Memorandum

Probable Effect of Silt on the
Yield of Matilija Reservoir
by
Richard H. Jamison
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Purpose of Memorandum

The purpose of this memorandum is to show, graphically, the probable effect of silt deposit on the future yield of Matilija Reservoir. Also to set up an estimate of the cost of the new water which can be obtained from the reservoir in order that this estimate may be used as a guide in determining the price of the water.

Future Weather Conditions

To look into the future in regard to weather conditons, it is necessary to look at past records.

In order to do this the rainfall record at the Sheldon Ranch was used. The gage is located about a mile from the dam.

The annual mean was determined for the period 1892-93 to 1947-48. The percent of this mean for each year was computed. The accumulated variation, in percent, from this mean was determined. The result was platted and is shown on Graph No. 1. Lines sloping downward to the right, on this graph indicate years below normal and lines sloping upward to the right indicate years above normal. A general trend downward to the right indicates a dry period and a general trend upward to the right indicates a wet period.

It will be noted that years above normal occur during dry periods and that years below normal occur during wet periods. The downward slope at the right end of the graph indicates that we have entered

a dry period. In this forecast of the future, the last dry period, that is, the period beginning 1917-18 and extending to 1933-34 was selected. During this dry period there were four years with rainfall above normal that would have caused run-off more than sufficient to fill Matilija Reservoir.

Silt Accumulation in Matilija Reservoir

The probable silt accumulation in the reservoir was determined by using the factor 0.6 of one percent of the discharge entering the reservoir. This factor was taken from the report "Safe Yield of Matilija Reservoir", by Harold Conkling dated May 1948. Table 3 on Page 18a of this report shows that a silt deposit of 0.69% of the discharge of the stream might be expected. However, because of a statement in footnote No. 4 of this table, a reduction of 13% of this 0.69% was used, giving a factor of 0.6% of the discharge of the stream. Using this factor table No. 1 was prepared. This table shows the annual silt deposit and the accumulated amount that might be expected. The annual discharge of 1921-22 through 1926-27 was estimated by Mr. H. O. Banks of Mr. Conkling's office. All other years are measured discharge. This accumulation of silt or loss of storage space is shown on Graph No. 2.

Future Operation of Matilija Reservoir-1830 Ac. Ft. Yield

Graph No. 2 was prepared to show the probable effect of siltation on the yield of the reservoir using an 1830 acre foot yield. This is the yield of new water determined after the Upper Gravity Rights and the Lower Pumping Rights have been considered.

The graph begins with the year 1918 (top of graph) and assumes that the dam was built and that the reservoir was full. The span of years 1918 to 1946 covers one dry and one wet period, (see graph No. 1). Beginning with the year 1946 it is assumed that the future pattern of weather conditions and runoff will be similar to that beginning in 1918. The span of years 1918 to 1939 are repeated on the graphs.

In order to project this scheme into the future the years are shown along the bottom of the graph beginning with the year 1946 written under the year 1918 at the top of the graph. The capacity in acre feet, of the reservoir is shown vertically at each end of the graph and extends from zero at the bottom to 7000 acre feet at the top. The diagonal line beginning in the fall of 1949 (bottom of graph) and extending upward across the graph indicates the storage lost due to siltation. This graph indicates that the coming winter (1949-50) will be a season of above normal rainfall and runoff that will fill the reservoir. Siltation is assumed to start 1949-50. The hatched blocks above the 7000 acre feet capacity line indicate periods of overflow. The depressions below the 7000 acre feet line indicate draft on storage. At the bottom of the graph is shown the period of bond redemption beginning in 1946 and ending 1980. An inspection of Graph No. 2 reveals that beginning in 1950 a safe yield of 1830 acre feet annually could be expected for 31 years with possible deficiencies during the latter parts of 1977 and 1980. Beyond 1980 the possibility of obtaining 1830 acre feet annually is questionable.

It will be necessary to make surveys of the reservoir, probably every ten years to determine the capacity lost by silt deposit. The wet period from 1932 to 1946 inclusive, was a very wet one and contained some years of extremely high runoff, with large silt carrying power.

It is possible that the next wet period, that is, the one projected on the graph as beginning in 1960 and ending in 1974, will not be so wet and thus carry less silt. If this should prove to be true, then we might expect 36 years of 1830 acre feet annual safe yield. For the purpose of this memorandum the 36 year period is assumed for determining costs. However the future silt surveys will be the deciding factor in this respect.

In Mr. Conkling's "Report on Cost and Location of Pipelines from Matilija Reservoir for Distribution of Water", dated March 1949, it is suggested that by constructing Casitas Reservoir it would be possible to serve the lower pumping rights from Casitas Reservoir thus relieving the Matilija Project of this responsibility. If this can be accomplished a yield of 3700 acre feet could be expected from Matilija Reservoir for the upper valley. Considerable effort should be made to accomplish this suggestion. However since Casitas Dam is not yet in existance, for this memorandum a yield of 1830 acre feet must be used in determining the cost of water from Matilija Reservoir. Should Mr. Conkling's suggestion be accomplished the cost of water from Matilija Reservoir would be revised downward.

Cost of Matilija Project and Cost of Water

It is difficult at this time to determine the total amount of money that will be spent on the Matilija Project before it is completed and ready for use.

An itemized table of expenditure on the project was prepared by Mr. Robert L. Ryan, Flood Control Engineer, dated February 26, 1949, which shows an expenditure as of that date of $2,705,704.

The "Report on Cost and Location of Pipe Lines from Matilija Reservoir for Distribution of Water" by Mr. Harold Conkling, dated March 1949, shows an estimated cost of the pipe line to be $708,000.

The total probable cost is the sum of these expenditures:

Expenditures to February 26, 1949	$2,745,704
Estimated cost of pipe lines.	708,000
	$3,453,704

Since this amount, which is partially an estimate, is so close to the amount of the bonds $3,400,000), the amount of the bonds is used in this memorandum as the cost of the project. The total amount of the interest and redemption of the bonds for the 34-year period is $4,199,750.

As stated before, a yield of 1830 acre-feet per year for 36 years might be expected. However, some curtailment at times may be necessary.

With these assumptions the cost of the water per acre-feet for the cost of the bonds equals $63.75. An amount of $25,000 is assumed for the annual operation and maintenance cost or $13.66 per acre-foot

On these assumption the total cost per acre-foot is $77.41. This cost per acre-feet when expressed in cost per 100 cubic feet is 17.77 cents per 100 cubic feet. This cost is based on the sale of water beginning in 1950.

Charge for Water by Various Water Companies

It is assumed that the water from Matilija Reservoir will go entirely for domestic use. On pages 7, 8, 9, are listed the costs or charges to the consumer by six companies serving domestic water.

The charges are expressed, in most cases, in cost per 100 cubic feet. Where the amount is expressed in gallons, the gallons have been changed to cubic feet and the cost computed per 100 cubic feet. All have been extended to show the rate per acre-feet.

The cost per 100 cubic feet for the first 500 cu.ft. varies from 14.3 cents charged by the Santa Paula Water Works to 40.2 cents charged by the Los Ranchitos Mutual Water Company. It is noted that the latter company charges only 2.88 cents per 100 cu. ft. for all water used over 468 cu. ft.

The following list shows the charges per 100 cu. ft. by the various water companies in the Ventura-Ojai area for the first 500 cu.ft. or less.

Ojai Mutual Water Company	24.0 ¢
Southern Calif. Water Company	25.0 ¢
Los Ranchitos Mutual Water Co.	40.2 ¢
Garden Water Co. (Oakview)	20.0 ¢
Ventura Water Dept. (inside city) (treated)	22.0 ¢
Ventura Water Dept. (outside city) (treated)	33.0 ¢
Average	27.4 ¢

None of these companies has had any expense in creating storage space for the supply. Practically all of the cheap natural water in Ventura County has been appropriated. The increase in population with its increase in water demand is overtaking the natural cheap water supply in drought periods. For example, the City of Ventura is now mining its last cheap emergency supply.

Surface storage is necessary if the economic structure of Zone 1 is to be protected. Surface storage is not cheap in this area when compared to underground storage.

CHARGES TO CONSUMERS
BY VARIOUS WATER COMPANIES

(1) Ojai Mutual Water Company

	Cubic Feet	Cost per 100 cu.ft.	Total Cost	Rate per Acre-foot
1st	1,000	24¢	$2.40 min.	104.54
Next	4,000	19¢	7.60	82.76
"	10,000	16¢	16.00	69.70
"	15,000	14¢	21.00	60.98
"	70,000	12¢	16.27	52.27
Over	100,000	10¢		43.56

Cost of 1st Acre-foot $63.27
Cost of 2nd " " 52.27
Cost of 3rd " " 46.14
Cost of all over 3rd Ac.ft..... 43.56 per Ac.Ft.

(2) Southern California Water Company
Ojai District

	Cubic Feet	Cost per 100 cu.ft.	Total Cost	Rate per Acre-foot
1st	600	25¢	$ 1.50 min.	$108.90
Next	9,400	25¢		108.90
"	90,000	20¢		87.12
Over	100,000	15¢		65.34

Cost of 1st Acre-foot $92.12
Cost of 2nd " " 87.12
Cost of 3rd " " 71.78
Cost of all over 3rd Ac.ft..... 65.34 per ac.ft.

(3) Los Ranchitos Mutual Water Company
Tract - South of Meiners Oaks

1st 3500 gallons, or 468 cu.ft.....$2.00 minimum
All over 3500 gallons at the rate of 13,000 gallons or
1739 cu.ft. for 50¢ ..... 2.88¢ per 100 cu.ft.

	Cubic feet	Cost per 100 cu.ft.	Total Cost	Rate per Acre-foot
1st	468	42.74¢	$2.00	$186.18
All over	468	2.88¢		12.55

Cost of 1st Acre-foot ..... $ 14.40
Cost of all over 1st Acre foot ..... 12.55 per ac.ft.

(4) Gardens Water Company
Oak View, Calif.

	Cubic Feet	Cost per 100 cu.ft.	Total Cost	Rate per Acre foot.
1st	750	20¢	$1.50 min.	$87.12
Next	1,250	20¢	2.50	87.12
"	8,000	17.5¢		76.23
Over	10,000	15¢		65.34

Cost of 1st Acre-foot..... $68.34
Cost of all over " " " ..... 65.34 per ac.ft.

(5) Ventura City Water Department
Within City Limits. Treated Water

	Cubic Feet	Cost per 100 cu.ft.	Total Cost	Rate per Acre-foot
1st	500 or less	22¢	$1.10	$95.83
Next	500	17¢	.85	74.00
"	9,000	13¢		56.63
"	10,000	11¢		47.92
Over	20,000	11¢		47.92

Cost of 1st acre-foot.....$50.57
Cost of all over " " " 47.92

(5A) Ventura City Water Department
Outside City Limits. Treated Water

	Cubic Feet	Cost per 100 cu.ft.	Total Cost	Rate per Acre-foot
1st	500 or less	33¢	$1.65	$143.75
Next	500	19¢	.95	82.76
"	9,000	17¢		74.05
"	10,000	15¢		65.34
Over	20,000 (treated)	15¢		65.34
"	20,000 (raw)	13¢		56.63

Cost of 1st ac.ft .....$68.24 Treated
Cost of all over " " " 65.34

Cost per acre-foot, Raw water..... 56.63

(6) Mound Water Company

Bills are rendered every quarter of year.
50,000 gallons per year costs $28.00
12,500 gallons, or 1671 cu.ft. per three month period cost $7.00 minimum.
Next 7,500 gallons, or 1000 cu.ft. and over costs 50¢ or 5¢ per 100 cu.ft.

	Cubic Feet	Cost per 100 cu.ft.	Total Cost	Rate per Acre-foot.
1st	1671	41.89¢	$7.00	$182.47
Next	1000 and more	5.00¢		21.78

On a Monthly Basis

	Cubic Feet	Cost per 100 cu.ft.	Total Cost	Rate per Acre-foot.
1st mo.	557	41.89¢	$2.34	
2nd "	557	41.89¢	2.33	
3rd "	557	41.89¢	2.33	
	1671		$ 7.00	

Quarterly bill is $7.00 plus cost of extra water at 5¢ per 100 cu.ft.

(7) Santa Paula Water Works

	Cubic Feet	Cost per 100 cu.ft.	Total Cost	Rate per Acre-foot
1st	700	14.3¢	$1.00	$62.29
Next	4,300	10 ¢	4.30	43.56
"	5,000	7 ¢	3.50	30.49
"	33,560	5 ¢	16.78	21.78

Cost of 1st Ac.ft.....$25.58

Domestic Water Demand from Matilija Reservoir

The probable domestic demand is based on the following assumptions:

100 gallons per person.
3 1/3 persons per family.
1 family per lot.
Size of lot, 60 ft. x 120 ft. or 7200 sq.ft.

These assumptions can be expressed in the following values if the full amount is used.

Average Monthly Amount per lot	1337 cu. ft.
Annual Amount per lot	16,044 cu. ft.
Annual Depth of water on lot	2.23 ft. or 26.75 in.
Annual Amount in acre-feet	0.3683

With these assumptions and no line loss, 1830 acre-feet will serve 4968 lots.

On the above assumption, if the Zone charges 18 cents per 100 cu. ft. and it is delivered to the consumer for 33 cents per 100 cu. ft., a family using the average amount as shown above will pay a monthly bill of $4.41. No sliding scale has been considered.

Chlorinating the Water

Since most or all of the water is likely to be used for domestic purposes it might be well for the Zone to give some consideration to chlorinating the water.

A chlorinating plant is expensive and for the small sub-divider who expects to use Matilija Reservoir water this may become a problem. Some of the older established sub-divisions desiring supplemental water from the Matilija Reservoir are now making an effort to form a County Water District for their mutual benefit. Chlorination is one of these benefits.

This suggestion that the Zone chlorinate the water is made for the benefit of those desiring to sub-divide small tracts and also to expedite the creating of market for the water. The chlorinating could probably be done with no increase in the wholesale price of 18 cents per 100 cubic feet.

Conclusion

As stated at the beginning, the purpose of this memorandum is to show the probable active life of Matilija Project and the cost of water based on the bond issue. It is hoped that this memorandum can be used as an aid in forming a policy for the operation of Matilija Project.

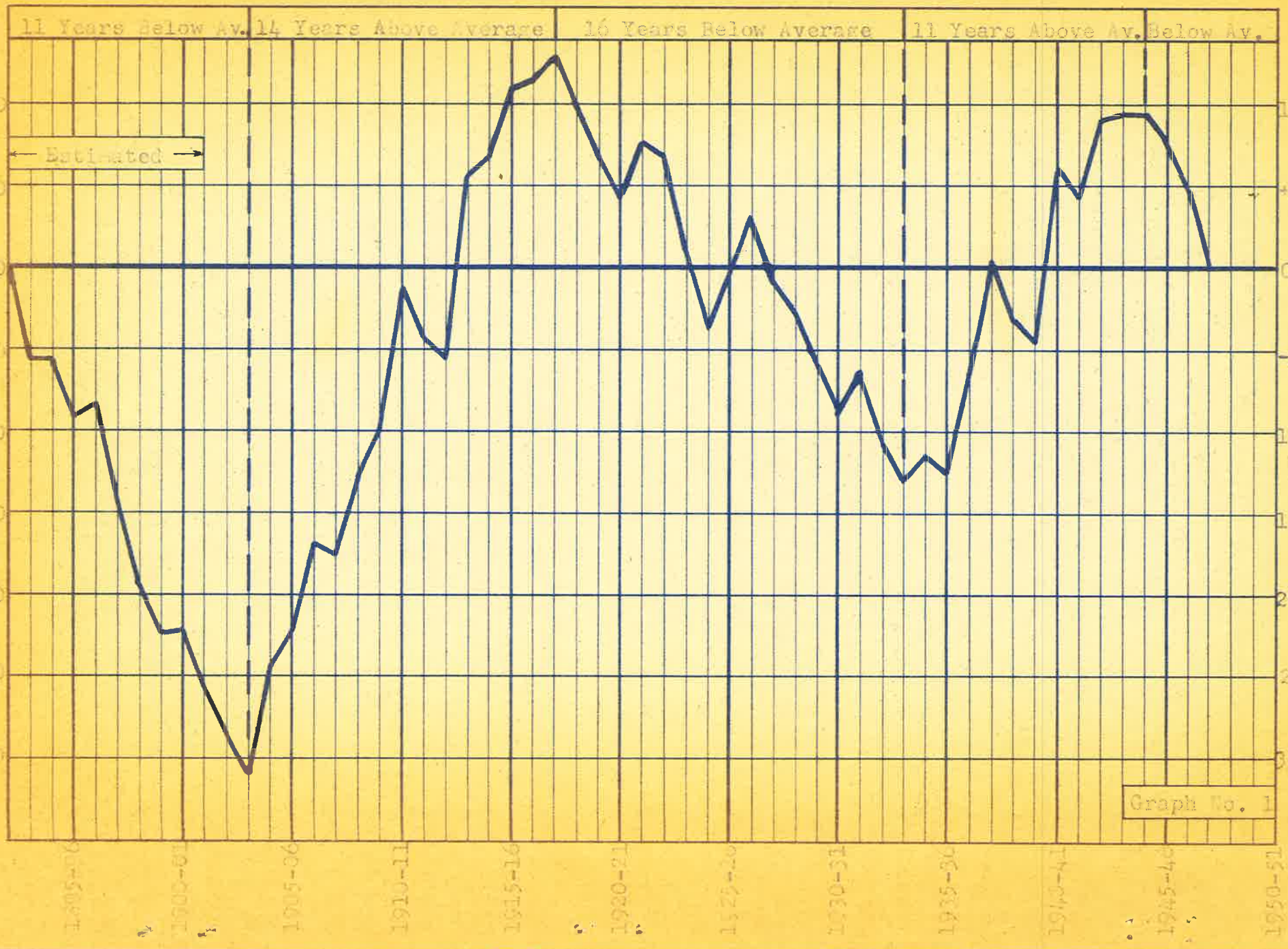
Table No. 1
Matilija Reservoir
Probable Silt Accumulation

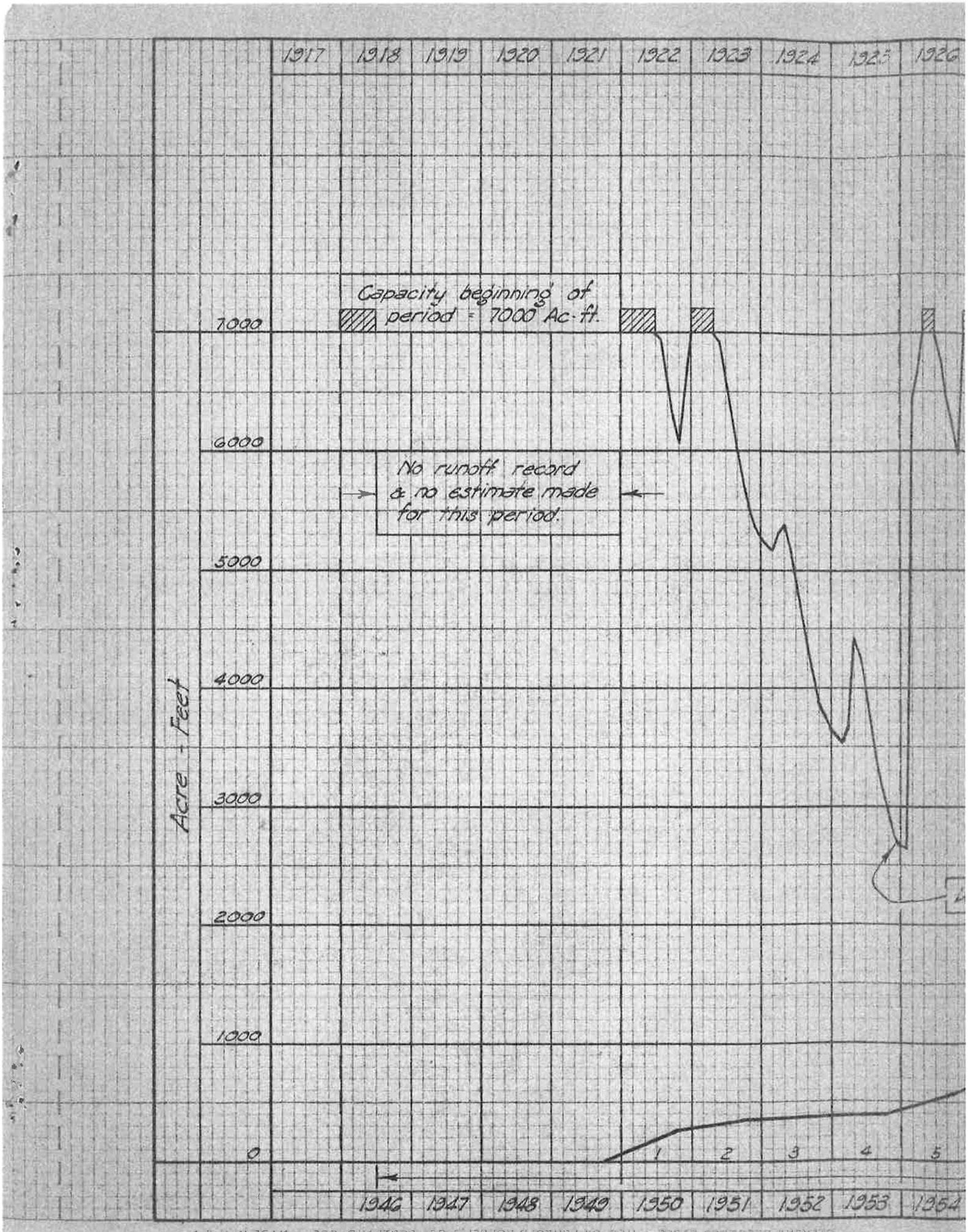
Substitute Runoff year.	Runoff year.	Annual Discharge. Ac-ft.	Silt deposit 0.6% of disch. Ac-ft	Silt Accumulation Ac-ft.
1	2	3	4	5
	1918-19			
	19-20			
	1920-21			
	21-22	45,000 *	270	270
	22-23	14.200 *	85	355
	23-24	2,800 *	17	372
	24-25	3,600 *	22	394
	1925-26	32,300 *	194	588
	26-27	35,000 *	210	798
	27-28	5,380	32	830
	28-29	3650	22	852
	29-30	3630	22	874
	1930-31	1950	12	886
	31-32	25,100	151	1037
	32-33	8,930	54	1091
	33-34	12,200	73	1164
	34-35	25,840	155	1319
	1935-36	12,780	77	1396
	36-37	51,230	307	1703
	37-38	81,160	487	2190
	38-39	13,200	79	2269
	39-40	8,660	52	2321
	1940-41	125,280	752	3073
	41-42	12,950	78	3151
	42-43	59,660	358	3509
	43-44	37,620	226	3735
	44-45	14,350	86	3821
	1945-46	18,130	109	3930

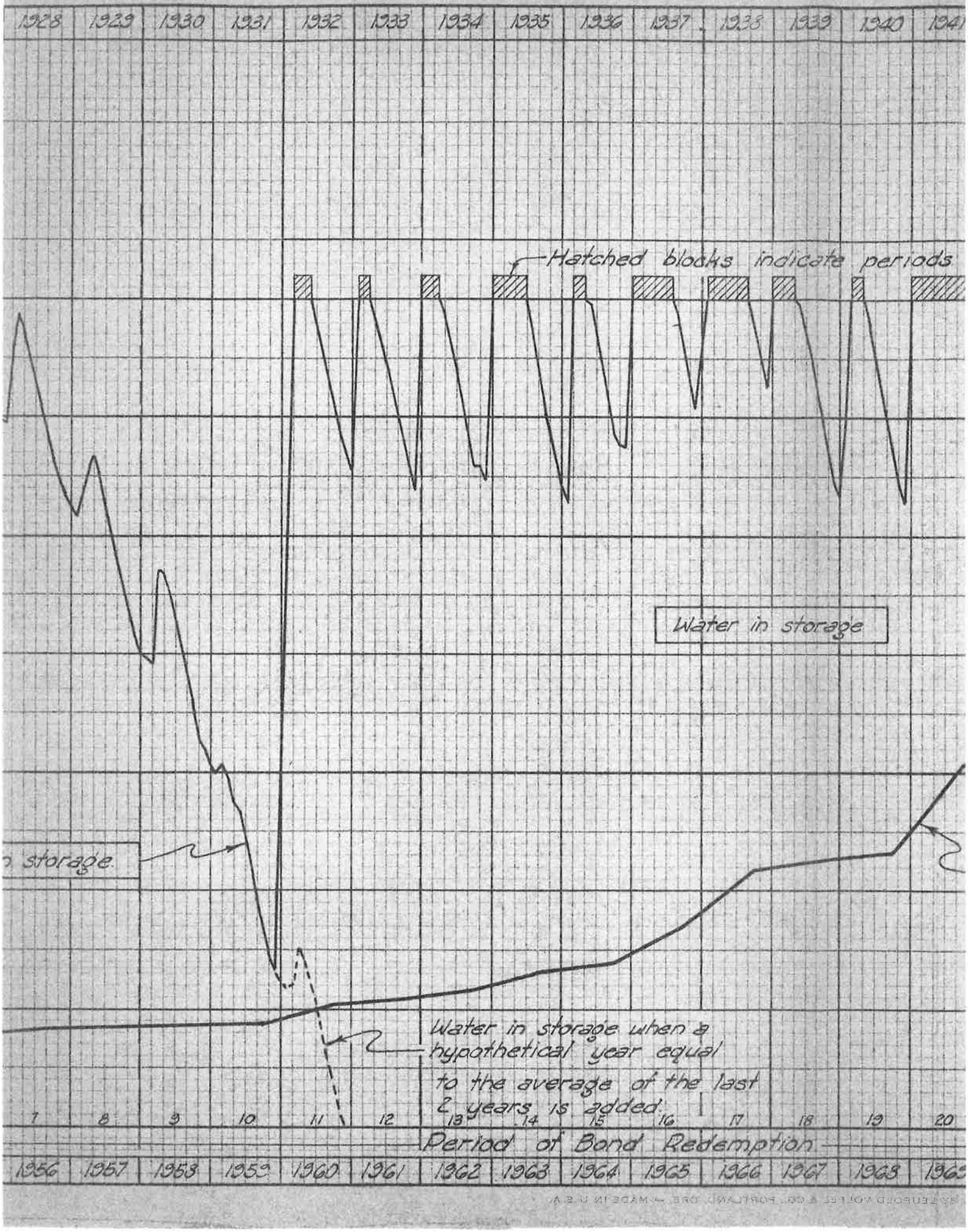
Substitute Runoff year	Runoff year	Annual Discharge Ac-ft.	Silt deposit 0.6% of disch. Ac-ft.	Silt Accumulation Ac-ft.
1	2	3	4	5
1918-19	1946-47	9546	57	3987
19-20	47-48	2200	13	4000
1920-21	48-49	—	* 12	4012
21-22		45,000*	270	4270
22-23		14,200*	85	4355
23-24		2,800*	17	4372
24-25		3,600*	22	4394
1925-26		32,300*	194	4588
26-27		35,000*	210	4798
27-28		5380	32	4830
28-29		3650	22	4852
29-30		3630	22	4874
1930-31		1950	12	4886
31-32		25,100	151	5037
32-33		8930	54	5091
33-34		12,200	73	5164
34-35		25,840	155	5319
1935-36		12,780	77	5396
36-37		51,230	307	5703
37-38		81,160	487	6190
38-39		13,200	79	6269
39-40		8,660	52	6321
1940-41		125,280	752	7073
41-42		12,950	78	
42-43		59,660	358	
43-44		37,620	226	
44-45		14,350	86	
45-46		18,130	109	

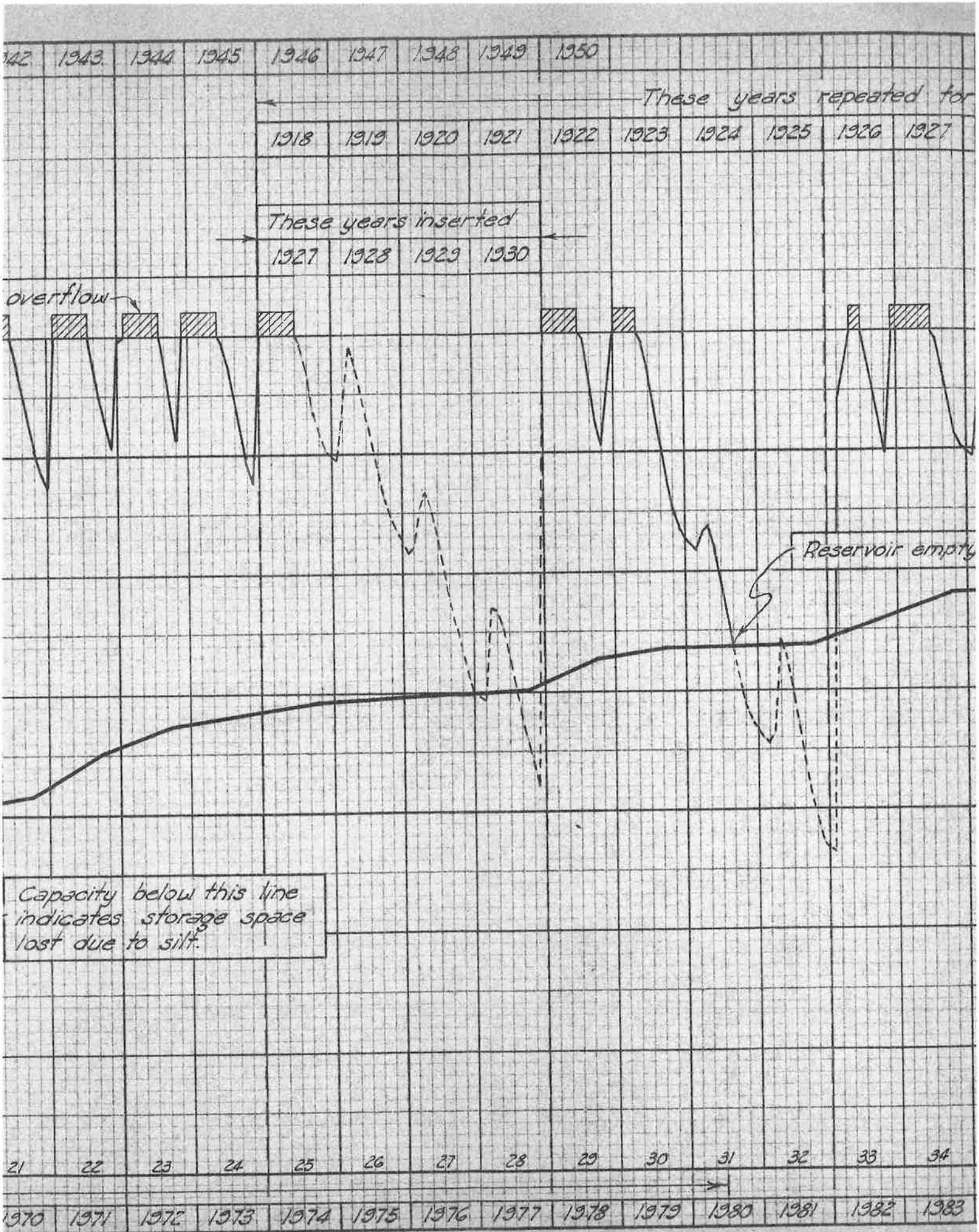
* = Estimated.

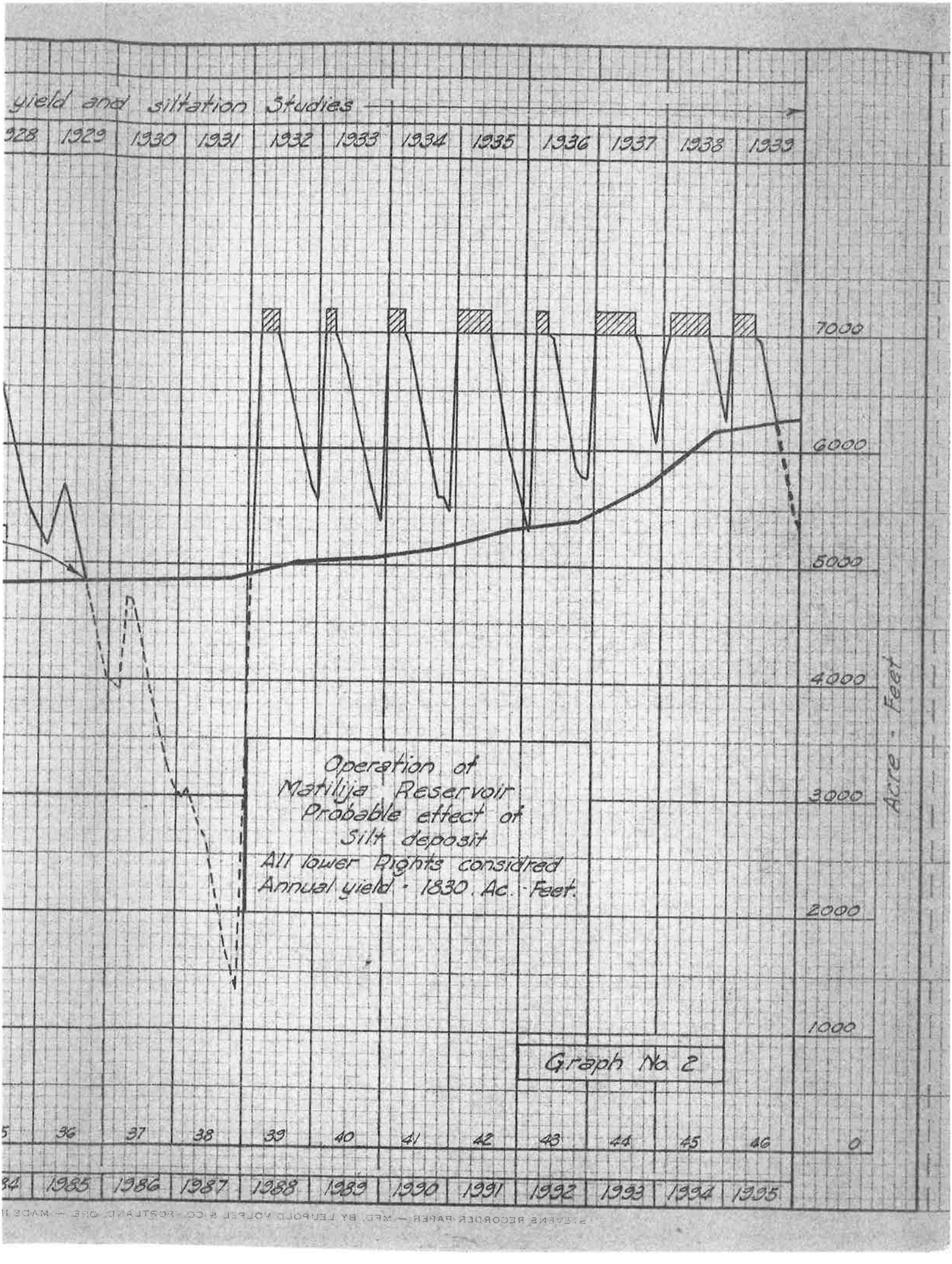
Rainfall Record at Sheldon Ranch
Cumulative Variation, in Percent, of Annual Mean
55 Years of Record




1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
Capacity beginning of period = 7000 Ac-ft.
7000
6000
5000
4000
3000
2000
1000
0
No runoff record & no estimate made for this period.
Acre - Feet
1
2
3
4
5
1946
1947
1948
1949
1950
1951
1952
1953
1954


1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
Hatched blocks indicate periods
Water in storage
storage
Water in storage when a hypothetical year equal to the average of the last 2 years is added.
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Period of Bond Redemption
1956
1957
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969


1942
1943
1944
1945
1946
1947
1948
1949
1950
These years repeated for
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
These years inserted
1927
1928
1929
1930
overflow
Reservoir empty
Capacity below this line indicates storage space lost due to silt.
21
22
23
24
25
26
27
28
29
30
31
32
33
34
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983


yield and siltation Studies
1928 1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939
7000
6000
5000
4000
3000
2000
1000
0
Acre - Feet
Operation of
Matilija Reservoir
Probable effect of
Silt deposit
All lower Rights considred
Annual yield - 1830 Ac. - Feet.
Graph No. 2
36 37 38 39 40 41 42 43 44 45 46
1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995