SANTA YNEZ RIVER WATERSHED HYDROLOGY

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(Panel I)

1. CLIMATE

Santa Ynez River Basin has a Mediterranean climate characterized by hot, dry summers and cool, wet winters. Precipitation varies by location within the watershed due to orographic effects, averaging annually from approximately 14 inches near the Pacific Ocean to about 30 inches at Juncal Dam. Almost all precipitation occurs between November and April, with large variations in annual amounts occurring from one year to another. For example, precipitation at Gibraltar Reservoir has ranged from about 11 inches in the winter of 1923-1924 to about 73 inches in the winter of 1997-1998. Prolonged drought periods, typical in the Santa Ynez River watershed, are shown in the precipitation cumulative departure curves (Figure 1) indicating historical wet and dry periods. A wet period is indicated by an upward trend of the graph over a period of years. Conversely where the graph trends downward over a period of years a dry period is indicated as in the periods 1947-1951 and 1987-1991. A cloud-seeding program has been implemented intermittently in Santa Barbara County during the majority of the winter seasons since 1950.

2. RESERVOIRS ON SANTA YNEZ RIVER

- Jameson
- Gibraltar
- Cachuma

The Santa Ynez River flows west approximately 90 miles to the Pacific Ocean, draining approximately 900 square miles (Figure 2). There are two smaller water supply reservoirs in the upper Santa Ynez River basin above Cachuma Reservoir. Jameson Reservoir, the most upstream reservoir, was completed in 1930, and is owned and operated by the Montecito Water District. Jameson Lake stores approximately 5,000 acre-feet of water with a safe yield of about 1,150 acre-feet per year. Gibraltar Reservoir was completed in 1920 and raised in 1948 to restore its original capacity depleted by sediment deposition. Gibraltar Reservoir is owned and operated by the City of Santa Barbara, and provides 7,600 acre-feet of storage with an annual safe yield of about 2,000 acre-feet. It should be noted that both reservoirs are not operated based on safe yield. They are operated based on demand and availability of other back up sources, such as ground water in drought periods. Construction of Bradbury Dam on the Santa Ynez River, about 48.7 river miles from the Pacific Ocean, was completed in December 1952. The drainage area of the Santa Ynez River basin upstream of Bradbury Dam is approximately 422 square miles. Cachuma Reservoir was constructed with a storage capacity of about 205,000 acre-feet. The safe yield of Cachuma Project was determined in the 1960's to be 27,800 acre-feet. However, according to recent surveys, the storage capacity of Cachuma Reservoir has been reduced to approximately 188,000 acre-feet as a consequence of siltation. Currently the reservoir is drafted at a rate of about 25,700 acre-feet per year to meet existing demands among the water districts that hold contract rights to receive Cachuma Project water. The U.S. Bureau of Reclamation (USBR) operates the Cachuma Project to deliver water to the Project Member Units. Project operation also includes the storage and release of water for downstream water rights as a condition of the Project=s State Water Resources Control Board (SWRCB) permits.

3. STREAMFLOW CHARACTERISTICS

Several major tributaries downstream of Bradbury Dam contribute significant flows to the lower Santa Ynez River, including Santa Agueda, Alamo Pintado, Zaca, Alisal, and Salsipuedes creeks. Figure 3 shows the tributaries and the USGS gages downstream of Bradbury Dam. The soils, geology, and topography of the watershed create relatively rapid runoff conditions, with streamflow hydrographs showing a rapid rise and fall in response to precipitation. As a result, the Santa Ynez River is characterized as a Aflashy@ system, with intermittent surface flow conditions.

The Santa Ynez River Hydrology Model (SYRHM) was used to estimate natural flow of the Santa Ynez River at the Bradbury dam site. Natural flow is calculated by the SYRHM as the sum of monthly inflows to Jameson Lake, accretions from Juncal Dam to Gibraltar Dam, and accretions from Gibraltar Dam to Bradbury Dam for water years 1918 through 1993

(76 years). Figure 4 shows the frequency distribution of annual flows for the 76-year period. The annual flows presented in Figure 4 do not reflect the influence of cloud seeding. Figure 4 shows that the natural flows of the Santa Ynez River are characterized by wide variability in magnitude, typical of Southern California coastal rivers. Average annual flow for the 76-year base period was about 75,000 acre-feet, which corresponds to an annual exceedence frequency of 70 percent. This means that in 70 percent of the years, the natural flow at the Bradbury dam site can be expected to be less than 75,000 acre-feet. By comparison, the median annual flow for the same base period was about 24,900 acre-feet, significantly lower than the average annual amount of 75,000 acre-feet.

In fact the average flow is influenced by few wet years such as 1941, 1969, and 1983 with annual flows of 474,700; 485,200; and 425,000 acre-feet, respectively. In contrast, low annual flows were frequent with less than 24,900 acre-feet in 50 percent of years. In some years the flow was non-existent or the natural flow was less than 6,000 acre-feet per year in 15 years out of the 76-year period. This signifies the extreme variability of natural flow with predominantly low flow conditions in the Santa Ynez River watershed.

4. CRITICAL DROUGHTS

The sequencing of several years with below average precipitation and runoff creates a critical drought period. In the Santa Ynez River watershed, the critical drought periods are 1947-1951 and 1987-1991 with five and four and a half years in a row, respectively, of substantially below average runoff. The drought of 1987-1991 was ended with a storm event in March 1991, referred to as “March Miracle.”

The amount of runoff from the Santa Ynez River watershed area upstream of the Bradbury dam site during the critical periods is shown in Table 1.

Table 1 Estimated Watershed Runoff at Bradbury Dam Site During Critical Periods 1947-1951 and 1987-1991

Water Year	Runoff (acre-feet)	Water Year	Runoff (acre-feet)
1947	16,100	1987	2,100
1948	400	1988	14,300
1949	1,900	1989	4,800
1950	4,600	1990	1,900
1951	100	1991*	1,300
Total	23,100		24,400

** Oct 90 – Feb 91*

During the 1987-1991 drought, Gibraltar Reservoir went completely dry and the City of Santa Barbara resorted to extracting small quantities of water from the water table in sediments deposited behind the dam. The storage hydrographs of Gibraltar and Cachuma reservoirs for the 1987-1991 drought periods are shown in Figures 5a-b.

The drought of 1947-1951 is considered to be more severe than the drought of 1987-1991 because of its duration. This drought (1947-1951) is used to determine the water supply availability from Jameson, Gibraltar, and Cachuma reservoirs during a critical period.

5. STREAMFLOW PRIOR TO CONSTRUCTION OF BRADBURY DAM

As indicated earlier, the natural flow in the Santa Ynez River varied significantly from one year to another. This was demonstrated in terms of frequencies of annual flow amounts at the Bradbury dam site. In addition to this analysis, actual flows of the Santa Ynez River measured by the U.S. Geological Survey (USGS) near the dame site were analyzed.

The USGS gage (ID 11126000) on the Santa Ynez River, about 1.1 miles downstream of the Bradbury dam site at San Lucas Bridge (Hwy 154), was in operation from January 1929 through September 1976 (except data for water year 1932 not available). The daily flow data for the period January 1929 through October 1952 were analyzed to determine the seasonal flow characteristics of the Santa Ynez River prior to the completion of Bradbury Dam.

Figures 6a-f show daily flow hydrographs of the Santa Ynez River for the period 1929-1952 (no record for WY1932). The hydrographs indicate that Santa Ynez River flows ceased to exist in summer months, except in wet years, and in some years the no-flow condition extended into fall. In extreme dry years, such as 1931, 1948, and 1951, there was no flow in the river near the Bradbury dam site throughout the year. Figure 7 shows the frequency of daily flows as measured by the USGS gage below the dam site at San Lucas Bridge (HWY 154) for the period January 1929 – October 1952 (prior to storage by Cachuma Reservoir). The median daily flow in the river was 0.8 cfs. That means the river experienced flows of less than 0.8 cfs in 50 percent of days during the period of record prior to Cachuma Reservoir. Figure 8 indicates that there were practically no flows in 60 percent of days and less than one cfs in 80 percent of days during six months of summer-fall period (June-November).

6. FLOW AS A FUNCTION OF DISTANCE FROM DAM

Tributary inflow below Cachuma and percolation of the Santa Ynez River to the riparian alluvial ground water aquifer determine whether the flow increases or decreases as a function of distance from the dam. In the winter during a storm, flow increases as it moves downstream from Bradbury Dam to the Pacific Ocean as a result of significant tributary flow below Cachuma Reservoir. During water rights releases, the flow decreases as it moves downstream with percolation into the riparian aquifer. The greatest impact of Bradbury Dam on flow quantities in the Santa Ynez River, in the absence of downstream releases from Cachuma, is the area directly below Bradbury Dam where the tributary contribution is smallest.

7. RIPARIAN GROUND WATER RESOURCES

The Santa Ynez River flows westerly from Bradbury Dam to the Lompoc Narrows. The alluvial groundwater basin above the Lompoc Narrows is divided into four subareas as shown in Figure 9: the Santa Ynez sub-unit from Bradbury Dam to the Solvang Bridge; the Buellton sub-unit from Solvang Bridge to Buellton Bend; the East Santa Rita sub-unit from

Buellton Bend to Salsipuedes Creek; and the West Santa Rita sub-unit from confluence of Salsipuedes Creek to Robinson Bridge. Water budget parameters for the alluvial ground water are percolation from the Santa Ynez River, drainage to the river, underflow, bank infiltration, depletions by riparian vegetation, agricultural consumptive use, municipal and industrial consumptive use, mountain front recharge, and return flows.

8. WET PERIOD FROM 1993 – 2002

The period from 1993 through 2002 has been one of the wettest decades in the Santa Ynex River watershed. Cachuma Reservoir spilled in five out of ten years as shown in Table 2. With the exception of one year, the amount of spill in each of those years exceeded 100,000 acre-feet. The total amount of spill for the ten-year period was in excess one million acre-feet.

TABLE 2 ESTIMATED SPILLS FROM CACHUMA RESERVOIR (ACRE-FEET)

Water Year	Spill
1993	280,698
1994	0
1995	354,402
1996	0
1997	0
1998	386,055
1999	0
2000	6,295
2001	112,312
2002	0

Source: U.S. Bureau of Reclamation