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CASITAS Municipal Water District Ventura Lib

#37

INTER-DEPARTMENTAL MEMORANDUM

TO: VIRGINIA
RE: JOHN
THIS MAY BE A LITTLE DATED...

DATE: June 7, 1989

TO: General Manager

FROM: Engineering Department Manager

SUBJECT: WATER SUPPLY AND DEMAND STATUS REPORT

RECOMMENDATIONS

It is recommended that the General Manager request that the Board of Directors take the following actions:

1. Direct staff to develop the alternatives for matching demand to supplies within 3 to 6 months.

2. Direct staff to advertise this discussion on supply and demand as widely as possible, inviting all interested groups to become a part of the discussion.

BACKGROUND AND OVERVIEW

This report summarizes information that predicts that Casitas Municipal Water District's water supply will not meet demands within one to two years. The various options to provide adequate supplies or reduce demands are then identified.

I. WATER SUPPLIES

A. Lake Casitas

The total capacity of Lake Casitas is 254,000 acre-feet, with a usable capacity of approximately 250,000 acre-feet. The lake first stored water in 1959 and filled for the first time in 1978. While present storage is approximately 188,000 acre-feet, it is projected that storage may drop to approximately 155,000 acre-feet by January 1, 1990, assuming no appreciable runoff during the next 8 months.

The United States Bureau of Reclamation (USBR) initially determined the safe annual yield of Lake Casitas in the project feasibility studies which were published in 1954. The USBR defined the safe annual yield of the project as the firm annual yield obtainable over the most critical runoff period of record under the most critical sedimentation conditions, which occur at the end of the project repayment period. The USBR studies pointed out that the most critical period of record is not the same for all sizes of reservoirs. For smaller reservoirs the most intense drought is critical, while for larger reservoirs, the

drought with the greatest product of length times mean deficiency is critical.

The United States Bureau of Reclamation (USBR) found that the drought with the greatest product of length times mean deficiency provided the critical period for Lake Casitas. The most critical period on record at that time was from 1918 through 1936. The USBR assumed that the drought would occur during the 43rd to 60th project years, or 2001 to 2018, when Matilija storage would be reduced considerably due to sedimentation.

The 1954 USBR studies found that the safe annual yield of Lake Casitas was 27,800 acre-feet with integrated operation of Lake Matilija, in order to maximize diversions through the Robles Canal. During the early years of the Casitas project operations, before modifications to Matilija Dam were made, Casitas Municipal Water District (CMWD) operated under the assumption that the safe annual yield was 27,800 acre-feet.

In October of 1968, the USBR issued a report entitled Ventura River Project Extension, Ventura County, California, which reported on the feasibility of enlarging the Robles Diversion Canal from its original capacity of 500 cfs to 2,200 cfs. This report indicated that the USBR had reduced their estimates of the Lake Casitas safe annual yield from 27,800 acre-feet per year to 20,350 acre-feet per year, based on the following circumstances:

1. New critical drought period - The period 1944 through 1965 was found to produce a greater product of length times mean deficiency than the 1918-1936 period used in the original studies. Thus, it became the critical period.

2. Increased evaporation - A greater evaporation rate was used for the 1968 studies based on records maintained during the first few years of Lake Casitas operation.

3. Reduced regulatory storage in Lake Matilija - By 1967, due to a combination of lowering the crest of Matilija Dam for safety reasons, and heavy silt loading during wet years, the capacity of Lake Matilija had been reduced from its original 7,000 acre-feet to 3,000 acre-feet. The projected capacity of Lake Matilija used for this study was 1,900 acre-feet.

All of the USBR's safe yield studies were carried out on the basis of

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fully utilizing the entire storage capacity of Lake Casitas during the drought cycle. The lake would be full at the beginning of the long term drought and would be drawn to zero active storage during the most critical drought year. The full safe annual yield would have been available every year throughout the drought period.

During the past several months, numerous studies relative to the actual safe annual yield of Lake Casitas under current operating criteria and conditions, as well as under various projected assumed conditions, have been carried out by Don Kienlen, of Murray, Burns and Kienlen, Consulting Engineers, Inc. (MBK). These studies have been completed in accordance with Casitas' agreements with MBK to perform Supply and Demand and Ojai Groundwater Basin Investigations.

The safe annual yield study which depicts current operating criteria and conditions is identified as Study Number D-20. The safe annual yield of Lake Casitas as determined by this study is 21,500 acre-feet. Major differences between the United States Bureau of Reclamation's (USBR) 1968 study and the current study are as follows: (1) Integrated operation with Lake Matilija is deleted from the current study. As current storage capacity of Matilija is only 1,100 acre-feet, it is assumed that any single major flood year, or a very few above-normal runoff years, will cause complete sedimentation, thereby eliminating the capacity of increasing diversions to Casitas. (2) Decreased net evaporation from Lake Casitas. Long-term records maintained by Casitas Municipal Water District (CMWD) since 1959 show significantly less evaporation than used by the USBR. The USBR studies estimated the net evaporation at 3.08 feet per year, compared to 1.9 feet based on actual records. For the 1944 to 1965 critical dry cycle, net evaporation averaged 4,600 acre-feet under the USBR studies, compared to only 2,700 acre-feet under the current Study Number D-20.

Figure Number 1 shows the storage in Lake Casitas for the period 1944 through 1983 under Study Number D-20, utilizing a safe annual yield demand of 21,500 acre-feet. Study Number D-20 assumes that downstream releases to the Ventura River for Water Rights purposes are 20 cfs in accordance with the Robles Diversion operation criteria dated November 1959. Under Study Number D-20, Lake Casitas would have been full in 1944 at the beginning of the dry cycle, would have reached a minimum of 100 acre-feet of active storage in 1965, and would have filled again in 1980.

In summary, the current safe yield of Lake Casitas is 21,500 acre-feet, operated under existing criteria, without benefit for integrated operation with Lake Matilija.

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B. LAKE MATILIJA

When construction of Matilija Dam was completed during 1948, the Lake had a storage capacity of approximately 7,000 acre-feet. As a result of both sediment loading and lowering of the spillway crest from elevation 1,125 to 1,095, the active storage capacity was reduced to approximately 3,350 acre-feet by 1965. Present active storage capacity is approximately 1,100 acre-feet. During 1954, the United States Bureau of Reclamation estimated that Lake Matilija would contribute 1,900 acre-feet to the Casitas project safe annual yield, and during 1968 reduced this amount to 1,700 acre-feet.

While it is relatively certain that a very few or even a single flood year will fill Lake Matilija with sediment, the question remains as to how much safe annual yield Matilija will contribute to the Casitas project if we are actually entering or have entered a critical drought period such as 1944 through 1965.

Figure 2 shows the estimated actual active storage remaining in Lake Matilija during the period 1965 through 1989. During this period, the major sediment loading occurred during the flood years of 1969, 1973, and 1978. Considerable sedimentation also occurred during 1983 and 1986 but did not significantly impact active storage because it took place in the dead storage space below the level of the outlet gate. Figure 2 also illustrates estimated future active storage capacity based upon both dry cycle and wet cycle conditions. Under wet cycle conditions, it is estimated that there will be no active storage remaining after 1999, while under dry cycle conditions, there will be approximately 420 acre-feet remaining in active storage in the year 2010. If the 1944 through 1965 critical dry year is repeated beginning in 1986, the remaining storage at the end of the cycle will be the projected year 2010 storage of 420 acre-feet.

Figure 3 illustrates the relationship between Lake Matilija safe annual yield and active storage capacity assuming integrated operation with Lake Casitas during the 1944-1965 critical dry period. At an active storage capacity of 1,100 acre-feet, Lake Matilija contributes approximately 620 acre-feet of additional safe annual yield to the Casitas project. At 500 acre-feet of storage capacity, yield will decrease to approximately 300 acre-feet.

If the District has re-entered a dry period, Lake Matilija will be reduced from its present active storage capacity of 1,100 acre-feet to 420 acre-feet at the end of the dry period in 2010. Lake Matilija's safe annual yield under integrated operation with Lake Casitas is presently 620 acre-feet and will be reduced to 220 acre-feet in 2010.

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The average safe annual yield attributed to Lake Matilija throughout the drought period is estimated to be 420 acre-feet. The estimated storage capacity and safe annual yield, assuming repetition of the 1944-1965 dry period, is shown in Figure 4.

In summary, it is estimated that Lake Matilija will contribute an average of 420 acre-feet per year of additional safe yield to the Casitas project, if the District has entered a repetition of the 1944-1965 critical period. Conversely, if we enter a wet period, Lake Matilija's usefulness could become zero in ten years or less.

C. OJAI GROUNDWATER BASIN YIELD

In August of 1988, a report entitled Ojai Groundwater Basin Study for Casitas Municipal Water District (OGBS) was published by Murray, Burns & Kienlen, Consulting Civil Engineers, Sacramento, California (MBK). This report summarized previous reports containing information on the Ojai Basin as published by the California Department of Water Resources during 1952 and the Ventura Department of Public Works in 1971. The 1988 report presents information relative to the storage capacity of the Ojai Basin, historic groundwater storage conditions, estimated recharge to the basin and use from the basin, and water quality.

The Ojai Groundwater Basin study lists the capacity of the basin at 68,722 acre-feet, and states that the maximum historical groundwater depletion of 28,000 acre-feet occurred during 1951. The quantity of water remaining in storage under the 1951 low level condition was approximately 40,700 acre-feet. The study evaluated basin operations and conditions during the period 1958 through 1978 and included information on water use during 1984. During the 1958-1978 study period there were four years when groundwater depletion was approximately 25,600 acre-feet, leaving 43,200 acre-feet in storage. The average quantity pumped from the Ojai Basin during the 1958-1978 study period was estimated at 4,555 acre-feet per year, of which 3,454 acre-feet were for agricultural use and 1,101 acre-feet were for municipal use. Beginning in 1976, it appears that there has been a significant reduction in pumping from the Ojai Basin, with the present use estimated at 3,700 acre-feet, of which approximately 2,100 acre-feet is for agricultural use and 1,600 acre-feet is for municipal use. Thus, in recent years it appears that agricultural pumping has decreased by approximately 1,350 acre-feet per year, while municipal use pumping has increased by approximately 500 acre-feet per year.

The decrease in pumping from the Ojai Basin for agricultural use has been offset by an increase in agricultural demand on the Casitas

supply. Reasons for the shift to the Casitas supply include the ease with which the Casitas supply can be utilized, dependability of the Casitas supply, major costs associated with rehabilitating or replacing wells when they need repair, and cost of Casitas water.

The yield of the Ojai Basin is dependent upon the criteria under which it is operated and is difficult to describe under conventional definitions of "safe annual yield". As an example, during 1952, the State Department of Water Resources (DWR), in DWR Bulletin Number 12, determined that the safe annual yield of the Ojai Basin was only 1,200 acre-feet per year. This determination was based on the premise that there were many shallow wells along the upper edge of the basin, and that when water levels within the basin dropped to the point where these wells failed, the safe yield was exceeded even though considerable storage remained in the basin and it could refill in a single wet year. Once Lake Matilija and Lake Casitas supplies became available within the Ojai Basin, those farmers with shallow wells can switch to Casitas' supply and those farmers and agencies with deeper wells can continue to pump without causing major adverse impacts on others. Many of the farmers with shallower and less dependable wells have switched entirely to Casitas' supply, thus invalidating the DWR 1952 criteria.

The method with which Casitas and its engineering consultants have chosen to evaluate the Ojai Basin yield is in terms of the historical low groundwater level which occurred during 1951. As stated previously, under this condition the basin storage was depleted by 28,000 acre-feet, a total of 40,700 acre-feet remained in storage, and the basin refilled without major adverse impacts. No major water quality problems occurred during the drawdown or refilling of the basin and it is not anticipated that any will occur with reoccurence of the 1951 conditions. The criteria with which Casitas has chosen to evaluate the available annual yield of the Ojai Basin are summarized as follows:

1) The basin was modeled during the historical dry period from 1944 through 1983. This period includes the 1944-1965 critical dry period.

2) The basin was drawn down to a minimum storage level of 40,700 acre-feet corresponding with the historic low.

3) Annual pumping demands tested are as follows:

   a) 3,700 acre-feet, which is estimated current demand;

   b) 4,555 acre-feet, which is average demand for 1958-1978 period;

c) 4,200 acre-feet, which is demand at which historical low level condition will be reached but not exceeded.

Figure 5 illustrates the estimated Ojai Groundwater Basin storage during the 1944 through 1983 period, assuming 3,700 acre-feet per year annual demand. Assuming the 1944-1983 cycle is repeated beginning in 1986, estimated groundwater storage for the period 1986-2025 is also shown. Under this operation the maximum basin depletion would be approximately 17,500 acre-feet, leaving 51,200 acre-feet in storage during 1951. During the 40-year operation period, the basin would have refilled 14 times. Under this operation, it is concluded that the basin is underutilized by a significant amount.

Figure 6 illustrates estimated Ojai Groundwater Basin storage during the 1944 through 1983 period assuming an average annual demand of 4,555 acre-feet. This operation study shows that basin storage would have reached approximately 42,500 acre-feet in 1951, but would have been drawn considerably below the 40,700 acre-feet minimum level during 1957, 1961, and 1965. During 1965, the basin would have been depleted by 33,800 acre-feet, leaving 34,900 acre-feet in storage. The basin would have filled 10 times in 40 years under this operation.

While conducting the 4,555 acre-feet per year demand study, it was determined that through the 1951-1986 period the basin had been artificially recharged through spreading of water. During the period 1951 through 1963 a total of 10,407 acre-feet was delivered to the Ojai Basin from Lake Matilija and released into spreading ponds for artificial recharge. This spreading water caused the average annual yield to be increased.

Due to changes in methods of distribution system operation, sedimentation of Lake Matilija and destruction of the original spreading ponds, the artificial recharge is no longer available. Figure 7 illustrates estimated storage conditions in the Ojai Basin during the 1944 through 1983 period, assuming an average annual demand of 4,555 acre-feet and corrected to include the artificial recharge that occurred historically. Under these conditions, the basin would not have been drawn to the historical low level condition.

As noted in the 1988 Ojai Groundwater Basin study, the San Antonio Water Conservation District also carried out spreading and recharge operations in the basin prior to 1986. Records on quantities of water spread were not maintained; thus, actual impacts on groundwater levels are not known. Following the 1985 Ojai Fire, the spreading ponds were replaced with a debris basin from which little or no percolation occurs. The future impacts of loss of this recharge operation are not known.

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The Ojai Basin operation during the 1944 through 1983 period with an average annual demand of 4,200 acre-feet and no artificial recharge is shown in Figure 8. Under this operation, the basin would have reached its 1951 historical low level of storage of 40,700 acre-feet during 1957 and would have approached this level during 1961 and 1965. The basin would have refilled 10 times during the 40 year study period under this operation.

D. VENTURA RIVER GROUNDWATER BASIN YIELD

The capacity and annual available yield of the Ventura River Groundwater Basin under various operating criteria has been determined by Murray, Burns and Kienlen (MBK) in conjunction with the Ventura River Conjunctive Use studies, which have been conducted over the past several years. The majority of the usable capacity of the basin is in that area between the Robles Diversion Dam and the City of Ventura's concrete diversion structure at Foster Park. The capacity of the basin has been determined to be 14,000 acre-feet. The nature of the basin is that it empties during a 1 to 3 year critical dry year period and refills within a period of weeks during flood conditions. The relatively rapid depletion of the basin can be attributed to two factors: 1) extraction by pumping and (2) natural draining. Natural draining occurs since the water elevation at the upper end near Robles Dam is approximately 700 feet above sea level, while at the lower end at Foster Park the elevation is only 230 feet above sea level. This elevation difference causes water to simply flow downhill out of the Basin. Thus, even without pumping, the basin will drain during critically dry periods. It is this change in elevation, combined with a natural underground barrier that extends to the surface, that accounts for the rising water and "live" stretch of the river near Casitas Springs. A profile of the Ventura River Basin is shown in Figure 9.

Figure 10 illustrates storage and yield conditions within the Ventura River Basin during the 1944 through 1983 period under study Number D-20, previously discussed in the Casitas Operation Section. Study D-20 includes the following criteria:

1) Releases downstream to the Ventura River from Robles Dam are in accordance with the 1959 Ventura River Trial Operation criteria. Under this criteria, generally, the first 20 cfs are released downstream from Robles and natural flows in excess of the 500 cfs capacity of the Canal pass downstream. When flows exceed 500 cfs, flows in Matilija Creek are stored in Lake Matilija in accordance with available capacity for later diversion.

2) Groundwater users between Robles Dam and Foster Park will pump 2,200 acre-feet annually from the basin during all years that quantity is available. During years that less than 2,200 acre-feet is available, they will utilize the available amount. The annual demands are also broken down on a monthly basis for the study.

3) The City of Ventura (City) will divert 6,000 acre-feet annually from the Ventura River at Foster Park through a combination of surface diversion and pumping during all years that quantity is available. During years that less than 6,000 acre-feet is available, the City will utilize the available amount. The annual diversions are also broken down on a monthl basis for the study.

From Figure 10 it can be seen that under the operating criteria presented, the Ventura River Basin would have contained little or no storage during 4 years of the study period 1944-1983. The basin would have refilled 22 times during this period.

During the years 1949, 1950, 1951, 1961 and 1982, the Ventura River would not have provided sufficient yield to meet the full demands of either the City or the users between Robles Dam and Foster Park. During the critical 1949-1951 period, the City demands would have totalled 18,000 acre-feet, while only 7,509 acre-feet would have been available for their use. Upstream demands during this three-year period would have totalled 6,600 acre-feet, compared to an available supply of 2,187 acre-feet.

For the Ventura River Basin it is appropriate to define yield in terms of the average quantity available throughout the study period. The average yield during the 1944-1983 period is 5,506 acre-feet to the City and 1,987 acre-feet to the users between Robles Dam and Foster Park. When utilizing the concept of average yield, it must be recognized that a supplemental water supply must be available from an alternate source such as Lake Casitas, imported water, etc., to meet demands during the water short years.

The supply obtained from the Ventura River by the City is utilized primarily within those areas of the City outside of Casitas' boundaries. Thus, it is not included in the total of supplies available for use within the Casitas Municipal Water District.

In addition to the yield of the Ventura River Groundwater Basin between Robles Dam and Foster Park, there is a combination surface and groundwater supply available in the reach of the Ventura River above Robles Dam. The studies by Murray, Burns & Kienlen (MBK) have determined that the annual yield of this supply is 2,800 acre-feet and that

it would be available every year throughout the 1944-1983 period.

In summary, the yield of the Ventura River Basin is defined in terms of average available yield, 2,800 acre-feet above Robles Dam, 1,987 acre-feet for users between Robles Dam and Foster Park, and 5,506 acre-feet for the City. Total equals 4,787 acre-feet excluding the City and 10,293 acre-feet including the City. It is noted that there will be several years during the dry cycle when the full yield is not available and supply must be obtained from an alternate source.

E. TOTAL AVAILABLE SUPPLIES

Table 1 summarizes the estimated water supply available from sources available within the Casitas Municipal Water District, assuming repetition of the 1944-1965 dry cycle beginning in 1986.

Excluding the water supply available to the City for use outside of Casitas' boundaries, the total available yield is 30,907 acre-feet per year.

It is pointed out that there are other minor supplies available within Casitas' boundaries, particularly in the Upper Ojai and Mira Monte areas, but these supplies are generally adequate to meet demands. Neither these supplies or the demands placed on them are included in this report.

II. CURRENT WATER DEMANDS

A. LAKE CASITAS DEMANDS

Table 2, Casitas Municipal Water District Operation Summary, contains information on the total annual releases from Lake Casitas during the period of operation from 1959 through 1988. These releases, which range from a minimum of 658 acre-feet during the first year of operation in 1959, to a maximum of 23,080 acre-feet in 1984, represent the total demand on the lake. Total annual demands include quantities of water served, main conveyances, and distribution system losses and releases for water rights purposes to the Coyote Creek area downstream of Casitas Dam. The 1978 downriver release of 2,677 acre-feet occurred during an extremely wet year, and was for operational rather than water rights purposes. During the period 1967 through 1973, releases to the main conveyance system included water considered as surplus to the needs of users within Casitas' boundaries. This surplus water, which ranged from a minimum of 1,322 acre-feet during 1967 to a maximum of 3,590 acre-feet during 1971, was sold primarily for delivery within the City of Ventura's service area outside of Casitas' district boundaries. During the period 1959 through 1965

Casitas delivered some water to its main conveyance from Lake Matilija, which was in addition to the Lake Casitas releases.

Even though demands have generally increased in recent years, there is a major reduction in demands during wet years, which are depicted by high inflow to Lake Casitas, as compared to dry years depicted by low inflow. For example, during the wet year 1983, demands totalled only 15,830 acre-feet, as compared to the following dry year in 1984, when demands rose sharply to 23,080 acre-feet.

Figure 11 presents a plot of historic releases to Casitas' main conveyance system during the period 1959 through 1988. The quantities of surplus water sold during the 1967 through 1973 period are not included in the quantities plotted. The line plotted on the graph depicts the mathematical average of actual and projected water demands during the period 1968 through 2000 based on a computerized analysis. Based on the information presented in the graph, the 1989 water demand is expected to be 21,400 acre-feet. The average increase in demand from Figure 11 is 450 acre-feet per year.

Table 3 lists Casitas' estimated 1989 Lake Casitas demands as determined on the basis of the past 5 year, 3 year and 2 year average demands, as well as the demand determined by the plot presented in Figure 11. Based upon the various analyses presented in Table 2, it is concluded that the 1989 level of demand on Lake Casitas is approximately 21,400 acre-feet per year.

B) OJAI GROUNDWATER BASIN NON-CASITAS DEMANDS

The current level of water demand on the Ojai Groundwater Basin is estimated to be 3,700 acre-feet per year. As discussed previously, the current demand is estimated on the basis of findings included in the August 1988 Ojai Basin Study conducted by Murray, Burns and Kienlen (MBK). A majority of agricultural groundwater pumping from the Ojai Basin is from non-metered wells, thus demands are estimated on the basis of crop acreage and water requirements. Municipal demands listed in the basin study are actual, as wells are metered and quantities pumped are recorded on a regular basis.

C. VENTURA RIVER GROUNDWATER BASIN NON-CASITAS DEMAND

1. Area between Matilija Dam and Robles Dam

Users of water within this area of the Ventura River include one water district, four ranches and one resort. The current level of water use in this area is estimated to be 2,827 acre-feet. This estimate is

based on data furnished to Casitas by one water utility, by data contained in the 1989 Local Agency Formation Commission (LAFCO) Inventory of Water Purveyors, by reports of water use to the State Water Resources Control Board, and by one estimate on a non-reported demand.

The current estimated demand of 2,827 acre-feet checks closely with an estimate of 2,800 acre-feet as determined by Murray, Burns and Kienlen during their Ventura River Conjunctive Use Operation studies.

2. Area Between Robles Dam and Foster Park

Major water users within this area of the Ventura River Groundwater Basin include four water utilities, a Ventura County Sheriff's Honor Farm, a mobile home park and three ranches. The current water demand in this area is estimated to be 2,393 acre-feet. This estimate is based on data furnished by water utilities, by data contained in the February 1989 Local Agency Formation Commission (LAFCO) Inventory of Water Purveyors, and by uses reported to the State Water Resources Control Board.

The estimated current demand of 2,393 acre-feet exceed the 2,200 acre-feet per year demand used by MBK during their Ventura River Conjunctive Use studies.

D. TOTAL ESTIMATED CURRENT DEMANDS WITHIN CASITAS MWD

The current total demand within Casitas boundaries is estimated to be 30,320 acre-feet. Table 3 summarizes the estimated demands by each area discussed previously. There are other minor demands within Casitas' District that are offset by supplies not included in the estimate of total supplies.

Table 4 lists the estimated 1990 total water demands within Casitas' boundaries as provided by various studies conducted since 1968. These estimates range from a minimum of 30,600 acre-feet to a maximum of 34,600 acre-feet. Casitas' 1989 estimate of 30,320 acre-feet demand is close to the 1990 estimates.

III. CURRENT STATUS OF SUPPLY VERSUS DEMAND

Based upon the information presented previously and upon the assumption that the area may be re-entering the 1944-1965 critical dry period, the estimated 1989 supply versus demand for various areas within Casitas is summarized as follows:

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SOURCE	SUPPLY	DEMAND
Lake Casitas Assuming Integrated Operation With Lake Matilija	21,920 acre-feet	21,400 acre-feet
Ojai Groundwater Basin	4,200 acre-feet	3,700 acre-feet
Ventura River Basin:		
a) Matilija-Robles	2,800 acre-feet	2,827 acre-feet
b) Robles-Foster Park	1,987 acre-feet	2,393 acre-feet
	30,907 acre-feet	30,320 acre-feet

Under current conditions, the total available supplies within Casitas appear to be in excess of demands under dry cycle conditions. Certain demands will have to be shifted to the Lake Casitas supply when insufficient Ventura River supply is available.

IV. ESTIMATES OF FUTURE WATER DEMANDS AND RELATIONSHIP TO EXISTING SUPPLIES

A. LAKE CASITAS DEMANDS

Data compiled by Murray, Burns and Kienlen (MBK), in conjunction with Casitas' water supply and demand studies, and as plotted on Figure 11, indicate that average water demands from Lake Casitas will increase from approximately 21,400 acre-feet in 1989 to 27,800 acre-feet in the year 2003. Figure 12 illustrates the impacts of these increasing demands on Lake Casitas storage assuming repetition of the 1944-1965 critical dry period beginning in 1986.

Under the safe annual yield study, which utilized a constant demand of 21,500 acre-feet per year, reservoir storage was depleted during the 1965 critical year but demands were met every year during the drought period. As shown in Figure 12, with increasing demands Lake Casitas would have been emptied during 1957 and 1961. During 1961 only 10,439 acre-feet would have been available from Lake Casitas. This study was not extended to 1965.

The sensitivity of the Lake Casitas supply to demands in excess of the 21,500 acre safe yield is also illustrated in Figure 13. The constant demand of 22,120 acre-feet per year used in this study is equivalent to the actual demand which occurred during 1988. Under this operation, the reservoir would empty during July of 1965 and only 11,869

acre-feet would have been available for use during that year.

These studies illustrate the point that demands in excess of the 21,500 acre-feet safe yield will severely impact water supply availability during a long-term critical dry period.

In summary, Lake Casitas demands are approaching safe annual yield and any significant increase above present levels could ultimately lead to a water supply shortage. Under present conditions, demands are increasing at an average rate of 450 acre-feet per year.

B) TOTAL DEMANDS WITHIN CASITAS MUNICIPAL WATER DISTRICT

Based upon data compiled by James M. Montgomery, Consulting Engineers, Inc. during 1987, total estimated demands within Casitas boundaries will increase from the current level of 30,320 acre-feet to a range of 31,450 - 34,890 acre-feet in the year 2005. Based upon the James M. Montgomery data, total district demand will equal supply in approximately 1990 and without additional supplies or reduced demands, there will be a supply deficit ranging from 543 to 3,983 acre-feet by the year 2005.

IV. IMPACT OF WEATHER CONDITIONS ON SUPPLY AND DEMAND

All of the previous discussion on water supply evaluate supply on the basis of quantities available during critical dry periods. Critical dry periods differ for different sources of supply. The critical dry period for Lake Casitas is approximately 20 years, as compared to 1-3 years for the Ventura River Groundwater Basin and 3-5 years for the Ojai Groundwater Basin.

Since demands on local supplies are approaching yield of available sources, it would be helpful to know if we have entered or are entering a critical dry period. A critical dry period causes the need for the District to be careful not to exceed the safe yield of Lake Casitas, or the yields of other supplies. Exceeding such yields would result in drastic shortages in later years of the critical dry period.

Figure 1 illustrates the comparison between estimated Lake Casitas storage during the 1944-65 critical dry period and actual present storage assuming that 1986 was the beginning of a similar dry period. It can be seen from this graph that present Lake Casitas storage in 1989 is actually less than it would have been at the same point during the critical period, even though demands for the past three years have averaged less than the 21,500 acre-feet per year safe yield demand. This lower storage is attributed to the fact that inflow to Lake

Casitas during the past three years was actually less than it was during the 1944-1947 comparison period. This suggests that it is time to plan for a critical dry period.

One way to evaluate wet period versus dry period conditions is through examination of precipitation records. Figure 14 shows a plot of the progressive ten-year mean precipitation for rainfall stations with the Casitas Reservoir Watershed, Ojai Valley, Ventura area for the period 1880 to date. For determining the progressive ten-year mean precipitation, a single year's rainfall is computed as the average of all stations measured and each year's rainfall plotted on the graph represents the average of the previous 10 years' rainfall. As an example, the rainfall as plotted for 1880 is the average rainfall for the period 1870-1879, the rainfall plotted for 1881 is the average for the period 1871-1880, etc. From this graph it can be seen that there have been four major periods of below normal rainfall. On the basis of comparison with historical conditions, it appears that the area could be entering another major period of below normal rainfall and drought conditions.

V. DISCUSSION

Based upon this water supply and demand information, it is concluded that the Casitas Municipal Water District (Casitas) is at a point where water supply and demand policies and management practices must be established. If Casitas permits demands to increase without the addition of supplemental supplies, a severe water shortage may occur. Likewise, if other water agencies and users that depend on Ventura River and Ojai groundwater basin supplies continue to increase their level of demands, they could be facing situations which could lead to increased demands on the Casitas supply.

In cooperation with other water agencies and water users within Casitas' service area, Casitas needs to consider implementing a process of examining alternatives for balancing water supply and demand, both on a short term and long term basis. Once the alternatives have been established, it should be a goal to adopt and implement those found to best meet the needs of residents within Casitas' service area.

The following is a list of alternatives for consideration. This list may not be complete and should be revised as deemed appropriate by those involved in the process of establishing future water supply policy and management practices.

1) Maintain Status Quo - Under this alternative, water supplies would

be managed as they are presently; demands would be allowed to increase without restriction and no additional supplies would be developed.

Impacts of maintaining status quo on both a short-term (1-2 years) basis versus a long-term (greater than 2 years) basis should be defined as soon as possible.

2) Reduce Water Consumption Through the Adoption of Economic Incentives - Economic incentives to reduce water consumption could be established on either a short-term or long-term basis. It is important that an early evaluation be made as to the magnitude of the incentive for each class of water user and how much water demand can be reduced.

On one hand, the incentive can be used to reduce water use by increasing water rates in accordance with a block structure whereby the more water one uses, the higher rate they pay or by increasing rates for certain types of service. On the other hand, overall water use or use of certain critical supplies could be reduced by the water agency, providing an economic incentive to the user. Examples of this would include a rebate by the agency for installation of low volume flush toilets, low volume shower heads, etc. At times when ground water basins are full or levels are above normal, it may be appropriate to provide an incentive for ranchers to pump their own well, rather than utilize the Lake Casitas supply.

It may be appropriate to establish economic incentives for different classes of use, such as residential, industrial, agricultural and wholesale.

3. Water Conservation

To date, most water conservation programs within Casitas' area have requested that conservation be practiced on a voluntary basis. An exception is the City of Ventura, which recently adopted an ordinance establishing a mandatory program. A mandatory program for the entire Casitas Municipal Water District area may or may not be desirable.

The cost of implementing various water conservation measures should be considered, along with reliable estimates of the quantities of water to be saved.

Examples of types of programs to be considered include use of low volume toilets, low volume showerheads and others, which include the installation of hardware which actually reduce water use.

Conservation of water used for agriculture may be obtained by upgrading the ranchers' systems to provide more uniform distribution of water and limiting the quantity of water applied to that required. The irrigation system evaluation mobile lab, operated by the Ventura County Resource Conservation District and State of California California Irrigation Management Information Systems (CIMIS) weather station data could be utilized to help farmers achieve conservation.

There is little or no information presently available as to how much water is presently being saved through conservation. This information must be acquired in order to evaluate the quantity of additional water that can be saved.

4. Allocation, Rationing Programs - Allocation of existing supplies to various individual water users or class of users may provide an appropriate means for limiting demand. Depending on methods selected, allocation could be on the basis of past use, priority of use, specific water requirement for crop production, etc. The concept associated with allocations would be to divide the fully available supply (safe yield) for individual or combined water sources among the various users.

During years when the full yield of a water source is not available due to inadequate storage or supply it may be advisable or necessary to impose rationing in terms of a percentage of the total yield. As with allocations, rationing could involve individual users or classes of users.

An example of allocation would be to allow use to equal but not exceed the 21,500 acre-foot safe yield of Lake Casitas under current conditions when storage is approximately 180,000 acre-feet. An example of rationing would be to not permit use to exceed 75% of the safe yield when Lake Casitas storage drops to 50,000 acre-feet or less.

It may be appropriate to allocate supplies on either a short-term or long-term basis, while rationing may be appropriate only on a short-term basis.

5. Moratorium: Short-term or Long-term - One way to control increase in demand on a local water supply or supplies would be through the adoption and implementation of a moratorium on new services. It may be appropriate to issue a short-term moratorium while adoption and implementation of other programs such as allocations and mandatory water conservation are taking place. On the other hand, it may be appropriate to adopt a long-term moratorium to allow for the development of additional water supplies.

Interdepartmental Memorandum
Water Supply & Demand Study
Status Report by R. Barnett
June 6, 1989

6. Development of Additional Water Supplies - Numerous alternatives are available for increasing the quantities of water supply available for use within the Casitas Municipal Water District (CMWD) service area. These alternatives range from planning for and implementing conjunctive use of the local groundwater supplies with the Lake Casitas supply, to enlarging of the Robles-Casitas Canal, to replacing Matilija Dam or removing sediment from the lake, to importation of state water. CMWD currently administers the contract with the State Department of Water Resources for importation of state water into Ventura County. Local residents have been paying for a share of the state water project for several years, and should have the opportunity to provide input on this project.

While it would take several years to complete a project like importation of state water, it may take only 1-2 years to implement a project like Lake Casitas-Ojai Groundwater Basin Conjunctive Use.

CMWD's Urban Water Management Plan, which was adopted during 1986, lists several projects for increasing water supplies within the area. It may be advisable to review and update estimated cost and yield of water for these projects.

It is important to maintain a balance between water supplies and demand, and to anticipate potential adverse impacts to the local area if water supply shortages develop. Therefore a process of examining, establishing and implementing the various alternatives needs to be conducted as soon as possible.

RHB:rlm

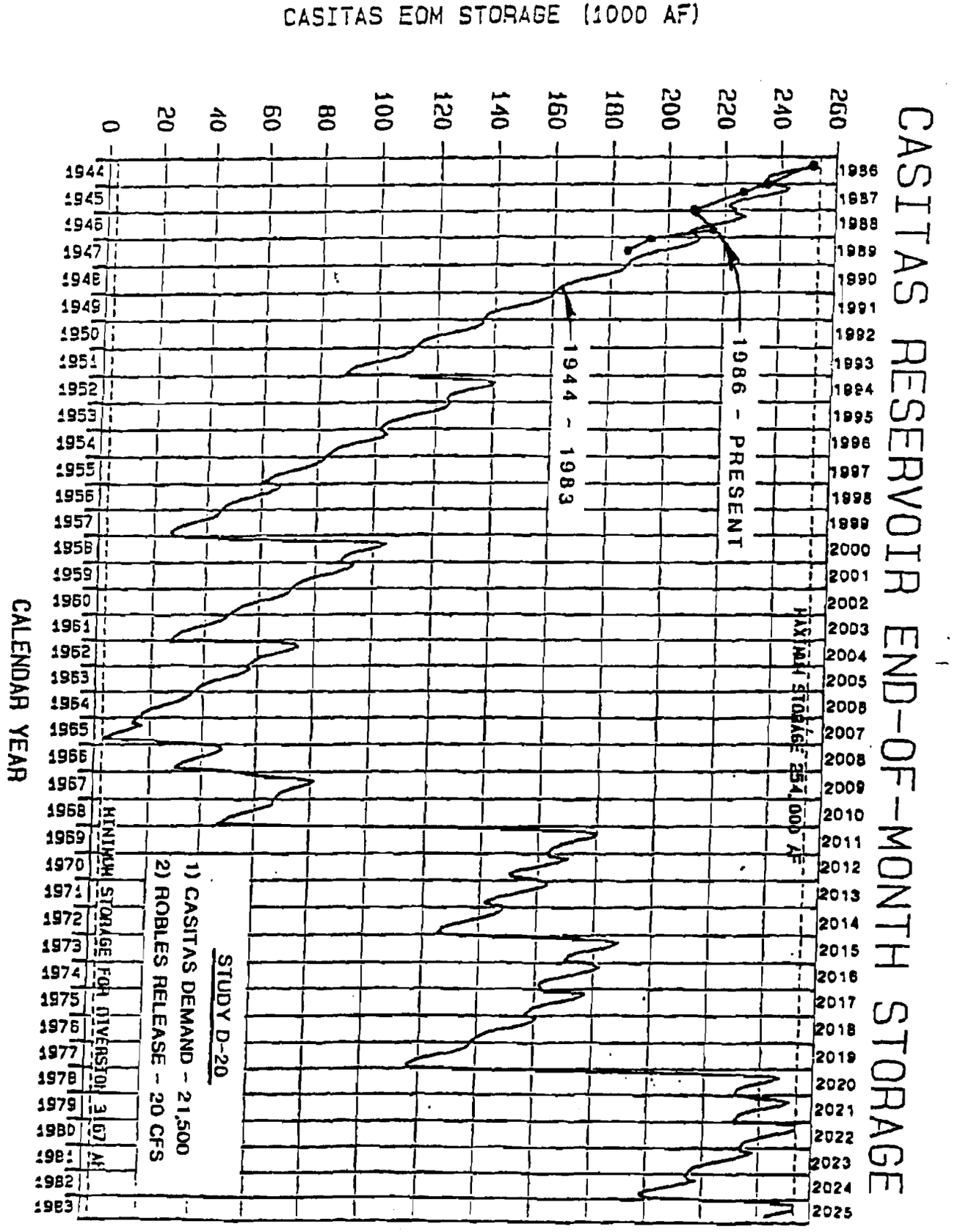


FIGURE 1

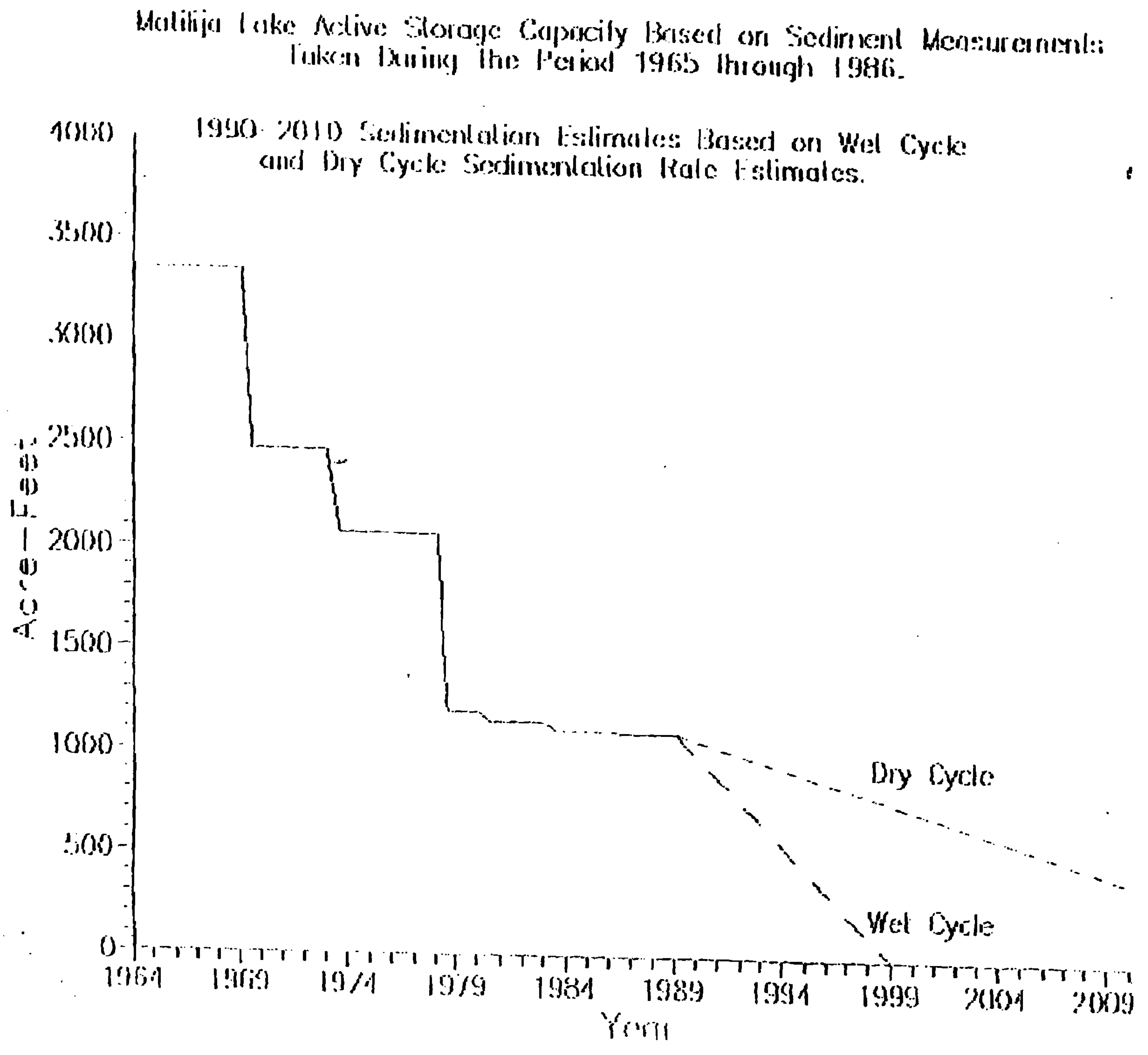
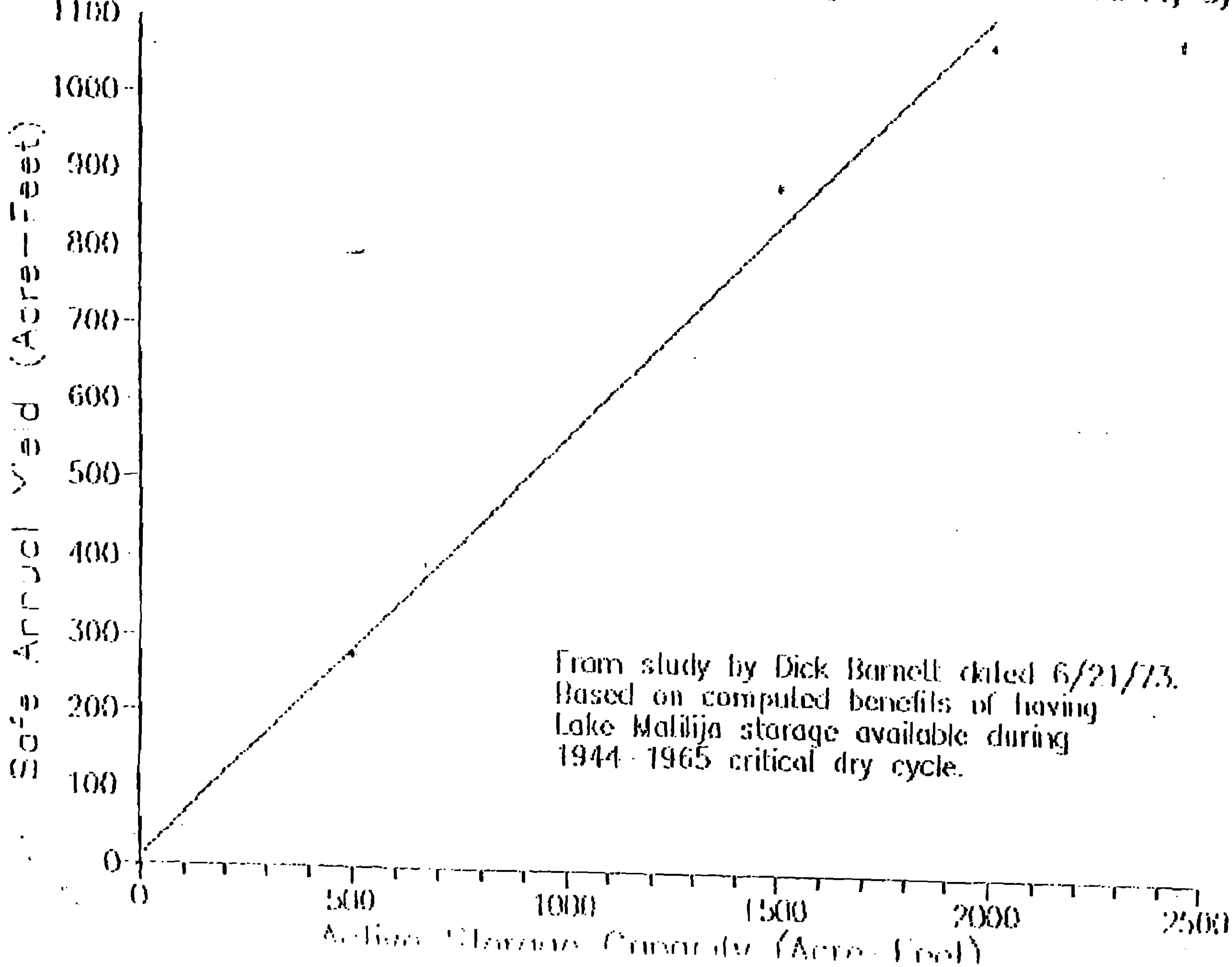

Matilija Lake Active Storage Capacity Based on Sediment Measurements
Taken During the Period 1965 through 1986.
1990-2010 Sedimentation Estimates Based on Wet Cycle
and Dry Cycle Sedimentation Rate Estimates.
Acre-Feet
4000
3500
3000
2500
2000
1500
1000
500
0
Dry Cycle
Wet Cycle
1964
1969
1974
1979
1984
1989
1994
1999
2004
2009
Year

FIGURE 2

FIGURE 3

Lake Matilija Safe Annual Yield versus Active Storage Capacity assuming Integrated Operation with Lake Casitas during 1944 1965 Critical Dry Cycle



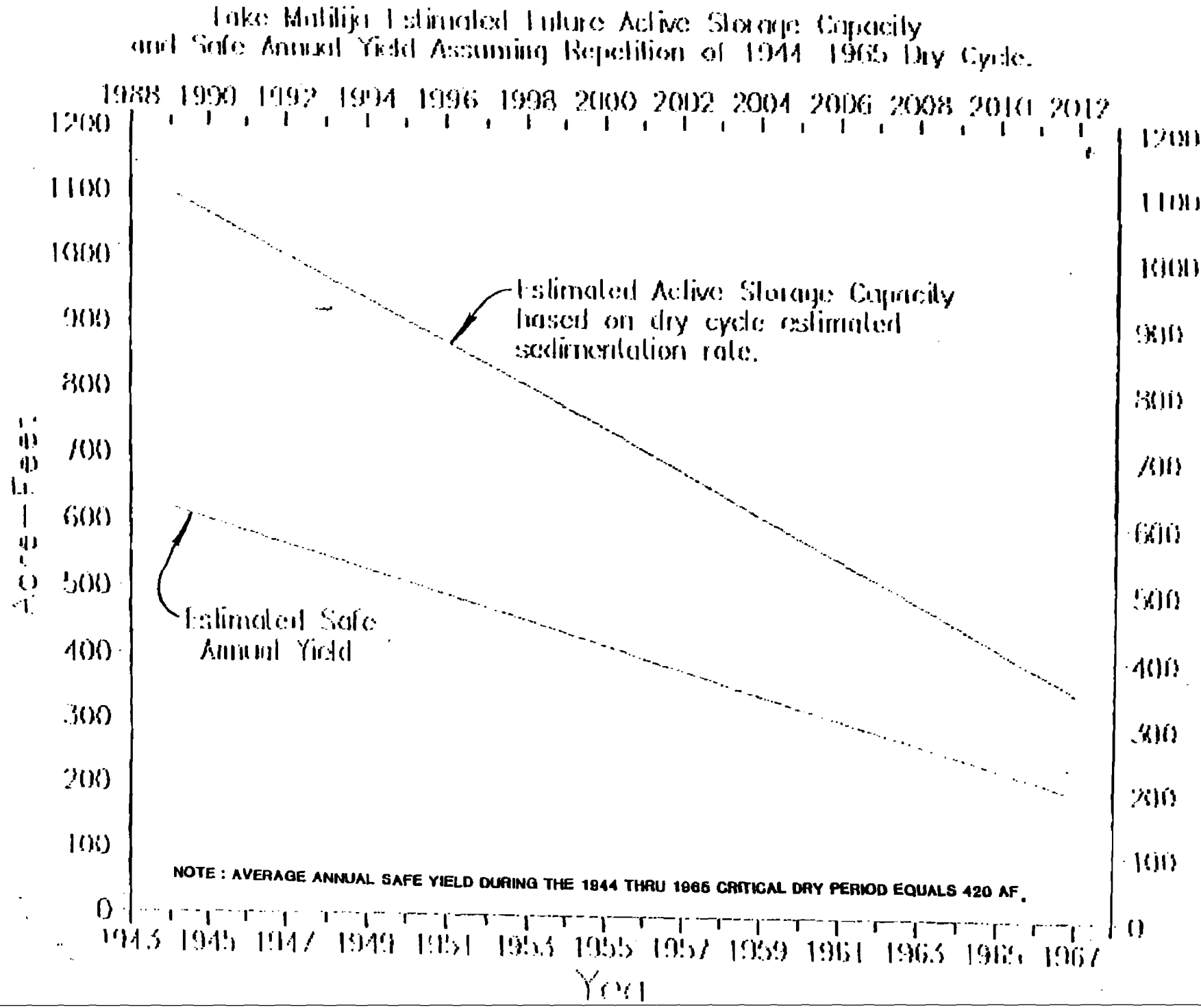
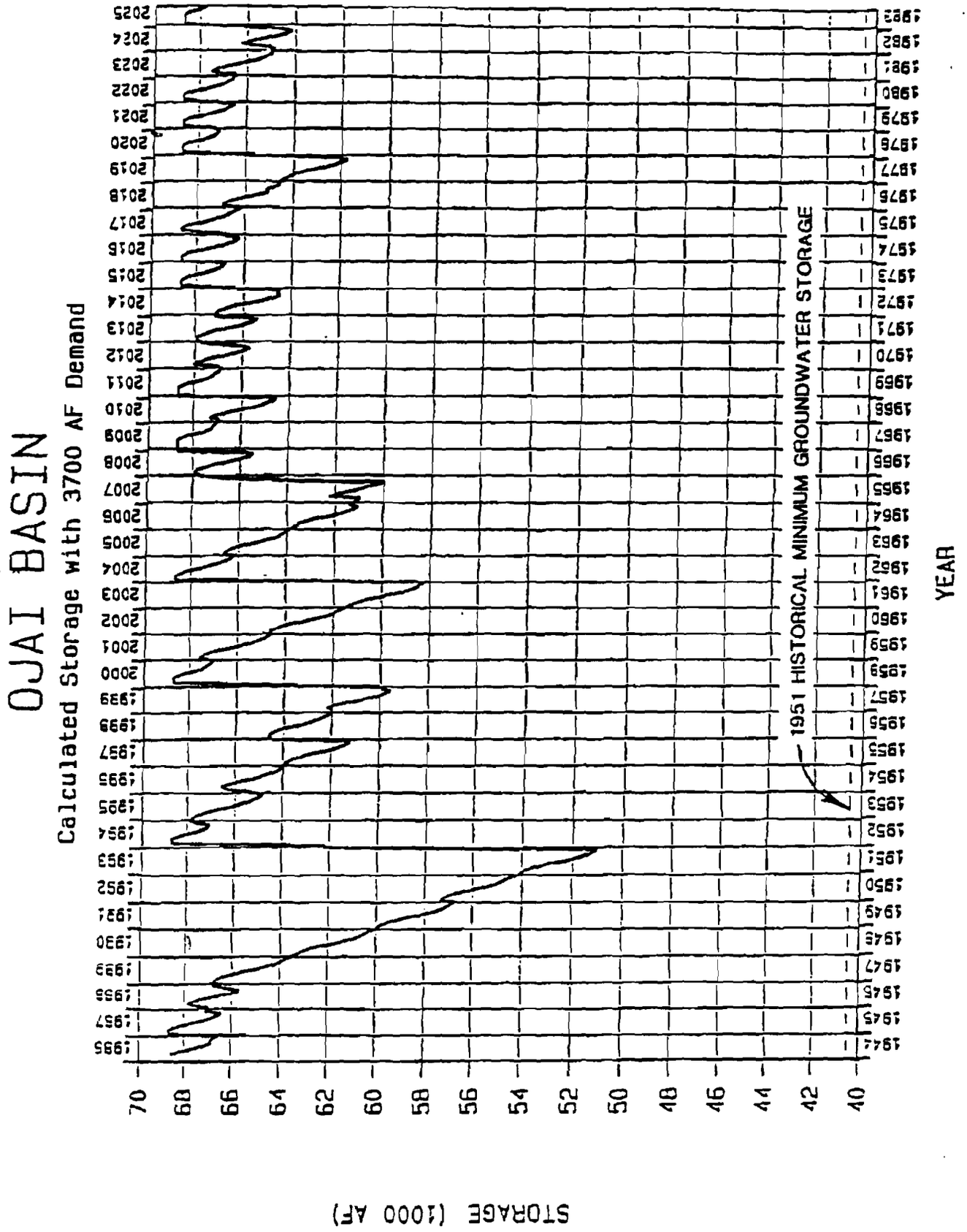

Lake Matilija Estimated Future Active Storage Capacity
and Safe Annual Yield Assuming Repetition of 1944 1965 Dry Cycle.
1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
Estimated Active Storage Capacity based on dry cycle estimated sedimentation rate.
Estimated Safe Annual Yield
NOTE : AVERAGE ANNUAL SAFE YIELD DURING THE 1944 THRU 1965 CRITICAL DRY PERIOD EQUALS 420 AF.
1943 1945 1947 1949 1951 1953 1955 1957 1959 1961 1963 1965 1967
Year

FIGURE 4

FIGURE 5


OJAI BASIN
Calculated Storage with 3700 AF Demand
1951 HISTORICAL MINIMUM GROUNDWATER STORAGE
STORAGE (1000 AF)
YEAR
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62
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OJAI BASIN

Calculated Storage with 1555 AF Demand and Matilija Recharge

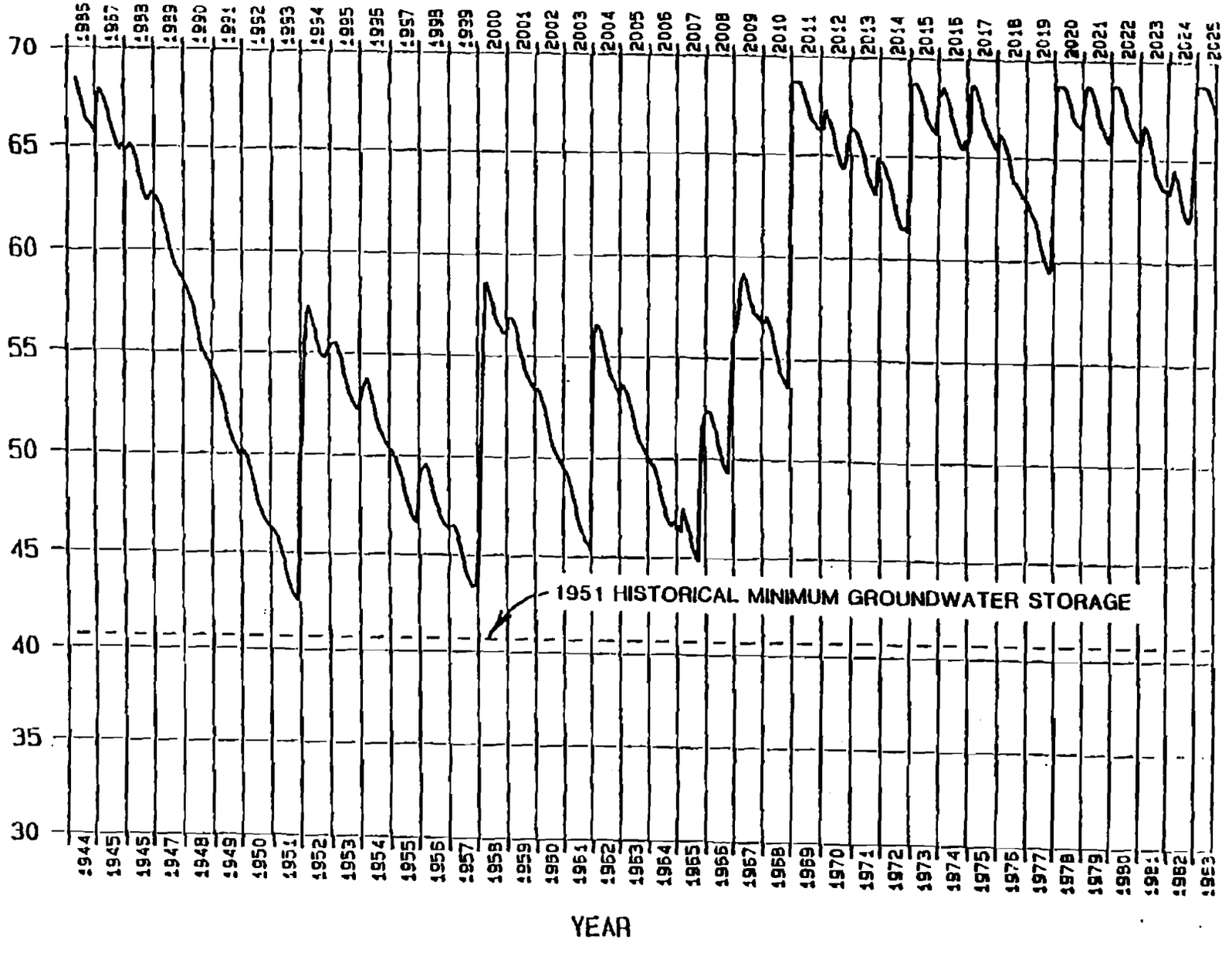
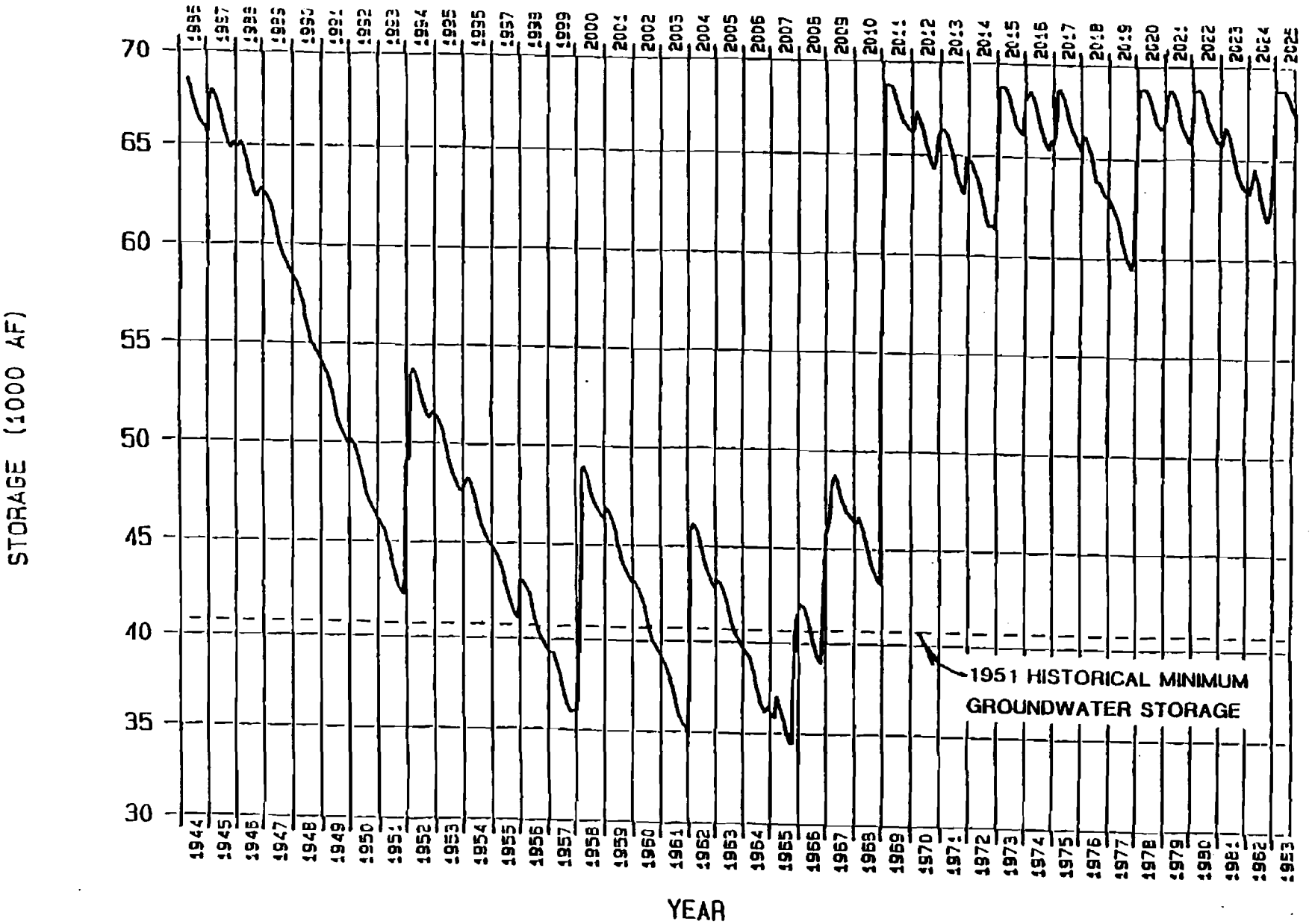
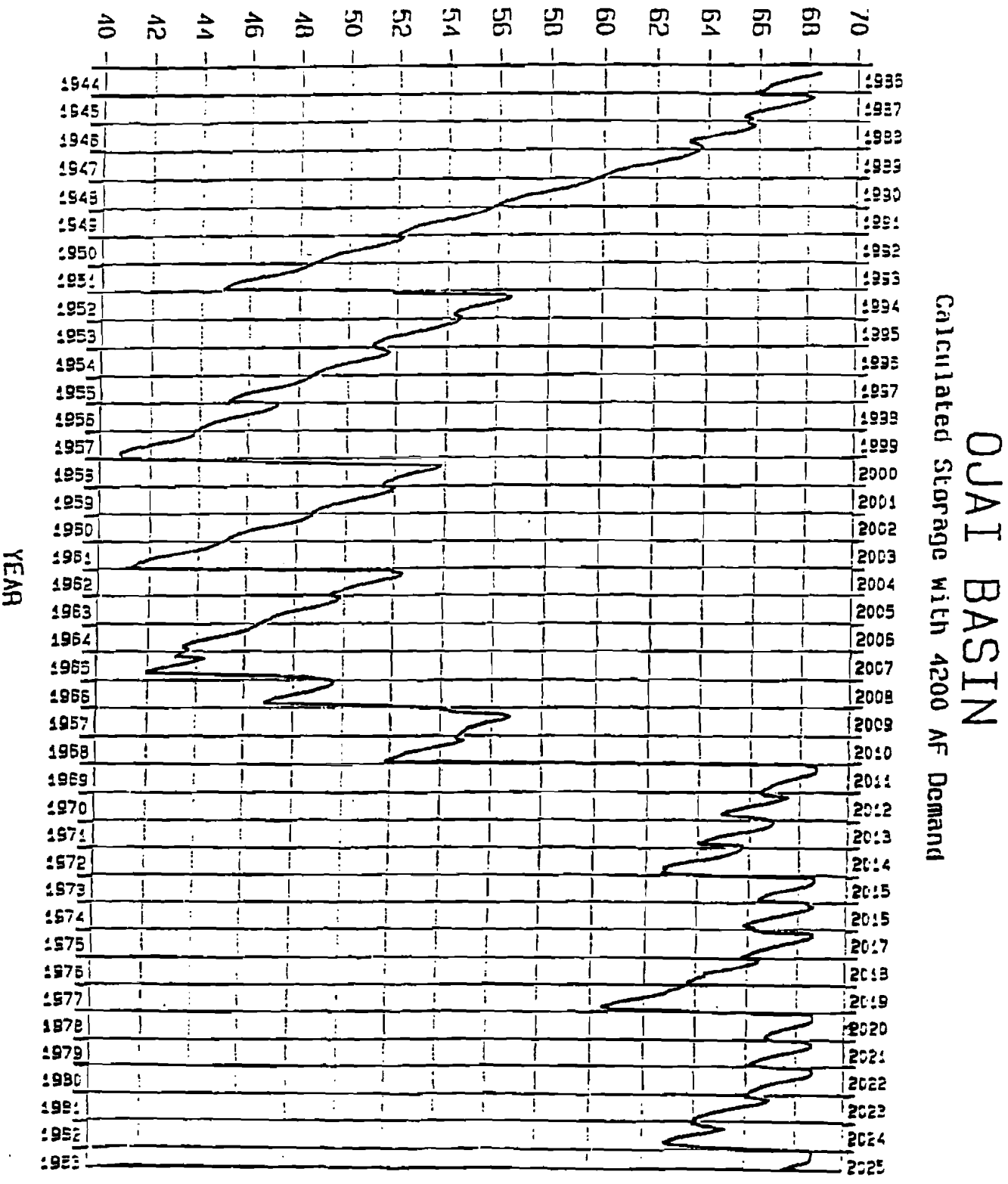


FIGURE 7

OJAI BASIN

Calculated Storage with 4555 AF Demand




STORAGE (1000 AF)
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44
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64
66
68
70
YEAR
1944
1945
1946
1947
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2023
2024
2025
OJAI BASIN
Calculated Storage with 4200 AF Demand

FIGURE 8

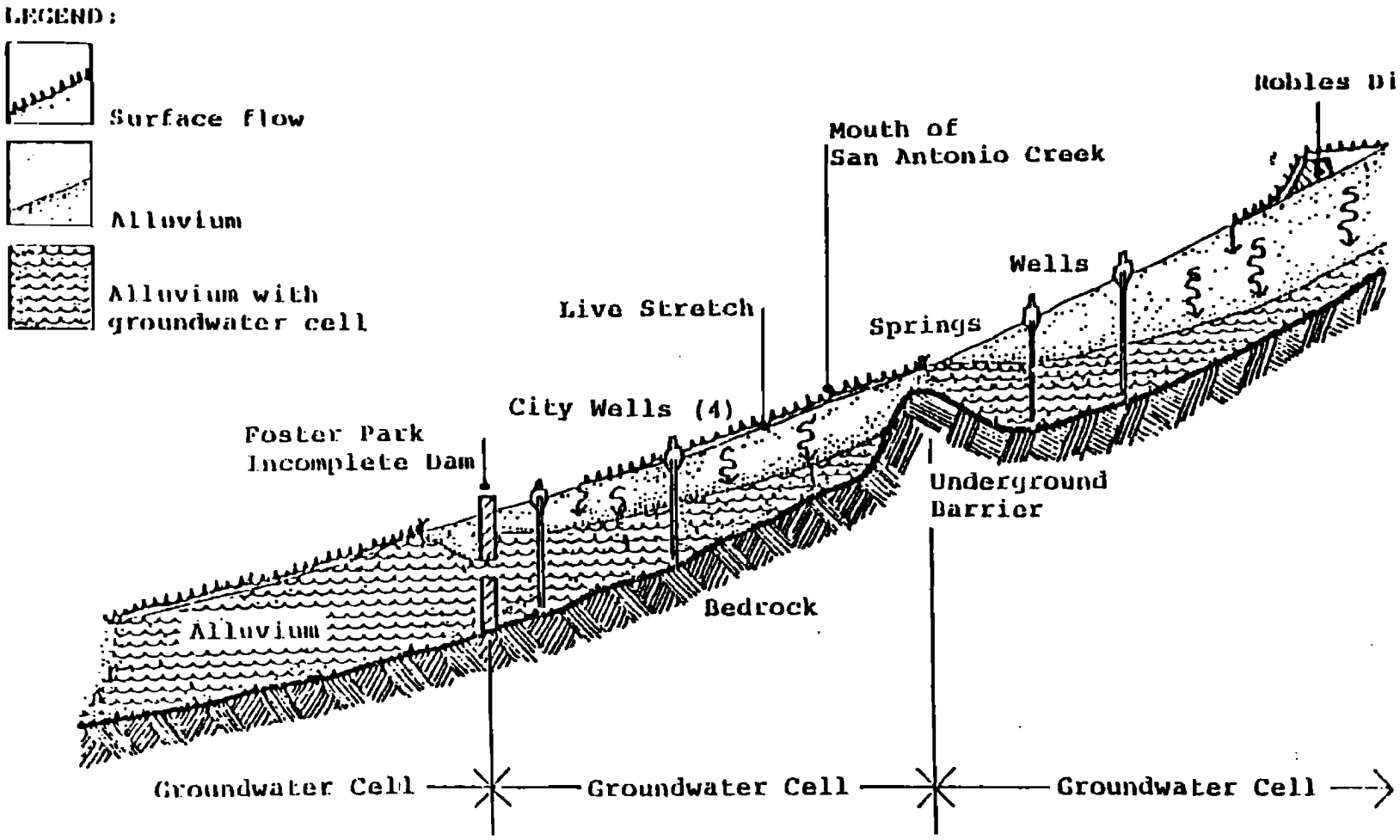


FIGURE 9

Ventura River at Casitas Springs

Schematic Diagram of Ventura River at Casitas Springs - Summer Condition

VENTURA RIVER GROUNDWATER BASIN STORAGE – 1944 THRU 1983

STUDY O-20
1) ROBLES RELEASE – 20 CFS
2) CITY OF VENTURA DEMAND – 6000 AF/YEAR
3) ROBLES TO FOSTER PARK DEMAND – 2200 AF/YEAR

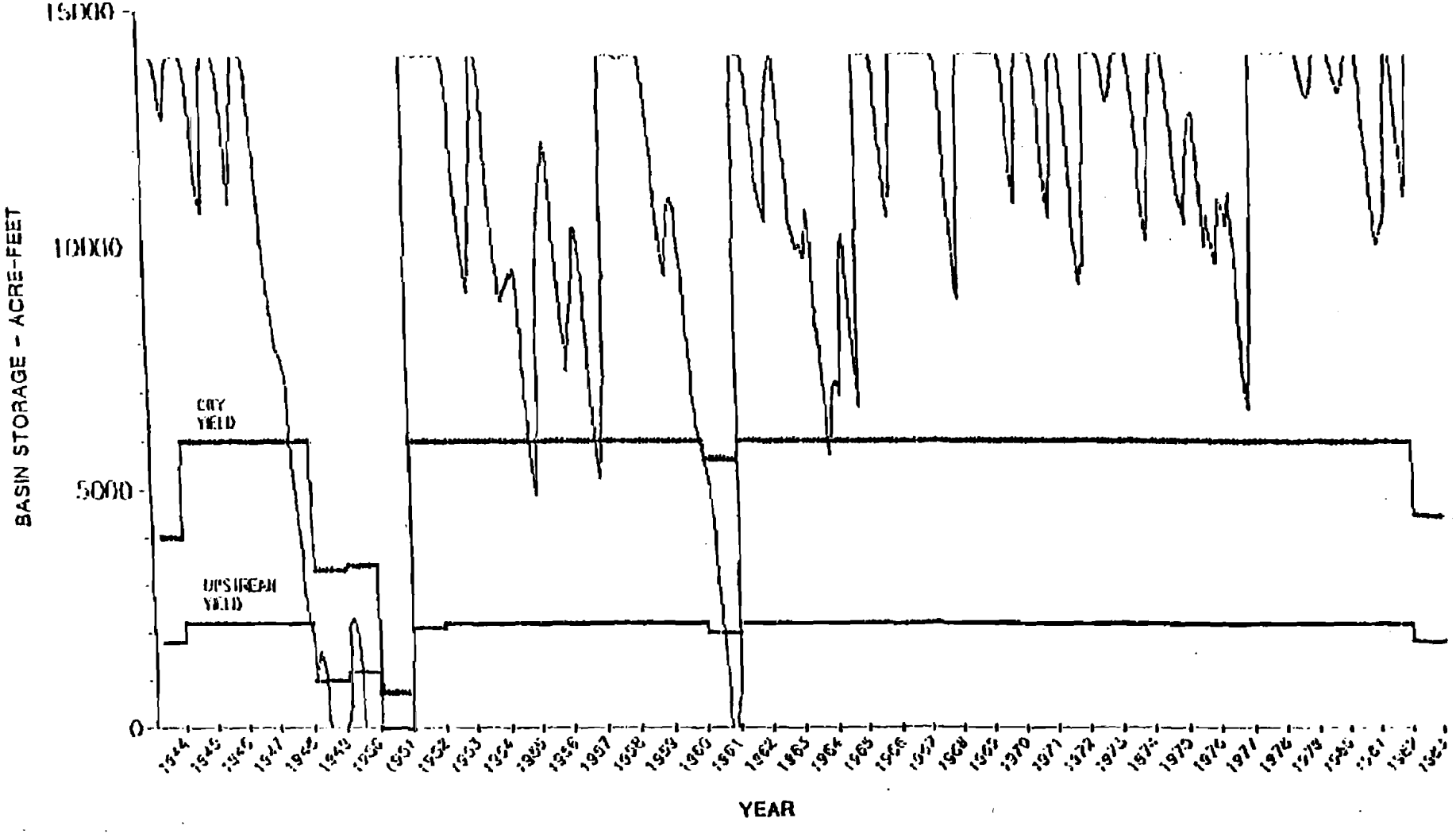


FIGURE 10

TABLE NUMBER 1
WATER SUPPLY AVAILABLE FROM SOURCES WITHIN
CASITAS MUNICIPAL WATER DISTRICT ASSUMING REPETITION OF 1944-1965
DRY CYCLE BEGINNING IN 1986

(QUANTITIES IN ACRE-FEET)

YEARS	Lake Casitas Safe Annual YIELD	Lake Matilija Safe Annual YIELD	Ojai Basin YIELD	VENTURA RIVER BASIN YIELD a) Above Robles Dam	b) Below Robles Dam	c) City of Ventura	TOTAL AVAILABLE SUPPLY a) Including Yield to City of Ventura	b) Excluding Yield to City of Ventura
1944 - 1986	21,500	620	4,200	2,800	2,200	6,000	37,220	31,320
45 87	21,500	601	4,200	2,800	2,200	6,000	37,201	31,201
46 88	21,500	582	4,200	2,800	2,200	6,000	37,182	31,182
47 89	21,500	563	4,200	2,800	2,200	6,000	37,163	31,163
48 1990	21,500	544	4,200	2,800	2,200	6,000	37,144	31,144
49 91	21,500	525	4,200	2,800	1,001	3,323	33,249	29,926
1950 92	21,500	506	4,200	2,800	1,186	3,425	33,517	30,092
51 93	21,500	487	4,200	2,800	0	761	29,648	28,887
52 94	21,500	468	4,200	2,800	2,110	6,000	36,978	30,978
53 95	21,500	449	4,200	2,800	2,200	6,000	37,049	31,049
54 96	21,500	430	4,200	2,800	2,200	6,000	37,030	31,030
55 97	21,500	411	4,200	2,800	2,200	6,000	37,011	31,011
56 98	21,500	392	4,200	2,800	2,200	6,000	36,992	30,992
57 99	21,500	373	4,200	2,800	2,200	6,000	36,973	30,973
58 2000	21,500	354	4,200	2,800	2,200	6,000	36,954	30,954
59 01	21,500	335	4,200	2,800	2,200	6,000	36,935	30,935
1960 02	21,500	316	4,200	2,800	2,200	6,000	36,916	30,916
61 03	21,500	297	4,200	2,800	2,010	5,628	36,335	30,707
62 04	21,500	278	4,200	2,800	2,200	6,000	36,878	30,878
63 05	21,500	259	4,200	2,800	2,200	6,000	36,659	30,859
64 06	21,500	240	4,200	2,800	2,200	6,000	36,840	30,840
65 07	21,500	220	4,200	2,800	2,200	6,000	36,820	30,820
Averages:	21,500	420	4,200	2,800	1,987	5,506	36,304	30,907

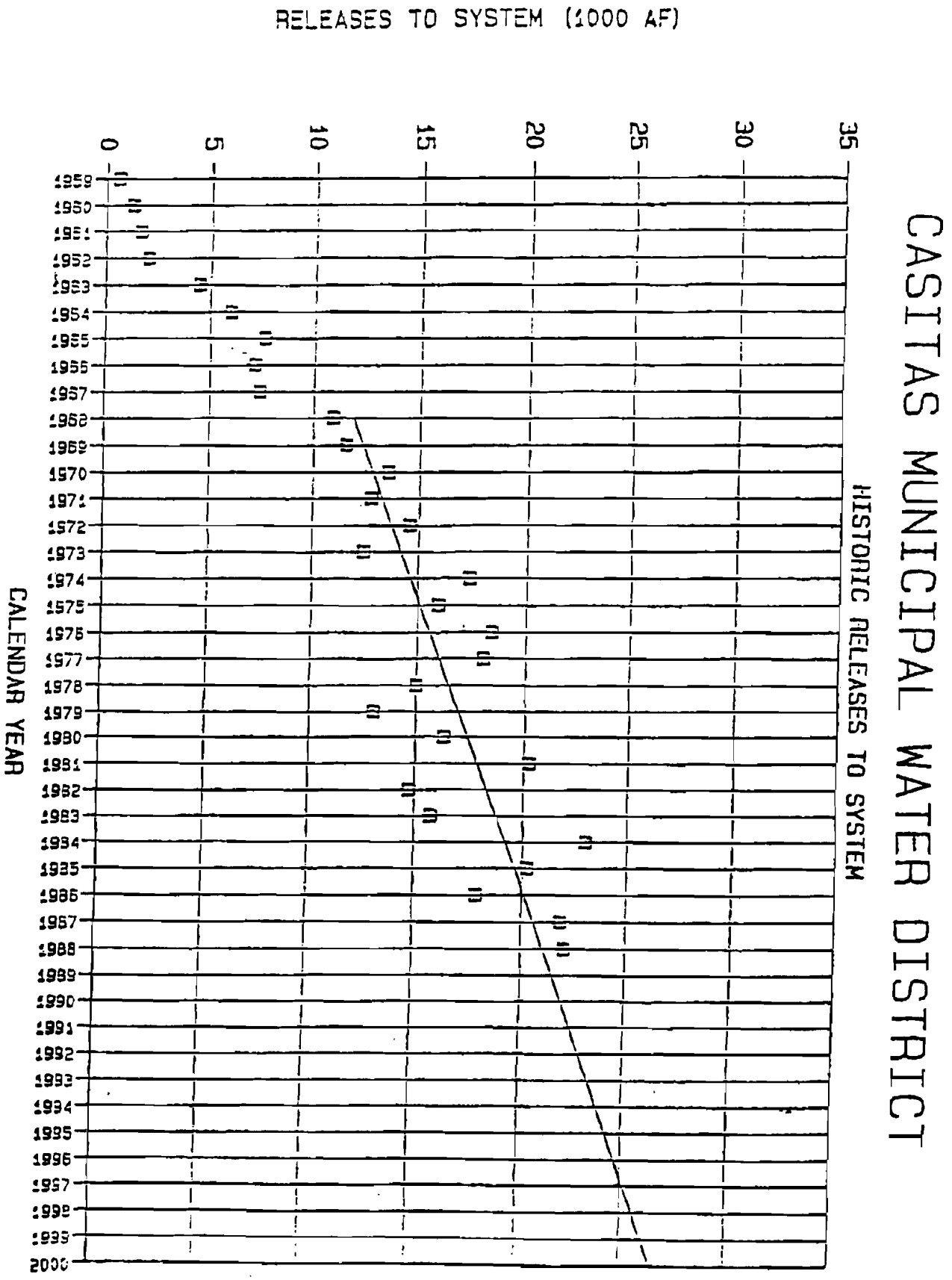
LAB[illegible]2

CASITAS MUNICI[illegible] WATER DISTRICT

LAKE CASITAS OPERATION SUMMARY

(QUANTITIES IN ACRE-FEET)

Year	Reservoir Data First of Year: Elev. Above M.S.L.	Reservoir Data First of Year: Storage	InFlow for Year: Diversion From Ventura River: Direct	InFlow for Year: Diversion From Ventura River: Total	Releases for Year: To Conv. System	Releases for Year: Down River	Releases for Year: Total	Spill for Year	Evaporation for Year	Rainfall on Lake Surface	Maximum Storage for Year
1959	–	0	2,305	5,105	7,410	586	72	658	0	728	59	7,022
1960	366.66	5,908	1,322	24	1,346	1,277	80	1,357	0	1,068	372	6,846
1961	363.28	5,201	967	33	1,000	1,625	18	1,644	0	819	133	5,201
1962	355.46	3,870	26,428	21,915	48,343	1,988	55	2,043	0	3,505	1,014	51,977
1963	477.68	47,679	2,114	2,939	5,053	4,445	72	4,517	0	3,498	1,664	51,524
1964	446.13	46,381	1,841	354	2,201	6,024	72	6,096	0	3,406	1,293	46,381
1965	438.57	40,373	15,279	21,438	36,717	7,631	72	7,703	0	2,957	2,421	68,851
1966	469.42	68,851	11,941	25,323	37,264	7,162	73	7,235	0	5,030	1,915	95,765
1967	490.62	95,765	12,961	35,172	48,133	8,759	72	8,831	0	6,214	3,480	138,996
1968	513.22	132,333	1,677	1,070	2,747	13,729	74	13,803	0	6,593	2,133	132,549
1969	504.25	116,818	55,379	50,349	105,728	14,040	73	14,113	0	8,413	7,625	216,790
1970	548.94	207,694	7,112	15,859	22,971	16,417	72	16,489	0	9,841	5,395	217,656
1971	549.78	207,729	3,758	10,957	14,715	16,392	24	16,416	0	9,552	3,433	214,692
1972	546.52	201,908	813	1,718	2,531	17,878	73	17,951	0	8,758	1,706	202,690
1973	536.70	179,435	22,262	39,588	61,850	13,963	33	13,966	0	8,937	4,520	239,330
1974	555.75	224,519	5,240	11,732	16,972	17,400	23	17,423	0	9,394	5,423	238,096
1975	553.99	220,096	5,352	12,988	18,340	15,937	73	16,010	0	8,870	2,813	235,437
1976	552.49	216,370	3,031	3,438	6,469	18,371	104	18,475	0	9,142	3,782	219,324
1977	545.29	199,003	1,590	1,094	2,684	18,035	70	18,105	0	8,821	3,352	200,062
1978	536.10	178,113	49,376	28,695	78,071	12,390	2,677	15,067	1,572	9,622	9,879	255,307
1979	561.68	239,802	7,584	8,845	16,429	13,072	32	13,104	1,193	9,963	5,395	255,116
1980	560.75	237,365	28,923	2,717	31,640	16,283	73	16,356	16,855	9,900	7,393	260,034
1981	559.18	233,286	3,112	5,772	8,884	20,242	73	20,315	0	9,412	4,002	240,222
1982	552.52	216,444	5,206	9,933	15,139	14,739	73	14,812	0	8,339	5,645	223,208
1983	551.56	214,078	44,548	22,131	66,679	15,757	73	15,830	17,877	8,844	11,699	259,264
1984	565.49	249,931	2,878	2,087	4,965	23,007	73	23,080	0	10,637	2,924	249,958
1985	555.15	223,006	4,220	3,014	7,234	20,219	73	20,292	0	9,149	2,637	223,208
1986	545.97	200,605	18,783	39,316	58,099	17,870	73	17,943	742	9,699	5,589	254,926
1987	560.16	235,828	-914	1,614	700	21,848	73	21,921	0	9,118	3,142	236,063
1988	549.35	208,687	1,506	9,154	10,661	22,047	73	22,120	0	9,006	3,714	216,543



Mbk 13 APR 1989

FIGURE 11

Table Number 3

Estimated 1989 Level of Water Demands
Within Casitas Municipal Water District
Assuming Continuation of Drought Cycle

1. Casitas Municipal Water District Water Demand

   A) Average demand for 5-year period 1984 through 1988 equals 21,071 acre-feet.

   B) Average demand for 3-year period 1985 through 1988 equals 20,661 acre-feet.

   C) Average demand for 2-year dry period 1987 through 1988 equals 22,020 acre-feet.

   D) 1989 demand based on regression analysis of historic demands 1968 through 1988 equals 21,400 acre-feet.

   For 1944-1965 critical dry period use: 21,400 acre-feet.

2. Ojai Groundwater Basin Non-Casitas Demand

   Current demand in accordance with findings of August 1988 Ojai Basin study: 3,700 acre-feet.

3. Ventura River Groundwater Basin Non-Casitas Demand

   A) Area between Matilija Dam and Robles Dam:

   Demands based on the following:

   1. Data furnished by water utility
   2. Data contained in February 1989 LAFCO Inventory of Water Purveyors
   3. SWRCB-reported water uses
   4. Estimate on non-reported demand 2,827 acre-feet.

   B) Area Between Robles Dam & Foster Park:

   Demands based on the following:

   1. Data furnished by water utilities
   2. Data contained in February 1989 LAFCO Inventory of water purveyors
   3. SWRCB-reported water uses 2,393 acre-feet.

Estimated 1989 Total Demand Within Casitas MWD: 30,320 acre-feet.

Table Number 4

Estimated 1990 Water Demands
Within Casitas Municipal Water District
As Provided by Various Studies

Demand in Acre-feet

Source	1990 Estimated Demand
1) U.S.B.R.; Ventura River Project Extension, October 1968	34,600
2) U.S.B.R.; Water Supplies Of The Central California Coastal Area, May, 1969	31,140
3) Penfield and Smith Engineers, Inc.: Casitas MWD MAster Plan for Water Facilities, October 1970	30,600
4) Engineering-Science Inc., Feasibility Study for Importation of State Project Water, December 1975	31,700
5) Casitas Municipal Water District, September 29, 1978	32,500
6) Casitas Municipal Water District, March 7, 1984	30,600
7) Ventura County Planning Division, Urban Water Management Plan: Ventura County, February 1986 (from plan submitted by Casitas)	31,880
8) James M. Montgomery, Consulting Engineers Inc., Feasibility of Importing State Project Water Into Ventura County, June 1987	a) Original Estimate: 30,990 b) Maximum Estimate: 31,100

CASITAS RESERVOIR END-OF-MONTH STORAGE

INCREASING DISTRICT DEMAND

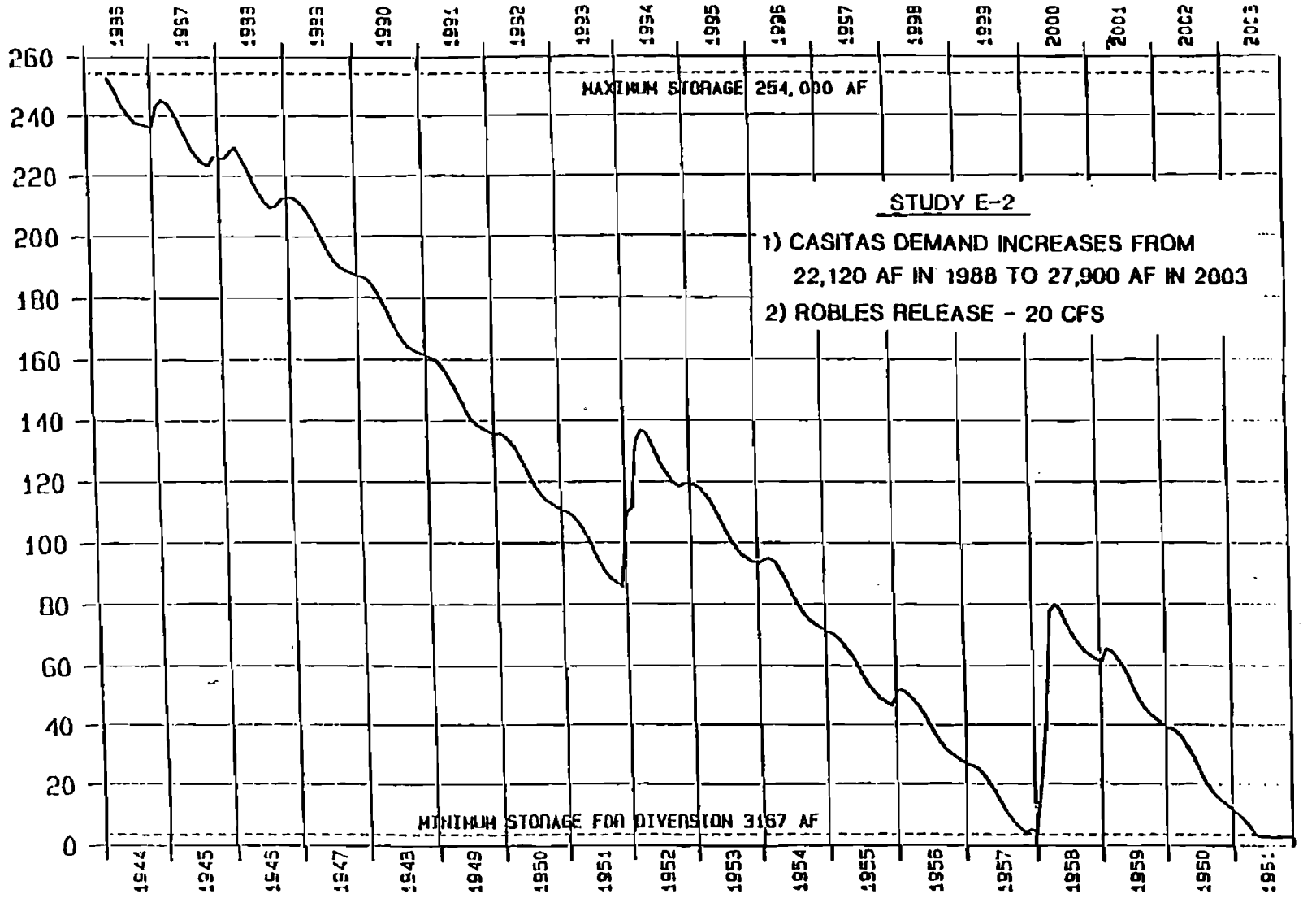


FIGURE 12

CASITAS RESERVOIR END-OF-MONTH STORAGE

DISTICT DEMAND 22,120 AF

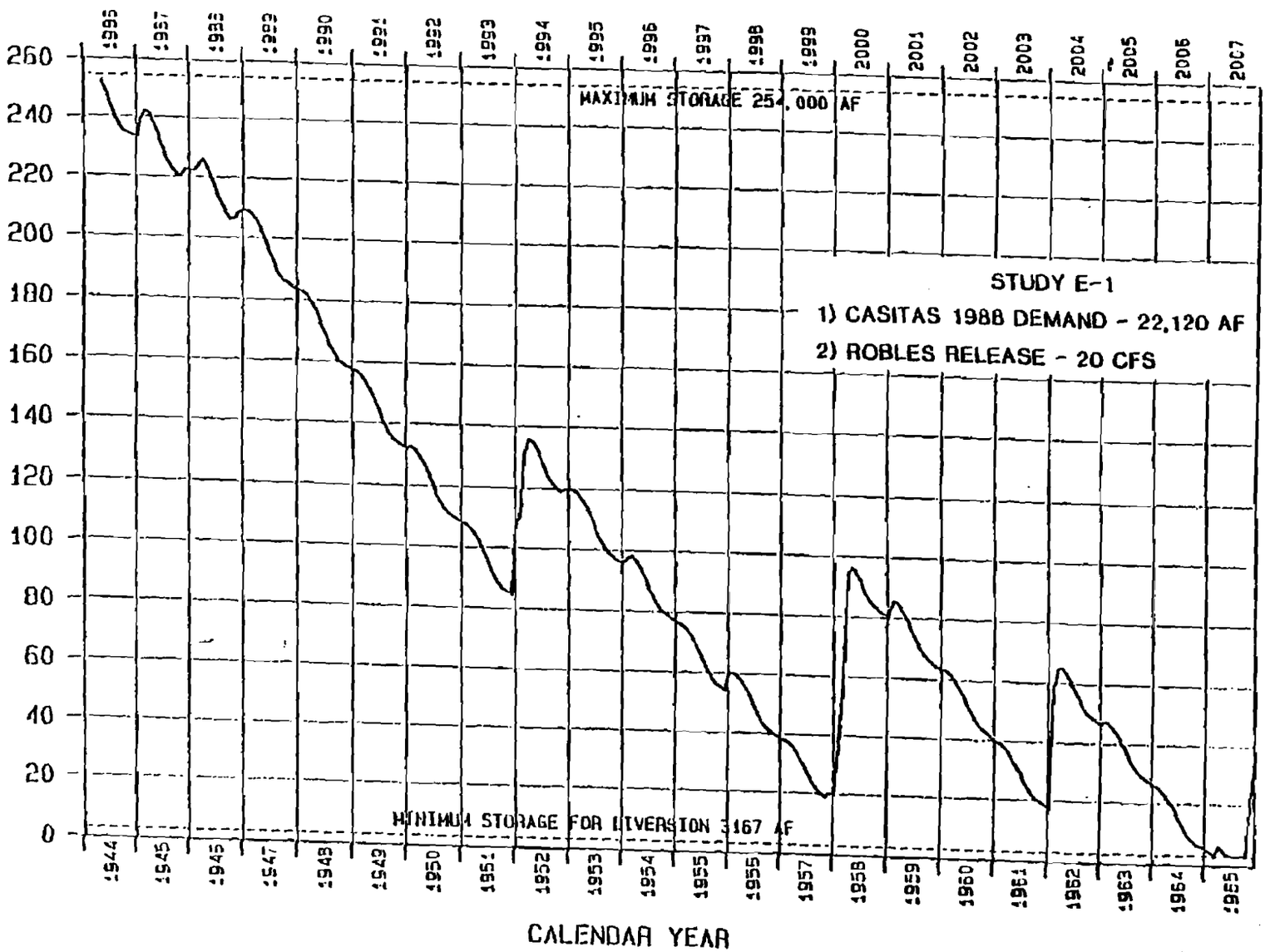


FIGURE 13

mbk 13 APR 1989

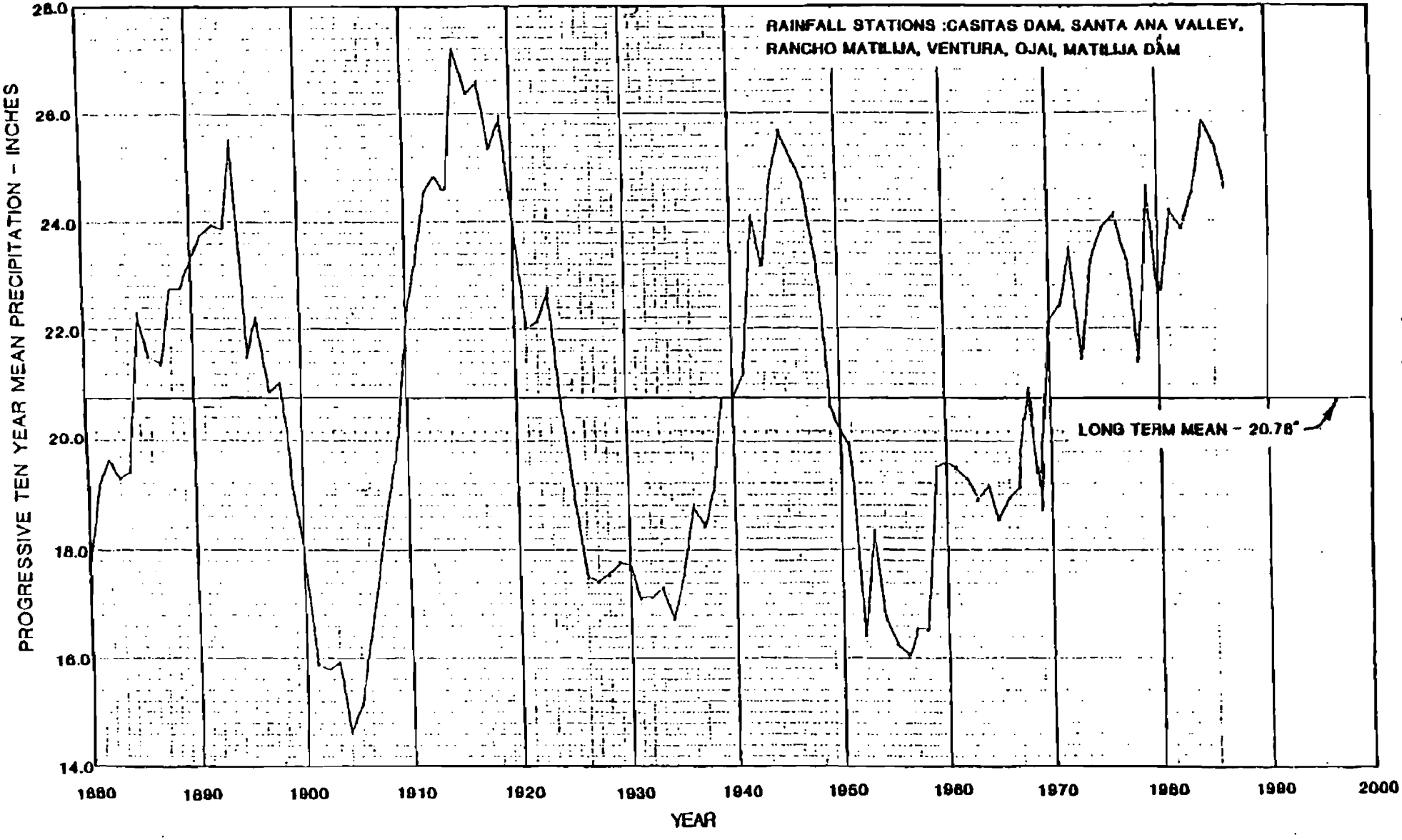


FIGURE 14

PROGRESSIVE TEN YEAR MEAN PRECIPITATION IN LAKE CASITAS AREA