917	.9195	.9123	.9028	.9587
4	.2040	.2537	.3348	.4981	.6489	.7621	.7882	.7860	.7881	.8492
10	.1545	.1946	.2569	.3745	.4913	.5848	.6083	.6130	.6301	.6958
20	.1155	.1478	.1951	.2776	.3672	.4441	.4651	.4746	.5013	.5685
50	.0601	.0801	.1057	.1410	.1911	.2407	.2568	.2696	.3052	.3707
80	.0265	.0374	.0494	.0601	.0843	.1125	.1230	.1355	.1693	.2246
95	.00977	.0149	.0197	.0212	.0311	.0448	.0506	.0594	.0851	.1284
99	.00334	.00582	.00768	.00646	.0106	.0175	.0206	.0255	.0418	.0732
γ	1.590	1.808	1.801	1.530	1.637	1.772	1.904	2.071	2.749	3.550
β	.04723	.05409	.07151	.1187	.1480	.1641	.1624	.1529	.1273	.1140
β√γ	.05956	.07271	.09596	.14688	.18940	.21844	.22404	.21993	.21107	.21477

Remarks: Durations greater than the 90-day are non-representative for the upper parts of the computed points.



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

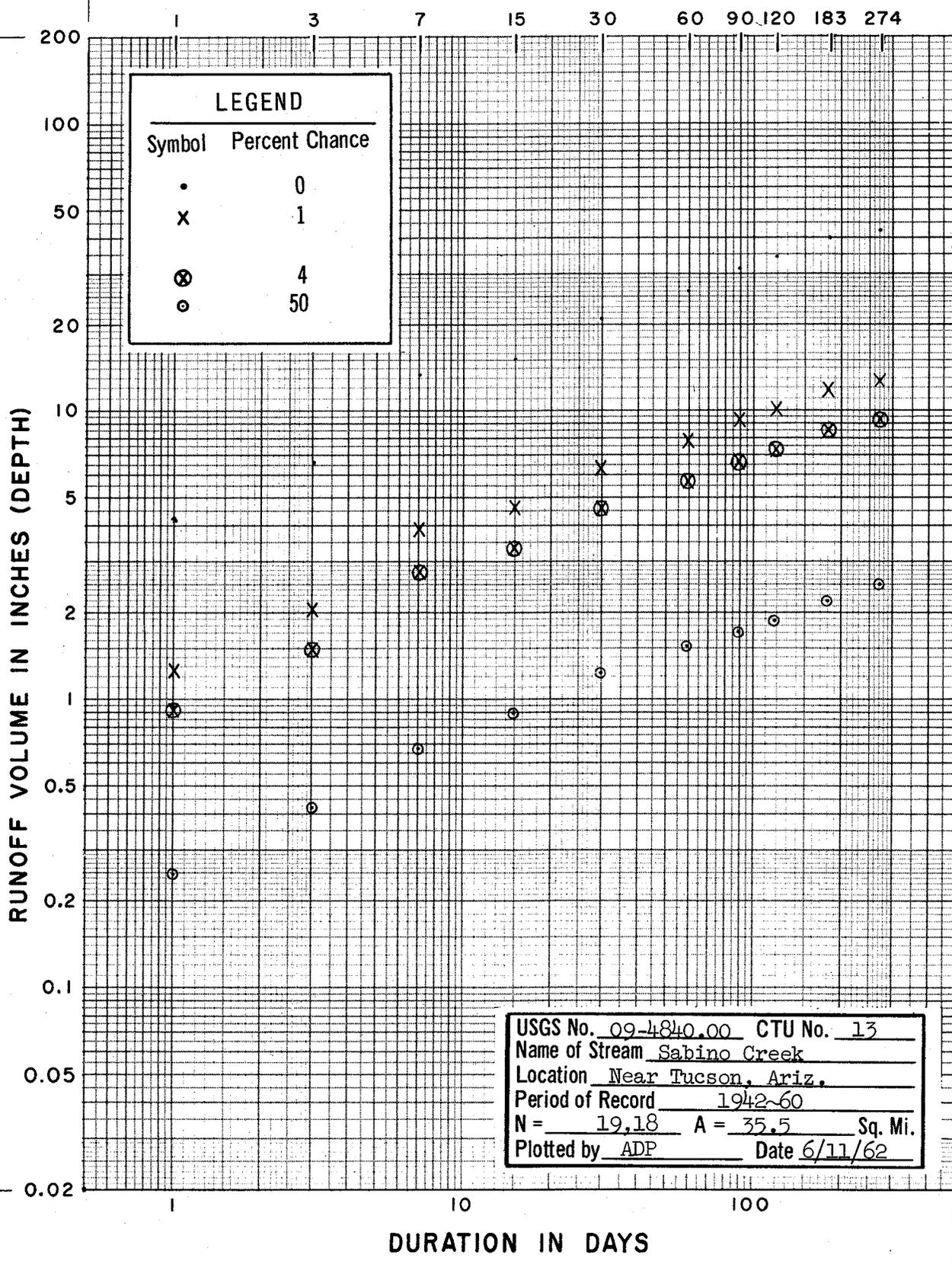
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Sabino Creek Gage Location near Tucson, Arizona
 USGS No. 09-4840 CTU No. 13 Drainage Area 35.5 Sq. Mi.
 Period of Record 1933-1960 Date 6/8/62 N = 27,28 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	4.279	7.400	12.39	14.46	19.64	25.11	31.89	36.10	40.47	42.86
0.2	1.723	2.980	4.837	5.822	7.906	10.11	12.64	14.09	15.80	16.98
1	1.321	2.284	3.665	4.464	6.062	7.752	9.632	10.68	11.97	12.95
2	1.146	1.982	3.157	3.872	5.258	6.724	8.328	9.198	10.31	11.19
4	.9674	1.673	2.638	3.269	4.439	5.677	6.994	7.685	8.615	9.400
10	.7275	1.258	1.952	2.458	3.338	4.269	5.218	5.685	6.373	7.014
20	.5392	.9323	1.416	1.822	2.474	3.164	3.830	4.126	4.625	5.148
50	.2739	.4736	.6798	.9253	1.257	1.607	1.892	1.981	2.220	2.543
80	.1167	.2018	.2661	.3942	.5354	.6847	.7752	.7752	.8690	1.042
95	.0411	.0710	.0826	.1388	.1885	.2411	.2584	.2407	.2698	.3473
99	.0126	.0217	.0222	.0424	.0576	.0737	.0729	.0648	.0726	.0980
Y	1.450	1.475	1.328	1.469	1.480	1.494	1.357	1.306	1.346	1.409
B	.2369	.4062	.6890	.7953	1.076	1.370	1.789	2.025	2.236	2.359
B√Y	.2853	.4933	.7942	.9639	1.309	1.674	2.08	2.314	2.594	2.801

Remarks: 1954 appears as a high outlier and is omitted from the 1 and 3-day durations.



USGS No. 09-4840.00 CTU No. 13
 Name of Stream Sabino Creek
 Location Near Tucson, Ariz.
 Period of Record 1942-60
 N = 19,18 A = 35.5 Sq. Mi.
 Plotted by ADP Date 6/11/62

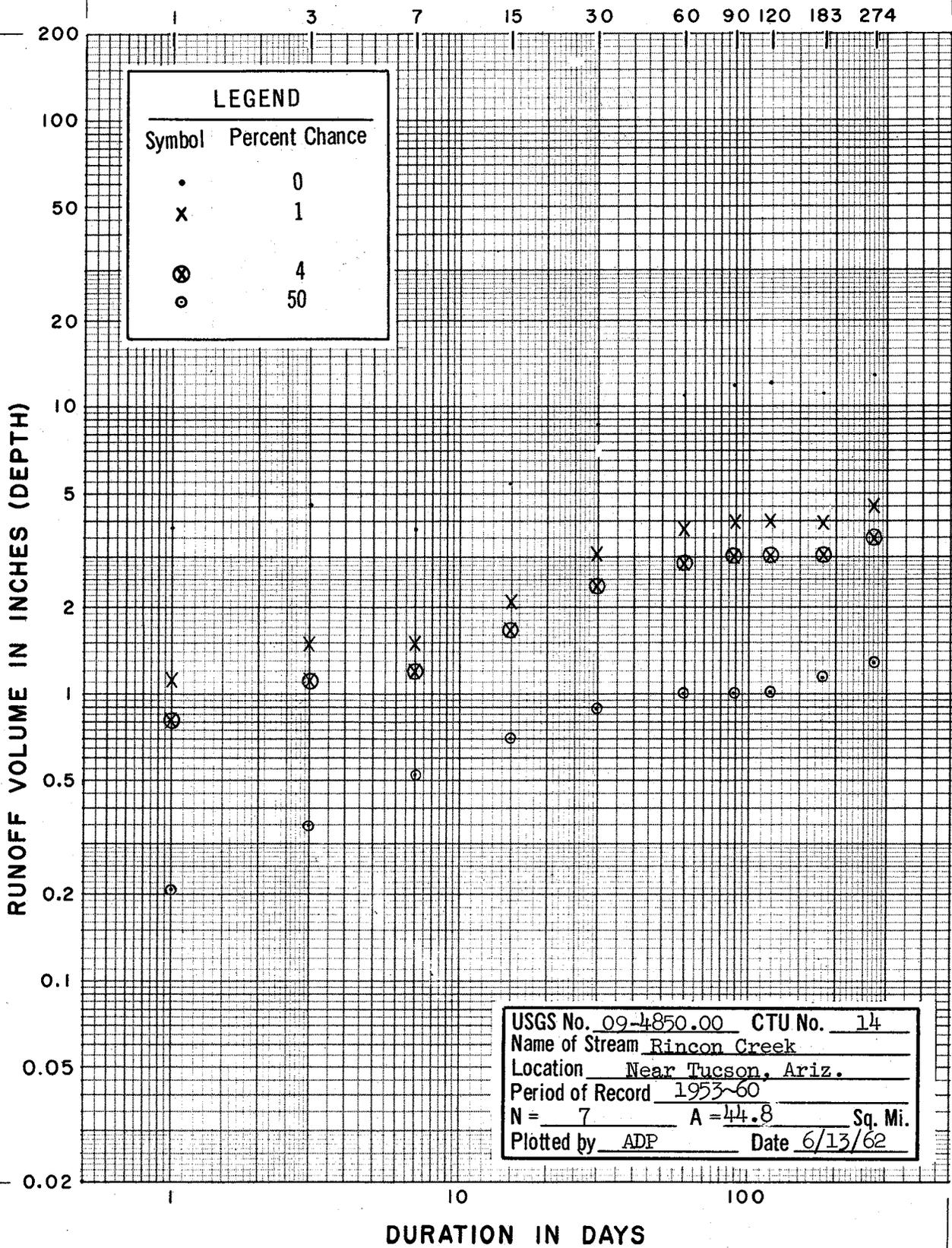
VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Sabino Creek Gage Location Tucson, Arizona
 USGS No. 09-4840 CTU No. 13 Drainage Area 35.5 Sq. Mi.
 Period of Record 1942-1960 Date 6/11/62 N 18, 19 Years

% Probability (Greater than)	Runoff Volume in Inches (Depth)									
	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	4.095	6.550	13.29	15.06	20.81	25.75	31.08	34.02	39.75	41.98
0.2	1.623	2.638	5.120	5.967	8.246	10.20	12.13	13.28	15.52	16.64
1	1.237	2.022	3.853	4.549	6.286	7.779	9.193	10.07	11.76	12.68
2	1.070	1.754	3.306	3.933	5.435	6.725	7.918	8.669	10.13	10.97
4	.8982	1.481	2.748	3.303	4.564	5.648	6.615	7.243	8.462	9.209
10	.6702	1.114	2.012	2.464	3.405	4.214	4.894	5.359	6.260	6.871
20	.4919	.8253	1.444	1.809	2.500	3.093	3.552	3.889	4.543	5.043
50	.2430	.4192	.6705	.8937	1.235	1.528	1.705	1.867	2.181	2.492
80	.0996	.1786	.2491	.3661	.5059	.6261	.6673	.7306	.8536	1.021
95	.0332	.0629	.0702	.1220	.1686	.2087	.2072	.2268	.2650	.3403
99	.00937	.0192	.0176	.0344	.0476	.0589	.0558	.0611	.0713	.0960
Y	1.406	1.489	1.209	1.373	1.387	1.411	1.347	1.315	1.332	1.399
B	.2257	.3579	.7603	.8399	1.154	1.417	1.716	1.902	2.208	2.319
B√Y	.2676	.4367	.8360	.9842	1.360	1.683	1.992	2.181	2.548	2.774

Remarks: 1954 appears as a high outlier and is omitted from the 1 and 3-day durations.



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

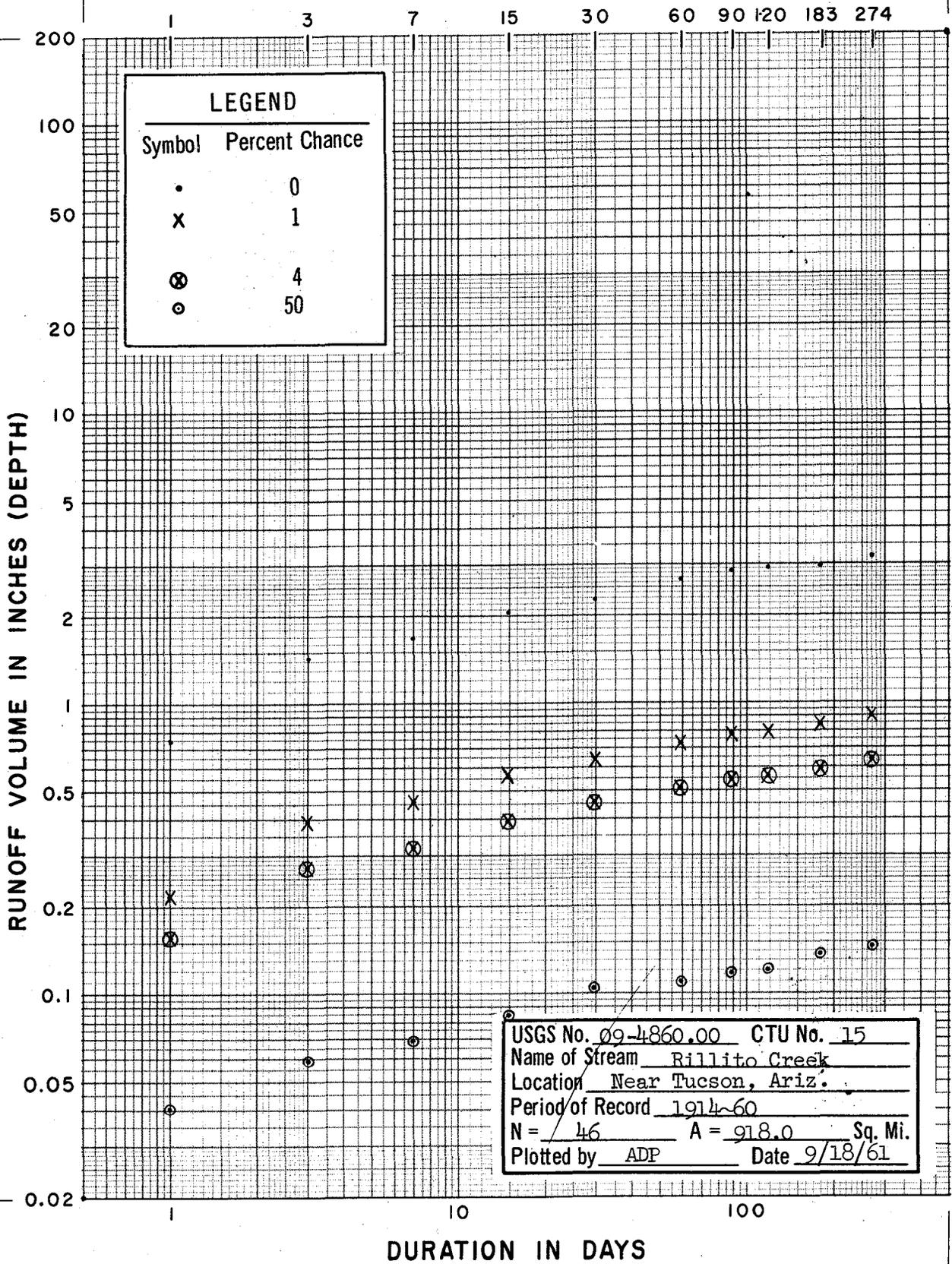
Name of Stream Rincon Creek Gage Location near Tucson, Arizona
 USGS No. 09-4850 CTU No. 14 Drainage Area 44.8 Sq. Mi.
 Period of Record 1953-1960 Date 6/13/62 N = 7 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	3.769	4.563	3.709	5.451	8.655	10.95	11.86	11.99	11.10	12.89
0.2	1.472	1.901	1.811	2.584	3.862	4.744	5.070	5.124	4.952	5.707
1	1.115	1.478	1.487	2.105	3.083	3.750	3.977	4.019	3.953	4.541
2	.9604	1.294	1.341	1.890	2.735	3.309	3.496	3.533	3.506	4.020
4	.8024	1.106	1.190	1.667	2.378	2.859	3.004	3.036	3.049	3.490
10	.5936	.8483	.9769	1.356	1.887	2.239	2.331	2.357	2.420	2.758
20	.4308	.6443	.7947	1.099	1.490	1.744	1.794	1.814	1.910	2.169
50	.2068	.3492	.5246	.7026	.8888	1.004	1.006	1.016	1.139	1.279
80	.0809	.1632	.3206	.4150	.4799	.5150	.4939	.4992	.6153	.6796
95	.0251	.0650	.1851	.2292	.2312	.2317	.2101	.2124	.2965	.3207
99	.0068	.0254	.1068	.1258	.1092	.1024	.0881	.0891	.1399	.1479
Y	1.292	1.843	3.743	3.272	2.473	2.173	2.037	2.021	2.522	2.421
B	.2125	.2334	.1551	.2373	.4107	.5384	.5936	.6023	.5214	.6135
B \sqrt{Y}	.2416	.3169	.2991	.4292	.6459	.7936	.8472	.8563	.8281	.9545

Remarks: 1956 appears as a low outlier and is omitted from all durations.

Large Gamma and low Beta with the short record leads to inconsistencies for the 7 and 183-day durations.



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

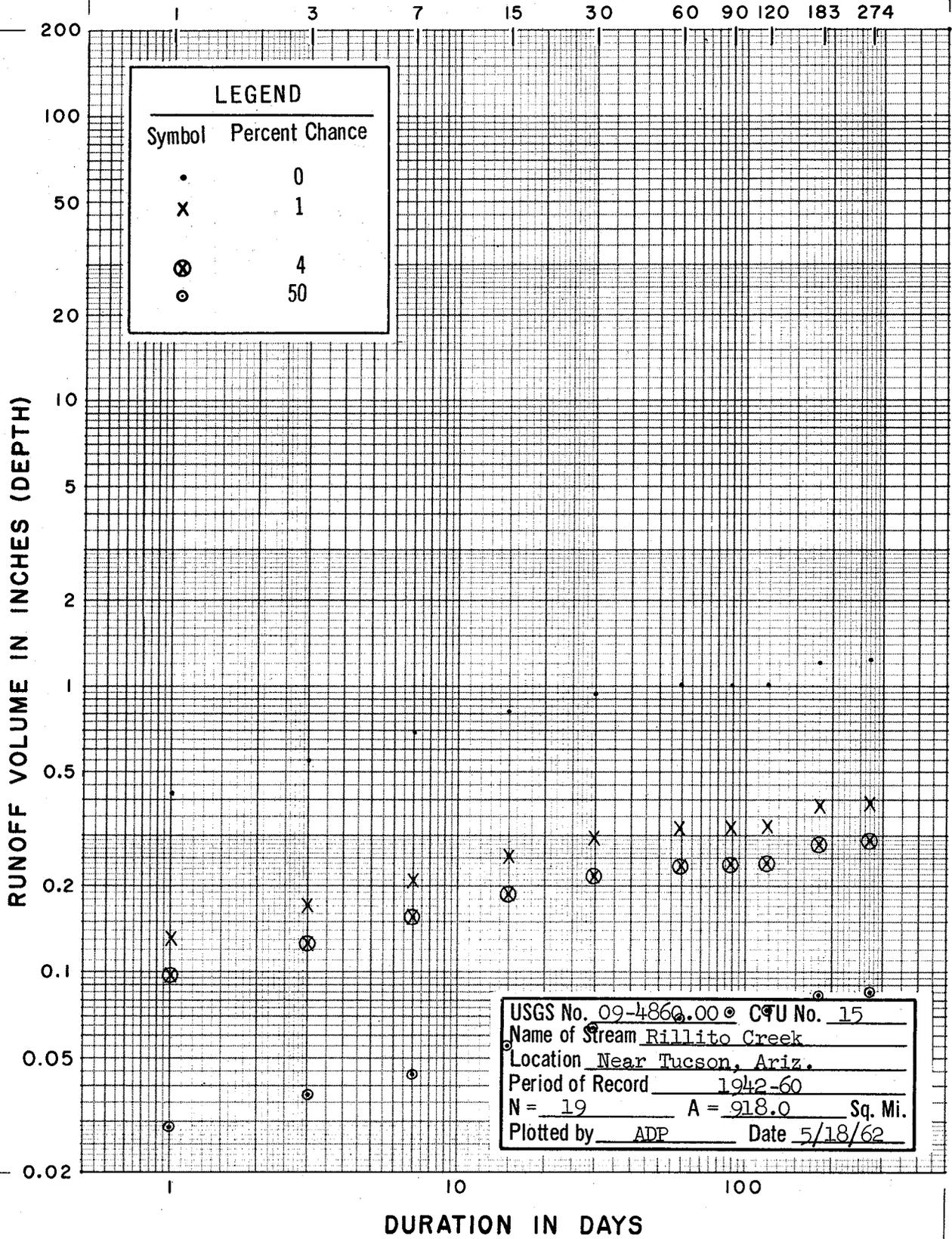
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Rillito Creek Gage Location Near Tucson, Ariz.
 USGS No. 09-4860. CTU No. 15 Drainage Area 918 Sq. Mi.
 Period of Record 1914~1960 Date 9/18/61 N = 46 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	.7332	1.443	1.687	2.069	2.279	2.677	2.878	2.942	2.980	3.201
0.2	.2863	.5308	.6203	.7607	.8617	.9845	1.058	1.082	1.127	1.211
1	.2169	.3933	.4596	.5637	.6439	.7294	.7842	.8017	.8420	.9046
2	.1868	.3342	.3905	.4790	.5498	.6198	.6664	.6812	.7190	.7724
4	.1561	.2750	.3214	.3941	.4549	.5100	.5484	.5606	.5948	.6391
10	.1156	.1967	.2298	.2819	.3294	.3648	.3922	.4010	.4307	.4627
20	.0838	.1375	.1607	.1971	.2333	.2550	.2742	.2803	.3051	.3278
50	.0402	.0592	.0692	.0848	.1046	.1098	.1180	.1207	.1367	.1459
80	.0158	.0190	.0223	.0273	.0365	.0353	.0380	.0388	.0477	.0513
95	.0049	.0044	.0052	.0064	.0092	.0082	.0089	.0091	.0121	.0130
99	.0013	.0009	.0100	.0122	.0020	.0016	.0017	.0017	.0026	.0027
γ	1.317	1.020	1.012	1.002	1.051	1.0352	1.040	1.031	1.061	1.072
β	.04094	.08455	.09922	.1223	.1364	.1557	.1670	.1715	.1775	.1896
β√γ	.0470	.0854	.0998	.1224	.1398	.1584	.1703	.1741	.1828	.1964

Remarks:



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

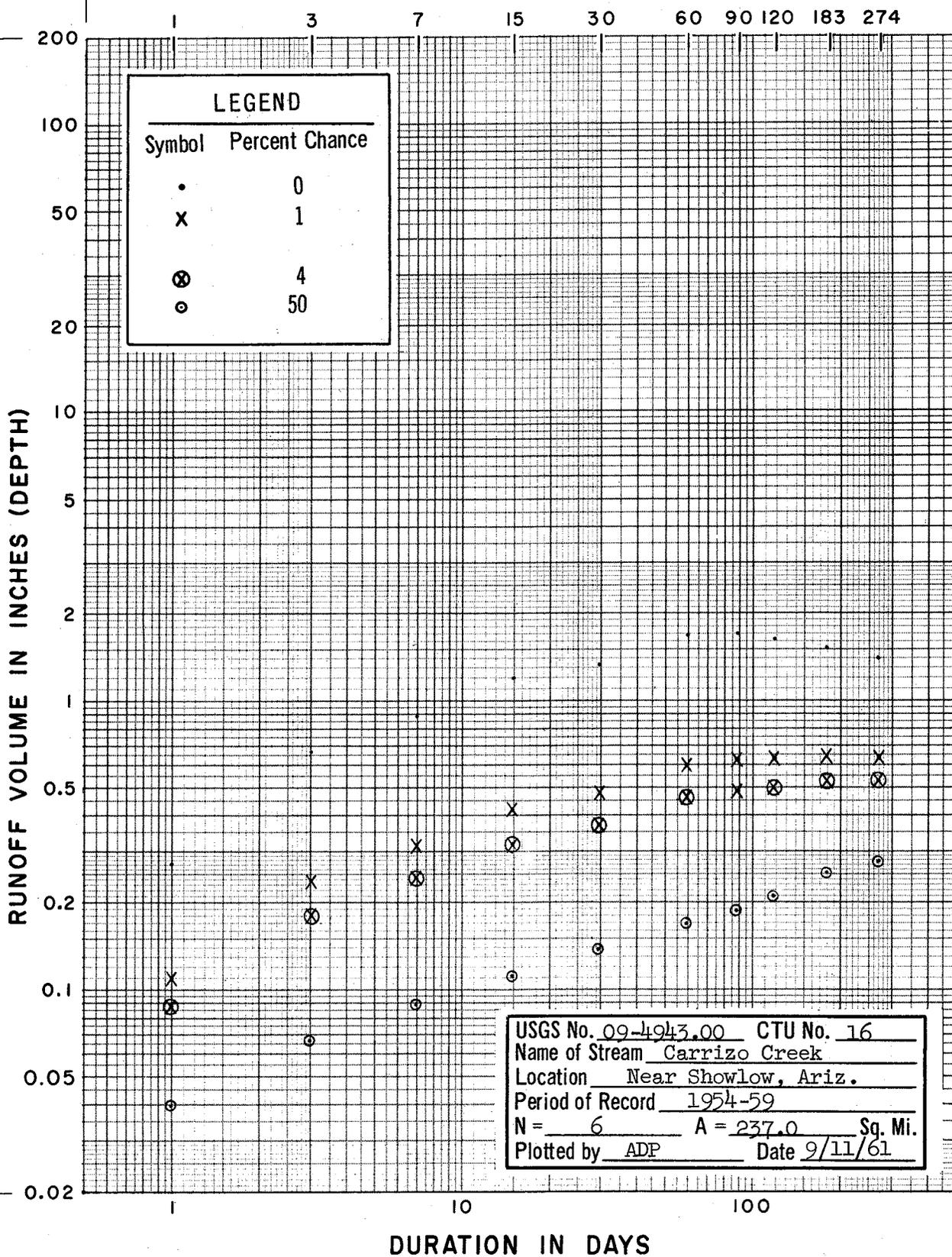
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Rillito Creek Gage Location Near Tucson, Ariz.
 USGS No. 09-4860 CTU No. 15 Drainage Area 918 Sq. Mi.
 Period of Record 1942-1960 Date 5/18/62 N = 19 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	.4209	.5477	.6912	.8160	.9448	1.017	1.011	1.022	1.224	1.252
0.2	.1713	.2229	.2783	.3322	.3846	.4139	.4164	.4208	.4984	.5098
1	.1320	.1717	.2134	.2559	.2963	.3189	.3223	.3256	.3840	.3927
2	.1149	.1495	.1851	.2227	.2578	.2775	.2812	.2842	.3342	.3418
4	.0974	.1268	.1563	.1889	.2187	.2354	.2395	.2421	.2834	.2899
10	.0738	.0960	.1175	.1430	.1656	.1782	.1826	.1845	.2146	.2195
20	.0551	.0718	.0871	.1069	.1238	.1332	.1376	.1391	.1604	.1641
50	.0287	.0373	.0442	.0556	.0644	.0693	.0732	.0739	.0835	.0854
80	.0127	.0165	.0188	.0245	.0284	.0306	.0333	.0336	.0368	.0377
95	.00466	.00607	.00687	.00904	.0105	.0113	.0128	.0130	.0136	.0139
99	.00159	.00207	.00203	.00309	.00358	.00385	.00471	.00476	.00463	.00474
Y	1.566	1.613	1.528	1.569	1.629	1.612	1.729	1.719	1.557	1.626
B	.0227	.0291	.03728	.04402	.05001	.05413	.05269	.05339	.06630	.06636
B/Y	.02844	.0370	.04608	.05514	.06384	.06871	.06927	.0700	.08273	.08462

Remarks: This base period of record has a small Gamma and large Beta in the 60-day duration. The upper parts of the computed points are non-representative.



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

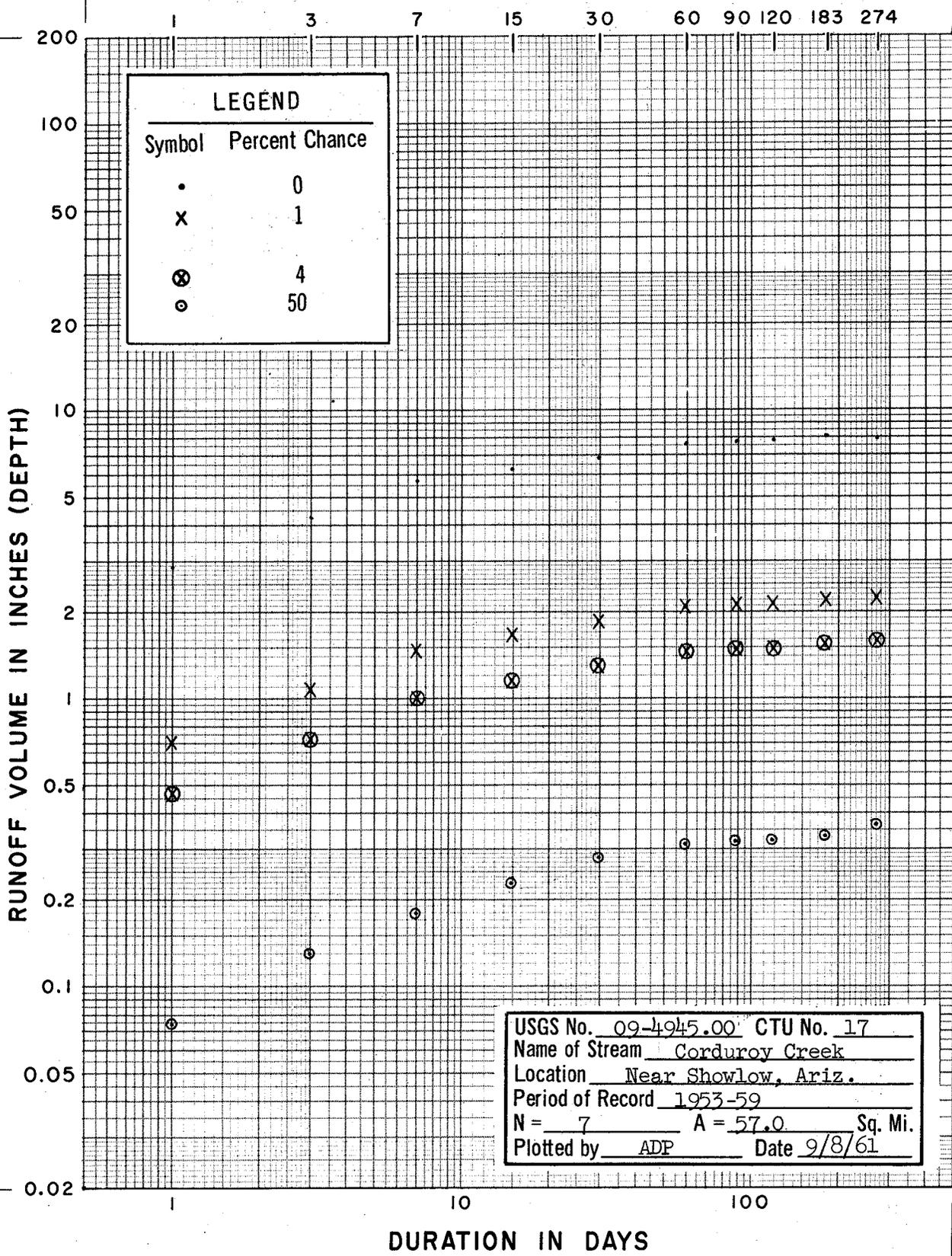
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Carrizo Creek Gage Location Above Corduroy Creek near Show Low, Ariz.
 USGS No. 09-4943. CTU No. 16 Drainage Area 237.0 Sq. Mi.
 Period of Record 1954-1959 Date 9/11/61 N = 6 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	.2690	.6637	.8845	1.204	1.335	1.685	1.707	1.632	1.521	1.402
0.2	.1319	.2984	.3976	.5291	.6004	.7575	.7668	.7737	.7700	.7477
1	.1086	.2374	.3163	.4182	.4792	.6027	.6261	.6303	.6431	.6342
2	.0982	.2102	.2801	.3690	.4251	.5337	.5573	.5658	.5856	.5826
4	.0873	.1824	.2431	.3188	.3697	.4632	.4865	.4990	.5256	.5283
10	.0720	.1442	.1921	.2497	.2922	.3660	.3889	.4059	.4404	.4507
20	.0592	.1134	.1511	.1944	.2316	.2879	.3095	.3291	.3690	.3852
50	.0393	.0669	.0891	.1120	.1382	.1698	.1884	.2104	.2545	.2778
80	.0244	.0355	.0473	.0574	.0746	.0902	.1045	.1243	.1667	.1925
95	.0143	.0168	.0223	.0258	.0359	.0426	.0525	.0686	.1049	.1296
99	.0084	.0077	.0103	.0114	.0140	.0196	.0258	.0377	.0667	.0889
Y	3.918	2.369	2.432	2.223	2.540	2.352	2.724	3.334	4.834	6.234
B	.01099	.03241	.02562	.05939	.06301	.08264	.07897	.07031	.05673	.05161
B \sqrt{Y}	.0217	.0499	.0665	.0885	.1004	.1267	.1303	.1285	.1247	.1178

Remarks: Durations greater than the 90-day are inconsistent due to the short period of record (use only as an approximation)



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

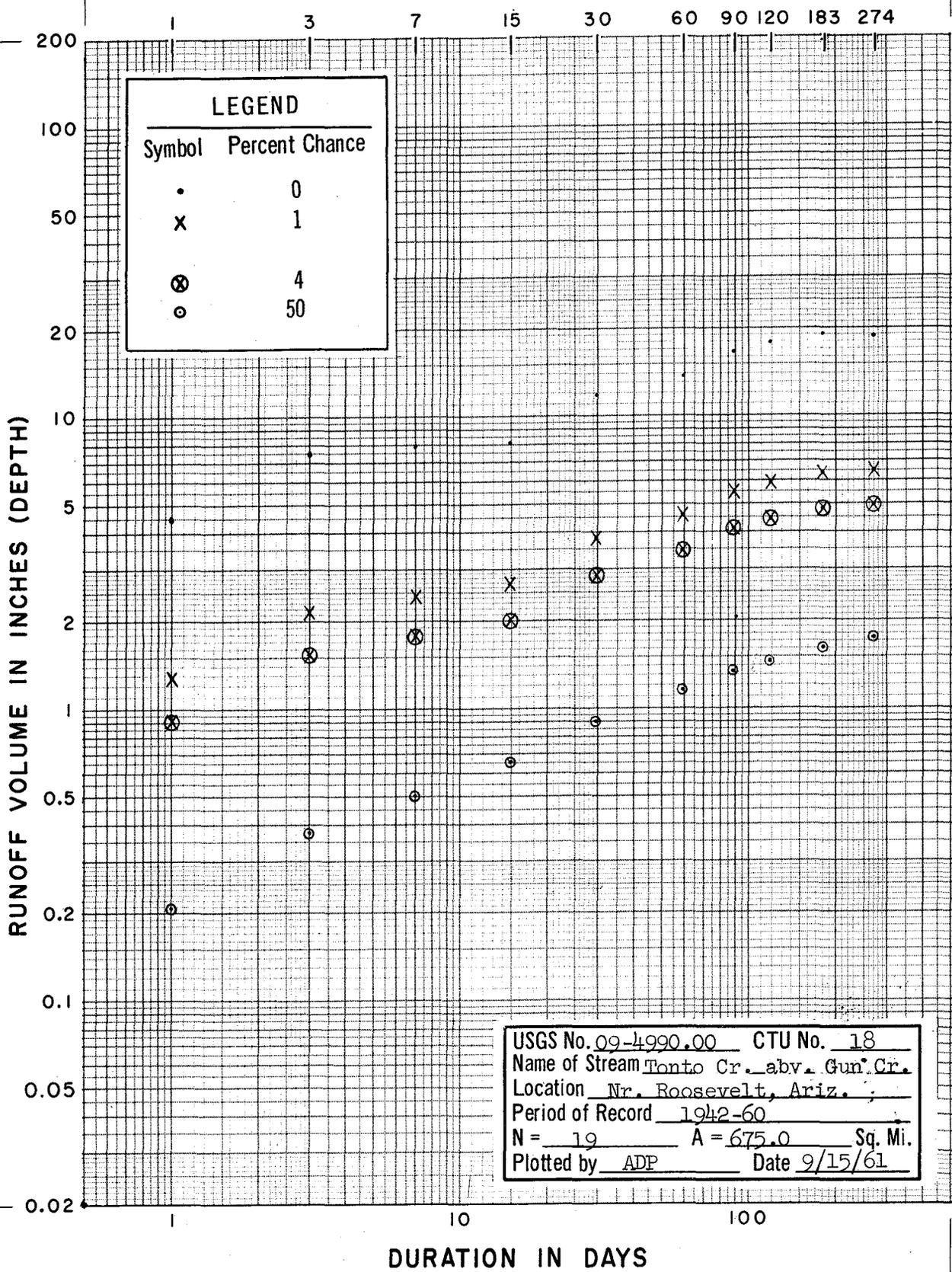
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Corduroy Creek Gage Location Above Forestdale Creek near Show Low, Ariz.
 USGS No. 09-4945 CTU No. 17 Drainage Area 57.0 Sq. Mi.
 Period of Record 1953-1959 Date 9/8/61 N = 7 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	2.824	4.236	5.690	6.226	6.807	7.575	7.752	7.809	8.071	7.914
0.2	.9697	1.474	2.021	2.259	2.503	2.786	2.851	2.872	2.968	2.993
1	.6960	1.065	1.468	1.659	1.855	2.064	2.112	2.128	2.199	2.236
2	.5796	.8902	1.232	1.401	1.576	1.754	1.795	1.808	1.869	1.909
4	.4646	.7173	.9976	1.145	1.297	1.443	1.477	1.488	1.538	1.580
10	.3156	.4926	.6921	.8076	.9276	1.032	1.056	1.064	1.100	1.144
20	.2065	.3271	.4654	.5550	.6485	.7216	.7385	.7440	.7689	.8103
50	.0733	.1294	.1790	.2275	.2791	.3106	.3179	.3202	.3310	.3632
80	.0165	.0295	.0467	.0666	.0898	.1000	.1023	.1030	.1065	.1267
95	.0029	.0053	.0089	.0140	.0209	.0233	.0239	.0240	.0248	.0320
99	.0001	.0006	.0013	.0022	.0040	.0045	.0046	.0046	.0048	.0068
Y	.6774	.7510	.8103	.9285	.9837	.9838	.9827	.9800	1.0288	1.063
B	.1825	.2656	.3531	.3734	.4062	.4519	.4627	.4668	.4708	.4710
B \sqrt{Y}	.1502	.2302	.3179	.3599	.4028	.4482	.4587	.4621	.4776	.4855

Remarks: The 274-day duration is inconsistent due to the short period of record (use only as an approximation)



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

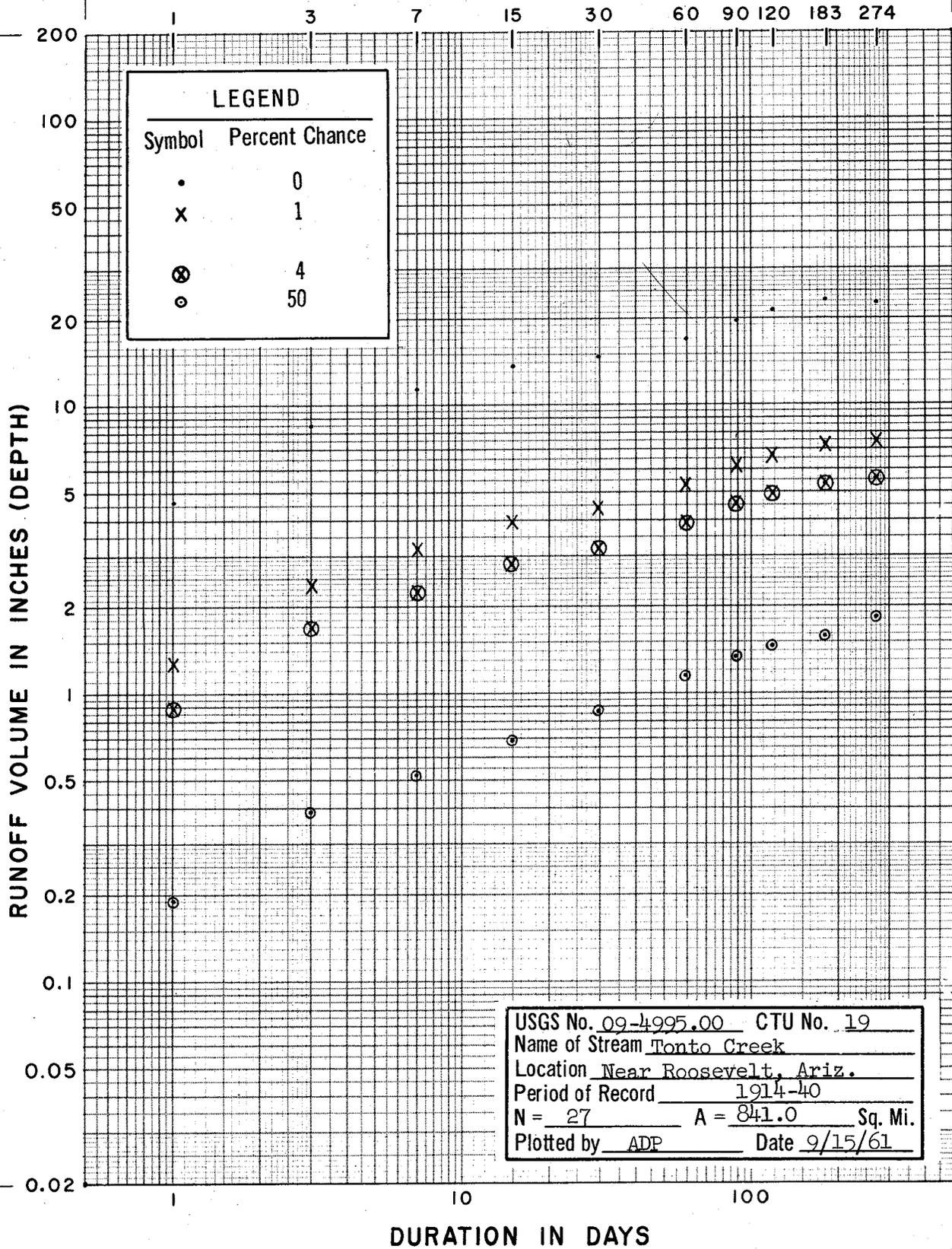
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Tonto Creek Gage Location Above Gun Creek near Roosevelt, Ariz.
 USGS No. 09-4990 CTU No. 18 Drainage Area 675.0 Sq. Mi.
 Period of Record 1942-1960 Date 9/15/61 N = 19 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	4.497	7.444	7.827	8.067	11.78	13.61	16.54	17.85	18.93	18.62
0.2	1.701	2.867	3.152	3.403	4.907	5.815	6.980	7.531	8.090	8.184
1	1.271	2.158	2.416	2.658	3.815	4.562	5.451	5.882	6.346	6.469
2	1.085	1.851	2.096	2.331	3.339	4.010	4.781	5.159	5.578	5.707
4	.8978	1.539	1.769	1.999	2.854	3.446	4.098	4.422	4.794	4.931
10	.6500	1.127	1.331	1.542	2.190	2.674	3.163	3.413	3.721	3.862
20	.4605	.8086	.9862	1.179	1.663	2.058	2.419	2.610	2.864	3.008
50	.2064	.3755	.5009	.6510	.9013	1.154	1.335	1.441	1.605	1.732
80	.0720	.1395	.2134	.3119	.4212	.5666	.6396	.6901	.7882	.8885
95	.0182	.0393	.0751	.1284	.1677	.2410	.2632	.2841	.3353	.3997
99	.0039	.0098	.0230	.0523	.0654	.1011	.1072	.1156	.1406	.1766
Y	1.057	1.168	1.510	1.874	1.794	2.011	1.888	1.917	2.022	2.209
B	.2684	.4331	.4245	.4150	.6107	.6853	.8475	.9077	.9511	.9212
B \sqrt{Y}	.2759	.4682	.5218	.5681	.8179	.9718	1.165	1.257	1.352	1.369

Remarks: A low scale statistic (Beta) in the 274-day duration gives non-representative values in the upper parts of the computed points.



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

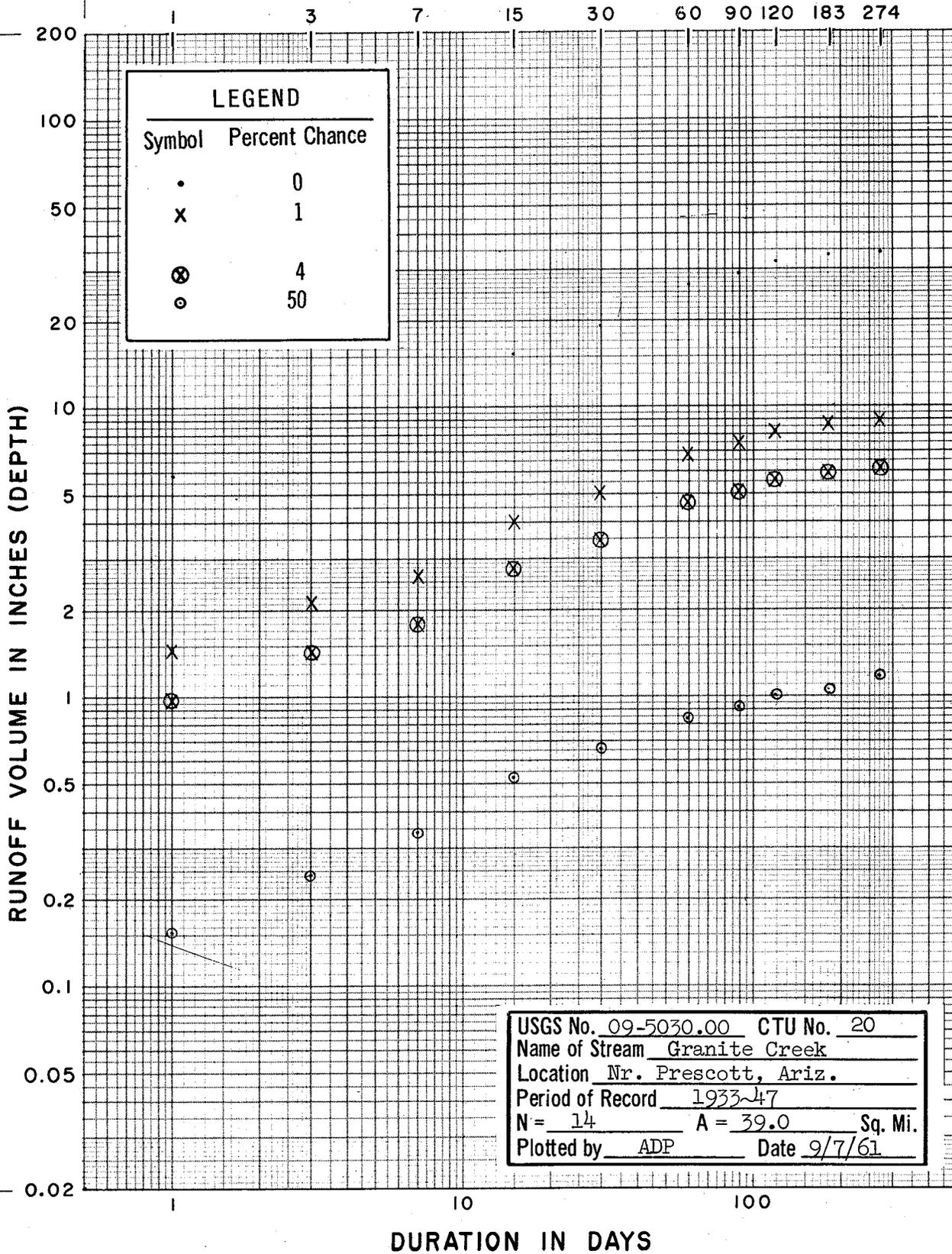
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Tonto Creek Gage Location Near Roosevelt, Ariz.
 USGS No. 09-4995. CTU No. 19 Drainage Area 841 Sq. Mi.
 Period of Record 1914-1940 Date 9/15/61 N = 27 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	4.629	8.502	11.39	13.70	14.72	17.08	19.83	21.59	23.38	22.85
0.2	1.702	3.216	4.307	5.276	5.833	6.952	8.072	8.789	9.518	9.640
1	1.261	2.402	3.218	3.971	4.447	5.356	6.219	6.771	7.333	7.529
2	1.072	2.051	2.748	3.407	3.845	4.661	5.412	5.893	6.382	6.603
4	.8820	1.697	2.273	2.832	3.229	3.954	4.591	4.999	5.413	5.660
10	.6308	1.229	1.646	2.074	2.409	2.993	3.476	3.785	4.099	4.368
20	.4410	.8706	1.166	1.488	1.768	2.238	2.598	2.829	3.064	3.340
50	.1898	.3902	.5226	.6910	.8736	1.164	1.352	1.472	1.594	1.844
80	.0611	.1361	.1823	.2568	.3579	.5135	.5963	.6493	.7031	.8833
95	.0142	.0344	.0461	.0724	.1193	.1893	.2198	.2393	.2591	.3636
99	.0027	.0073	.0098	.0181	.0337	.0646	.0750	.0817	.0885	.1480
Y	1.035	1.067	1.144	1.233	1.433	1.600	1.561	1.575	1.620	1.852
B	.2693	.5048	.6532	.7758	.8035	.9119	1.072	1.162	1.241	1.182
B√Y	.2739	.5216	.6986	.8616	.9621	1.154	1.340	1.459	1.580	1.609

Remarks: A low scale statistic (Beta) in the 274-day duration gives non-representative values in the upper parts of the computed points.



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

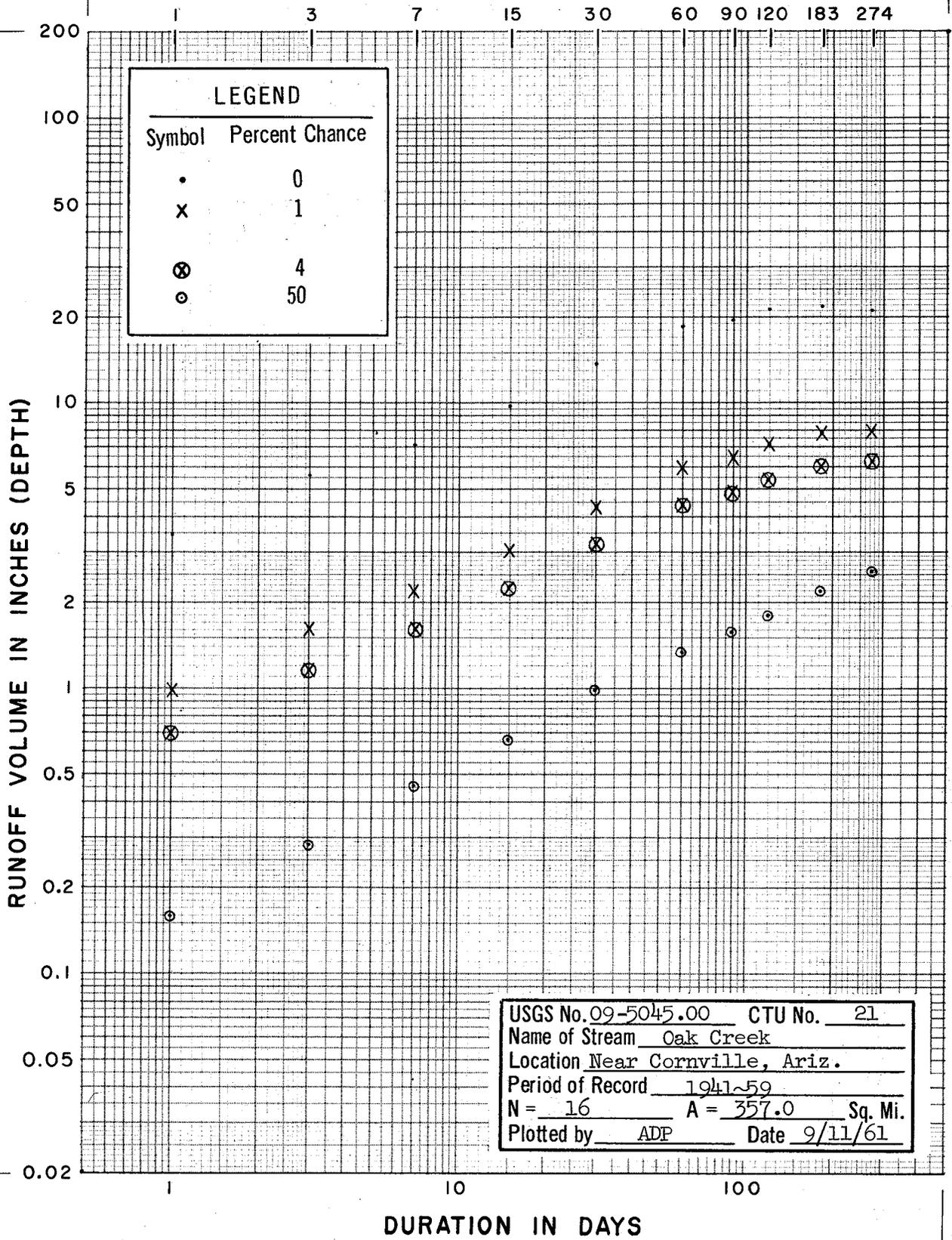
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Granite Creek Gage Location Near Prescott, Arizona
 USGS No. 09-5030. CTU No. 20 Drainage Area 39 Sq. Mi.
 Period of Record 1933-1947 Date 9/7/61 N = 14 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	5.879	8.523	10.04	15.61	19.47	26.87	29.41	32.26	34.01	34.72
0.2	2.019	2.966	3.601	5.600	6.984	9.542	10.44	11.46	12.08	12.46
1	1.449	2.142	2.631	4.091	5.102	6.932	7.587	8.322	8.774	9.101
2	1.207	1.791	2.215	3.444	4.296	5.816	6.367	6.983	7.363	7.663
4	.9672	1.443	1.802	2.802	3.495	4.710	5.156	5.655	5.962	6.235
10	.6570	.9912	1.261	1.962	2.446	3.268	3.577	3.923	4.136	4.364
20	.4300	.6582	.8583	1.335	1.665	2.197	2.405	2.638	2.782	2.969
50	.1526	.2436	.3416	.5312	.6625	.8451	.9250	1.015	1.070	1.182
80	.0344	.0592	.0947	.1472	.1836	.2206	.2415	.2649	.2793	.3275
95	.0059	.0107	.0194	.0302	.0376	.0420	.0460	.0505	.0532	.0671
99	.0004	.0014	.0028	.0044	.0055	.0060	.0066	.0072	.0076	.0099
Y	.6826	.7435	.8745	.8307	.8549	.8202	.8159	.8043	.7928	.8464
β	.3785	.5371	.6126	.9730	1.196	1.657	1.819	2.009	2.135	2.130
β√Y	.3127	.4632	.5729	.8868	1.106	1.501	1.643	1.802	1.900	1.973

Remarks:



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

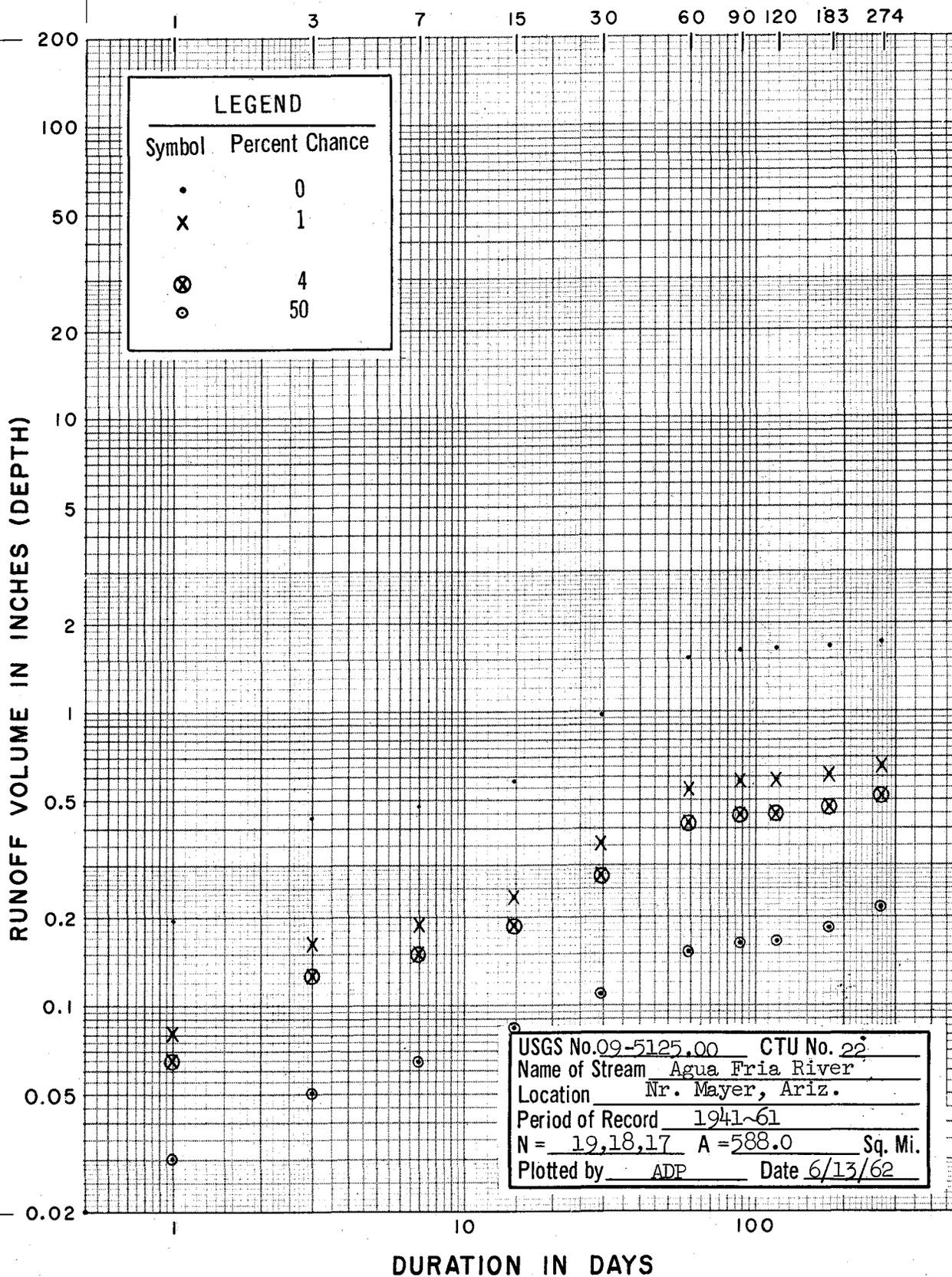
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Oak Creek Gage Location Near Cornville, Arizona
 USGS No. 09-5045. CTU No. 21 Drainage Area 357 Sq. Mi.
 Period of Record 1941~1959 Date 9/11/61 N = 16 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	3.431	5.586	7.103	9.747	13.64	18.66	19.57	21.32	21.89	21.05
0.2	1.298	2.151	2.860	3.967	5.615	7.682	8.256	9.114	9.841	9.805
1	.9696	1.619	2.193	3.057	4.345	5.945	6.448	7.149	7.830	7.951
2	.8279	1.389	1.902	2.660	3.792	5.189	5.655	6.284	6.933	7.119
4	.6850	1.155	1.606	2.256	3.230	4.419	4.848	5.401	6.018	6.259
10	.4959	.8456	1.207	1.708	2.462	3.369	3.741	4.191	4.755	5.064
20	.3513	.6067	.8949	1.277	1.856	2.539	2.861	3.226	3.740	4.082
50	.1575	.2817	.4546	.6645	.9864	1.350	1.579	1.808	2.206	2.570
80	.0549	.1047	.1937	.2931	.4484	.6134	.7565	.8879	1.172	1.490
95	.0139	.0295	.0682	.1080	.1728	.2364	.3114	.3777	.5531	.8013
99	.00295	.0074	.0208	.0369	.0635	.0869	.1268	.1584	.2551	.4243
Y	1.081	1.241	1.459	1.599	1.688	1.711	1.922	2.036	2.427	3.070
B	.2025	.3153	.3919	.5210	.7189	.9773	.9942	1.067	1.057	.9313
B/Y	.2105	.3513	.4735	.6586	.9341	1.278	1.378	1.523	1.646	1.632

Remarks: A low scale statistic (Beta) in the 274-day duration gives non-representative values in the upper parts of the computed points.



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

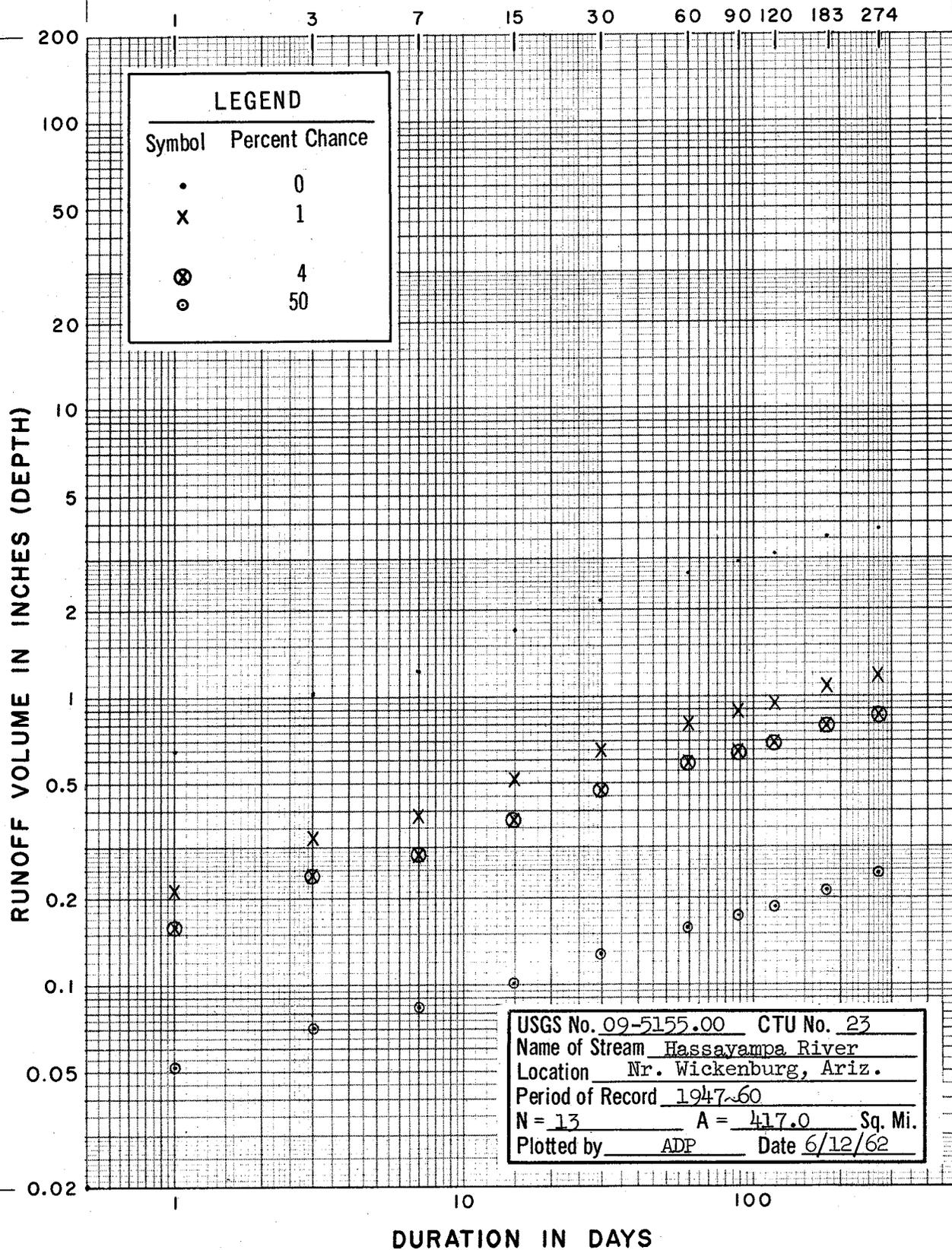
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Agua Fria River Gage Location near Mayer, Arizona
 USGS No. 09-5125 CTU No. 22 Drainage Area 588 Sq. Mi.
 Period of Record 1941 ~ 1960 Date 6/13/62 N = 17,18,19 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	.1947	.4375	.4774	.5823	.9806	1.532	1.627	1.649	1.675	1.728
0.2	.0968	.2018	.2305	.2852	.4484	.6886	.7316	.7415	.7523	.8118
1	.0803	.1628	.1886	.2350	.3609	.5479	.5821	.5900	.6142	.6598
2	.0729	.1454	.1697	.2124	.3216	.4851	.5154	.5224	.5467	.5915
4	.0651	.1274	.1501	.1889	.2814	.4211	.4474	.4534	.4773	.5209
10	.0541	.1025	.1227	.1558	.2257	.3327	.3535	.3583	.3816	.4227
20	.0449	.0821	.1000	.1282	.1802	.2617	.2780	.2818	.3036	.3417
50	.0303	.0509	.0648	.0849	.1107	.1543	.1640	.1662	.1848	.2168
80	.0193	.0289	.0390	.0527	.0621	.0820	.0871	.0883	.1025	.1269
95	.0117	.0150	.0220	.0310	.0318	.0387	.0411	.0417	.0515	.0691
99	.00720	.00767	.0124	.0183	.0159	.0179	.0190	.0192	.0253	.0373
γ	4.340	2.858	3.471	3.857	2.812	2.390	2.388	2.448	2.745	3.171
β	.007599	.01990	.02050	.02391	.04464	.07450	.07919	.07927	.07716	.07580
β/γ	.01583	.03365	.03819	.04696	.07485	.1152	.1224	.1240	.1278	.1350

Remarks: 1952 appears as a high outlier and is omitted from the 1-day duration.
 1951 appears as a high outlier and is omitted from the 1,3,7,15, and 30-day durations
 1941 appears as a high outlier and is omitted from all durations.



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

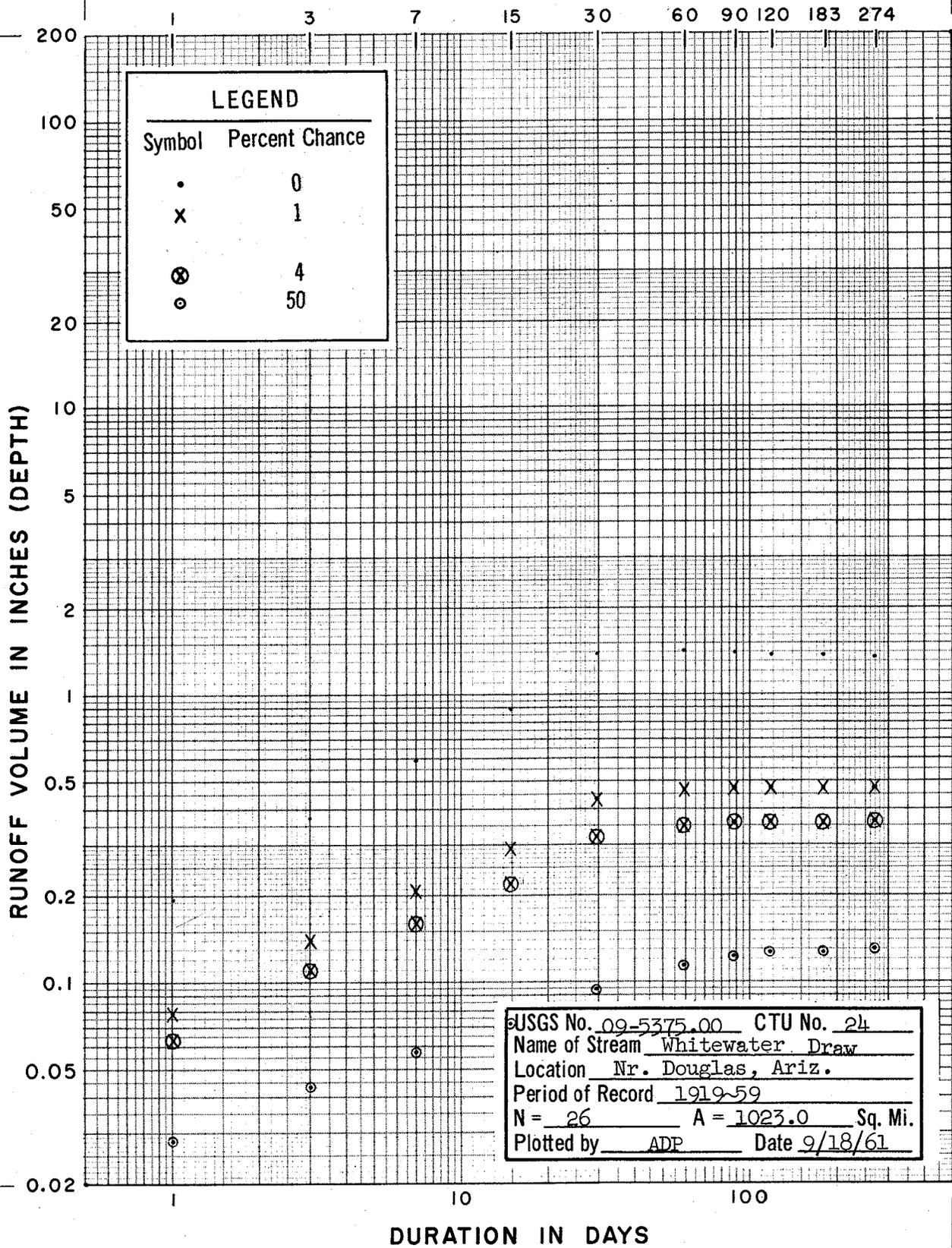
VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Hassayampa River Gage Location At Box Dam site Near Wickenburg, Arizona
 USGS No. 09-5155. CTU No. 23 Drainage Area 417 Sq. Mi.
 Period of Record 1947-1960 Date 6/12/62 N = 13 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	.6390	1.036	1.220	1.701	2.158	2.664	2.930	3.128	3.578	3.798
0.2	.2696	.4217	.4967	.6740	.8553	1.056	1.161	1.240	1.418	1.529
1	.2106	.3249	.3827	.5138	.6520	.8049	.8851	.9450	1.081	1.173
2	.1847	.2828	.3331	.4442	.5637	.6959	.7652	.8170	.9344	1.017
4	.1583	.2399	.2825	.3731	.4734	.5844	.6427	.6862	.7847	.8586
10	.1222	.1816	.2139	.2784	.3533	.4361	.4795	.5120	.5855	.6456
20	.0934	.1358	.1599	.2043	.2593	.3201	.3520	.3758	.4298	.4786
50	.0516	.0706	.0832	.1009	.1281	.1581	.1739	.1856	.2123	.2431
80	.0247	.0312	.0367	.0414	.0525	.0648	.0712	.0761	.0870	.1036
95	.0102	.0115	.01352	.0138	.0175	.0216	.0237	.0254	.0290	.0365
99	.00414	.00392	.00462	.00389	.00494	.00610	.00479	.00716	.00818	.0111
Y	1.904	1.648	1.567	1.431	1.419	1.371	1.356	1.353	1.370	1.548
B	.03261	.05454	.06588	.09293	.1184	.1487	.1645	.1758	.1998	.2035
B \sqrt{Y}	.0450	.0700	.08246	.11116	.14108	.17414	.1915	.2045	.2338	.2532

Remarks: 1951 appears as a high outlier and is omitted from all durations.



VOLUME - DURATION - PROBABILITY CURVES ON AN ANNUAL BASIS

VOLUME-DURATION-PROBABILITY ANALYSIS
(Two-Parameter Gamma Distribution)

Name of Stream Whitewater Draw Gage Location Near Douglas, Arizona
 USGS No. 09-5375. CTU No. 24 Drainage Area 1023 Sq. Mi.
 Period of Record 1919~1959 Date 9/18/61 N = 26 Years

Runoff Volume in Inches (Depth)

% Probability (Greater than)	Duration in Days									
	1	3	7	15	30	60	90	120	183	274
0.0	.1934	.3744	.5923	.8918	1.391	1.419	1.398	1.367	1.365	1.345
0.2	.0946	.1727	.2642	.3762	.5663	.5985	.6016	.6008	.6002	.6002
1	.0778	.1393	.2096	.2938	.4363	.4674	.4738	.4749	.4744	.4760
2	.0703	.1244	.1852	.2577	.3797	.4100	.4173	.4190	.4186	.4208
4	.0624	.1090	.1604	.2209	.3220	.3514	.3595	.3620	.3616	.3644
10	.0514	.0877	.1262	.1705	.2438	.2712	.2804	.2835	.2832	.2866
20	.0422	.0703	.0988	.1304	.1823	.2073	.2171	.2208	.2206	.2243
50	.0278	.0435	.0576	.0720	.0948	.1145	.1233	.1271	.1270	.1308
80	.0171	.0247	.0301	.0345	.0418	.0548	.0620	.0652	.0652	.0684
95	.0100	.0129	.0139	.0142	.0154	.0226	.0272	.0293	.0293	.0315
99	.0058	.0066	.0063	.0058	.0053	.0092	.0117	.0130	.0130	.0143
Y	3.801	2.921	2.290	1.889	1.608	1.915	2.126	2.153	2.198	2.317
B	.008027	.01684	.02921	.04572	.07410	.07218	.06900	.06849	.06771	.06575
B \sqrt{Y}	.0156	.0288	.0442	.0628	.0940	.0999	.1006	.1005	.1004	.1004

Remarks: All durations greater than the 60-day have low Betas. The upper parts of these computed points are non-representative.