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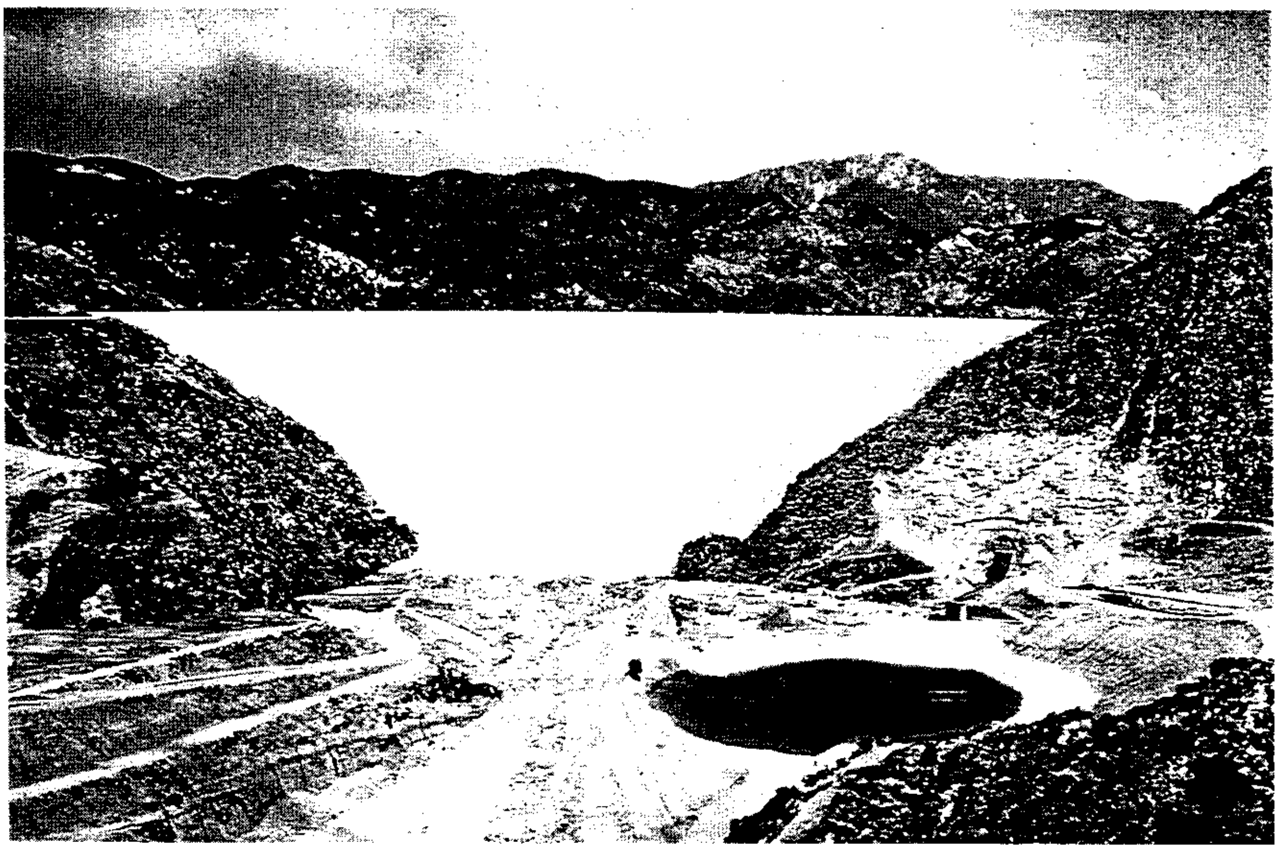
Feasibility Report

Seven Oaks Dam Water Conservation
Santa Ana River Basin, California



Volume II

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June 1997

Seven Oaks Dam Water Conservation Feasibility Report

Guide to Volume II

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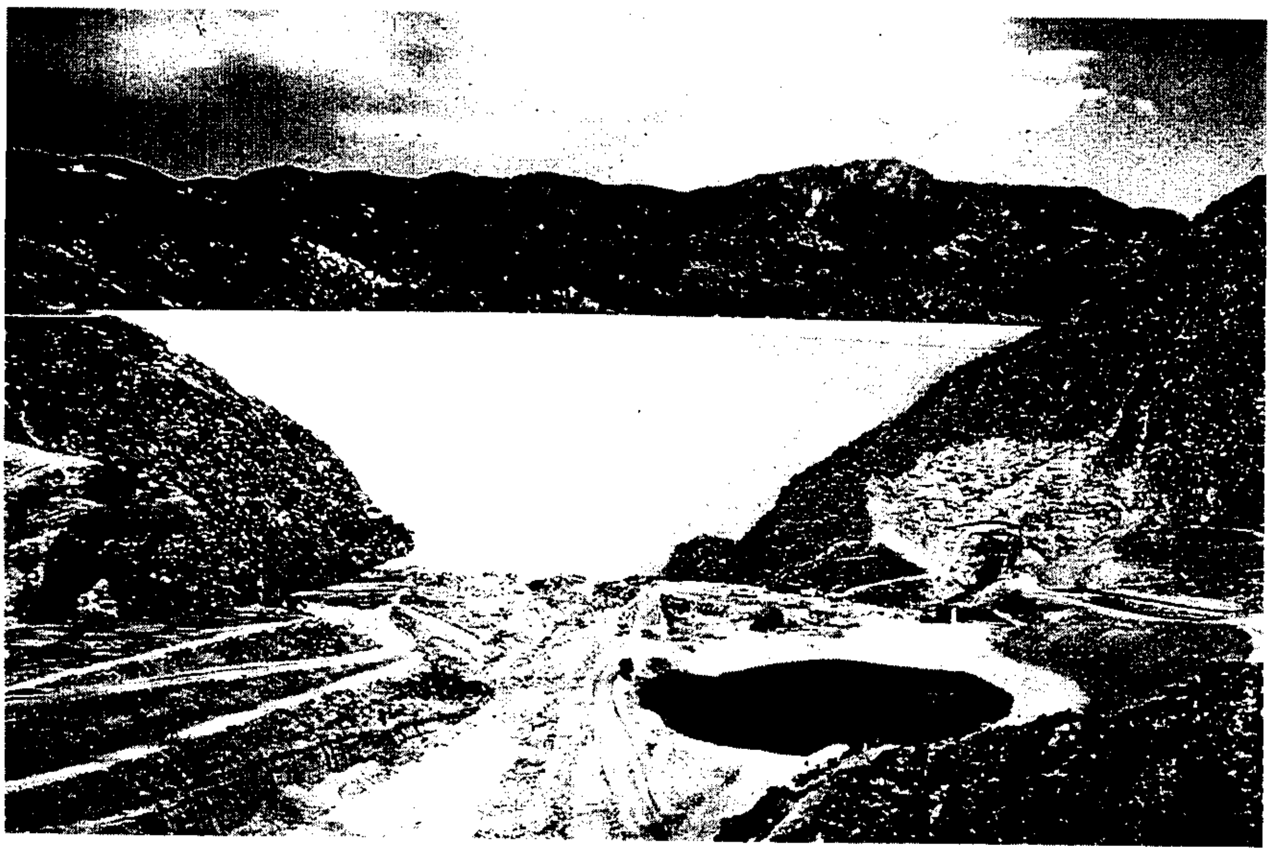

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I. INTRODUCTION

1.01 **Purpose and Scope**. This hydrologic feasibility study investigates various alternatives involving the operation of Seven Oaks Dam for water conservation on the Santa Ana River in San Bernardino County, California. The main purpose of Seven Oaks Dam is to assist in providing flood protection for communities downstream of the dam as a component of the on-going Santa Ana River Project. After the flood season has passed, the flood control space behind the dam could be utilized to conserve runoff and groundwater brought to the surface by the dam to some predisposed target pool level. In the dry summer months, the pool would be drawn down by releasing water through the outlet works to downstream users at a rate more commensurate with their diversion and groundwater recharge capabilities. This report presents results of the analysis for water conservation at Seven Oaks Dam. The dam configuration and release schedule used for this study represent the designs presented in the 1988 Santa Ana River Phase II General Design Memorandum (GDM). Present (2000) and future (2050) conditions were investigated for each alternative.

The results present a comparison of the various alternatives and their effect on water conservation. This analysis was performed to determine the additional impacts that result from the water conservation management efforts. Yields and inundation durations were determined for economic and environmental considerations.

1.02 **Previous Reports**.
a. The most recent water conservation study is presented in "Seven Oaks and Prado Dams Water Conservation Study, Final Reconnaissance Report", dated October 1992.

b. Some criteria used in this study were derived in "Hydrology Appendix, Santa Ana River Basin, Prado Dam and Reservoir, Orange County, California, Prado Dam Water Conservation Study", dated June 1988.

c. The most recent hydrology available for the Santa Ana River is presented in the "Phase II, General Design Memorandum on the Santa Ana River Mainstem including Santiago Creek, Volume 7, Hydrology", dated August 1988.

II. DESCRIPTION OF THE SEVEN OAKS WATERSHED

2.01 **General**. The Seven Oaks Dam watershed (plate 1) drains approximately 177 square miles, excluding the closed area of 32 square miles tributary to Baldwin Lake. The headwaters lie within the rugged San Bernardino Mountains. Elevations vary from 10,664 feet NGVD at Anderson Peak and 11,503 feet NGVD at San Gorgonio Peak to 2,060 feet NGVD at the damsite, which is approximately 1 mile upstream from the canyon mouth. Generally trending southwesterly, the 27 miles of river upstream of the damsite have an average gradient of 300 feet/mile, with individual stream gradients of 450 and 628 feet/mile for subareas A2 and A3, respectively. However, some smaller tributaries originating in the high mountains have gradients that exceed 1,900 feet/mile. Bear Creek (subarea A4), the principal tributary within the Seven Oaks canyon area, comprises 55 square miles and possesses an average gradient of approximately 460 feet/mile. Well-developed growths of fir and pine occur above elevations of about 5,000 feet NGVD. Many steep slopes within the watershed are covered with a moderate to dense growth of chaparral and sage scrub. Lower slopes carry a heavy cover of grasses and forbs. The drainage area above the dam is expected to remain largely undeveloped during the project life.

2.02 **Seven Oaks Dam**. Seven Oaks Dam is a 550-foot high earth-rockfill dam with a gross storage capacity of 145,600 acre-feet at spillway crest (elevation 2580 feet NGVD). Located 1-mile upstream of the mouth to the Upper Santa Ana River Canyon, the dam will control 177 square miles of watershed. The dam is designed to control the Reservoir Design Flood of 85,000 cubic feet per second (cfs) by making 50 cfs releases between elevations 2200 feet to 2298 feet. Above elevation 2298 feet, the outflow is increased to 500 cfs until the peak water surface at Prado Dam has passed, then increasing releases up to 7,000 cfs in order to drain the flood control pool. As described in the Phase II GDM, the unlined, trapezoidal spillway is 500 feet wide and 1,400 feet long and fashioned out of a natural saddle just east of the dam. The spillway can safely pass the full Probable Maximum Flood of 185,000 cfs.

2.03 **Structures Affecting Runoff**. Big Bear Dam is the only existing structure which would affect runoff in this watershed. Big Bear Lake is a water conservation reservoir, owned by the Big Bear Municipal Water District. The lake has a drainage area of about 38 square miles and has a surcharge storage of about 8,600 acre-feet between the top of the conservation pool and the top of the dam.

III. WATER CONSERVATION ALTERNATIVE OPERATIONS

3.01 **General**. The hydrologic analysis for water conservation at Seven Oaks Dam includes the investigation of alternatives based on varying seasonally expanded target pool levels for present (2000) and future conditions (2050). The study focuses on the comparison of these alternatives with the base condition (Phase II, GDM operation). The various operations are as follows:

Operation	Present	Future
BASE CONDITION	Existing, Phase II GDM Operation	Existing, Phase II GDM Operation
ALTERNATIVE 1	Seasonal Water Conservation Pool Expanded to El. 2300 Ft (Storage 16,293 ac-ft)	Seasonal Water Conservation Pool Expanded to El. 2300 Ft (Storage 7,194 ac-ft)
ALTERNATIVE 2	Seasonal Water Conservation Pool Expanded to El. 2375 Ft (Storage 35,000 ac-ft)	Seasonal Water Conservation Pool Expanded to El. 2375 Ft (Storage 22,050 ac-ft)
ALTERNATIVE 3	Seasonal Water Conservation Pool Expanded to El. 2418 Ft (Storage 50,000 ac-ft)	Seasonal Water Conservation Pool Expanded to El. 2418 Ft (Storage 36,500 ac-ft)
ALTERNATIVE 4	Seasonal Water Conservation Pool Expanded to El. 2265 Ft (Storage 10,270 ac-ft)	Seasonal Water Conservation Pool Expanded to El. 2265 Ft (Storage 3,370 ac-ft)

One critical stipulation to any operation at Seven Oaks Dam is the requirement for a minimum 3 cfs release from the reservoir at all times to meet downstream groundwater requirements. The significance of this discharge is based on the determination that the 3 cfs is the estimated historical groundwater flow passing the dam. As the dam foundation interrupts this flow and forces it to the surface, the minimum discharge line is designed to direct the discharge through the outlet works to the plunge pool where it percolates into the aquifer and continues down slope as groundwater.

3.02 Since the Seven Oaks Dam watershed is part of the Prado Dam drainage, the flood versus non-flood season presented in the 1988 Prado Dam water conservation study was adopted for this study. The flood season is defined as beginning in November and concluding at the end of February. The period from 1 March to 10 March is a transitional period between the flood season and the dry season. From historical data at Prado Dam, the remainder of the month has low flood potential. The basis for the March breakdown is the average 2-day discharges. The 2-day volume is the critical factor in implementing flood control releases at Prado Dam. The maximum 2-day discharge for inflow at Prado Dam for the period of record (1920-1985) and the average of annual maximum 2-day discharges over the period of record show that after 10 March, a significant decrease of the 2-day discharges occurs. The flood runoff potential in early March is determined by antecedent conditions from January and /or February. If January and /or February are particularly wet and early March produced floods, the operation of choice is flood control. If January and/or February are dry and early March floods occur, the runoff potential is low, hence, no adverse impacts will likely result by expanding the pool and the dam will be operated for water conservation. The period of the year through October is then defined as the non-flood season.

3.03 Inflow to the reservoir, used in the simulation analysis, is the period of record 1915-1990 daily values from the "Santa Ana River at Mentone" U.S.G.S. streamgage (11051500). (Appendix A is the complete daily value record used in the study). The future condition inflow required no adjustment for increased runoff due to urbanization since future development in the Seven Oaks Dam watershed is projected to be minimal. The future conditions yields would be affected solely by the loss of storage due to the 50-year sediment deposition in the reservoir.

3.04 The base condition operation of the reservoir for flood control is described as making releases of 50 cfs to 500 cfs when the water surface elevation is above the designated debris pool during the period of November through May during storm and flood events. During major flood events, Seven Oaks Dam and Prado Dam are operated in tandem with each other. Flood control releases at Seven Oaks Dam are restricted to a constant 50 cfs release between elevations 2200 feet to 2298 feet. Above elevation 2298 feet, the outflow is increased only to 500 cfs until the flood is over and the water surface at Prado Dam is decreasing. Subsequently, releases at Seven Oaks Dam increase up to a maximum of 7,000 cfs until the debris pool level is again attained. The release schedule is presented on Plate 5.

3.05 March is a transitional period between the flood season and the conservation season where the maximum conservation pool is expanded linearly to the maximum target level. The seasonally expanded target pool level is attained and/or sustained during the period from 10 March through May. All inflow to bring the reservoir to the target elevation is stored during this time except for a minimum 3 cfs release. Beginning in June and continuing through September, the pool is drained at a discharge which includes any coincident inflow plus a rate designed to empty the reservoir by the end of September. No carry over storage occurs from September to October for any of the alternatives. The purpose of this operation is to allow for routine maintenance and to minimize any water quality problems that may develop with the perennial impoundment of water.

3.06 The modeling of the base condition and the four alternative scenarios was accomplished through the use of the HEC-5 Reservoir Systems computer program. Present conditions storage capacities were developed for the Phase II GDM. Future conditions storage capacities were computed using conic deposition computations for 50-years of sediment (16,000 acre-feet). Under the Phase II GDM operation schedule, the debris pool elevation advances 1 foot a year to account for sediment deposition. The target elevation for the water conservation pool stays constant so the capacity of the conservation pool decreases over time because of sedimentation. Release schedules are found in the Phase II GDM and listed on plates 5 through 24. The average net evaporation was computed by compiling average monthly pan evaporation from records at the San Bernardino County Flood Control Yard and the average monthly precipitation from Santa Ana River

Powerhouse 3. Using the net evaporation equation for reservoirs:

Net Reservoir Evaporation = 0.70 (EVAP-PRECIP), where:
0.70 = pan coefficient for this region
EVAP = average monthly pan evaporation
PRECIP = average monthly precipitation

The resulting net evaporation rates for this study are as follows:

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
3.64	1.58	0.01	0.17	0.21	1.11	3.07	4.88	5.70	7.93	7.34	5.22

All units presented are expressed in inches per month.

3.07 **Description of Alternatives**. The base conditions and four alternative water conservation operations (plate 2 and table 1) were examined in this study. Rule curves governing the water conservation operation are presented on plates 3 and 4.

a. Base Condition. This operation is described as the existing Phase II GDM operation. From the beginning of November to the end of May, the target debris pool elevation is 2200 feet (2,968 acre-feet) for present conditions and 2250 feet (2,189 acre-feet) for future conditions (plate 2). During this time, all inflows are stored until the target debris pool level is attained after which releases from the dam should equal inflow. Beginning in June, releases from the dam include all inflows plus a release to empty the debris pool by the end of August. The debris pool releases for present conditions are as follows: June, 10 cfs; July, 20 cfs; and August, 20 cfs. The debris pool releases for future conditions are as follows: June, 6 cfs; July, 15 cfs; and August, 15 cfs.

b. Alternative 1. This operation involves normal flood operations in the winter months (debris pool to elevation 2200 feet for present conditions and elevation 2250 feet for future conditions), then at the beginning of March, the seasonal conservation pool is expanded linearly over 10 days to a target conservation level of elevation 2300 feet (16,293 acre-feet, present and 7,194 acre-feet, future; plate 2) on 10 March. From 10 March through May, all inflow is released from the dam after the target elevation is reached. From June through September, all inflow plus a conservation pool release is made to insure the conservation pool is drained by the end of September. Conservation pool releases for present conditions are as follows: June, 65 cfs; July, 70 cfs; August, 70 cfs; and September, 70 cfs. Conservation pool releases for future conditions are as follows: June, 25 cfs; July, 32 cfs; August, 32 cfs; and September, 32 cfs.

c. Alternative 2. This operation involves normal flood operations in the winter months, then at the beginning of March, the seasonal conservation pool is expanded linearly over 10 days to a target conservation level of elevation 2375 feet (35,000 acre-feet, present, and 22,050 acre-feet, future; plate 2) on 10 March. From 10 March through May, all inflow is released from the dam after the target elevation is reached. From June through September, all inflow plus a conservation pool release is made to insure the conservation pool is drained by the end of September. Conservation pool releases for present conditions are as follows: June, 145 cfs; July, 145 cfs; August, 145 cfs; and September, 145 cfs. Conservation pool releases for future conditions are as follows: June, 85 cfs; July, 93 cfs; August, 93 cfs; and September, 93 cfs.

d. Alternative 3. This operation involves normal flood operations in the winter months, then at the beginning of March, the seasonal conservation pool is expanded linearly over 10 days to a target conservation level of elevation 2418 feet (50,000 acre-feet, present and 35,600 acre-feet, future; plate 2) on 10 March. From 10 March through May, all inflow is released from the dam after the target elevation is reached. From June through September, all inflow plus a conservation pool release is made to insure the conservation pool is drained by the end of September. Conservation pool releases for present conditions are as follows: June, 208 cfs; July, 208 cfs; August, 208 cfs; and September, 208 cfs. Conservation pool releases for future conditions are as follows: June, 135 cfs; July, 155 cfs; August, 155 cfs; and September, 155 cfs.

d. Alternative 4. This operation involves normal flood operations in the winter months, then at the beginning of March, the seasonal conservation pool is expanded linearly over 10 days to a target conservation level of elevation 2265 feet (10,270 acre-feet, present and 3,370 acre-feet, future; plate 2) on 10 March. From 10 March through May, all inflow is released from the dam after the target elevation is reached. From June through September, all inflow plus a conservation pool release is made to insure the conservation pool is drained by the end of September. Conservation pool releases for present conditions are as follows: June, 42 cfs; July, 42 cfs; August, 42 cfs; and September, 42 cfs. Conservation pool releases for future conditions are as follows: June, 11 cfs; July, 15 cfs; August, 15 cfs; and September, 15 cfs.

3.08 **Results**.

a. **Procedures**. Period of record daily inflows (1915-1990) were routed through the reservoir using the operation plans described above for the base condition and the four alternatives. The HEC-5 computer program was used to perform the simulations. During the period June through September when water from the conservation pool is being released there will in most cases still be inflow, especially during the early part of the period. The diversion option of HEC-5 was used to simulate the releases from the conservation pool while the reservoir outlet schedule was used to simulate flood control releases. Within the capabilities of HEC-5, this is the most straight forward method of modeling the reservoir operation. To simplify Feasibility Study estimates, no analyses were made of historic diversions or water rights. It is assumed that the historic diversions, particularly during the period March through May, could be offset by more complex water conservation measures. However, further analyses of diversions, water rights and water conservation impoundment and releases should be made during the development of the water control manual for the Selected Plan. In other water conservation studies, the yield would then have been determined by summing the diversion quantities. In the case of Seven Oaks, no firm downstream diversion requirement or diversion capacity has been established. The simulated diversion release from the conservation pool was set to empty the conservation pool (including inflow) by the end of September given that the conservation pool was at maximum allowable level on May 31. In most years, the conservation pool will be emptied long before the end of September.

The assumption was also made that the downstream diversion facilities and recharge facilities would be developed to accommodate the release for each alternative and the selected plan. The release rate under actual operating conditions may be quite different from that simulated and the conservation pool emptied sooner based on downstream conditions and/or to minimize evaporation losses during the summer.

b. **Yields**. In order to keep the yield determination simple and straight forward, yields from the simulation results were determined by tabulating (summing) the accumulated storage at the end of May each year over the period of record and dividing by the number of years to obtain the average annual yield. The amount of water in storage above the debris pool elevation at the end of May, before any releases were made from the conservation pool, was considered the additional yield. Arguments can be made that this is not the actual yield because the flow records from the Mentone gage, used in the simulations, include flows that have historically been diverted at the Santa Ana River Intake into the downstream recharge basins. The records also include diversions made by Bear Valley Mutual Water Company to Edison Powerhouse #3 afterbay. During the period 1 March thru 31 May when the simulation runs indicate the conservation pool would be filling, some of that historically diverted water would not be available. Records from San Bernardino Valley Water Conservation District show an average annual recharge from the Santa Ana River of about 9,600 acre feet of which about 50 percent is recharged during the months March, April and May. For Alternative 1, about 70 per cent of the additional yield is realized in the years when the conservation pool is filled and excess water is released downstream during the March - May period. This excess water would be available in these years for downstream diversion and recharge, and would still supply some of the water historically diverted at the Santa Ana River Intake. Also, storing water in the conservation pool makes it available for periods when it can best be used downstream. High groundwater conditions may limit the downstream recharge capability in the spring after a wet winter. The simulation runs did not reflect any release of water from the conservation pool during the March thru May period. In actual operation for years like 1978, early March inflows could be captured and released for downstream recharge thus making space for May runoff. This would increase the yield determined from the simulations. In years like 1939 and 1976, the conservation pool could capture the September flood runoff which was not included in the determined yield. All these factors, while not rigorously addressed quantitatively, would increase the actual yield and tend to offset any loss in historical recharge not accounted for in the simulations. The results for the base condition and four alternatives for present and future conditions are presented in Table 2. The results do not include any losses due to evaporation after June first but since the pool is being emptied the evaporation losses will be relatively insignificant. Additional incidental yield is provided by the flood control operation just by virtue of storing floodflows during the flood season and releasing them at a lower rate. However, this yield should be the same for all alternatives, hence, no attempt was made to quantify this additional base condition yield..

c. For the base condition and the four alternatives, the following summary lists the percentage of years that the debris pool (base condition) and the maximum target elevation (alternatives) was attained:

Percentage of Time Target Elevations Attained

	Present	Future
Base Condition - Elevation 2200 (p) & Elevation 2250 Ft (f)	64%	70%
Alternative 1 - Elevation 2300 Ft	25%	36%
Alternative 2 - Elevation 2375 Ft	13%	22%
Alternative 3 - Elevation 2418 Ft	11%	13%
Alternative 4 - Elevation 2265 Ft	33%	57%

d. Elevation-Duration Frequency Curves. Annual and seasonal elevation-duration frequency curves were developed for the base condition and each of the alternatives (plates 5 through 24) to assess environmental impacts. The annual curves (plates 5 through 14) were developed to represent the expected inundation periods and reservoir stages for various frequency events over a period of 365 days. The seasonal curves (plates 15 through 24) represent the 204 days between 10 March and 30 September to assess impacts from the increased inundations.

e. Present and future annual elevation-duration frequency curves for the base condition and the four alternatives were derived by routing inflow data from 1915 to 1990 through Seven Oaks Dam using the simulation model with the appropriate present or future condition release schedule. The resulting simulated daily water surface elevations were ranked by magnitude for durations 1 to 365 days for each year. Each duration was then ranked by magnitude for the period of record and plotted using median plotting positions. For example, the largest event for the period of record represents approximately a 100-year event and the median event represents approximately a 2-year event. Smooth, best fit curves were then drawn for each duration. Seasonal curves were developed similarly to the annual curves except the duration of flows is reduced to the 204 days spanning the non-flood season (10 March through September).

3.09 **Impact of Water Conservation Storage at Seven Oaks Dam on Yield at Prado Dam.** The 2,968 acre-foot debris pool (elevation 2200 feet, present conditions) is filled only about two-thirds of the years. This means no additional yield is available, beyond the incidental yield, in about one-third of the years.

3.10 The yield at Seven Oaks Dam is determined by a period of record simulation. The yield at Prado Dam was determined from the years 1950 through 1988, which was determined to be representative of the long term record. This common period was analyzed for determining the percentage of the yield at Seven Oaks Dam that would not reduce the yield at Prado Dam. Water is stored in the Seven Oaks Dam water conservation pool during the months of March, April and May. The simulation yield is the amount of water above the debris pool in storage as of 31 May of each year.

3.11 A major percentage of the yield at Seven Oaks Dam is produced in years when water is wasted at Prado Dam. This percentage is truly an additional yield at Seven Oaks Dam. Infiltration and evapotransporation losses between Seven Oaks and Prado Dams are not a factor in these flood years since these losses only reduce the amount of water wasted at Prado Dam. As an example, for alternative 1 (elevation 2300 feet), present conditions, 54% of the Seven Oaks yield is produced in years when water is wasted at Prado Dam.

3.12 The remaining yield at Seven Oaks Dam is in the years when water is not wasted at Prado Dam in the March-May period. For alternative 1, this percentage is 46%. During these non-flood years, flows from Upper Santa Ana Canyon that route towards Prado Dam are subject to channel infiltration and evapotranspiration losses. Based on estimated flow widths and wetted acres for the average daily discharges between E Street and Seven Oaks Dam during the conservation period (March through May), and in conjunction with an estimated infiltration rate of 1 cfs/wetted acre, flows from Upper Santa Ana Canyon reaching E Street are effectively reduced by 50%.

3.13 From E Street to Prado Dam, discharges of treated effluent continuously flow in the Santa Ana River commingling with the Upper Santa Ana River discharges. Based on measurements of released treated effluent and amounts reaching Prado Dam, about 10% is lost between E Street and Prado Dam. Hence, the March-May non-flood flows will be reduced by an estimated 60% between Seven Oaks and Prado Dams.

3.14 For alternative 1, present conditions, 28% (60% of the 46%) of the Seven Oaks yield would not reach Prado Dam, hence, would not adversely impact the Prado yield and would be a true yield at Seven Oaks Dam. A total of 82% (54% plus 28%) of the simulated average annual yield of 5,020 acre-feet would be the true yield at Seven Oaks Dam. The true yield percentages for all four alternatives, present and future, are listed in table 4. The true increase in yield is listed in Table 2.

IV. GROUNDWATER

4.01 Subsurface flow from Santa Ana River Canyon enters the Bunker Hill-San Timoteo Basin downstream from the canyon mouth. A California Department of Water Resources' study (1971) estimated the average amount of subsurface outflow from Santa Ana River Canyon to be 2,500 acre feet / year (3.5 cfs). This estimate assumed an average permeability of 1,000 gal/day/sq ft, a hydraulic gradient of 0.03 ft/ft and a saturated cross sectional area of 75,000 square feet. The construction of the dam will block the natural subsurface flow. The impervious core of the dam will extend to the bedrock, effectively cutting off flow in the aquifer. The blockage will cause the groundwater to rise to the surface behind the dam. At the damsite, approximately one mile upstream from the canyon mouth, the permeability of the alluvium was calculated from pumping test data to be at most 2,200 gal/day/sq ft and the saturated cross-sectional area of the alluvium was determined to be approximately 30,000 square feet. Using these variables and the hydraulic gradient of 0.03 ft/ft, the estimated outflow is calculated to be approximately 2,200 acre-feet/year (3 cfs). The groundwater (3 cfs) cut off by the dam would rise up through the aquifer upstream from Seven Oaks Dam. Once there, the operation at the dam will provide for the release of the flow through the outlet works and into the plunge pool where it will percolate back into the streamed aquifer far enough upstream to result in no impact to the downstream groundwater levels. A release of 3 cfs or greater will be made year around even when the debris pool is being formed . Net evaporation from the plunge pool is estimated at 6 acre-feet/year. However, construction of the dam and the implementation of the operation schedule will actually enhance water supply for the downstream users. Floodwater previously passing through the canyon and the downstream wash will be captured and released at a slower rate, thus allowing flows normally lost to be utilized more effectively by the downstream users. Groundwater recharge operations conducted downstream of the dam would benefit greatly by a more efficient management of the controlled water conservation releases. Hence, any of the water conservation alternatives would have a positive impact on groundwater.

V. WATER QUALITY

5.01 Water quality concerns are from three areas. The first concern is that the TDS and other chemicals in the water stored in the reservoir may be increased due to evaporation. Secondly, the water stored in the reservoir may be degradated through mixing with any contaminant source. The last concern is the stratification of the pool and the growth of algae or other biological elements in the reservoir.

5.02 The Seven Oaks Dam has a reservoir area at spillway crest of 780 acres providing a gross capacity of 145,600 acre-feet of storage. The reservoir surface area of the debris pool elevation of 2200 feet is 74 acres. The recommended regulation of Seven Oaks Dam for flood control purposes is described in the Phase II GDM and is not changed by any water conservation alternatives. The regulation of Seven Oaks Dam for flood control and water conservation is described in Section 3.

5.03 From June through September, controlled releases of all inflow plus a constant discharge from the debris or conservation pool (to empty the pool no later than September) are made to meet downstream requirements. The maximum monthly amount of water stored in the reservoir and the associated evaporations under the base conditions and four alternative water conservation operations are shown in Table 3. The table shows the monthly data on reservoir storage, reservoir water surface area, evaporation rates, the maximum volume of evaporation possible, and the percentage of storage being evaporated if the pool was at the maximum elevation. As shown in this table, the highest percentage of evaporation for present conditions occurs in July under the base condition with an estimated 2 percent while the highest percentage of evaporation for future conditions occurs in July under the base condition and August under alternative 1 with an estimated 3%. The rest of the estimated percentage of evaporation under different operation conditions in different months is either less than 2 percent to negligible. This evaluation indicates that water quality changes, due to increased concentration by evaporation, is negligible.

5.04 The quality of water in the Santa Ana River at the damsite in the Santa Ana River Wash is excellent. The water contains low concentrations of total dissolved solids, nitrates, and other pollutants. Average values of the concentrations are well within Regional Water Quality Board objectives. At the damsite area, no known contaminant sources exist, consequently, water degradation through mixing with contaminants at the Seven Oaks Dam area is not a concern. Therefore, the quality of the water released from Seven Oaks Dam to the Santa Ana River will be good for all four alternatives.

5.05 The concern of the stratification of the pool and the growth of algae and other microbiological elements in the reservoir depends on the temperature, flow rate and residence time, and water chemistry. For all the four water conservation alternatives, the operations involve normal flood operations in the winter months, then at the beginning of March, the seasonal conservation pool is expanded linearly over 10 days to a target conservation level on 10 March. From 10 March through May, all inflow is released from the dam after the target elevation is reached. From June through

September, all inflow plus a conservation pool release is made to insure the conservation pool is drained by the end of September. According to the operation procedures, the maximum storage time of the water in the pool is about three months(March, April and May). Besides the storage time, the following summary lists the percentage of years that the maximum target elevation (alternatives) was attained:

Percentage of Time Target Elevations Attained

	Present	Future
Alternative 1 - Elevation 2300 Ft	25%	36%
Alternative 2 - Elevation 2375 Ft	13%	22%
Alternative 3 - Elevation 2418 Ft	11%	13%
Alternative 4 - Elevation 2265 Ft	33%	57%

As shown in this table, the percentage of time target elevation attained for the four alternatives is in general low. Judging from the fact that the maximum storage time is about three months and the low percentage of time target elevations attained, the probability of the stratification of the pool and developing anaerobic condition should be on the lower side. However, a Water Quality Monitoring Program will be implemented to establish a data base for those chemical, limnological, and bacteriological parameters that could adversely impact the environment in the upper Santa Ana River. The parameters will be monitored during the months of January, April, May, and June. The results of the water quality monitoring program will be analyzed each year to determine any necessary changes to the following year's monitoring program, any necessary changes in the regulation schedule, and any remedial measure to be implemented if required. The parameters to be monitored in the program are listed below.

a. Chemical Parameters. At a minimum, the chemical parameters that will be monitored are NH3 and NH4 (total ammonia), NO2, NO3, chlorophyll-a, pheophytin-a, chlorophyll-a/pheophytin-a ratio, and DDT. The parameters will be monitored at three levels, as follows: (a) on the surface near the dam intake structure; (b) near thermocline (either immediately above or immediately below); and © at the bottom of the reservoir pool. If no distinct thermocline exists, the depth will be halfway between the surface and bottom depths.

b. Limnological Parameters. The limnological parameters that will be measured are temperature, pH, dissolved oxygen, and specific conductivity. They will be monitored on the surface near the dam intake structure and at 15-foot depth increments to a depth of 190 feet.

c. Bacteriological Parameters. The bacteriological parameters that will be measured are total coliform, fecal coliform, and fecal streptococci. They will be monitored at the same levels as identified for the chemical parameters.

d. Downstream Water Quality Measurements. Water quality measurements will be taken at the United States Geological Survey (USGS) Gauge No. 11051500, located approximately one mile downstream of the dam site. Measurements will include all of the limnological and bacteriological parameters listed in the sections above, and all of the chemical parameters with the exception of the chlorophyll-a, pheophytin-a, and the chlorophyll-a/pheophytin-a ratio. Each parameter will be measured at only one depth, since downstream Santa Ana River flows will normally be fairly shallow. It should be noted that these water quality measurements exceed the normal stream gauge data collected by the USGS. Therefore, collection of this data is the responsibility of the San Bernardino Flood Control District.

VI. DOWNSTREAM IMPACTS OF WATER CONSERVATION

6.01 The operation of Seven Oaks Dam between 1 November and 28 February will be exactly the same for the water conservation alternatives as for flood control. During this period, a debris pool to elevation 2200 feet will be formed with available runoff. Flood control releases up to a maximum of 7,000 cfs will be made according to the water control plan any time water is higher than the debris pool. Peak discharges downstream from Seven Oaks Dam will not be affected by water conservation during this period. Annual maximum discharge frequency values for the base condition are listed in Table 5.

6.02 Under the preferred plan, the conservation pool to elevation 2300 feet is formed starting on 1 March and held until the end of May. During this period the downstream releases will be reduced to 3 cfs until the target elevation is reached. Then the release will be made equal to the inflow up to a maximum of 500 cfs during a flood event. After the flood event, releases will be made according to the water control plan for flood control. Seasonal (March through May) discharge frequency values for Alternative 1 are listed in Table 5 along with base conditions for comparison purposes. Discharge values for flood events up to about 3-year frequency are reduced to 3 cfs and up to about 10-year frequency are reduced to below 500 cfs. Discharge values for events from about 10-year to 50-year are reduced to 500 cfs. There is little difference for seasonal flood events greater than 50-year magnitude.

6.03 As listed in Table 5, the peak discharge will be reduced from 2500 cfs to 550 cfs for the 50-year seasonal flood event. At Greenspot Road about 1.5 miles downstream from the dam, the average depth will be decreased from about 5 feet to 3 feet and the average velocity will be reduced from about 6 ft/s to about 4 ft/s. However, as listed in Table 5, the discharge of 2500 cfs is only a 20-year event for annual maximum.

6.04 Mill Creek has a confluence with the Santa Ana River about 2.5 miles downstream from Seven Oaks Dam. The preservation area starts just downstream from this confluence on the north side of the river. Also listed in Table 5 are seasonal discharge frequency values for Mill Creek which are the same for base conditions and alternative 1. Comparison of these values with Santa Ana River flows, shows that Mill Creek runoff is controlling downstream from the confluence.

6.05 Starting in June, the conservation pool will be emptied at a rate of 70 cfs (Alternative 1) plus inflow to be empty at least by the end of September. During this period the downstream flows will be increased by about 50 cfs during the years that there was enough runoff to fill the conservation pool. This only happens in about 25% of the years based on simulation using recorded flows. For other years the period of increase will be shorter. All releases from the debris pool and the water conservation pool up to about 200 cfs will normally be captured by the distribution system or the downstream groundwater recharge basins. Flows exceeding about 200 cfs will travel downstream subject to infiltration and evapotranspiration.

TABLE 1
SEVEN OAKS DAM ALTERNATIVE OPERATIONS AND TARGET STORAGE
(Present Conditions)

BASE CONDITION - EXISTING PHASE II GDM OPERATION

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Storage[a] (ac-ft)	0	2968	2968	2968	2968	2968	2968	2968	2968	1168	0	0
Outflow (cfs)	I[b]	I	I	I	I	I	I	I	I+10[c]	I+20	I+20	I

1. SEASONAL WATER CONSERVATION POOL EXPANDED TO EL. 2300 FT. (16,293 Ac-Ft)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Storage (ac-ft)	0	2968	2968	2968	2968	16293	16293	16293	12500	8100	3800	0
Outflow (cfs)	I	I	I	I	I	I	I	I	I+65	I+70	I+70	I+70

2. SEASONAL WATER CONSERVATION POOL EXPANDED TO EL. 2375 FT. (35,000 Ac-Ft)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Storage (ac-ft)	0	2968	2968	2968	2968	35000	35000	35000	26500	17500	8600	0
Outflow (cfs)	I	I	I	I	I	I	I	I	I+145	I+145	I+145	I+145

3. SEASONAL WATER CONSERVATION POOL EXPANDED TO EL. 2418 FT. (50,000 Ac-Ft)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Storage (ac-ft)	0	2968	2968	2968	2968	50000	50000	50000	37500	25000	12500	0
Outflow (cfs)	I	I	I	I	I	I	I	I	I+208	I+208	I+208	I+208

4. SEASONAL WATER CONSERVATION POOL EXPANDED TO EL. 2265 FT. (10,270 Ac-Ft)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Storage (ac-ft)	0	2968	2968	2968	2968	10270	10270	10270	7775	5197	2620	0
Outflow (cfs)	I	I	I	I	I	I	I	I	I+ 42	I+ 42	I+ 42	I+ 42

Note:

a. All storage are end of month values. 1-10 March is a transitional period from flood control to water conservation. Target storage begins on 10 March.

b. I = release of natural inflow in cfs after target storage is attained.

c. I+xx = release of natural inflow + conservation pool release (to empty pool no later than the end of September).

TABLE 1 (Continued)
SEVEN OAKS DAM ALTERNATIVE OPERATIONS AND TARGET STORAGE (Future Conditions)

BASE CONDITION - EXISTING PHASE II GDM OPERATION

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Storage[a] (ac-ft)	0	2189	2189	2189	2189	2189	2189	2189	1830	910	0	0
Outflow (cfs)	I[b]	I	I	I	I	I	I	I	I+6[c]	I+15	I+15	I

1. SEASONAL WATER CONSERVATION POOL EXPANDED TO EL. 2300 FT. (7,194 Ac-Ft)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Storage (ac-ft)	0	2189	2189	2189	2189	7194	7194	7194	5400	3300	1100	0
Outflow (cfs)	I	I	I	I	I	I	I	I	I+25	I+32	I+32	I+32

2. SEASONAL WATER CONSERVATION POOL EXPANDED TO EL. 2375 FT. (22,050 Ac-Ft)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Storage (ac-ft)	0	2189	2189	2189	2189	22050	22050	22050	17000	11300	5600	0
Outflow (cfs)	I	I	I	I	I	I	I	I	I+85	I+93	I+93	I+93

3. SEASONAL WATER CONSERVATION POOL EXPANDED TO EL. 2418 FT. (50,000 Ac-Ft)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Storage (ac-ft)	0	2189	2189	2189	2189	35600	35600	35600	27600	17500	7330	0
Outflow (cfs)	I	I	I	I	I	I	I	I	I+135	I+155	I+155	I+155

4. SEASONAL WATER CONSERVATION POOL EXPANDED TO EL. 2265 FT. (3,370 Ac-Ft)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Storage (ac-ft)	0	2189	2189	2189	2189	3,370	3,370	3,370	2717	1796	875	0
Outflow (cfs)	I	I	I	I	I	I	I	I	I+11	I+15	I+15	I+15

Note:

a. All storage are end of month values. 1-10 March is a transitional period from flood control to water conservation. Target storage begins on 10 March.

b. I = release of natural inflow in cfs after target storage is attained.

c. I+xx = release of natural inflow + conservation pool release (to empty pool no later than the end of September).

TABLE 2
RESULTS FOR VARIOUS STORAGE ALTERNATIVES FOR WATER CONSERVATION AT SEVEN OAKS DAM

Present Conditions

Storage Alternative	Average Annual Inflow (ac-ft/yr)	Yield (ac-ft/yr)	Increase in Yield (ac-ft/yr)	True Increase in Yield (ac-ft/yr)	True Percent Increase in Yield
BASE CONDITION-Existing Phase II GDM Operation	24,000	2,430	-	-	-
Alt. 1. Seasonal Water Con. Pool Expanded to El. 2300 Ft	24,000	7,450	5,020	4,120	170
Alt. 2. Seasonal Water Con. Pool Expanded to El. 2375 Ft	24,000	11,120	8,690	7,470	307
Alt. 3. Seasonal Water Con. Pool Expanded to El. 2418 Ft	24,000	12,950	10,520	9,260	381
Alt. 4. Seasonal Water Con. Pool Expanded to El. 2265 Ft	24,000	5,650	3,220	2,510	103

Future Conditions

Storage Alternative	Average Annual Inflow (ac-ft/yr)	Yield (ac-ft/yr)	Increase in Yield (ac-ft/yr)	True Increase in Yield (ac-ft/yr)	True Percent Increase in Yield
BASE CONDITION-Existing Phase II GDM Operation	24,000	1,890	-	-	-
Alt. 1. Seasonal Water Con. Pool Expanded to El. 2300 Ft	24,000	4,410	2,520	2,140	113
Alt. 2. Seasonal Water Con. Pool Expanded to El. 2375 Ft	24,000	8,460	6,570	5,910	313
Alt. 3. Seasonal Water Con. Pool Expanded to El. 2418 Ft	24,000	10,600	8,710	8,010	424
Alt. 4. Seasonal Water Con. Pool Expanded to El. 2265 Ft	24,000	2,650	760	640	34

TABLE 3
SEVEN OAK DAM ALTERNATIVE OPERATIONS
TARGET STORAGES AND EVAPORATIONS
(Present Conditions)

BASE CONDITION - EXISTING PHASE II GDM OPERATION

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Stor.	0	2968	2968	2968	2968	2968	2968	2968	2968	1168	0	0
Area	0	73.7	73.7	73.7	73.7	73.7	73.7	73.7	73.7	40.0	0	0
Ev.	3.64	1.58	0.01	0.17	0.21	1.11	3.07	4.88	5.70	7.93	7.34	5.22
Evp.	0.	9.70	0.06	1.04	1.29	6.82	18.85	29.97	35.00	26.43	0	0
Pev.	0%	0.3%	<.1%	<.1%	<.1%	0.2%	0.6%	1%	1%	2%	0%	0%

1. SEASONAL WATER CONSERVATION POOL EXPANDED TO EL. 2300 ft. (16,293 Ac-Ft)

Mn.	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Stor.	0	2968	2968	2968	2968	16293	16293	16293	12500	8100	3800	9
Area	0	73.7	73.7	73.7	73.7	185	185	185	140	120	75	0
Ev.	3.64	1.58	0.01	0.17	0.21	1.11	3.07	4.88	5.70	7.93	7.34	5.22
Evp.	0.	9.70	0.06	1.04	1.29	17.1	47.3	75.2	66.5	79.3	45.8	0
Pev.	0%	0.3%	<.1%	<.1%	<.1%	0.1%	0.2%	0.4%	0.5%	0.9%	1%	0%

2. SEASONAL WATER CONSERVATION POOL EXPANDED TO EL. 2375 Ft. (35,000 Ac-Ft)

Mn.	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Stor.	0	2968	2968	2968	2968	35000	35000	35000	26500	17500	8600	0
Area	0	73.7	73.7	73.7	73.7	315	315	315	260	195	123	0
Ev.	3.64	1.58	0.01	0.17	0.21	1.11	3.07	4.88	5.70	7.93	7.34	5.22
Evp.	0.	9.70	0.06	1.04	1.29	29.1	80.6	128	123	128.8	75.2	0
Pev.	0%	0.3%	<.1%	<.1%	<.1%	<.1%	0.2%	0.3%	0.4%	0.7%	0.8%	0%

3. SEASONAL WATER CONSERVATION POOL EXPANDED TO EL. 2418 Ft. (50,000 Ac-Ft)

Mn.	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Stor.	0	2968	2968	2968	2968	50000	50000	50000	37500	25000	12500	0
Area	0	73.7	73.7	73.7	73.7	415	415	415	350	250	140	0
Ev.	3.64	1.58	0.01	0.17	0.21	1.11	3.07	4.88	5.70	7.93	7.34	5.22
Evp.	0.	9.70	0.06	1.04	1.29	38.4	106	168	166	165	85.6	0
Pev.	0%	0.3%	<.1%	<.1%	<.1%	<.1%	0.2%	0.3%	0.4%	0.6%	0.6%	0%

4. SEASONAL WATER CONSERVATION POOL EXPANDED TO EL. 2265 Ft. (10,270 Ac-Ft)

Mn.	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Stor.	0	2968	2968	2968	2968	10270	10270	10270	7775	5197	2620	0
Area	0	73.7	73.7	73.7	73.7	151	151	151	131	103	68	0
Ev.	3.64	1.58	0.01	0.17	0.21	1.11	3.07	4.88	5.70	7.93	7.34	5.22
Evp.	0.	9.70	0.06	1.04	1.29	14	39	61	62	68	42	0
Pev.	0%	0.3%	<.1%	<.1%	<.1%	0.1%	0.4%	0.6%	0.8%	1%	2%	0%

Note:
Mn. = Month
Stor. = Reservoir Storage in Acre-Feet, Maximum Monthly Amount - Actual average storage is less.
Area = Reservoir Water Surface Area in Acres
Ev. = Evaporation Rate in Inches
Evp. = Evaporation in Acre-Feet if pool was at maximum storage level. Actual loss is less.
Pev. = Percentage of Stored Water Being Evaporated

TABLE 3 (continued)
SEVEN OAK DAM ALTERNATIVE OPERATIONS
TARGET STORAGES AND EVAPORATIONS
(Future Conditions)

BASE CONDITION - EXISTING PHASE II GDM OPERATION

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Stor.	0	2189	2189	2189	2189	2189	2189	2189	1830	910	0	0
Area	0	70.5	70.5	70.5	70.5	70.5	70.5	70.5	70.5	41.0	0	0
Ev.	3.64	1.58	0.01	0.17	0.21	1.11	3.07	4.88	5.70	7.93	7.34	5.22
Evp.	0.	9.28	0.06	1.00	1.23	6.52	18.04	29.67	33.49	27.09	0	0
Pev.	0%	0.4%	<.1%	<.1%	<.1%	0.3%	0.8%	1%	2%	3%	0%	0%

1. SEASONAL WATER CONSERVATION POOL EXPANDED TO EL. 2300 ft. (7,194 Ac-Ft)

Mn.	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Stor.	0	2189	2189	2189	2189	7194	7194	7194	5400	3300	1100	0
Area	0	70.5	70.5	70.5	70.5	134	134	134	112	86	47	0
Ev.	3.64	1.58	0.01	0.17	0.21	1.11	3.07	4.88	5.70	7.93	7.34	5.22
Evp.	0.	9.28	0.06	1.00	1.23	12.4	34.3	54.5	53.2	56.8	28.8	0
Pev.	0%	0.4%	<.1%	<.1%	<.1%	0.2%	0.5%	1%	1%	2%	3%	0%

2. SEASONAL WATER CONSERVATION POOL EXPANDED TO EL. 2375 Ft. (22,050 Ac-Ft)

Mn.	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Stor.	0	2189	2189	2189	2189	22050	22050	22050	17000	11300	5600	0
Area	0	70.5	70.5	70.5	70.5	264	264	264	225	176	114	0
Ev.	3.64	1.58	0.01	0.17	0.21	1.11	3.07	4.88	5.70	7.93	7.34	5.22
Evp.	0.	9.28	0.06	1.00	1.23	24.4	67.5	107	106	116	69.7	0
Pev.	0%	0.4%	<.1%	<.1%	<.1%	.1%	0.3%	0.5%	0.6%	1%	1%	0%

3. SEASONAL WATER CONSERVATION POOL EXPANDED TO EL. 2418 Ft. (36,500 Ac-Ft)

Mn.	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Stor.	0	2189	2189	2189	2189	36500	36500	36500	27600	17500	7330	0
Area	0	70.5	70.5	70.5	70.5	373	373	373	308	226	135	0
Ev.	3.64	1.58	0.01	0.17	0.21	1.11	3.07	4.88	5.70	7.93	7.34	5.22
Evp.	0.	9.28	0.06	1.00	1.23	34.5	95	152	146	149	82.6	0
Pev.	0%	0.4%	<.1%	<.1%	<.1%	<.1%	0.3%	0.4%	0.5%	0.9%	1%	0%

4. SEASONAL WATER CONSERVATION POOL EXPANDED TO EL. 2265 Ft. (3,370 Ac-Ft)

Mn.	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Stor.	0	2189	2189	2189	2189	3370	3370	3370	2717	1796	875	0
Area	0	70.5	70.5	70.5	70.5	87	87	87	78	63	43	0
Ev.	3.64	1.58	0.01	0.17	0.21	1.11	3.07	4.88	5.70	7.93	7.34	5.22
Evp.	0.	9.28	0.06	1.00	1.23	8.05	22	35	37	42	26	0
Pev.	0%	0.4%	<.1%	<.1%	<.1%	.2%	0.6%	1%	1%	2%	3%	0%

Note:
Mn. = Month
Stor. = Reservoir Storage in Acre-Feet
Area = Reservoir Water Surface Area in Acres
Ev. = Evaporation Rate in Inches
Evp. = Evaporation in Acre-Feet if pool was at maximum storage level. Actual loss is less.
Pev. = Percentage of Stored Water Being Evaporated

Table 4
IMPACT OF WATER CONSERVATION STORAGE AT SEVEN OAKS DAM ON YIELD AT PRADO DAM

Present Conditions

Alternative	A	B	C
1. Seasonal Pool at El 2300 Ft	54	28	82
2. Seasonal Pool at El 2375 Ft	64	22	86
3. Seasonal Pool at El 2418 Ft	71	17	88
4. Seasonal Pool at El 2265 Ft	46	32	78

Future Conditions

Alternative	A	B	C
1. Seasonal Pool at El 2300 Ft	63	22	85
2. Seasonal Pool at El 2375 Ft	76	14	90
3. Seasonal Pool at El 2418 Ft	81	11	92
4. Seasonal Pool at El 2265 Ft	60	24	84

Notes:

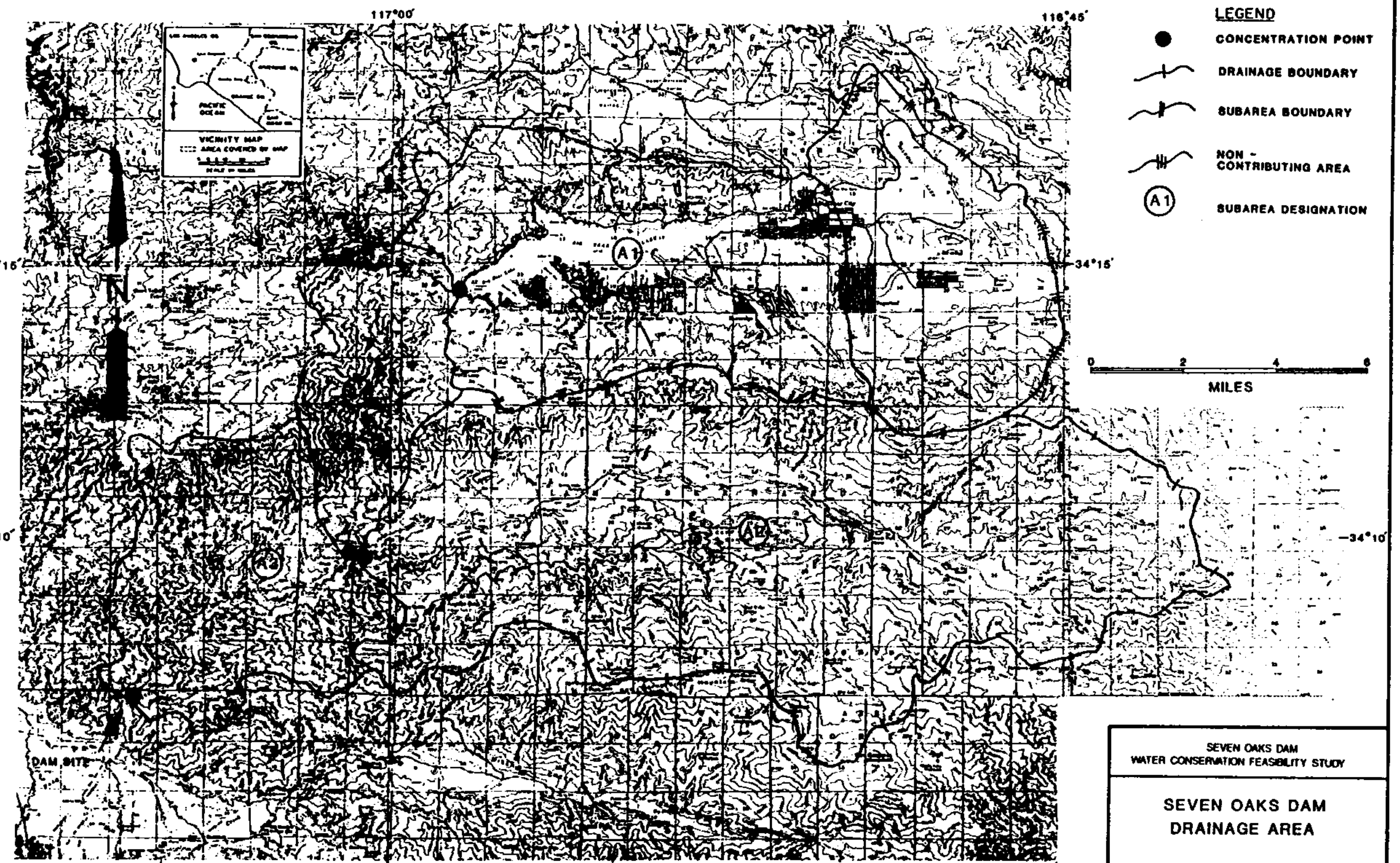
A = The percent of yield (from simulation results) at Seven Oaks Dam that occurs in years when water is wasted at Prado Dam during March through May.

B = The percent of yield (from simulation results) at Seven Oaks Dam that occurs in years when water is not wasted at Prado Dam times 60% losses..

C = The percent of yield (from simulation results) at Seven Oaks Dam that does not adversely effect the yield at Prado Dam and is the true yield.

Table 5. Discharge Frequency Values

Outflow from Seven Oaks Dam	Frequency of Peak Discharges (cfs)					
	2-yr	5-yr	10-yr	20-yr	50-yr	100-yr
Annual Maximum Base and alternatives	400	500	500	2500	4000	5200
Seasonal March thru May, Base conditions	90	500	500	600	2500	4500
Seasonal March thru May, Alternative 1 condition	3	200	500	500	550	4000
Mill Creek March thru May Base and Alternative Conditions	100	450	1000	2000	4000	7000

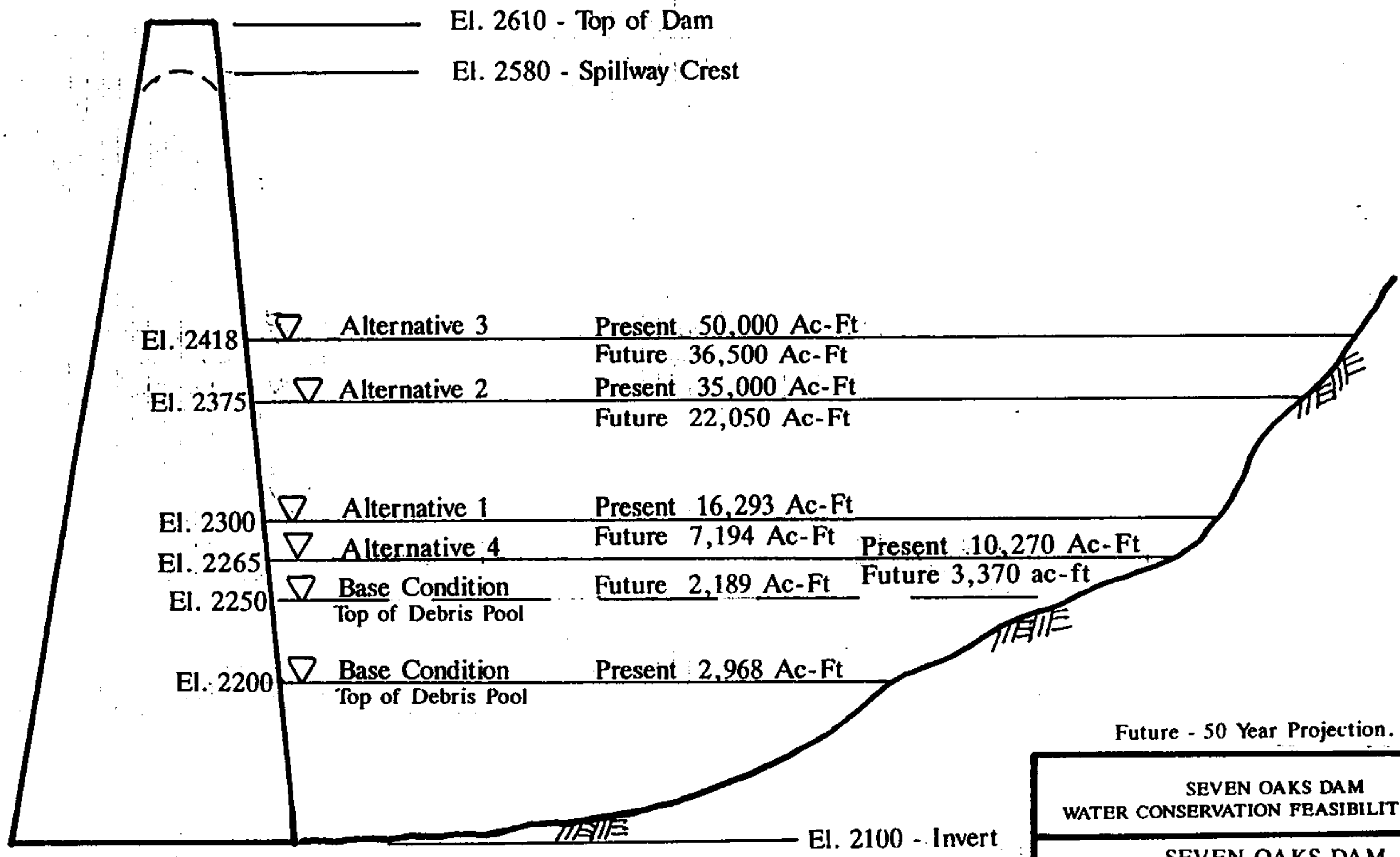


SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

SEVEN OAKS DAM
DRAINAGE AREA

US ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 1



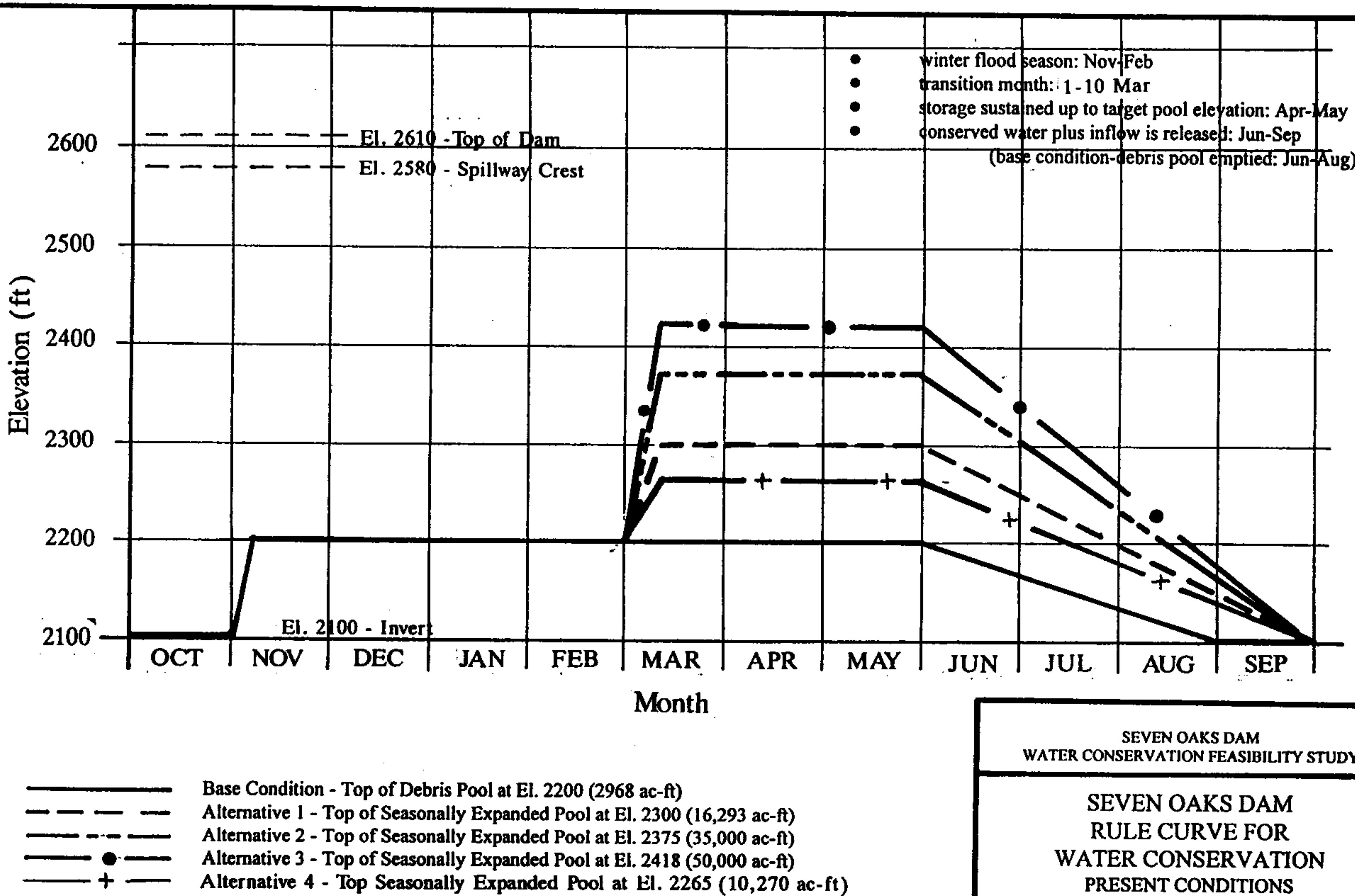
Future - 50 Year Projection.

SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

SEVEN OAKS DAM
BASE CONDITION
AND
ALTERNATIVES FOR
WATER CONSERVATION

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

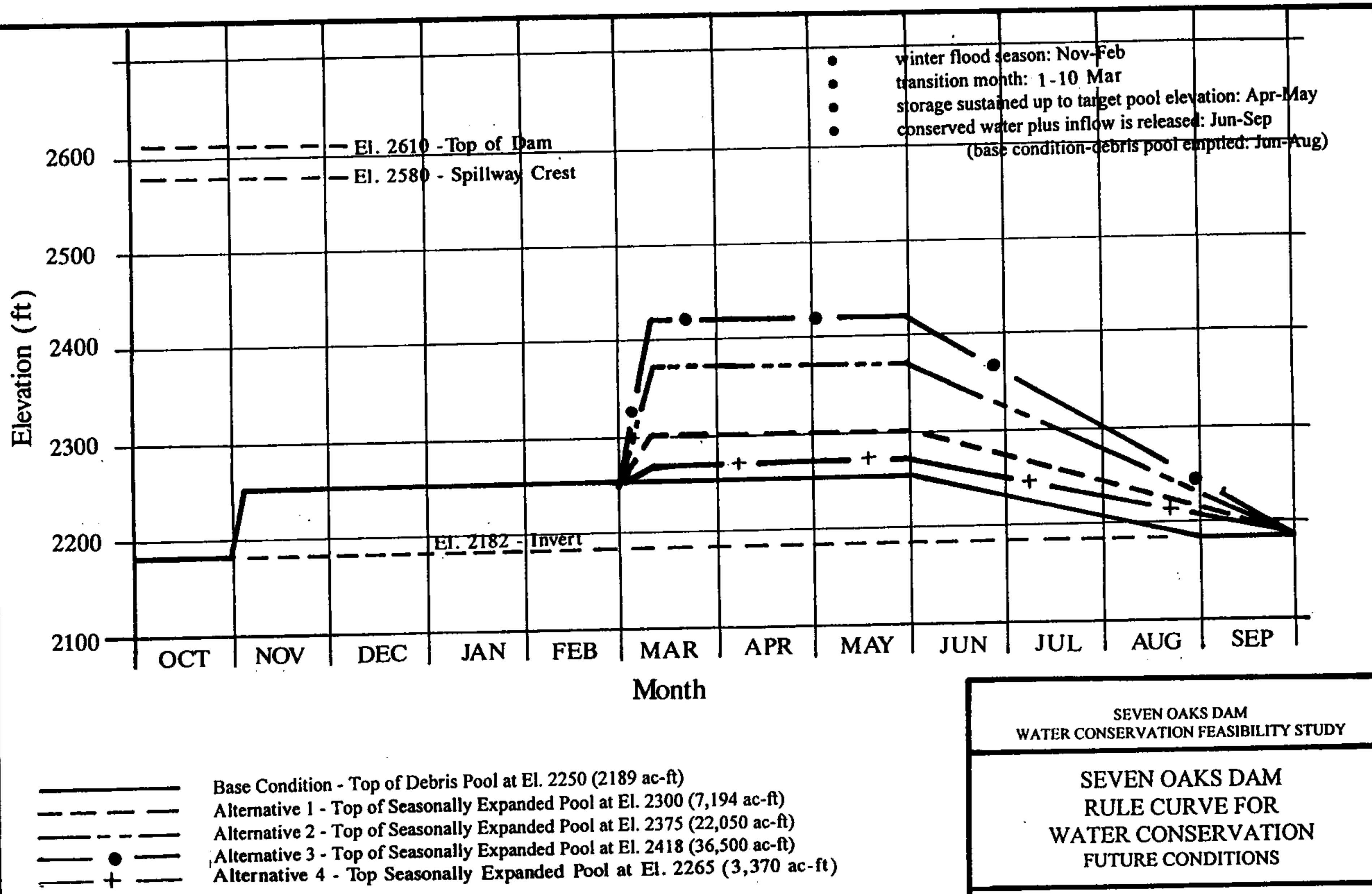
PLATE 2



SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

SEVEN OAKS DAM
RULE CURVE FOR
WATER CONSERVATION
PRESENT CONDITIONS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

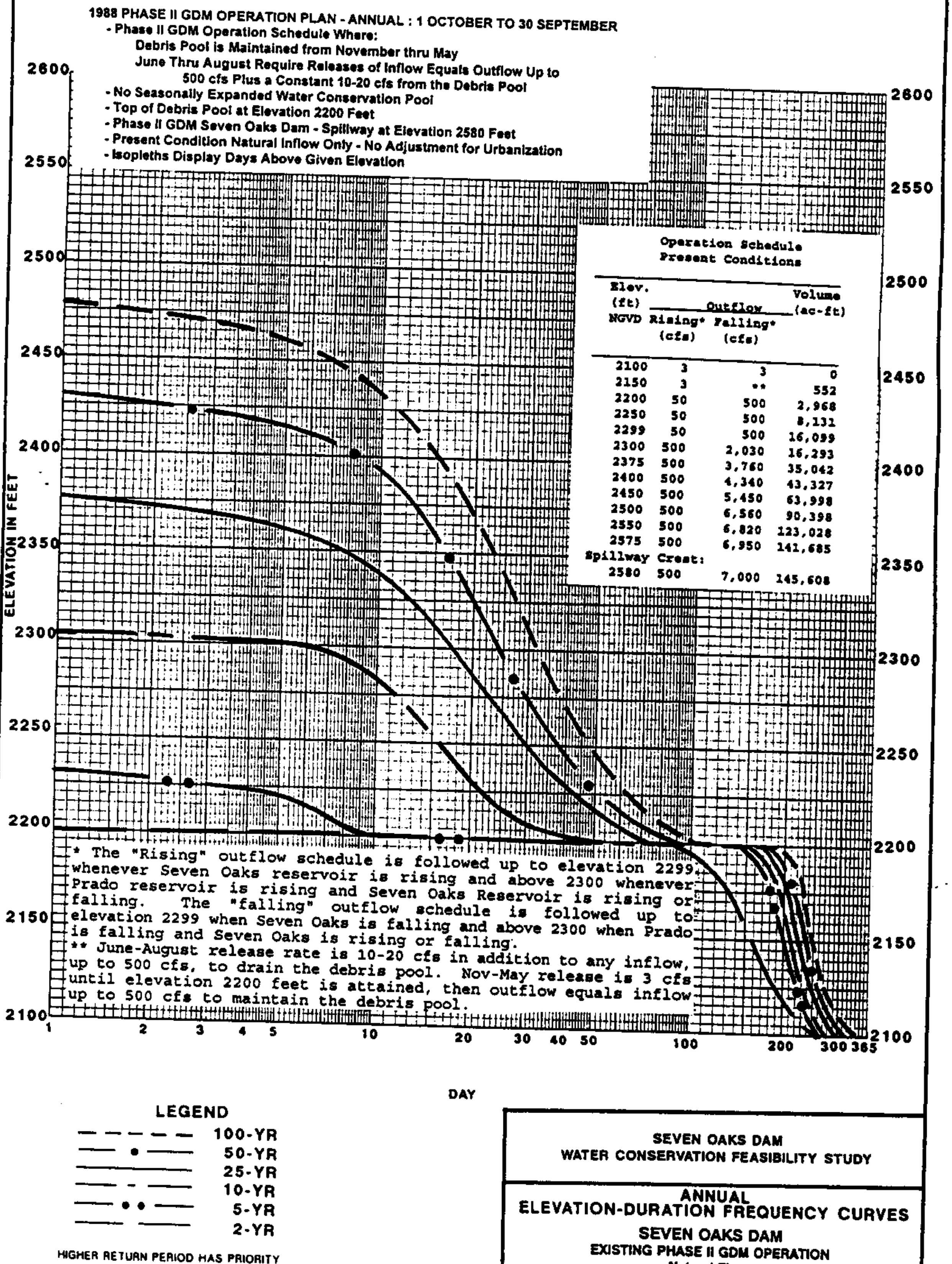


SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

SEVEN OAKS DAM
RULE CURVE FOR
WATER CONSERVATION
FUTURE CONDITIONS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 4



Operation Schedule
Present Conditions

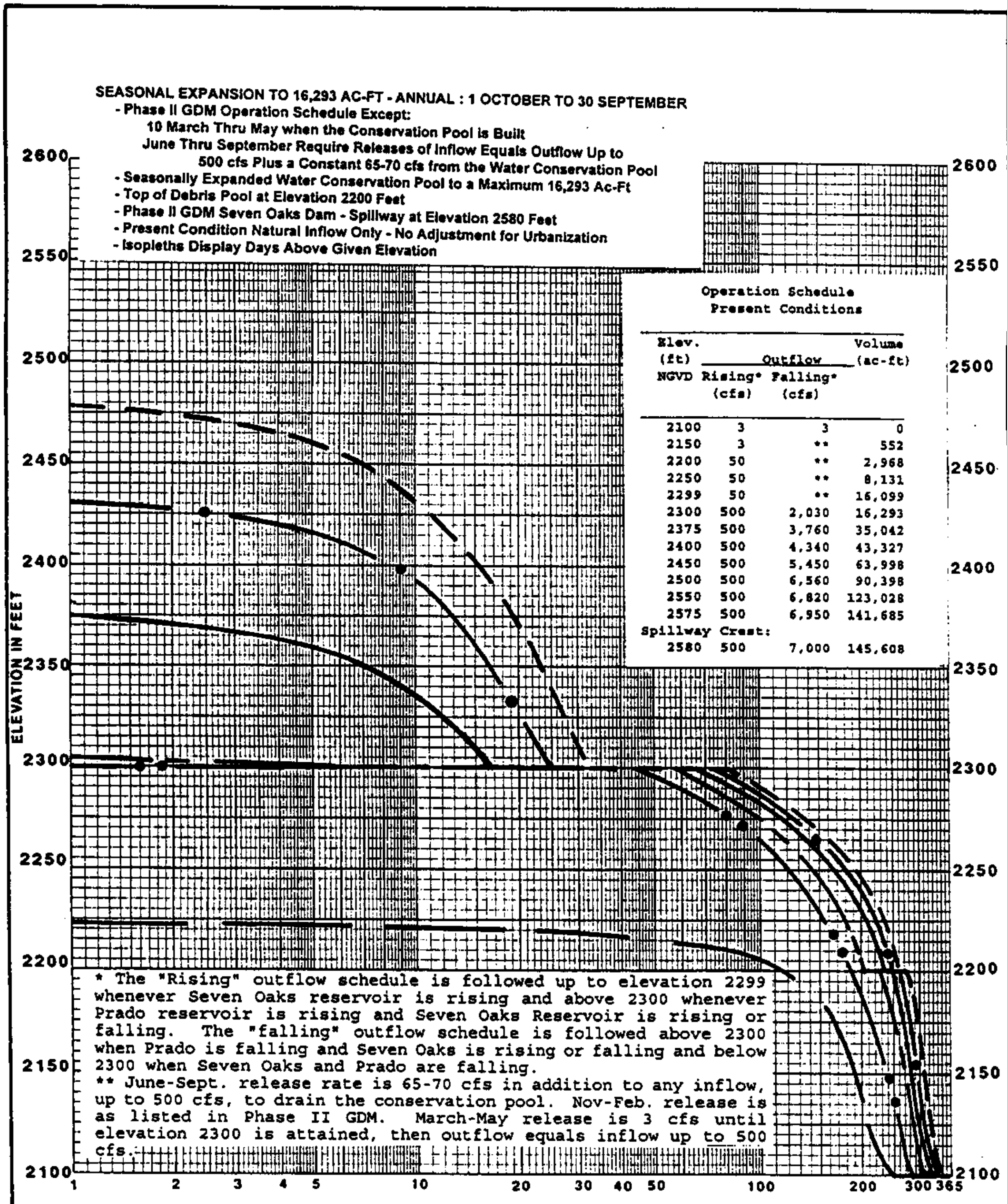
Elev. (ft) NGVD	Outflow Rising* (cfs)	Outflow Falling* (cfs)	Volume (ac-ft)
2100	3	3	0
2150	3	**	552
2200	50	500	2,968
2250	50	500	8,131
2299	50	500	16,099
2300	500	2,030	16,293
2375	500	3,760	35,042
2400	500	4,340	43,327
2450	500	5,450	63,998
2500	500	6,560	90,398
2550	500	6,820	123,028
2575	500	6,950	141,685
Spillway Crest:			
2580	500	7,000	145,608

SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

ANNUAL
ELEVATION-DURATION FREQUENCY CURVES
SEVEN OAKS DAM
EXISTING PHASE II GDM OPERATION
Natural Flows
Present Conditions

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SDPM1



Operation Schedule
Present Conditions

Elev. (ft) NGVD	Outflow Rising* (cfs)	Outflow Falling* (cfs)	Volume (ac-ft)
2100	3	3	0
2150	3	**	552
2200	50	**	2,968
2250	50	**	8,131
2299	50	**	16,099
2300	500	2,030	16,293
2375	500	3,760	35,042
2400	500	4,340	43,327
2450	500	5,450	63,998
2500	500	6,560	90,398
2550	500	6,820	123,028
2575	500	6,950	141,685
Spillway Crest:			
2580	500	7,000	145,608

LEGEND

- 100-YR
- 50-YR
- 25-YR
- 10-YR
- 5-YR
- 2-YR

HIGHER RETURN PERIOD HAS PRIORITY

SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

ANNUAL
ELEVATION-DURATION FREQUENCY CURVES

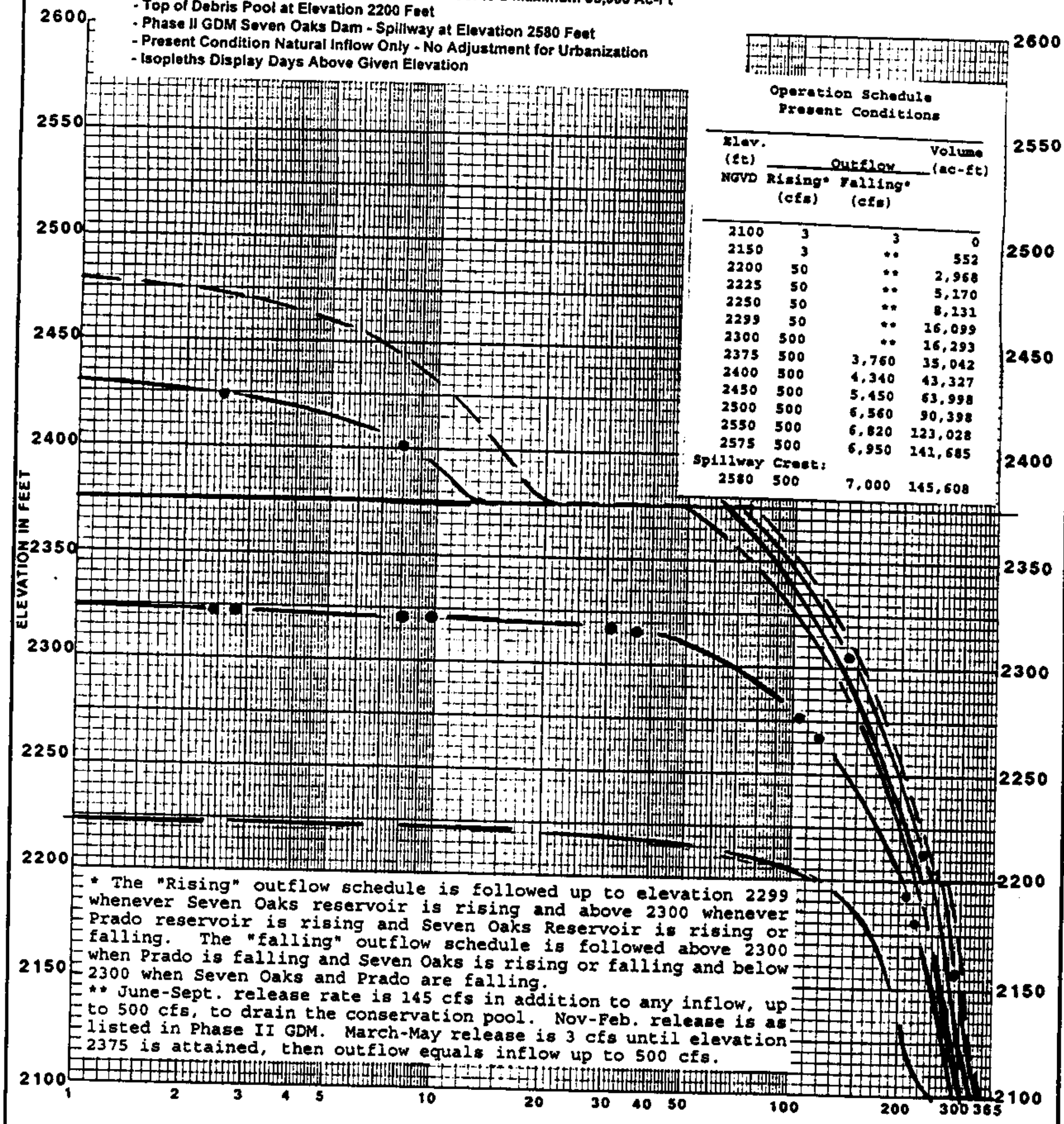
SEVEN OAKS DAM
SEASONAL POOL EXPANDED TO 16,293AC-FT (EL 2300 FL)
Natural Flows
Present Conditions

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SDPQ1

SEASONAL EXPANSION TO 35,000 AC-FT - ANNUAL : 1 OCTOBER TO 30 SEPTEMBER

- Phase II GDM Operation Schedule Except:
  - 10 March Thru May when the Conservation Pool is Built
  - June Thru September Require Releases of Inflow Equals Outflow Up to 500 cfs Plus a Constant 145 cfs from the Water Conservation Pool
- Seasonally Expanded Water Conservation Pool to a Maximum 35,000 Ac-Ft
- Top of Debris Pool at Elevation 2200 Feet
- Phase II GDM Seven Oaks Dam - Spillway at Elevation 2580 Feet
- Present Condition Natural Inflow Only - No Adjustment for Urbanization
- Isopleths Display Days Above Given Elevation



Operation Schedule
Present Conditions

Elev. (ft) NGVD	Outflow Rising* (cfs)	Outflow Falling* (cfs)	Volume (ac-ft)
2100	3	3	0
2150	3	**	552
2200	50	**	2,968
2225	50	**	5,170
2250	50	**	8,131
2299	50	**	16,099
2300	500	**	16,293
2375	500	3,760	35,042
2400	500	4,340	43,327
2450	500	5,450	63,998
2500	500	6,560	90,398
2550	500	6,820	123,028
2575	500	6,950	141,685
Spillway Crest:			
2580	500	7,000	145,608

* The "Rising" outflow schedule is followed up to elevation 2299 whenever Seven Oaks reservoir is rising and above 2300 whenever Prado reservoir is rising and Seven Oaks Reservoir is rising or falling. The "falling" outflow schedule is followed above 2300 when Prado is falling and Seven Oaks is rising or falling and below 2300 when Seven Oaks and Prado are falling.

** June-Sept. release rate is 145 cfs in addition to any inflow, up to 500 cfs, to drain the conservation pool. Nov-Feb. release is as listed in Phase II GDM. March-May release is 3 cfs until elevation 2375 is attained, then outflow equals inflow up to 500 cfs.

LEGEND

- 100-YR
- 50-YR
- 25-YR
- 10-YR
- 5-YR
- 2-YR

. HIGHER RETURN PERIOD HAS PRIORITY

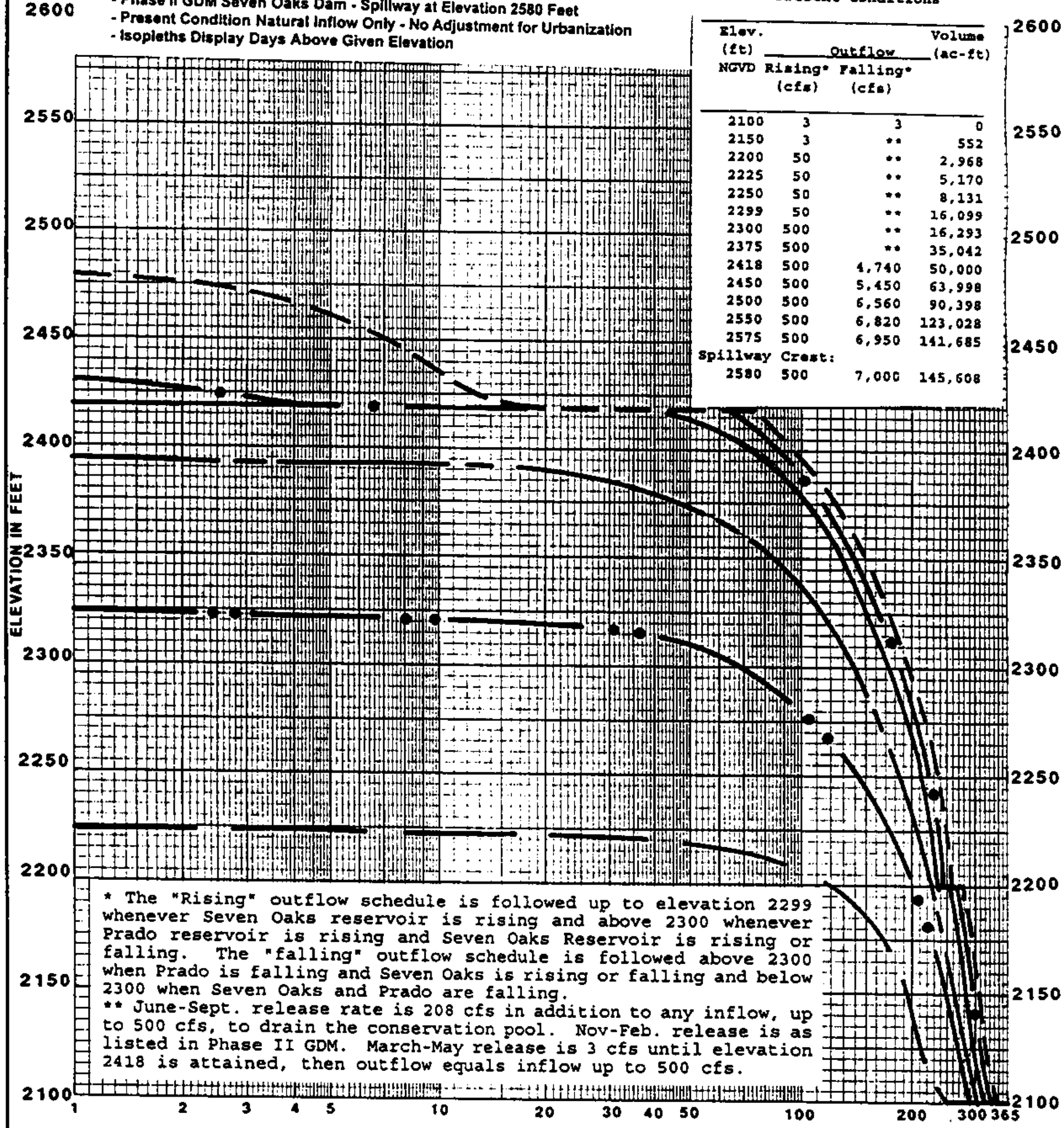
SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

ANNUAL
ELEVATION-DURATION FREQUENCY CURVES
SEVEN OAKS DAM
SEASONAL POOL EXPANDED TO 35,000 AC-FT (El. 2375 Ft.)
Natural Flows
Present Conditions

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SEASONAL EXPANSION TO 50,000 AC-FT - ANNUAL : 1 OCTOBER TO 30 SEPTEMBER

- Phase II GDM Operation Schedule Except:
  - 10 March Thru May when the Conservation Pool is Built
  - June Thru September Require Releases of Inflow Equals Outflow Up to 500 cfs Plus a Constant 208 cfs from the Water Conservation Pool
- Seasonally Expanded Water Conservation Pool to a Maximum 50,000 Ac-Ft
- Top of Debris Pool at Elevation 2200 Feet
- Phase II GDM Seven Oaks Dam - Spillway at Elevation 2580 Feet
- Present Condition Natural Inflow Only - No Adjustment for Urbanization
- Isopleths Display Days Above Given Elevation



Operation Schedule
Present Conditions

Elev. (ft) NGVD	Outflow Rising* (cfs)	Outflow Falling* (cfs)	Volume (ac-ft)
2100	3	3	0
2150	3	**	552
2200	50	**	2,968
2225	50	**	5,170
2250	50	**	8,131
2299	50	**	16,099
2300	500	**	16,293
2375	500	**	35,042
2418	500	4,740	50,000
2450	500	5,450	63,998
2500	500	6,560	90,398
2550	500	6,820	123,028
2575	500	6,950	141,685
Spillway Crest:			
2580	500	7,000	145,608

* The "Rising" outflow schedule is followed up to elevation 2299 whenever Seven Oaks reservoir is rising and above 2300 whenever Prado reservoir is rising and Seven Oaks Reservoir is rising or falling. The "falling" outflow schedule is followed above 2300 when Prado is falling and Seven Oaks is rising or falling and below 2300 when Seven Oaks and Prado are falling.

** June-Sept. release rate is 208 cfs in addition to any inflow, up to 500 cfs, to drain the conservation pool. Nov-Feb. release is as listed in Phase II GDM. March-May release is 3 cfs until elevation 2418 is attained, then outflow equals inflow up to 500 cfs.

LEGEND

— — — — —	100-YR
—— • ——	50-YR
————————	25-YR
—— - ——	10-YR
—— • • ——	5-YR
——— ———	2-YR

HIGHER RETURN PERIOD HAS PRIORITY

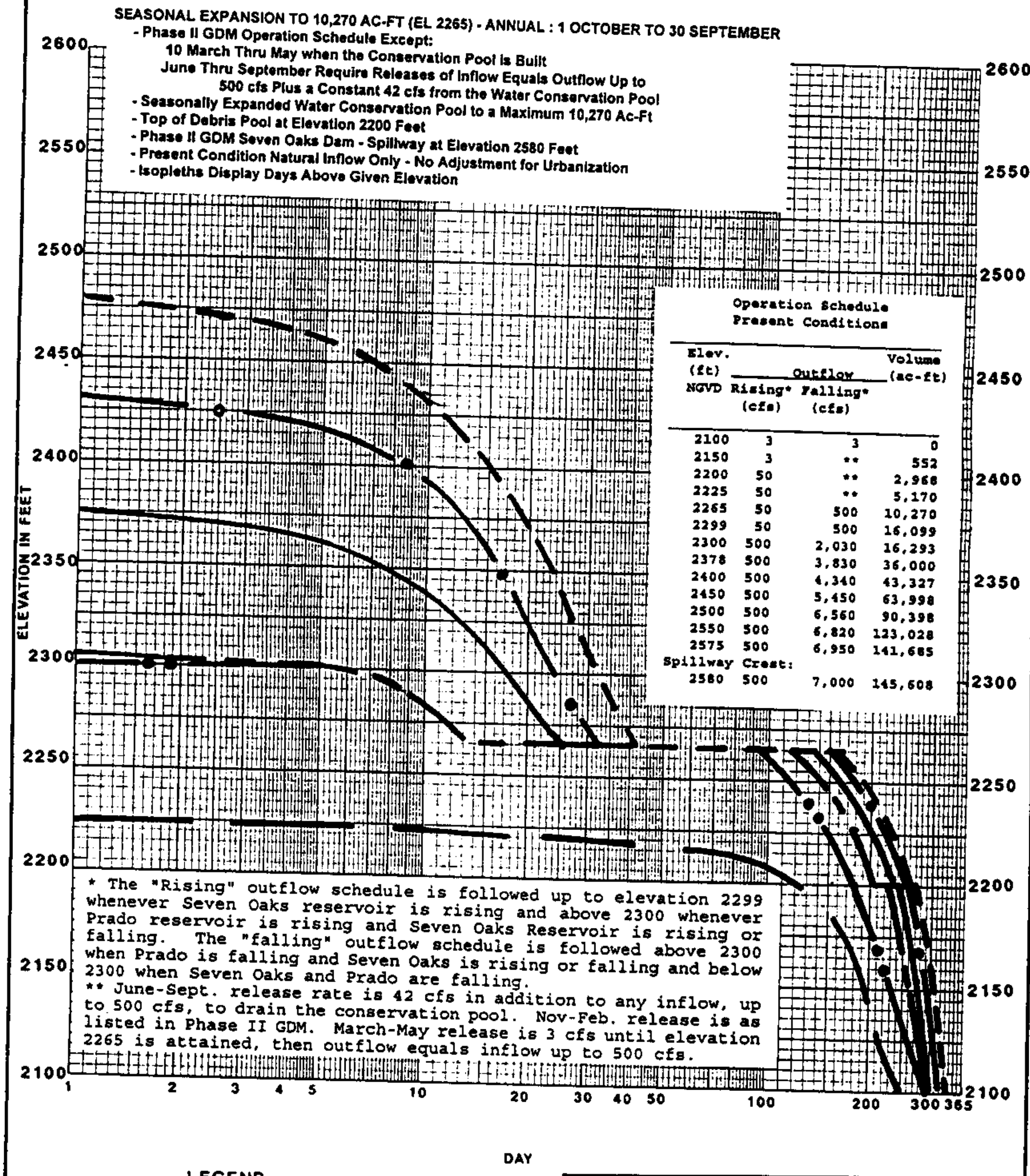
SDPP1

SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

ANNUAL ELEVATION-DURATION FREQUENCY CURVES SEVEN OAKS DAM

SEASONAL POOL EXPANDED TO 50,000 AC-FT (EL 2418 Ft.)
Natural Flows
Present Conditions

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



Operation Schedule
Present Conditions

Elev. (ft) NGVD	Outflow Rising* (cfs)	Outflow Falling* (cfs)	Volume (ac-ft)
2100	3	3	0
2150	3	**	552
2200	50	**	2,968
2225	50	**	5,170
2265	50	500	10,270
2299	50	500	16,099
2300	500	2,030	16,293
2378	500	3,830	36,000
2400	500	4,340	43,327
2450	500	5,450	63,998
2500	500	6,560	90,398
2550	500	6,820	123,028
2575	500	6,950	141,685
Spillway Crest:			
2580	500	7,000	145,608

* The "Rising" outflow schedule is followed up to elevation 2299 whenever Seven Oaks reservoir is rising and above 2300 whenever Prado reservoir is rising and Seven Oaks Reservoir is rising or falling. The "falling" outflow schedule is followed above 2300 when Prado is falling and Seven Oaks is rising or falling and below 2300 when Seven Oaks and Prado are falling.

** June-Sept. release rate is 42 cfs in addition to any inflow, up to 500 cfs, to drain the conservation pool. Nov-Feb. release is as listed in Phase II GDM. March-May release is 3 cfs until elevation 2265 is attained, then outflow equals inflow up to 500 cfs.

LEGEND

- 100-YR
- 50-YR
- 25-YR
- 10-YR
- 5-YR
- 2-YR

HIGHER RETURN PERIOD HAS PRIORITY

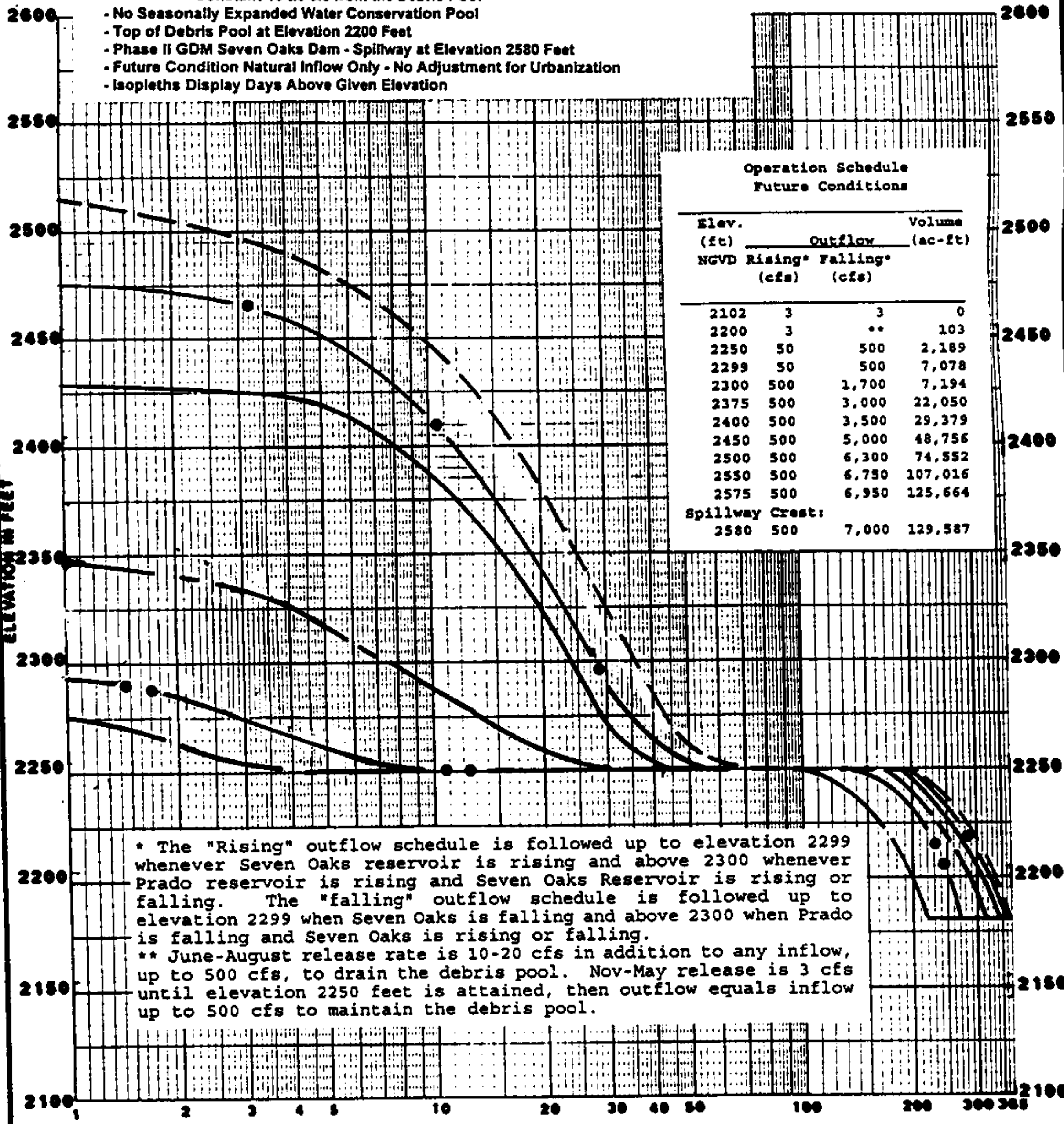
SEVEN OAKS AND PRADO DAMS
WATER CONSERVATION STUDY

ANNUAL
ELEVATION-DURATION FREQUENCY CURVES
SEVEN OAKS DAM
SEASONAL POOL EXPANDED TO 10,270 AC-FT (El. 2265 Ft.)
Natural Flows
Present Conditions

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

1988 PHASE II GDM OPERATION PLAN - ANNUAL : 1 OCTOBER TO 30 SEPTEMBER

- Phase II GDM Operation Schedule Where:
  - Debris Pool is Maintained from November thru May
  - June Thru August Require Releases of Inflow Equals Outflow Up to 500 cfs Plus a Constant 10-20 cfs from the Debris Pool
- No Seasonally Expanded Water Conservation Pool
- Top of Debris Pool at Elevation 2200 Feet
- Phase II GDM Seven Oaks Dam - Spillway at Elevation 2580 Feet
- Future Condition Natural Inflow Only - No Adjustment for Urbanization
- Isopleths Display Days Above Given Elevation



Operation Schedule
Future Conditions

Elev. (ft) NGVD	Outflow Rising* (cfs)	Outflow Falling* (cfs)	Volume (ac-ft)
2102	3	3	0
2200	3	**	103
2250	50	500	2,189
2299	50	500	7,078
2300	500	1,700	7,194
2375	500	3,000	22,050
2400	500	3,500	29,379
2450	500	5,000	48,756
2500	500	6,300	74,552
2550	500	6,750	107,016
2575	500	6,950	125,664
Spillway Crest:			
2580	500	7,000	129,587

* The "Rising" outflow schedule is followed up to elevation 2299 whenever Seven Oaks reservoir is rising and above 2300 whenever Prado reservoir is rising and Seven Oaks Reservoir is rising or falling. The "falling" outflow schedule is followed up to elevation 2299 when Seven Oaks is falling and above 2300 when Prado is falling and Seven Oaks is rising or falling.
** June-August release rate is 10-20 cfs in addition to any inflow, up to 500 cfs, to drain the debris pool. Nov-May release is 3 cfs until elevation 2250 feet is attained, then outflow equals inflow up to 500 cfs to maintain the debris pool.

LEGEND

- 100-YR
- 50-YR
- 25-YR
- 10-YR
- 5-YR
- 2-YR

HIGHER RETURN PERIOD HAS PRIORITY

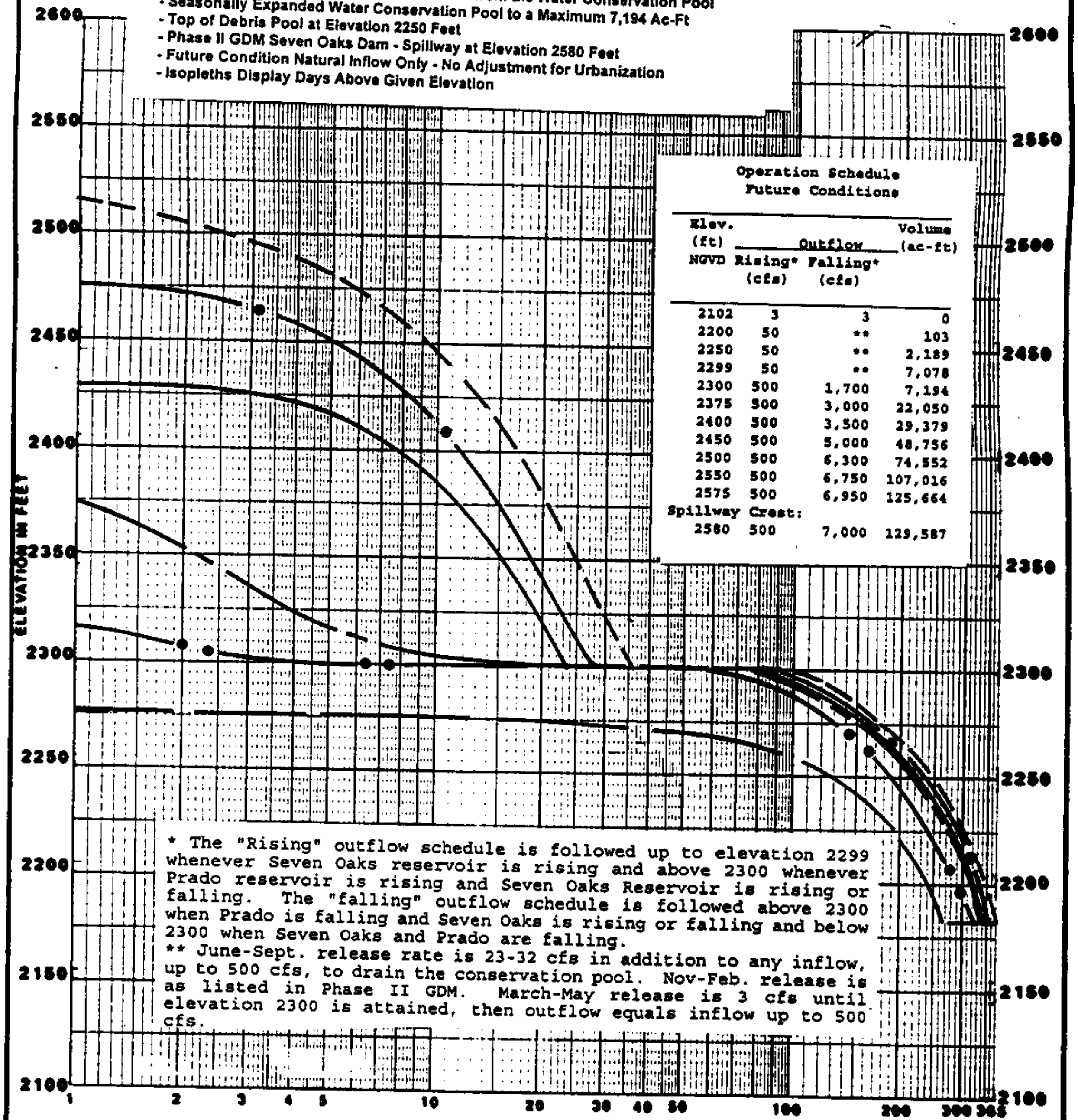
SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

ANNUAL
ELEVATION-DURATION FREQUENCY CURVES
SEVEN OAKS DAM
EXISTING PHASE II GDM OPERATION
Natural Flows
Future Conditions

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SEASONAL EXPANSION TO 7,194 AC-FT - ANNUAL : 1 OCTOBER TO 30 SEPTEMBER

- Phase II GDM Operation Schedule Except:
  - 10 March Thru May when the Conservation Pool is Built
  - June Thru September Require Releases of Inflow Equals Outflow Up to 500 cfs Plus Constant 25-32 cfs from the Water Conservation Pool
- Seasonally Expanded Water Conservation Pool to a Maximum 7,194 Ac-Ft
- Top of Debris Pool at Elevation 2250 Feet
- Phase II GDM Seven Oaks Dam - Spillway at Elevation 2580 Feet
- Future Condition Natural Inflow Only - No Adjustment for Urbanization
- Isopleths Display Days Above Given Elevation



Operation Schedule
Future Conditions

Elev. (ft) NGVD	Outflow Rising* (cfs)	Outflow Falling* (cfs)	Volume (ac-ft)
2102	3	3	0
2200	50	**	103
2250	50	**	2,189
2299	50	**	7,078
2300	500	1,700	7,194
2375	500	3,000	22,050
2400	500	3,500	29,379
2450	500	5,000	48,756
2500	500	6,300	74,552
2550	500	6,750	107,016
2575	500	6,950	125,664
Spillway Crest:			
2580	500	7,000	129,587

* The "Rising" outflow schedule is followed up to elevation 2299 whenever Seven Oaks reservoir is rising and above 2300 whenever Prado reservoir is rising and Seven Oaks Reservoir is rising or falling. The "falling" outflow schedule is followed above 2300 when Prado is falling and Seven Oaks is rising or falling and below 2300 when Seven Oaks and Prado are falling.

** June-Sept. release rate is 23-32 cfs in addition to any inflow, up to 500 cfs, to drain the conservation pool. Nov-Feb. release is as listed in Phase II GDM. March-May release is 3 cfs until elevation 2300 is attained, then outflow equals inflow up to 500 cfs.

LEGEND

- — — — — — 100-YR
- —— • —— 50-YR
- ———— 25-YR
- —— - —— 10-YR
- —— • • —— 5-YR
- —— —— 2-YR

HIGHER RETURN PERIOD HAS PRIORITY

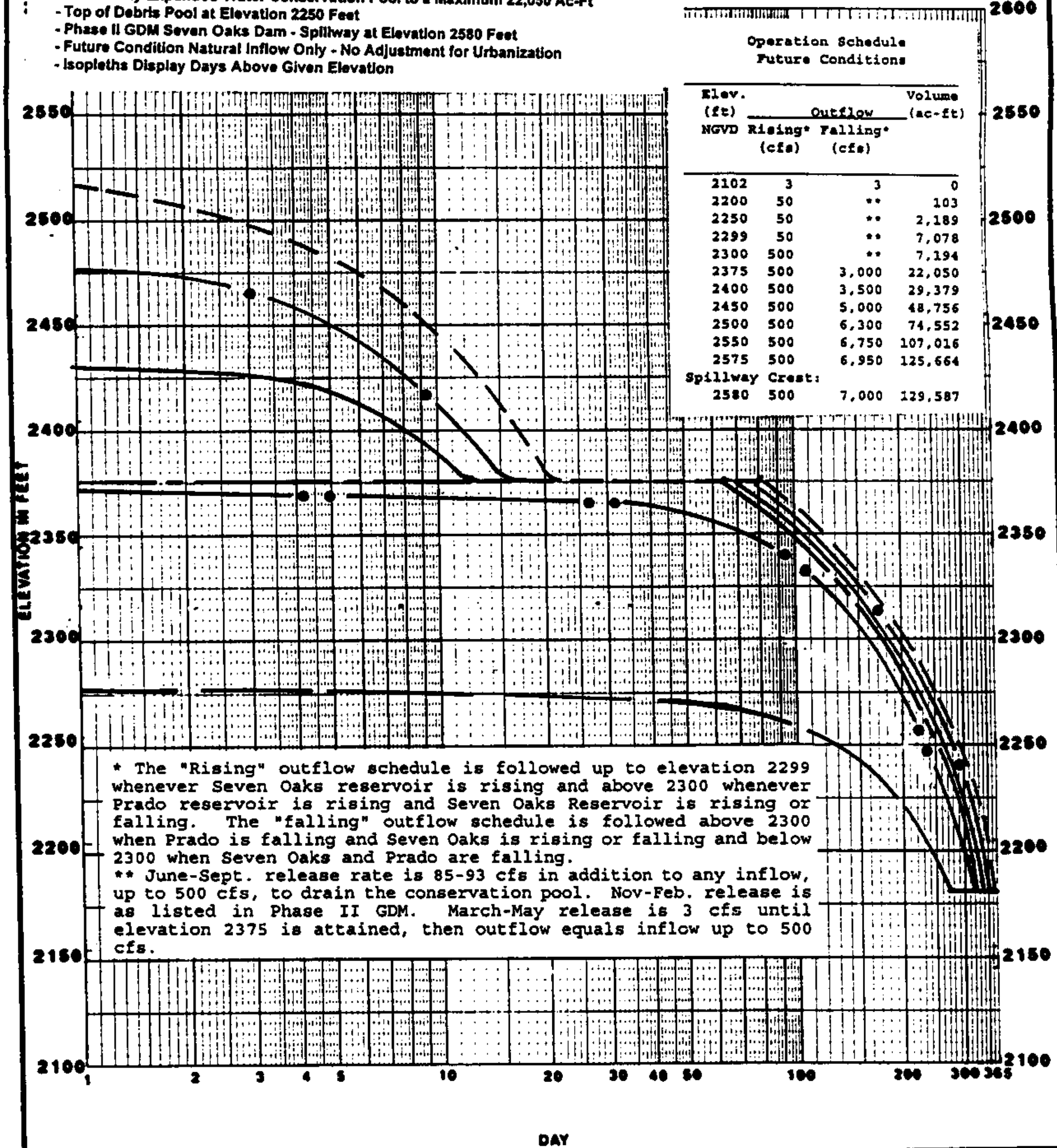
SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

ANNUAL
ELEVATION-DURATION FREQUENCY CURVES
SEVEN OAKS DAM
SEASONAL POOL EXPANDED TO 7,194 AC-FT (El. 2300 Ft.)
Natural Flows
Future Conditions

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SEASONAL EXPANSION TO 22,050 AC-FT - ANNUAL : 1 OCTOBER TO 30 SEPTEMBER

- Phase II GDM Operation Schedule Except:
  - 10 March Thru May when the Conservation Pool is Built
  - June Thru September Require Releases of Inflow Equals Outflow Up to 500 cfs Plus a Constant 85-93 cfs from the Water Conservation Pool
- Seasonally Expanded Water Conservation Pool to a Maximum 22,050 Ac-Ft
- Top of Debris Pool at Elevation 2250 Feet
- Phase II GDM Seven Oaks Dam - Spillway at Elevation 2580 Feet
- Future Condition Natural Inflow Only - No Adjustment for Urbanization
- Isopleths Display Days Above Given Elevation



Operation Schedule
Future Conditions

Elev. (ft) NGVD	Outflow Rising* (cfs)	Outflow Falling* (cfs)	Volume (ac-ft)
2102	3	3	0
2200	50	**	103
2250	50	**	2,189
2299	50	**	7,078
2300	500	**	7,194
2375	500	3,000	22,050
2400	500	3,500	29,379
2450	500	5,000	48,756
2500	500	6,300	74,552
2550	500	6,750	107,016
2575	500	6,950	125,664
Spillway Crest:			
2580	500	7,000	129,587

* The "Rising" outflow schedule is followed up to elevation 2299 whenever Seven Oaks reservoir is rising and above 2300 whenever Prado reservoir is rising and Seven Oaks Reservoir is rising or falling. The "falling" outflow schedule is followed above 2300 when Prado is falling and Seven Oaks is rising or falling and below 2300 when Seven Oaks and Prado are falling.

** June-Sept. release rate is 85-93 cfs in addition to any inflow, up to 500 cfs, to drain the conservation pool. Nov-Feb. release is as listed in Phase II GDM. March-May release is 3 cfs until elevation 2375 is attained, then outflow equals inflow up to 500 cfs.

LEGEND

— — — — —	100-YR
—— • ——	50-YR
————	25-YR
—— - ——	10-YR
—— • • ——	5-YR
—— ——	2-YR

HIGHER RETURN PERIOD HAS PRIORITY

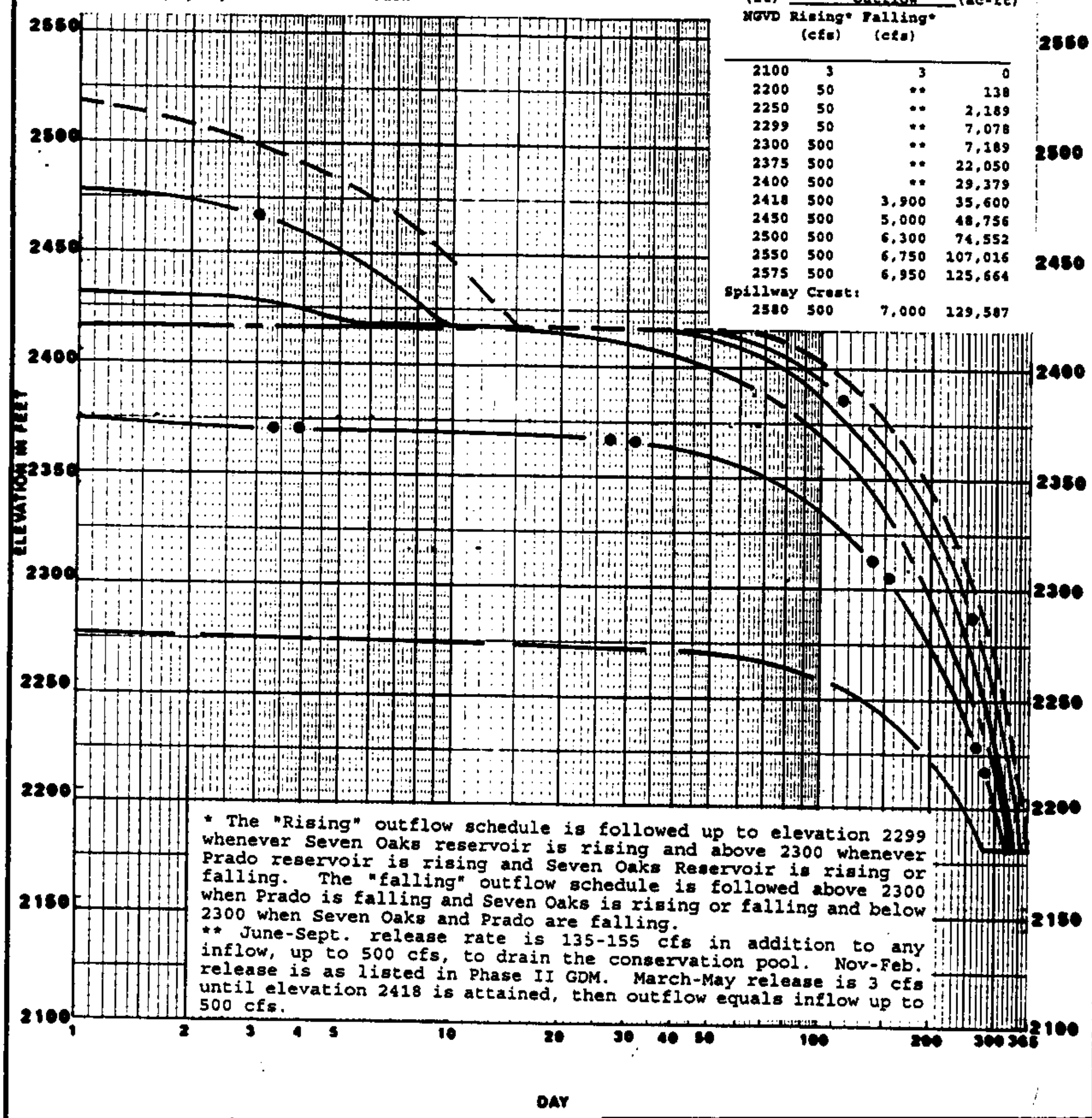
SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

ANNUAL
ELEVATION-DURATION FREQUENCY CURVES
SEVEN OAKS DAM
SEASONAL POOL EXPANDED TO 22,050 AC-FT (El. 2375 Ft.)
Natural Flows
Future Conditions

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SEASONAL EXPANSION TO 35,600 AC-FT - ANNUAL : 1 OCTOBER TO 30 SEPTEMBER

- Phase II GDM Operation Schedule Except:
  - 10 March Thru May when the Conservation Pool is Built
  - June Thru September Require Releases of Inflow Equals Outflow Up to 500 cfs Plus a Constant 135-155 cfs from the Water Conservation Pool
- Seasonally Expanded Water Conservation Pool to a Maximum 35,600 Ac-Ft
- Top of Debris Pool at Elevation 2250 Feet
- Phase II GDM Seven Oaks Dam - Spillway at Elevation 2580 Feet
- Future Condition Natural Inflow Only - No Adjustment for Urbanization
- Isopleths Display Days Above Given Elevation



Operation Schedule
Future Conditions

Elev. (ft) NGVD	Outflow Rising* (cfs)	Outflow Falling* (cfs)	Volume (ac-ft)
2100	3	3	0
2200	50	**	138
2250	50	**	2,189
2299	50	**	7,078
2300	500	**	7,189
2375	500	**	22,050
2400	500	**	29,379
2418	500	3,900	35,600
2450	500	5,000	48,756
2500	500	6,300	74,552
2550	500	6,750	107,016
2575	500	6,950	125,664
Spillway Crest:			
2580	500	7,000	129,587

* The "Rising" outflow schedule is followed up to elevation 2299 whenever Seven Oaks reservoir is rising and above 2300 whenever Prado reservoir is rising and Seven Oaks Reservoir is rising or falling. The "falling" outflow schedule is followed above 2300 when Prado is falling and Seven Oaks is rising or falling and below 2300 when Seven Oaks and Prado are falling.

** June-Sept. release rate is 135-155 cfs in addition to any inflow, up to 500 cfs, to drain the conservation pool. Nov-Feb. release is as listed in Phase II GDM. March-May release is 3 cfs until elevation 2418 is attained, then outflow equals inflow up to 500 cfs.

LEGEND

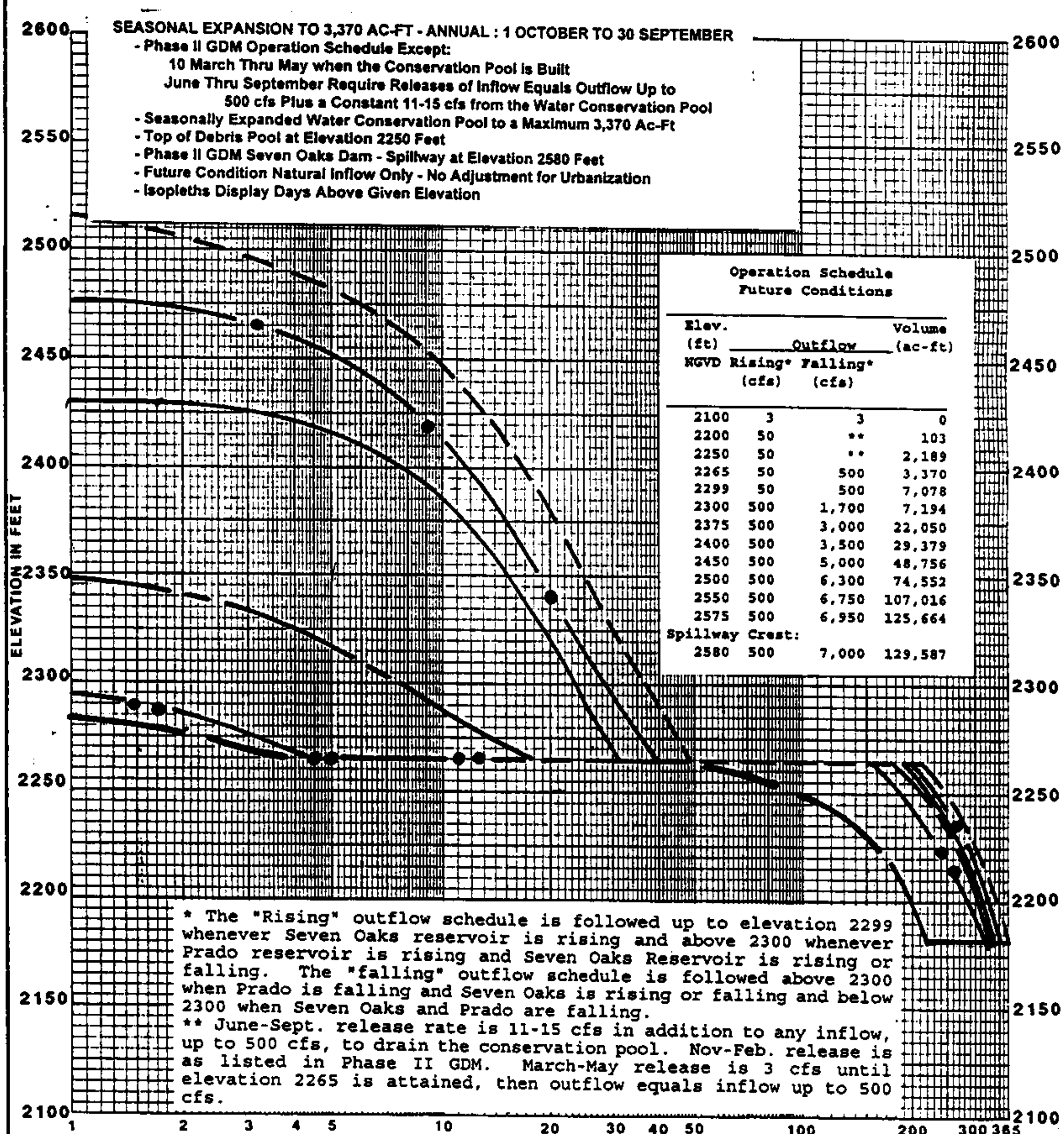
- — — — — — 100-YR
- —— • —— 50-YR
- ———— 25-YR
- —— - —— 10-YR
- —— • • —— 5-YR
- —— —— 2-YR

HIGHER RETURN PERIOD HAS PRIORITY

SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

ANNUAL
ELEVATION-DURATION FREQUENCY CURVES
SEVEN OAKS DAM
SEASONAL POOL EXPANDED TO 35,600 AC-FT (El. 2418 Ft.)
Natural Flows
Future Conditions

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



Operation Schedule
Future Conditions

Elev. (ft) NGVD	Outflow Rising* (cfs)	Outflow Falling* (cfs)	Volume (ac-ft)
2100	3	3	0
2200	50	**	103
2250	50	**	2,189
2265	50	500	3,370
2299	50	500	7,078
2300	500	1,700	7,194
2375	500	3,000	22,050
2400	500	3,500	29,379
2450	500	5,000	48,756
2500	500	6,300	74,552
2550	500	6,750	107,016
2575	500	6,950	125,664
Spillway Crest:			
2580	500	7,000	129,587

* The "Rising" outflow schedule is followed up to elevation 2299 whenever Seven Oaks reservoir is rising and above 2300 whenever Prado reservoir is rising and Seven Oaks Reservoir is rising or falling. The "falling" outflow schedule is followed above 2300 when Prado is falling and Seven Oaks is rising or falling and below 2300 when Seven Oaks and Prado are falling.

** June-Sept. release rate is 11-15 cfs in addition to any inflow, up to 500 cfs, to drain the conservation pool. Nov-Feb. release is as listed in Phase II GDM. March-May release is 3 cfs until elevation 2265 is attained, then outflow equals inflow up to 500 cfs.

LEGEND

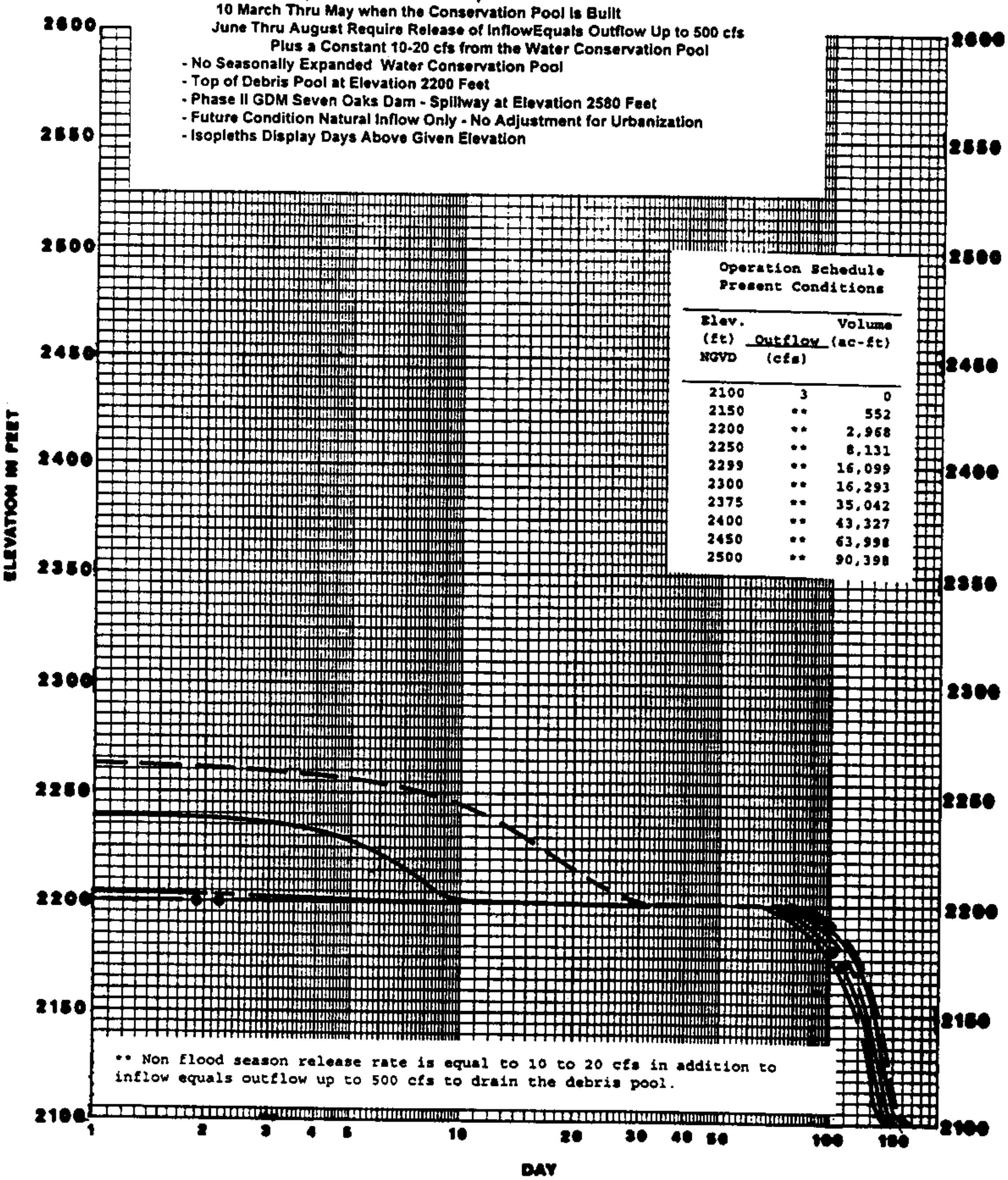
- — — — — — 100-YR
- —— • —— 50-YR
- ———— 25-YR
- —— - —— 10-YR
- —— • • —— 5-YR
- ——   —— 2-YR

HIGHER RETURN PERIOD HAS PRIORITY

SEVEN OAKS AND PRADO DAMS
WATER CONSERVATION STUDY

ANNUAL
ELEVATION-DURATION FREQUENCY CURVES
SEVEN OAKS DAM
SEASONAL POOL EXPANDED TO 3,370 AC-FT (El. 2265 Ft.)
Natural Flows
Future Conditions

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



Operation Schedule
Present Conditions

Elev. (ft) NGVD	Outflow (cfs)	Volume (ac-ft)
2100	3	0
2150	**	552
2200	**	2,968
2250	**	8,131
2299	**	16,099
2300	**	16,293
2375	**	35,042
2400	**	43,327
2450	**	63,998
2500	**	90,398

** Non flood season release rate is equal to 10 to 20 cfs in addition to inflow equals outflow up to 500 cfs to drain the debris pool.

LEGEND

- ———— 100-YR
- —•— 50-YR
- ——— 25-YR
- — - — 10-YR
- —••— 5-YR
- —— —— 2-YR

HIGHER RETURN PERIOD HAS PRIORITY.

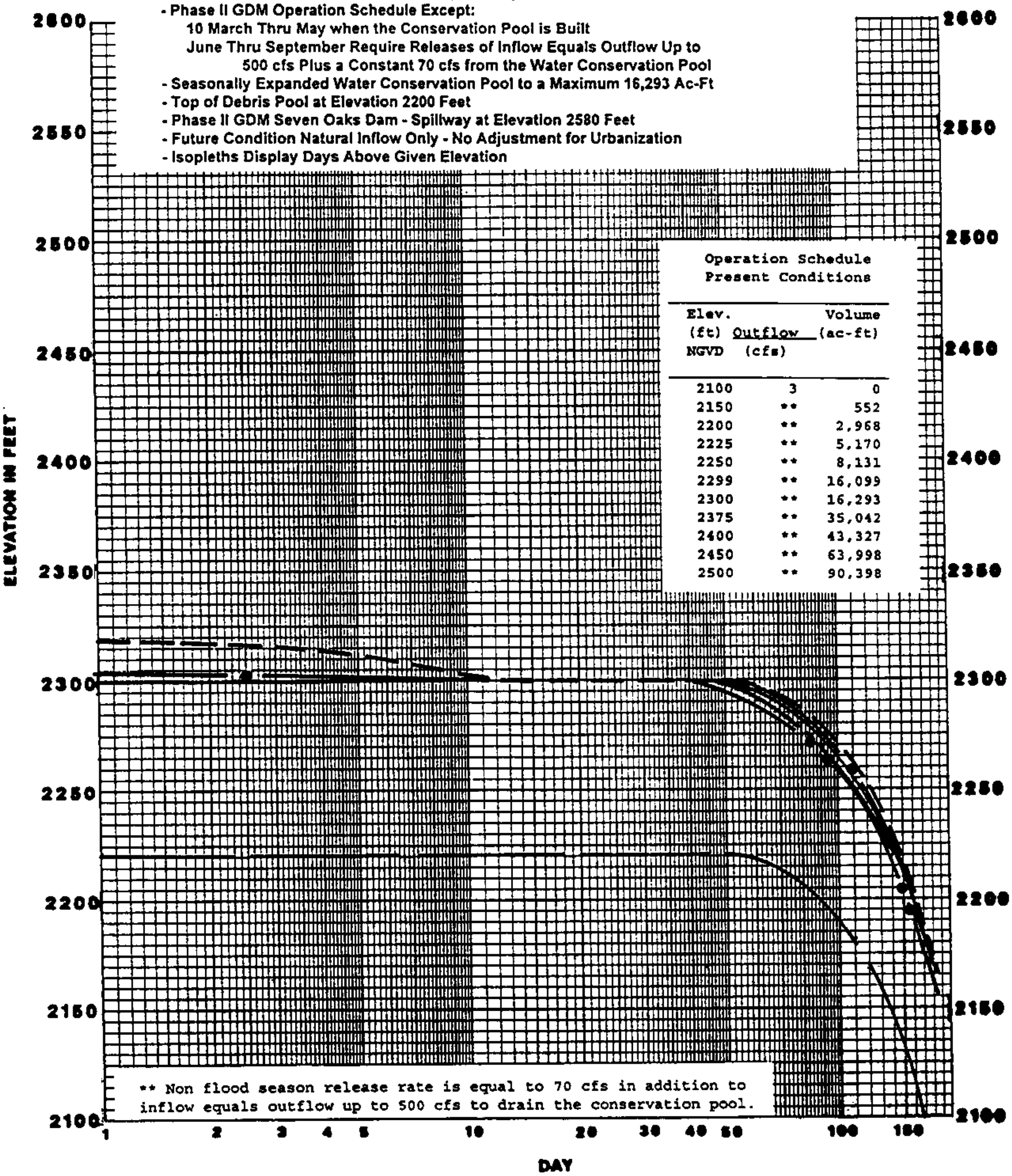
SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

SEASONAL
ELEVATION-DURATION FREQUENCY CURVES
SEVEN OAKS DAM
EXISTING PHASE II GDM OPERATION
Natural Flows
Present Conditions

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SEASONAL EXPANSION TO 16,293 AC-FT (EL 2300) - PERIOD : 10 MARCH TO 30 SEPTEMBER

- Phase II GDM Operation Schedule Except:
  - 10 March Thru May when the Conservation Pool is Built
  - June Thru September Require Releases of Inflow Equals Outflow Up to 500 cfs Plus a Constant 70 cfs from the Water Conservation Pool
- Seasonally Expanded Water Conservation Pool to a Maximum 16,293 Ac-Ft
- Top of Debris Pool at Elevation 2200 Feet
- Phase II GDM Seven Oaks Dam - Spillway at Elevation 2580 Feet
- Future Condition Natural Inflow Only - No Adjustment for Urbanization
- Isopleths Display Days Above Given Elevation



Operation Schedule
Present Conditions

Elev. (ft) NGVD	Outflow (cfs)	Volume (ac-ft)
2100	3	0
2150	**	552
2200	**	2,968
2225	**	5,170
2250	**	8,131
2299	**	16,099
2300	**	16,293
2375	**	35,042
2400	**	43,327
2450	**	63,998
2500	**	90,398

** Non flood season release rate is equal to 70 cfs in addition to inflow equals outflow up to 500 cfs to drain the conservation pool.

LEGEND

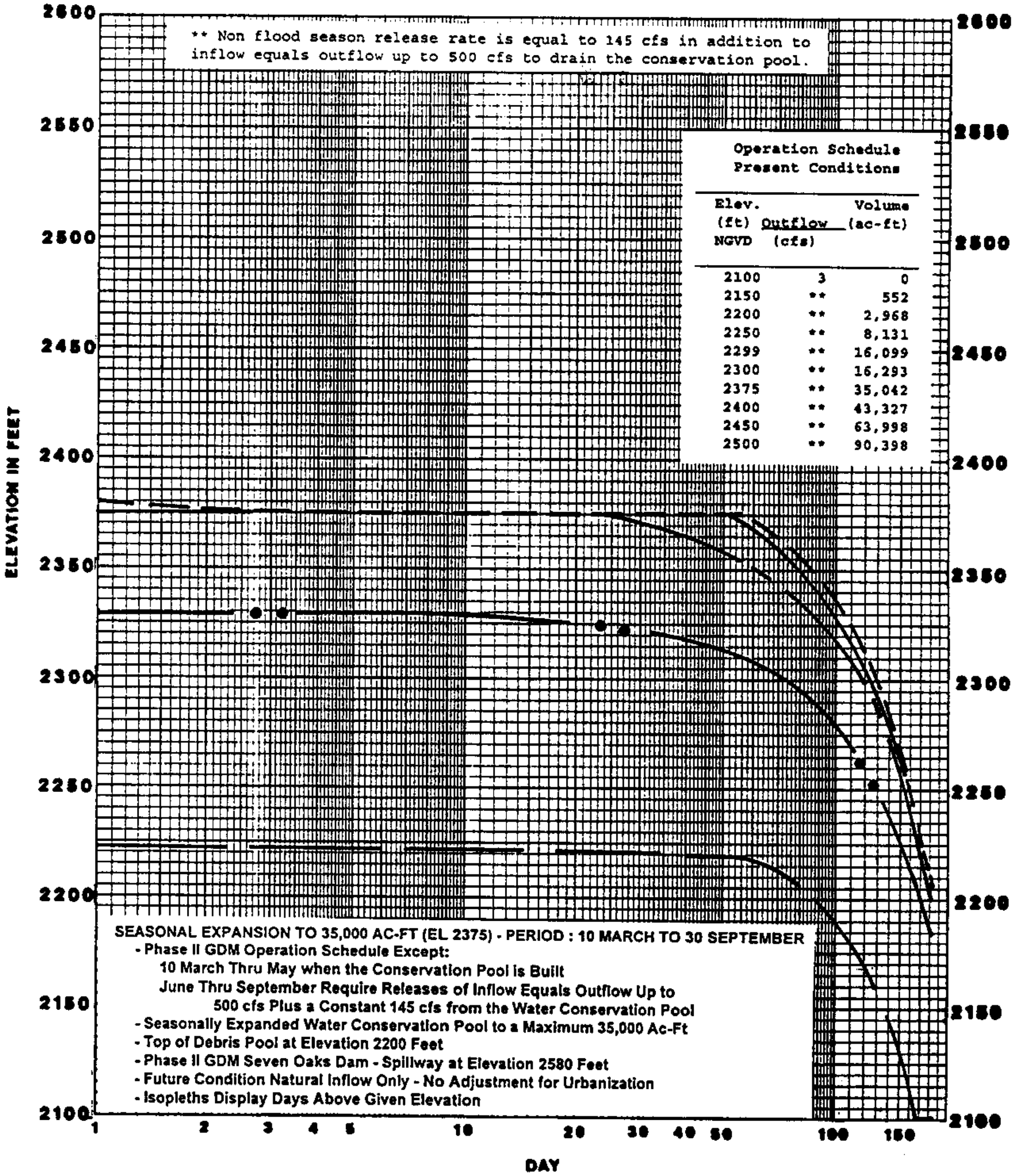
- ——————— 100-YR
- ——•—— 50-YR
- ——————— 25-YR
- —— – —— 10-YR
- ——• •—— 5-YR
- ——————— 2-YR

HIGHER RETURN PERIOD HAS PRIORITY.

SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

SEASONAL
ELEVATION-DURATION FREQUENCY CURVES
SEVEN OAKS DAM
SEASONAL POOL EXPANDED TO 16,293 AC-FT (El. 2300 Ft.)
Natural Flows
Present Conditions

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



LEGEND

- 100-YR
- 50-YR
- 25-YR
- 10-YR
- 5-YR
- 2-YR

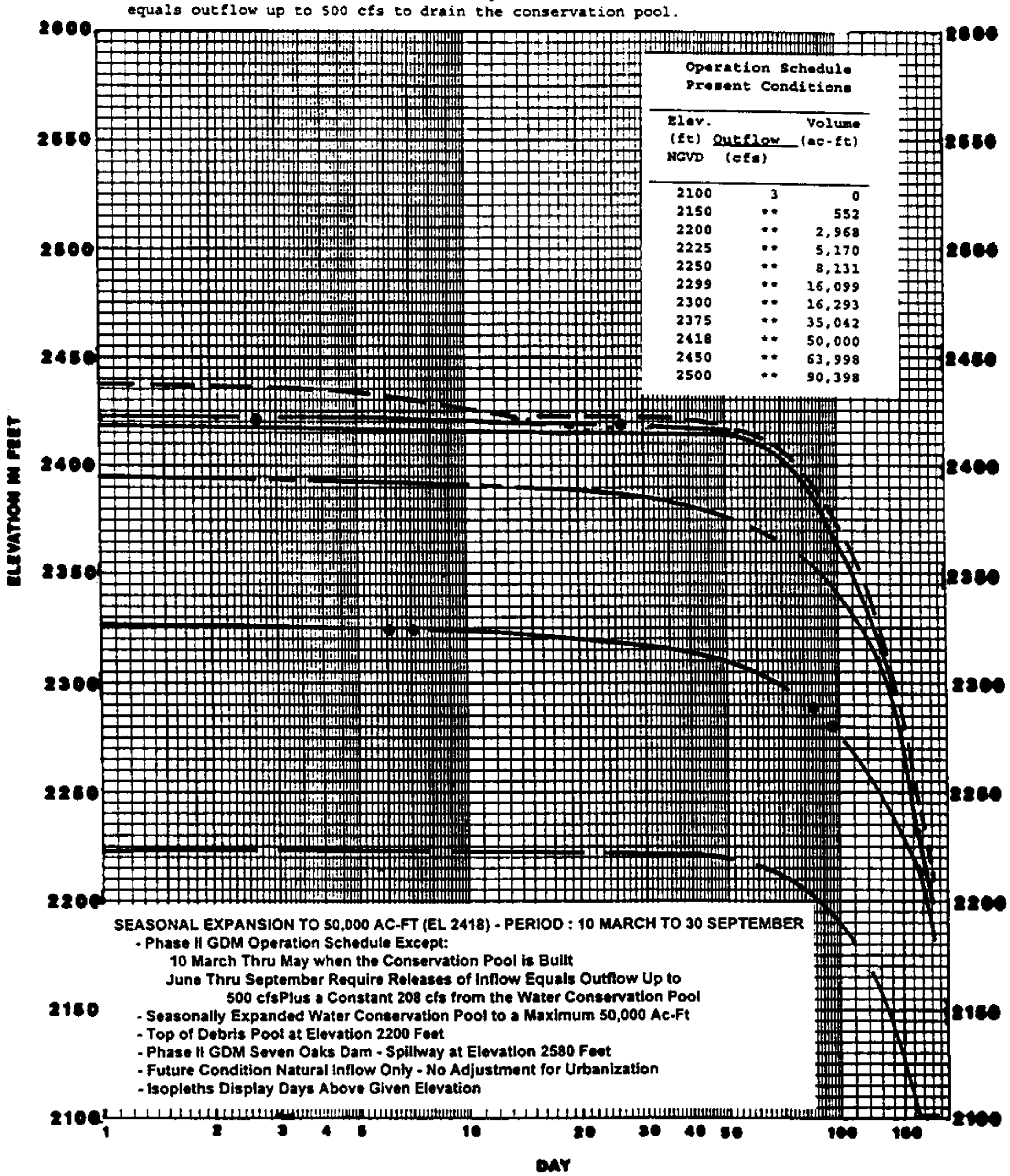
HIGHER RETURN PERIOD HAS PRIORITY.

SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

SEASONAL
ELEVATION-DURATION FREQUENCY CURVES
SEVEN OAKS DAM
SEASONAL POOL EXPANDED TO 35,000 AC-FT (El. 2375 Ft.)
Natural Flows
Present Conditions

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

** Non flood season release rate is equal to 208 cfs in addition to inflow equals outflow up to 500 cfs to drain the conservation pool.



Operation Schedule
Present Conditions

Elev. (ft) NGVD	Outflow (cfs)	Volume (ac-ft)
2100	3	0
2150	**	552
2200	**	2,968
2225	**	5,170
2250	**	8,131
2299	**	16,099
2300	**	16,293
2375	**	35,042
2418	**	50,000
2450	**	63,998
2500	**	90,398

LEGEND

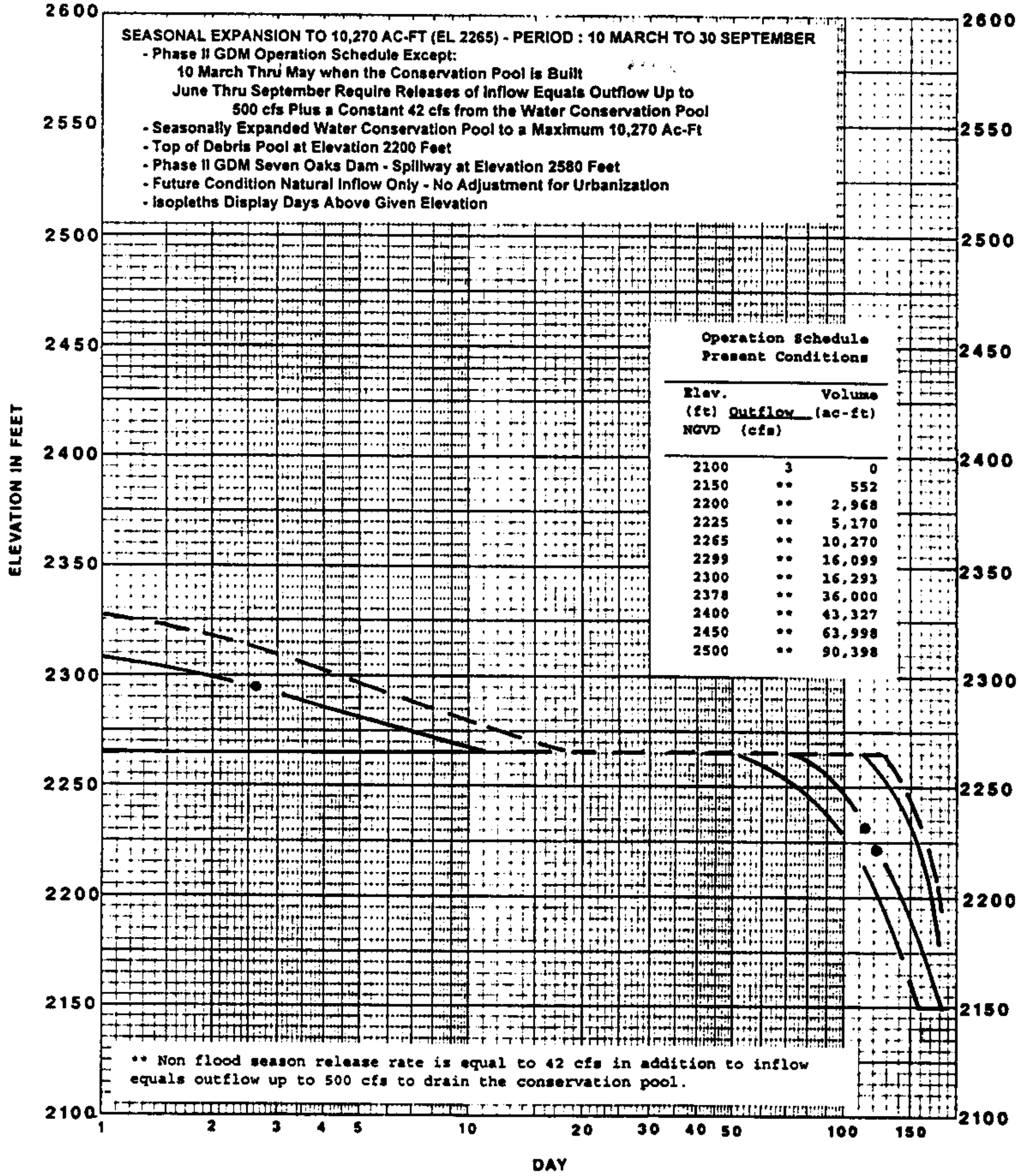
— — — —	100-YR
—— • ——	50-YR
————————	25-YR
—— – ——	10-YR
—— • • ——	5-YR
——— ———	2-YR

HIGHER RETURN PERIOD HAS PRIORITY.

SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

SEASONAL
ELEVATION-DURATION FREQUENCY CURVES
SEVEN OAKS DAM
SEASONAL POOL EXPANDED TO 50,000 AC-FT (El. 2418 Ft.)
Natural Flows
Present Conditions

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



Operation Schedule
Present Conditions

Elev. (ft) NGVD	Outflow (cfs)	Volume (ac-ft)
2100	3	0
2150	**	552
2200	**	2,968
2225	**	5,170
2265	**	10,270
2299	**	16,099
2300	**	16,293
2378	**	36,000
2400	**	43,327
2450	**	63,998
2500	**	90,398

LEGEND

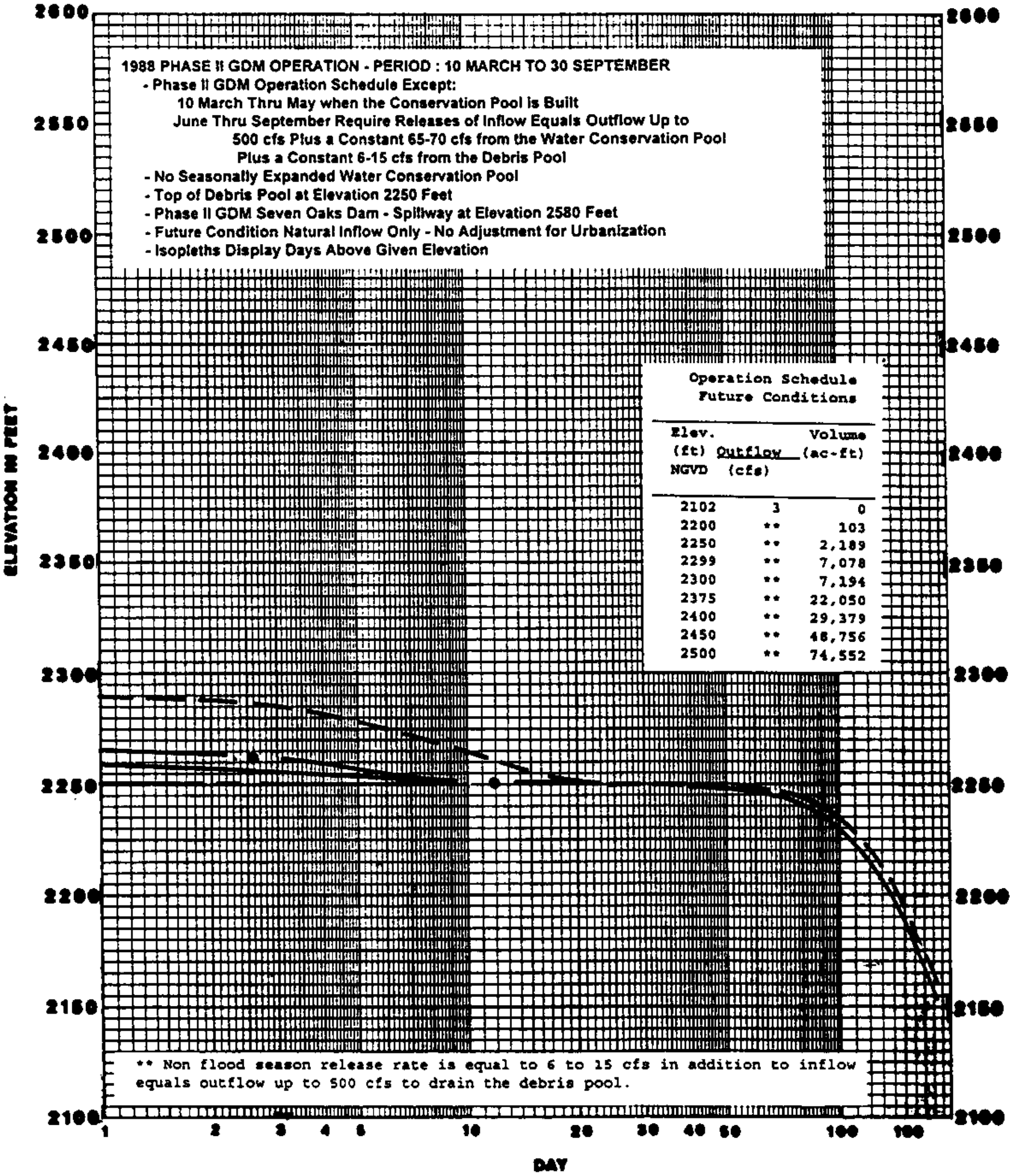
- — — — — 100-YR
- —— • —— 50-YR
- ———— 25-YR
- —— - —— 10-YR
- —— • • —— 5-YR
- ——— ——— 2-YR

HIGHER RETURN PERIOD HAS PRIORITY.

SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

SEASONAL
ELEVATION-DURATION FREQUENCY CURVES
SEVEN OAKS DAM
SEASONAL POOL EXPANDED TO 10,270 AC-FT (El. 2265 Ft.)
Natural Flows
Present Conditions

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



LEGEND

- 100-YR
- 50-YR
- 25-YR
- 10-YR
- 5-YR
- 2-YR

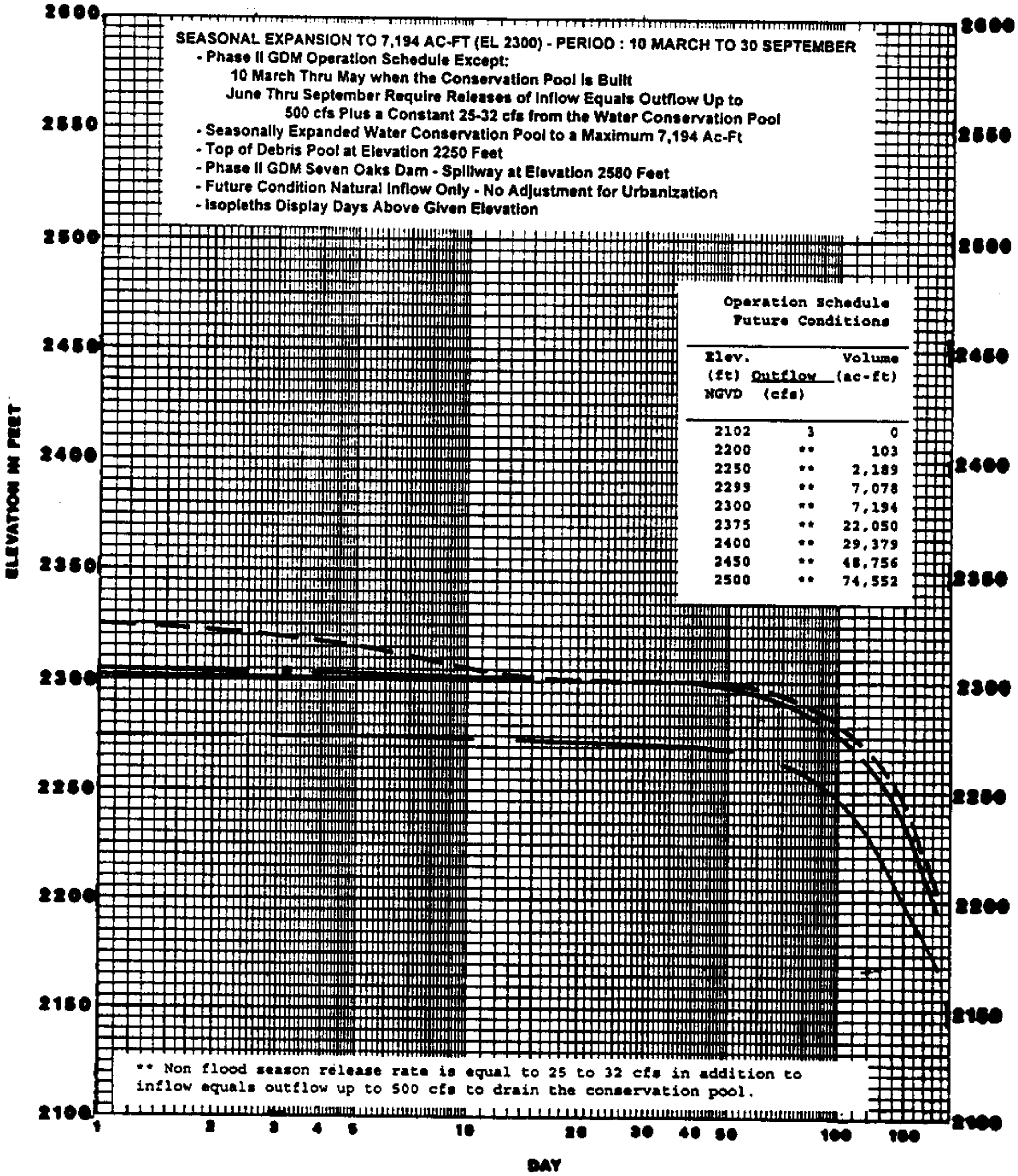
HIGHER RETURN PERIOD HAS PRIORITY.

SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

SEASONAL
ELEVATION-DURATION FREQUENCY CURVES
SEVEN OAKS DAM
EXISTING PHASE II GDM OPERATION
Natural Flows
Future Conditions

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 20



Elev. (ft) NGVD	Outflow (cfs)	Volume (ac-ft)
2102	3	0
2200	**	103
2250	**	2,189
2299	**	7,078
2300	**	7,194
2375	**	22,050
2400	**	29,379
2450	**	48,756
2500	**	74,552

LEGEND

- — — — — 100-YR
- ——•—— 50-YR
- ———— 25-YR
- —— - —— 10-YR
- ——••—— 5-YR
- ———— 2-YR

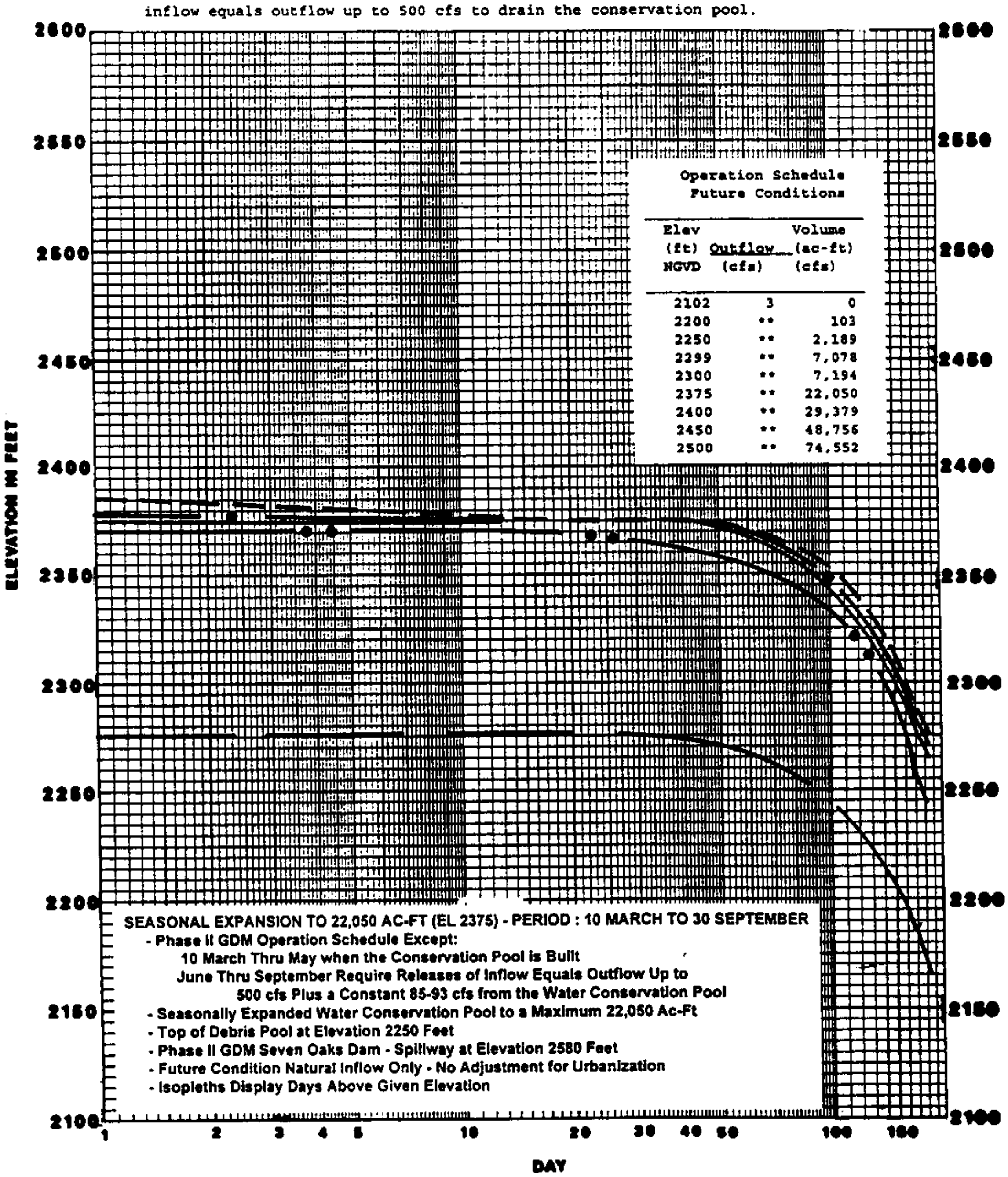
HIGHER RETURN PERIOD HAS PRIORITY.

SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

SEASONAL
ELEVATION-DURATION FREQUENCY CURVES
SEVEN OAKS DAM
SEASONAL POOL EXPANDED TO 7,194 AC-FT (El. 2300 Ft.)
Natural Flows
Future Conditions

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

** Non flood season release rate is equal to 85 to 93 cfs in addition to inflow equals outflow up to 500 cfs to drain the conservation pool.



LEGEND

- 100-YR
- 50-YR
- 25-YR
- 10-YR
- 5-YR
- 2-YR

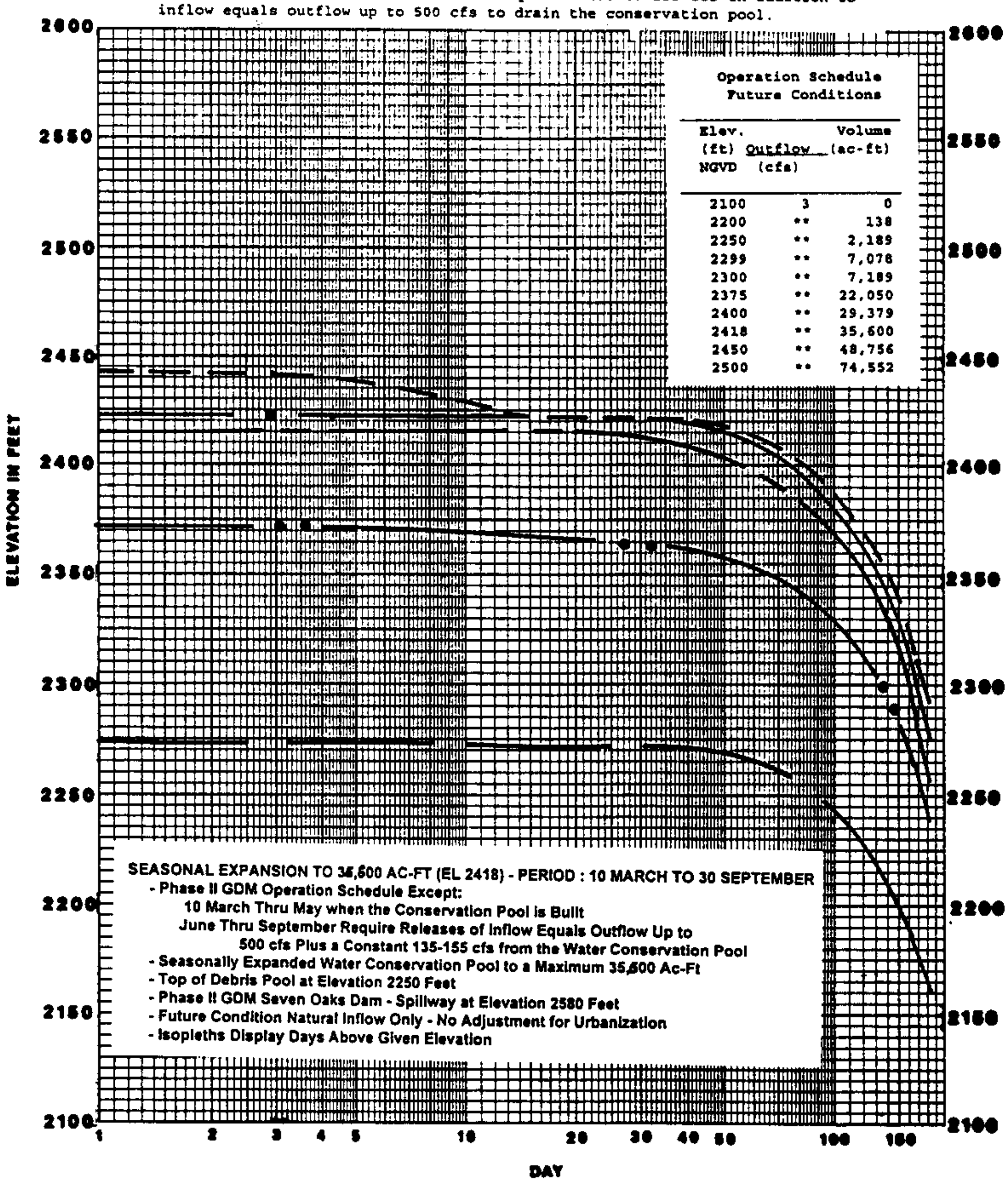
HIGHER RETURN PERIOD HAS PRIORITY.

SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

SEASONAL
ELEVATION-DURATION FREQUENCY CURVES
SEVEN OAKS DAM
SEASONAL POOL EXPANDED TO 22,050 AC-FT (El. 2375 Ft.)
Natural Flows
Future Conditions

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

** Non flood season release rate is equal to 135 to 155 cfs in addition to inflow equals outflow up to 500 cfs to drain the conservation pool.



Operation Schedule
Future Conditions

Elev. (ft) NGVD	Outflow (cfs)	Volume (ac-ft)
2100	3	0
2200	**	138
2250	**	2,189
2299	**	7,078
2300	**	7,189
2375	**	22,050
2400	**	29,379
2418	**	35,600
2450	**	48,756
2500	**	74,552

LEGEND

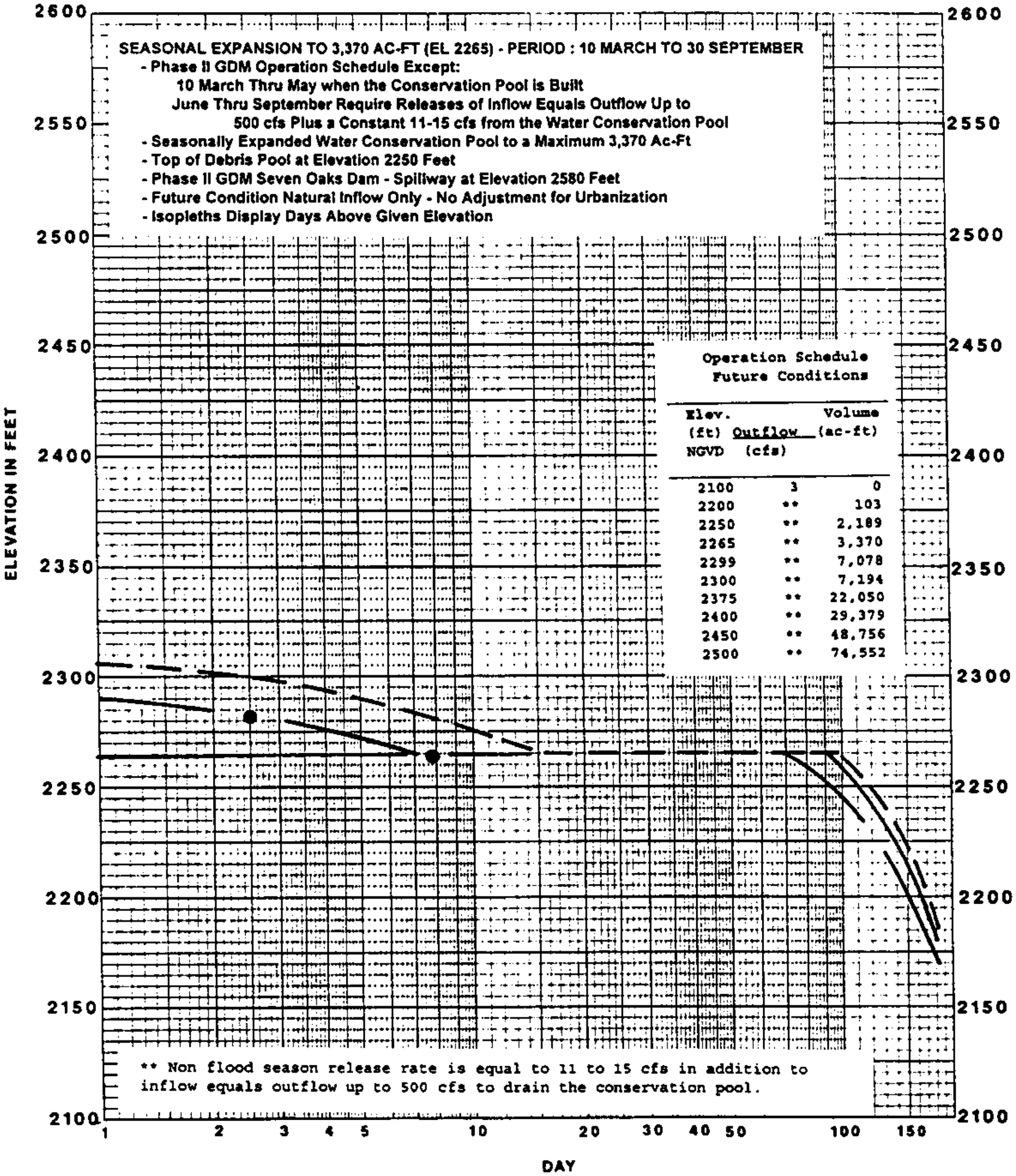
- 100-YR
- 50-YR
- 25-YR
- 10-YR
- 5-YR
- 2-YR

HIGHER RETURN PERIOD HAS PRIORITY.

SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

SEASONAL
ELEVATION-DURATION FREQUENCY CURVES
SEVEN OAKS DAM
SEASONAL POOL EXPANDED TO 35,600 AC-FT (EL 2418 Ft.)
Natural Flows
Future Conditions

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



LEGEND

— — — —	100-YR
—•—	50-YR
———	25-YR
— – —	10-YR
—• •—	5-YR
———	2-YR

HIGHER RETURN PERIOD HAS PRIORITY.

SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

SEASONAL
ELEVATION-DURATION FREQUENCY CURVES
SEVEN OAKS DAM
SEASONAL POOL EXPANDED TO 3,370 AC-FT (El. 2265 Ft.)
Natural Flows
Future Conditions

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

HYDROLOGIC FEASIBILITY REPORT FOR

SEVEN OAKS DAM WATER CONSERVATION STUDY

APPENDIX A

DAILY VALUES FROM 1914 TO 1990
FOR
SANTA ANA RIVER AT MENTONE, CALIFORNIA
STREAM GAGING STATION 11051500

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1914

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.600	110.0	119.0	27.00	108.0	47.00	18.00	2.00	2.00	1.70	1.70	1.80
2	0.600	84.00	108.0	24.00	108.0	59.00	13.00	2.00	2.00	1.70	1.70	1.80
3	0.600	53.00	108.0	24.00	108.0	58.00	13.00	2.00	2.00	1.70	1.70	1.80
4	0.600	37.00	96.00	23.00	96.00	58.00	13.00	2.00	2.00	1.70	1.70	1.80
5	0.600	18.00	76.00	40.00	96.00	58.00	13.00	2.00	2.00	1.70	1.70	1.80
6	0.600	14.00	76.00	40.00	86.00	57.00	13.00	2.00	2.00	1.70	1.70	1.80
7	0.600	10.00	76.00	59.00	86.00	56.00	13.00	2.00	1.00	1.70	1.70	1.80
8	0.600	10.00	68.00	40.00	76.00	55.00	10.00	2.00	1.00	1.70	1.70	1.80
9	0.600	10.00	68.00	40.00	76.00	48.00	10.00	2.00	1.00	1.70	1.70	1.80
10	0.600	10.00	68.00	39.00	68.00	36.00	10.00	2.00	1.00	1.70	1.70	1.80
11	0.600	7.00	68.00	38.00	68.00	29.00	10.00	2.00	1.00	1.70	1.70	3.00
12	0.600	4.00	67.00	46.00	60.00	28.00	10.00	2.00	1.00	1.70	1.70	1.80
13	0.600	4.00	60.00	45.00	60.00	26.00	10.00	2.00	1.00	1.70	1.70	1.80
14	0.600	4.00	51.00	45.00	60.00	26.00	10.00	2.00	1.00	1.70	1.70	1.80
15	171.0	2.00	50.00	44.00	60.00	26.00	3.00	2.00	1.00	1.70	1.70	1.80
16	325.0	2.00	50.00	38.00	59.00	26.00	3.00	2.00	1.00	1.70	1.70	1.80
17	50.00	2.00	49.00	31.00	58.00	26.00	3.00	2.00	1.00	1.70	1.70	1.80
18	32.00	30.00	48.00	32.00	58.00	25.00	3.00	2.00	1.00	1.70	1.70	1.80
19	156.0	355.0	48.00	34.00	57.00	25.00	3.00	2.00	1.00	1.70	1.70	1.80
20	118.0	1320	47.00	36.00	56.00	25.00	2.00	2.00	1.00	1.70	1.70	1.80
21	15.00	2190	46.00	37.00	55.00	25.00	2.00	2.00	1.00	1.70	1.70	1.80
22	12.00	624.0	46.00	51.00	48.00	25.00	2.00	2.00	1.00	1.70	1.70	3.00
23	7.00	388.0	45.00	38.00	47.00	22.00	2.00	2.00	1.00	1.70	1.70	1.80
24	7.00	206.0	39.00	39.00	46.00	22.00	2.00	2.00	1.00	1.70	1.70	1.80
25	97.00	27.00	38.00	35.00	45.00	22.00	2.00	2.00	1.00	1.70	1.70	1.80
26	1020	27.00	37.00	31.00	39.00	18.00	2.00	2.00	1.00	1.70	1.70	1.80
27	760.0	132.0	37.00	28.00	38.00	18.00	2.00	2.00	1.00	1.70	1.70	1.80
28	315.0	132.0	40.00	24.00	38.00	18.00	2.00	2.00	1.00	1.70	1.70	1.80
29	204.0		40.00	200.0	37.00	18.00	2.00	2.00	1.00	1.70	1.70	1.80
30	170.0		36.00	142.0	48.00	18.00	2.00	2.00	1.00	1.70	1.70	1.80
31	138.0		28.00		48.00		2.00	2.00		1.70		1.80
Mean	116.3	207.6	59.13	45.67	64.29	33.33	6.61	2.00	1.20	1.70	1.70	1.88
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0.600	2.00	28.00	23.00	37.00	18.00	2.00	2.00	1.00	1.70	1.70	1.80
Max	1020	2190	119.0	200.0	108.0	59.00	18.00	2.00	2.00	1.70	1.70	3.00
AF	7151	11528	3636	2717	3953	1984	406.6	123.0	71.41	104.5	101.2	115.4

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1915

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.80	198.0	100.0	121.0	198.0	198.0	100.0	29.00	4.00	1.00	2.00	2.30
2	1.80	121.0	100.0	144.0	260.0	228.0	100.0	29.00	4.00	1.00	2.20	2.30
3	1.80	121.0	100.0	144.0	198.0	228.0	100.0	29.00	4.00	1.00	2.20	2.30
4	1.80	121.0	100.0	170.0	198.0	198.0	100.0	29.00	4.00	1.00	2.20	26.00
5	1.80	121.0	100.0	170.0	198.0	170.0	100.0	29.00	4.00	1.00	2.20	2.70
6	1.80	121.0	100.0	144.0	198.0	170.0	100.0	21.00	3.00	2.00	2.20	3.50
7	1.80	121.0	64.00	121.0	198.0	170.0	100.0	21.00	3.00	2.00	2.20	3.10
8	1.80	121.0	64.00	121.0	198.0	170.0	100.0	21.00	3.00	2.00	2.20	2.70
9	1.80	144.0	64.00	121.0	198.0	170.0	100.0	21.00	2.50	2.00	2.20	2.70
10	1.80	870.0	64.00	121.0	228.0	170.0	100.0	18.00	2.50	2.00	2.50	2.30
11	1.80	870.0	64.00	144.0	228.0	170.0	100.0	18.00	2.50	2.00	2.50	2.30
12	1.80	510.0	64.00	170.0	260.0	170.0	100.0	18.00	2.50	2.00	2.50	2.30
13	1.80	510.0	64.00	170.0	295.0	144.0	100.0	18.00	2.00	2.00	2.50	2.30
14	1.80	510.0	64.00	170.0	260.0	144.0	81.00	18.00	2.00	2.00	2.50	2.50
15	1.80	144.0	64.00	144.0	260.0	144.0	72.00	18.00	2.00	2.00	2.20	3.10
16	46.00	144.0	64.00	144.0	228.0	144.0	72.00	15.00	2.00	2.00	2.20	15.00
17	1.80	144.0	100.0	144.0	260.0	144.0	64.00	15.00	2.00	2.00	2.20	15.00
18	1.80	100.0	100.0	144.0	260.0	144.0	64.00	15.00	2.00	2.00	2.20	2.50
19	1.80	100.0	100.0	170.0	260.0	144.0	64.00	15.00	2.00	2.00	2.20	2.50
20	1.80	100.0	100.0	170.0	260.0	121.0	64.00	10.00	1.50	2.00	2.20	2.50
21	1.80	100.0	100.0	228.0	260.0	121.0	57.00	5.50	1.50	2.00	2.20	2.50
22	1.80	100.0	100.0	170.0	260.0	121.0	57.00	5.50	1.50	2.00	2.20	2.50
23	1.80	100.0	144.0	170.0	260.0	121.0	50.00	5.50	1.00	2.00	2.20	2.50
24	1.80	100.0	144.0	170.0	198.0	121.0	64.00	5.50	1.00	2.00	2.30	2.50
25	1.80	100.0	170.0	170.0	198.0	121.0	64.00	5.50	1.00	2.00	2.30	2.50
26	1.80	100.0	144.0	170.0	198.0	121.0	57.00	5.50	1.00	2.00	2.30	2.50
27	1.80	100.0	121.0	170.0	198.0	121.0	50.00	5.50	1.00	2.00	2.30	2.50
28	1.80	100.0	121.0	170.0	198.0	100.0	38.00	5.50	1.00	2.00	2.30	2.50
29	330.0		198.0	228.0	198.0	100.0	38.00	5.00	1.00	2.00	2.30	2.50
30	198.0		170.0	198.0	198.0	100.0	38.00	5.00	1.00	2.00	2.30	3.10
31	198.0		144.0		198.0		38.00	4.00		2.00		3.50
Mean	26.47	214.0	103.1	159.7	226.0	149.6	75.23	15.00	2.18	1.84	2.27	4.16
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	1.80	100.0	64.00	121.0	198.0	100.0	38.00	4.00	1.00	1.00	2.00	2.30
Max	330.0	870.0	198.0	228.0	295.0	228.0	100.0	29.00	4.00	2.00	2.50	26.00
AF	1628	11883	6339	9503	13898	8902	4626	922.3	129.9	113.1	134.9	255.9

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1916

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	3.50		595.0	410.0	200.0	109.0	66.00	25.00	18.00	21.00	18.00	3.40
2	16.00		595.0	410.0	200.0	109.0	64.00	24.00	16.00	28.00	18.00	3.40
3	14.00		595.0	410.0	200.0	104.0	64.00	23.00	16.00	31.00	18.00	3.40
4	3.10		595.0	410.0	200.0	101.0	64.00	23.00	14.00	26.00	18.00	3.40
5	2.70		1300	410.0	187.0	99.00	60.00	23.00	13.00	18.00	16.00	3.40
6	41.00		1000	385.0	200.0	99.00	58.00	23.00	12.00	28.00	6.50	3.40
7	5.50		760.0	385.0	187.0	84.00	55.00	21.00	13.00	21.00	6.00	3.60
8	6.50		700.0	360.0	187.0	82.00	55.00	19.00	13.00	19.00	6.00	3.60
9	228.0		700.0	360.0	187.0	80.00	55.00	18.00	16.00	19.00	4.20	3.60
10	163.0		700.0	385.0	187.0	82.00	49.00	20.00	16.00	14.00	2.30	3.60
11	15.00	700.0	700.0	385.0	187.0	84.00	47.00	22.00	16.00	8.50	1.10	3.40
12	22.00	700.0	700.0	385.0	187.0	101.0	49.00	23.00	16.00	7.00	3.90	3.40
13	5.00	700.0	700.0	360.0	187.0	94.00	45.00	18.00	16.00	7.50	3.90	3.40
14	2.50	700.0	640.0	360.0	187.0	91.00	59.00	17.00	20.00	7.50	3.90	3.40
15	47.00	700.0	640.0	360.0	187.0	91.00	55.00	19.00	20.00	19.00	3.80	3.40
16	35.00	700.0	640.0	338.0	187.0	88.00	51.00	20.00	18.00	31.00	3.80	3.40
17	935.0	700.0	640.0	338.0	142.0	88.00	51.00	20.00	18.00	29.00	3.80	3.40
18		835.0	640.0	338.0	153.0	87.00	51.00	20.00	18.00	29.00	3.80	3.40
19		835.0	595.0	338.0	187.0	87.00	39.00	20.00	18.00	28.00	3.80	3.40
20		835.0	640.0	315.0	187.0	87.00	39.00	20.00	28.00	24.00	3.80	3.40
21		700.0	1090	315.0	241.0	87.00	36.00	20.00	18.00	21.00	3.60	3.40
22		700.0	1000	338.0	142.0	87.00	34.00	19.00	17.00	18.00	3.60	3.40
23		835.0	1090	315.0	136.0	87.00	34.00	18.00	16.00	17.00	3.60	3.40
24		835.0	1090	275.0	136.0	87.00	43.00	17.00	16.00	17.00	3.60	3.40
25		835.0	1000	241.0	136.0	85.00	39.00	17.00	19.00	18.00	3.60	20.00
26		700.0	1000	200.0	130.0	85.00	36.00	19.00	20.00	18.00	3.60	11.00
27		595.0	910.0	200.0	130.0	82.00	31.00	20.00	20.00	18.00	3.60	6.00
28		595.0	835.0	200.0	126.0	80.00	29.00	20.00	20.00	15.00	3.60	5.00
29		595.0	700.0	200.0	126.0	77.00	28.00	20.00	20.00	13.00	3.60	5.00
30			440.0	200.0	113.0	77.00	28.00	19.00	21.00	18.00	3.40	5.00
31			410.0		113.0		26.00	18.00		18.00		4.80
Mean	90.87	726.1	762.6	330.9	169.5	89.37	46.45	20.16	17.40	19.56	6.15	4.49
Cnt	17	19	31	30	31	30	31	31	30	31	30	31
Min	2.50	595.0	410.0	200.0	113.0	77.00	26.00	17.00	12.00	7.00	1.10	3.40
Max	935.0	835.0	1300	410.0	241.0	109.0	66.00	25.00	28.00	31.00	18.00	20.00
AF	3064	27362	46890	19688	10423	5318	2856	1240	1035	1203	365.8	276.1

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1917

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	4.20	5.00	25.00	26.00	70.00	4.50	5.00	4.20	12.00	9.50	1.60	2.50
2	4.20	5.00	23.00	19.00	67.00	3.90	5.00	11.00	12.00	10.00	1.60	4.50
3	9.00	5.00	15.00	18.00	64.00	3.90	3.90	9.00	9.00	9.00	1.70	5.50
4	6.50	5.00	12.00	18.00	68.00	3.90	8.00	13.00	9.00	8.50	2.00	10.00
5	6.50	5.00	9.00	18.00	73.00	3.60	4.20	11.00	8.50	6.50	1.60	44.00
6	5.50	5.00	8.00	18.00	73.00	3.60	4.20	10.00	8.00	4.50	4.20	21.00
7	5.00	4.50	6.50	18.00	69.00	3.00	4.20	12.00	8.00	8.00	2.00	2.60
8	4.50	4.50	6.50	67.00	72.00	3.00	5.00	14.00	7.50	6.00	1.60	2.30
9	4.50	4.50	7.00	26.00	60.00	3.00	5.00	14.00	6.00	6.00	1.60	1.80
10	4.80	4.50	14.00	31.00	58.00	3.00	4.50	17.00	6.00	6.50	1.40	1.60
11	4.80	4.50	14.00	26.00	52.00	3.00	5.00	19.00	5.50	3.90	1.40	1.50
12	4.50	4.80	13.00	24.00	49.00	2.90	5.00	39.00	3.00	4.80	1.30	1.40
13	5.00	4.80	10.00	24.00	49.00	2.80	5.00	29.00	4.40	9.50	1.30	1.40
14	4.50	5.50	9.50	24.00	45.00	3.30	5.50	19.00	5.50	9.50	1.20	1.40
15	6.00	5.50	8.50	31.00	43.00	3.30	6.00	17.00	8.00	9.50	1.10	1.40
16	6.00	6.00	7.50	35.00	43.00	3.30	5.50	15.00	7.00	6.00	1.20	1.50
17	6.00	8.00	6.50	32.00	41.00	18.00	5.00	12.00	8.00	6.00	1.40	1.50
18	6.50	8.00	6.00	29.00	34.00	4.20	4.50	9.50	6.00	4.20	1.40	1.40
19	62.00	8.00	7.00	25.00	31.00	3.90	3.60	5.00	6.00	3.00	1.40	1.30
20	17.00	8.00	9.50	25.00	34.00	3.60	3.30	3.90	5.50	2.40	1.30	1.30
21	13.00	9.50	10.00	26.00	24.00	3.60	3.30	4.50	6.00	2.00	1.40	1.40
22	11.00	113.0	10.00	27.00	15.00	4.20	3.30	4.20	5.50	1.80	1.40	1.50
23	8.00	88.00	10.00	29.00	14.00	6.00	3.30	6.00	7.50	3.00	1.40	1.40
24	7.00	51.00	9.00	32.00	14.00	7.50	5.00	15.00	8.50	3.20	1.40	1.40
25	6.50	164.0	7.50	37.00	18.00	7.00	6.50	16.00	7.50	4.80	1.30	1.40
26	6.50	91.00	12.00	43.00	15.00	6.50	6.00	12.00	6.00	5.00	1.30	1.30
27	6.00	58.00	16.00	43.00	9.00	5.50	5.50	12.00	4.50	3.60	1.30	1.30
28	6.00	32.00	25.00	64.00	6.50	5.00	14.00	10.00	5.00	3.30	1.30	1.30
29	6.00		32.00	72.00	5.50	5.00	11.00	9.50	4.80	2.20	1.20	1.20
30	8.00		39.00	73.00	5.50	5.00	7.50	9.00	3.60	1.80	1.20	1.30
31	5.50		34.00		4.50		5.00	9.00		1.80		1.40

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	8.40	25.63	13.61	32.67	39.55	4.63	5.41	12.61	6.79	5.35	1.52	4.03
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	4.20	4.50	6.00	18.00	4.50	2.80	3.30	3.90	3.00	1.80	1.10	1.20
Max	62.00	164.0	39.00	73.00	73.00	18.00	14.00	39.00	12.00	10.00	4.20	44.00
AF	516.7	1423	837.0	1944	2432	275.7	332.8	775.2	404.2	328.9	90.25	247.5

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1918

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.40	1.20	1.30	39.00	6.50	2.80	2.80	2.10	6.00	2.50	9.50	3.10
2	1.40	1.20	1.30	42.00	5.50	11.00	3.20	2.40	3.10	3.10	2.70	3.10
3	1.50	1.20	1.40	39.00	5.50	2.80	3.00	4.00	3.10	4.30	6.50	3.10
4	1.50	1.20	1.40	32.00	4.50	2.80	2.80	1.50	2.90	40.00	3.80	3.10
5	1.40	1.20	1.60	23.00	6.00	2.70	3.00	1.50	2.20	9.00	2.70	3.10
6	1.20	1.20	19.00	21.00	7.50	2.60	2.80	1.80	2.20	4.60	2.50	3.30
7	1.20	1.30	2390	20.00	7.50	2.40	2.70	2.20	2.20	3.10	2.20	22.00
8	1.20	1.30	545.0	20.00	9.50	2.20	15.00	2.20	2.20	2.90	2.20	6.00
9	1.30	1.30	123.0	19.00	10.00	2.20	18.00	2.40	2.20	2.00	2.20	3.80
10	1.40	1.30	1860	16.00	6.00	2.20	7.00	5.50	22.00	2.00	3.80	2.50
11	1.20	1.30	1770	15.00	4.50	2.40	6.00	3.50	6.00	1.80	2.70	2.40
12	1.20	1.30	3970	16.00	3.80	2.60	5.00	2.20	3.30	1.70	2.50	2.20
13	1.20	1.40	1810	29.00	3.80	2.70	4.00	2.00	3.60	2.50	2.20	2.00
14	1.20	1.40	495.0	25.00	6.50	2.80	2.20	2.80	4.60	3.80	2.00	1.90
15	1.20	1.40	278.0	16.00	7.00	3.80	2.10	5.50	6.50	7.50	2.00	1.90
16	1.20	1.40	184.0	12.00	6.00	17.00	2.00	9.00	8.00	3.30	2.50	1.80
17	1.20	1.80	123.0	10.00	7.00	20.00	1.80	10.00	7.50	2.00	2.70	1.80
18	1.20	6.00	80.00	8.50	6.50	6.50	1.60	8.00	7.00	2.70	3.80	1.80
19	1.40	20.00	112.0	8.50	7.00	4.50	1.50	4.50	6.00	2.20	3.30	1.80
20	1.20	1.80	109.0	9.00	4.80	3.20	1.50	3.80	4.30	2.20	2.90	1.90
21	1.10	1.70	80.00	9.00	4.00	2.20	1.60	3.20	4.00	2.00	2.50	1.90
22	1.10	37.00	80.00	11.00	3.20	2.10	1.80	3.00	6.50	2.20	2.50	1.90
23	1.30	11.00	78.00	7.50	3.20	2.10	2.00	2.80	5.50	2.00	2.20	1.90
24	1.10	2.00	70.00	8.50	2.80	2.10	2.10	2.80	4.00	2.20	23.00	1.90
25	1.20	1.60	68.00	8.50	2.80	2.10	2.00	2.60	2.20	2.50	4.60	1.90
26	1.40	1.60	62.00	9.00	2.80	2.20	1.70	2.70	2.00	2.70	3.80	1.90
27	1.20	1.40	62.00	9.00	3.50	2.20	1.40	2.40	2.20	2.70	3.60	1.90
28	1.20	1.40	49.00	8.50	6.50	2.40	1.40	2.00	2.20	2.50	3.30	1.90
29	1.20		39.00	8.00	6.50	2.40	1.40	1.80	2.00	2.20	3.10	2.00
30	1.20		39.00	7.50	4.20	2.70	1.40	6.00	2.00	1.80	3.10	1.90
31	1.20		40.00		3.00		1.40	15.00		1.80		1.80
Mean	1.25	3.85	469.1	16.88	5.42	4.06	3.43	3.91	4.58	4.12	3.88	3.02
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	1.10	1.20	1.30	7.50	2.80	2.10	1.40	1.50	2.00	1.70	2.00	1.80
Max	1.50	37.00	3970	42.00	10.00	20.00	18.00	15.00	22.00	40.00	23.00	22.00
AF	77.16	214.0	28844	1005	333.0	241.4	210.6	240.4	272.7	253.5	230.9	185.5

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1919

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.80	4.50	4.50	5.50	2.00	3.60	1.50	1.70	3.40	6.00	2.50	2.80
2	1.60	4.80	4.50	4.90	2.00	2.20	1.80	1.70	2.00	3.20	2.50	2.50
3	1.60	7.00	4.80	4.60	2.00	2.00	1.80	1.70	1.70	2.20	2.20	2.80
4	1.60	4.20	4.50	4.60	2.00	1.80	2.00	1.70	1.50	1.90	1.60	13.00
5	3.00	4.00	4.50	4.00	2.20	1.80	2.00	1.70	1.50	1.90	1.60	7.50
6	2.00	3.80	4.50	4.00	2.20	1.80	2.00	1.70	1.40	1.80	1.60	9.00
7	1.90	3.50	4.50	3.60	2.20	1.80	2.00	1.70	1.50	1.60	1.80	4.60
8	1.90	3.50	4.50	3.60	2.20	1.70	2.00	1.70	1.50	1.40	1.60	3.20
9	1.90	3.20	4.20	3.20	2.40	1.70	2.00	1.70	1.50	1.20	1.60	2.50
10	1.90	3.20	3.50	3.20	2.40	1.70	2.00	1.70	1.40	1.00	1.60	2.20
11	1.60	16.00	3.00	3.20	2.20	1.70	2.00	1.70	1.40	0.400	1.40	2.30
12	1.60	23.00	2.50	3.20	2.20	1.70	2.00	1.80	1.40	0.200	1.30	2.50
13	1.60	9.00	3.80	3.20	2.20	1.80	2.00	1.80	1.20	0.700	1.30	2.50
14	1.80	7.50	8.00	3.00	2.20	2.00	2.00	1.80	1.40	1.20	1.00	2.50
15	1.80	6.50	11.00	2.80	2.40	2.00	2.00	1.80	1.40	1.80	1.00	2.30
16	1.80	6.00	10.00	2.80	2.40	2.00	2.00	2.00	1.20	2.50	1.00	2.20
17	1.90	5.00	13.00	2.80	2.40	2.00	2.40	2.80	1.50	3.00	1.00	2.20
18	1.90	4.80	16.00	2.80	2.40	2.00	2.80	3.80	1.50	2.50	1.00	2.20
19	1.90	4.20	17.00	2.60	2.40	2.00	4.60	2.60	1.70	2.50	1.00	2.30
20	1.90	6.00	19.00	2.40	2.40	2.00	3.40	2.00	1.70	2.20	1.00	2.50
21	1.90	4.80	17.00	2.40	2.80	2.00	2.80	1.80	1.50	1.30	1.00	2.50
22	1.90	4.50	16.00	2.40	2.60	1.80	2.20	1.70	1.40	0.500	1.30	2.50
23	2.00	4.80	12.00	2.40	2.40	1.80	2.00	1.50	7.00	0.400	1.00	2.50
24	2.20	4.50	8.00	2.40	2.40	1.80	2.00	1.40	2.60	7.50	1.00	2.80
25	2.20	4.50	7.50	2.40	2.40	1.70	1.70	1.40	2.20	20.00	1.00	2.00
26	2.20	4.50	6.50	2.80	2.20	1.70	1.70	1.40	12.00	6.00	10.00	2.30
27	2.20	5.00	7.00	2.60	2.20	1.70	1.70	1.50	35.00	2.50	20.00	2.20
28	2.20	4.50	6.00	2.40	2.00	1.50	1.70	1.50	8.00	2.50	6.00	2.20
29	2.20		6.50	2.40	2.00	1.40	1.70	1.40	49.00	2.50	4.60	2.00
30	2.20		6.50	2.20	2.00	1.50	1.70	1.40	14.00	2.50	3.90	2.00
31	3.00		10.00		2.00		1.70	1.40		2.50		2.00
Mean	1.97	5.96	8.07	3.15	2.25	1.87	2.10	1.79	5.48	2.82	2.65	3.18
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	1.60	3.20	2.50	2.20	2.00	1.40	1.50	1.40	1.20	0.200	1.00	2.00
Max	3.00	23.00	19.00	5.50	2.80	3.60	4.60	3.80	49.00	20.00	20.00	13.00
AF	121.4	330.8	496.5	187.2	138.4	111.5	129.3	110.1	326.3	173.4	157.5	195.6

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1920

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.20	1.10	132.0	162.0	68.00	24.00	3.80	11.00	3.50	3.20	4.60	2.20
2	2.20	1.10	641.0	162.0	62.00	22.00	3.80	17.00	3.50	3.20	2.90	2.40
3	2.20	1.10	260.0	174.0	57.00	22.00	3.80	8.00	3.20	3.20	2.40	2.60
4	2.00	1.00	164.0	174.0	53.00	21.00	3.50	4.30	3.20	3.20	2.20	2.60
5	1.80	1.00	104.0	201.0	50.00	19.00	3.20	3.20	3.20	3.20	1.90	2.60
6	1.60	0.800	104.0	206.0	47.00	17.00	3.20	2.60	3.20	3.20	1.90	2.60
7	1.50	0.800	86.00	201.0	48.00	17.00	2.90	2.60	2.60	3.20	1.70	2.60
8	1.50	2.00	80.00	198.0	50.00	15.00	2.90	2.60	2.60	3.20	1.70	2.60
9	1.30	2.50	71.00	193.0	53.00	14.00	2.60	2.90	2.40	3.20	1.50	2.40
10	1.10	6.00	90.00	186.0	51.00	13.00	2.60	2.90	2.40	2.90	1.50	2.60
11	1.10	2.50	43.00	132.0	50.00	13.00	2.90	3.50	2.60	2.60	1.50	3.20
12	1.10	2.30	27.00	102.0	46.00	11.00	5.00	3.80	2.60	2.60	1.50	3.50
13	1.10	2.20	22.00	104.0	47.00	11.00	5.00	4.00	2.60	2.60	1.50	3.20
14	1.10	1.80	18.00	102.0	43.00	12.00	4.90	5.50	2.90	2.60	1.50	2.90
15	1.10	1.60	15.00	78.00	40.00	10.00	4.30	5.00	2.90	2.60	1.50	2.60
16	1.10	1.50	33.00	150.0	39.00	11.00	4.30	5.00	2.90	2.60	1.50	2.90
17	1.10	1.10	215.0	106.0	35.00	10.00	3.80	4.90	4.90	2.60	1.50	2.90
18	1.10	1.00	135.0	91.00	34.00	8.00	3.80	4.30	7.50	2.60	1.50	2.90
19	1.10	7.00	128.0	80.00	38.00	6.50	3.80	3.80	5.00	50.00	1.50	6.60
20	1.00	30.00	117.0	69.00	43.00	6.00	3.80	3.50	4.30	7.50	1.50	4.90
21	1.00	220.0	145.0	66.00	44.00	4.90	3.50	3.20	4.00	3.50	1.50	4.30
22	0.800	935.0	400.0	63.00	51.00	4.00	4.00	3.20	3.80	2.90	1.50	3.80
23	0.800	430.0	288.0	64.00	53.00	4.00	10.00	3.20	3.80	2.60	1.30	2.60
24	0.800	188.0	247.0	60.00	46.00	3.80	10.00	4.00	3.80	2.60	1.30	2.20
25	1.30	107.0	244.0	62.00	41.00	3.80	8.00	7.50	3.80	2.60	1.30	2.20
26	1.10	62.00	300.0	62.00	39.00	3.80	8.00	5.50	3.80	2.60	1.30	2.40
27	1.10	55.00	265.0	53.00	35.00	3.80	7.00	4.90	3.80	2.40	1.50	2.60
28	1.10	50.00	220.0	62.00	35.00	3.80	7.00	4.00	3.50	2.40	1.50	2.60
29	1.10	45.00	213.0	64.00	27.00	3.80	7.00	3.80	3.20	2.40	1.70	2.60
30	1.10		192.0	71.00	26.00	3.80	7.00	3.80	3.20	4.00	2.20	2.60
31	1.10		180.0		25.00		8.00	3.80		12.00		2.60
Mean	1.28	74.50	167.1	116.6	44.39	10.73	4.95	4.75	3.49	4.84	1.75	2.95
Cnt	31	29	31	30	31	30	31	31	30	31	30	31
Min	0.800	0.800	15.00	53.00	25.00	3.80	2.60	2.60	2.40	2.40	1.30	2.20
Max	2.20	935.0	641.0	206.0	68.00	24.00	10.00	17.00	7.50	50.00	4.60	6.60
AF	78.55	4285	10273	6938	2729	638.7	304.3	292.2	207.7	297.5	103.9	181.1

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1921

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.60	4.30	2.40	2.80	1.80	7.00	2.60	3.00	2.20	95.00	1.70	1.30
2	2.60	3.60	2.60	2.60	1.80	3.90	2.60	3.00	2.00	80.00	1.70	1.20
3	2.60	3.20	2.60	2.60	1.80	3.40	2.60	3.00	2.00	70.00	1.60	1.40
4	2.90	3.00	2.60	3.00	1.80	4.80	2.20	3.00	2.00	65.00	1.60	1.50
5	2.90	3.20	2.60	2.80	2.20	4.40	2.40	3.00	2.00	65.00	1.50	1.50
6	3.20	3.20	5.50	3.20	8.20	3.20	1.60	3.40	2.00	45.00	2.00	1.50
7	3.20	3.00	5.00	2.40	3.40	3.00	1.80	6.00	2.00	25.00	2.00	1.40
8	3.20	3.00	3.20	1.80	1.40	3.00	1.80	3.90	2.00	15.00	2.00	1.40
9	3.20	3.00	3.00	2.00	2.00	3.00	2.60	3.90	2.00	10.00	3.30	1.40
10	2.90	2.80	2.80	2.00	1.60	2.80	2.40	3.20	2.00	7.00	2.10	1.50
11	2.60	2.80	3.00	2.20	1.40	2.80	2.00	3.00	2.00	4.00	1.50	1.50
12	2.60	2.80	16.00	2.00	1.30	2.80	1.80	3.00	2.40	1.90	1.60	1.50
13	2.60	2.80	139.0	2.40	1.20	2.80	1.30	3.00	2.40	1.70	1.70	1.60
14	2.60	4.30	527.0	2.60	1.30	2.80	1.60	3.00	2.60	1.70	1.70	1.40
15	3.20	3.40	174.0	2.40	1.40	2.60	2.00	3.00	2.60	1.70	1.70	1.30
16	3.80	3.20	108.0	2.20	2.00	2.40	2.40	3.00	2.80	1.90	1.70	1.30
17	4.00	3.40	67.00	2.20	2.00	2.20	3.00	3.00	2.80	2.10	1.70	1.50
18	183.0	3.40	52.00	2.00	2.00	2.40	2.80	3.00	2.40	2.10	1.70	75.00
19	125.0	3.20	47.00	2.00	2.00	2.00	2.60	3.20	2.20	2.10	1.60	432.0
20	30.00	12.00	25.00	3.40	2.40	1.80	2.80	3.20	2.00	2.10	1.40	1700
21	7.00	6.00	18.00	2.00	29.00	1.80	3.00	3.00	1.80	1.90	1.30	990.0
22	5.00	2.20	10.00	2.00	52.00	2.00	3.00	2.80	1.80	1.90	1.30	490.0
23	3.20	1.80	18.00	2.20	47.00	2.60	3.00	2.80	1.60	2.40	1.30	256.0
24	2.00	1.60	11.00	5.50	41.00	2.80	3.00	2.80	1.60	2.70	1.40	158.0
25	1.40	1.50	5.50	2.40	33.00	3.00	3.00	2.60	1.40	2.10	1.40	170.0
26	1.10	1.80	6.50	2.00	24.00	3.00	3.00	2.60	1.40	1.90	1.30	1100
27	11.00	2.20	3.90	2.00	17.00	3.00	3.00	2.60	1.80	1.70	1.30	1000
28	76.00	2.40	3.40	1.80	17.00	2.80	3.00	2.60	1.80	1.70	1.40	665.0
29	15.00		3.20	1.80	9.00	2.80	3.00	2.40	2.20	1.70	1.30	445.0
30	6.00		3.00	1.80	6.00	2.60	3.00	2.40	4.40	1.70	1.30	319.0
31	5.00		3.00		5.50		3.00	2.20		1.70		242.0
Mean	16.82	3.32	41.15	2.40	10.44	2.98	2.51	3.05	2.14	16.76	1.64	260.2
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	1.10	1.50	2.40	1.80	1.20	1.80	1.30	2.20	1.40	1.70	1.30	1.20
Max	183.0	12.00	527.0	5.50	52.00	7.00	3.00	6.00	4.40	95.00	3.30	1700
AF	1034	184.7	2531	143.0	641.7	177.5	154.5	187.6	127.3	1031	97.39	15999

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1922

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	228.0	35.00	132.0	214.0	382.0	282.0	122.0	56.00	18.00	13.00	3.80	2.70
2	930.0	34.00	129.0	220.0	378.0	266.0	121.0	51.00	17.00	13.00	3.50	2.70
3	540.0	36.00	126.0	226.0	386.0	242.0	117.0	47.00	20.00	12.00	3.50	2.70
4	355.0	36.00	123.0	232.0	400.0	204.0	115.0	45.00	18.00	12.00	3.30	2.70
5	270.0	39.00	116.0	238.0	414.0	197.0	113.0	45.00	17.00	12.00	3.10	2.70
6	218.0	43.00	108.0	221.0	422.0	176.0	108.0	45.00	17.00	12.00	2.70	2.70
7	214.0	46.00	110.0	228.0	404.0	176.0	106.0	45.00	17.00	8.50	2.70	3.80
8	165.0	710.0	107.0	282.0	404.0	176.0	105.0	45.00	23.00	8.50	2.40	2.70
9	130.0	1520	102.0	278.0	440.0	158.0	100.0	46.00	21.00	9.00	60.00	2.00
10	115.0	1120	101.0	282.0	414.0	142.0	97.00	45.00	20.00	11.00	35.00	7.00
11	100.0	656.0	148.0	282.0	409.0	132.0	94.00	45.00	18.00	12.00	3.10	10.00
12	86.00	474.0	134.0	290.0	364.0	134.0	92.00	42.00	17.00	14.00	2.70	4.00
13	77.00	342.0	134.0	290.0	342.0	130.0	91.00	40.00	20.00	15.00	2.40	590.0
14	72.00	280.0	134.0	270.0	332.0	128.0	86.00	38.00	20.00	15.00	2.20	194.0
15	71.00	244.0	136.0	270.0	337.0	124.0	86.00	35.00	20.00	15.00	2.20	85.00
16	68.00	220.0	142.0	263.0	355.0	132.0	82.00	33.00	20.00	15.00	2.20	62.00
17	61.00	208.0	182.0	249.0	342.0	132.0	82.00	35.00	20.00	15.00	2.40	55.00
18	58.00	216.0	168.0	242.0	350.0	136.0	88.00	37.00	20.00	15.00	2.40	40.00
19	54.00	232.0	185.0	224.0	332.0	138.0	94.00	31.00	20.00	12.00	17.00	29.00
20	50.00	264.0	179.0	191.0	324.0	140.0	92.00	35.00	20.00	12.00	4.20	26.00
21	46.00	272.0	168.0	194.0	332.0	138.0	81.00	31.00	20.00	12.00	4.00	20.00
22	46.00	260.0	165.0	210.0	328.0	138.0	75.00	23.00	20.00	12.00	4.00	18.00
23	41.00	246.0	168.0	249.0	324.0	142.0	72.00	23.00	16.00	9.50	4.20	5.50
24	36.00	228.0	173.0	294.0	332.0	142.0	67.00	25.00	14.00	10.00	4.20	5.50
25	32.00	142.0	165.0	342.0	350.0	142.0	60.00	27.00	14.00	12.00	4.20	5.50
26	32.00	140.0	172.0	350.0	342.0	142.0	58.00	26.00	13.00	10.00	4.10	6.00
27	31.00	137.0	179.0	378.0	350.0	140.0	55.00	23.00	14.00	12.00	4.00	6.00
28	35.00	135.0	186.0	368.0	310.0	136.0	54.00	25.00	14.00	26.00	4.00	6.00
29	32.00		193.0	368.0	294.0	132.0	54.00	25.00	15.00	14.00	4.20	6.50
30	50.00		200.0	364.0	282.0	128.0	51.00	22.00	14.00	10.00	3.30	6.50
31	40.00		207.0		270.0		58.00	20.00		7.00		6.50
Mean	138.2	297.0	150.7	270.3	356.3	157.5	86.32	35.84	17.90	12.44	6.70	39.31
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	31.00	34.00	101.0	191.0	270.0	124.0	51.00	20.00	13.00	7.00	2.20	2.00
Max	930.0	1520	207.0	378.0	440.0	282.0	122.0	56.00	23.00	26.00	60.00	590.0
AF	8495	16493	9267	16084	21908	9372	5308	2204	1065	764.6	398.7	2417

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1923

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	6.00	14.00	22.00	4.60	36.00	8.00	5.50	6.50	0.800	1.00	1.70	1.90
2	5.50	10.00	21.00	7.00	22.00	3.80	6.50	6.00	1.10	0.900	1.70	1.60
3	8.00	9.50	35.00	15.00	18.00	2.70	7.50	6.00	5.50	0.900	1.70	1.60
4	8.00	21.00	28.00	4.20	15.00	2.00	7.00	6.00	4.20	0.800	1.70	1.60
5	7.50	22.00	17.00	1.40	9.50	2.00	6.50	5.50	0.600	0.900	1.70	1.60
6	5.50	20.00	13.00	36.00	6.50	2.00	5.50	4.60	0.300	1.20	1.70	1.60
7	3.50	20.00	12.00	53.00	8.00	1.70	4.90	4.00	0.300	1.30	1.70	1.60
8	3.50	20.00	4.20	33.00	12.00	1.00	4.80	3.50	0.300	23.00	1.70	1.10
9	3.80	30.00	12.00	25.00	8.00	3.10	4.70	3.10	0.300	0.900	4.20	1.30
10	4.20	28.00	14.00	58.00	6.50	5.50	4.60	2.70	1.40	0.900	4.20	1.20
11	3.50	32.00	7.00	78.00	9.50	5.50	4.50	3.30	2.40	0.900	2.00	1.20
12	3.80	30.00	3.80	69.00	10.00	5.50	4.40	6.50	4.90	0.900	2.00	1.20
13	4.00	31.00	2.70	66.00	11.00	6.00	4.30	4.90	4.90	0.900	1.80	1.20
14	3.50	40.00	2.90	67.00	8.50	6.00	4.20	3.80	10.00	0.900	1.60	1.30
15	4.00	43.00	3.10	65.00	5.50	7.00	4.00	3.10	2.70	0.900	1.40	1.30
16	4.00	46.00	7.50	62.00	5.50	6.50	4.00	3.50	1.00	0.900	1.40	1.30
17	5.50	50.00	4.60	61.00	5.50	6.00	6.00	1.90	0.300	0.900	1.40	1.30
18	4.00	53.00	12.00	69.00	5.50	6.50	8.00	1.30	0.300	0.900	1.40	1.30
19	4.60	51.00	5.50	70.00	7.00	6.00	8.00	0.500	0.200	0.900	1.70	1.40
20	4.00	50.00	3.80	73.00	8.50	6.50	7.00	0.300	0.200	0.900	1.70	1.30
21	2.70	49.00	4.00	76.00	8.50	5.50	6.50	0.300	0.200	0.900	1.40	1.30
22	1.60	45.00	3.50	74.00	7.00	5.50	6.50	0.200	0.200	0.900	1.30	1.30
23	3.80	42.00	3.50	72.00	3.10	4.90	8.50	0.200	0.900	0.900	1.30	1.20
24	8.50	42.00	3.30	69.00	0.500	4.20	6.00	0.200	0.500	0.900	1.30	1.20
25	12.00	41.00	20.00	69.00	1.80	3.80	5.50	0.400	1.30	0.900	1.30	1.10
26	7.50	37.00	11.00	70.00	3.10	3.80	5.50	0.700	1.60	0.900	1.60	1.30
27	5.50	23.00	6.50	70.00	2.90	3.50	6.00	0.700	1.30	1.00	1.40	1.40
28	3.30	23.00	4.90	67.00	4.20	3.50	6.50	0.600	1.60	1.00	1.40	1.30
29	4.90		3.80	67.00	8.50	4.00	5.50	0.500	1.70	0.900	1.30	1.60
30	30.00		3.50	65.00	9.50	4.60	6.00	0.500	1.40	0.900	1.40	2.00
31	22.00		3.30		9.50		6.50	0.500		1.60		2.40
Mean	6.39	32.95	9.63	53.87	8.92	4.55	5.84	2.64	1.75	1.66	1.74	1.42
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	1.60	9.50	2.70	1.40	0.500	1.00	4.00	0.200	0.200	0.800	1.30	1.10
Max	30.00	53.00	35.00	78.00	36.00	8.00	8.50	6.50	10.00	23.00	4.20	2.40
AF	393.1	1830	591.9	3206	548.6	270.9	358.8	162.3	103.9	102.3	103.3	87.27

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1924

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.90	1.10	1.30	4.20	2.20	1.80	1.60	0.700	1.00	0.900	1.00	0.900
2	2.00	1.10	1.80	19.00	2.40	1.80	1.80	0.700	1.10	0.900	0.900	0.900
3	1.90	1.10	1.70	7.50	2.00	1.70	1.30	0.700	1.00	0.900	0.800	0.900
4	1.90	1.10	1.60	4.90	2.00	1.70	1.20	0.700	1.20	1.00	0.800	0.900
5	1.80	1.30	1.30	18.00	2.00	1.60	1.20	0.700	1.30	1.00	0.800	0.800
6	1.80	1.30	1.20	28.00	2.00	1.70	1.20	0.700	1.20	1.00	0.800	1.20
7	1.60	1.30	1.20	66.00	2.00	1.80	1.20	0.700	1.00	1.10	0.800	0.900
8	1.60	1.20	1.20	32.00	2.00	1.80	1.20	0.700	1.00	1.00	0.800	6.00
9	1.60	1.10	1.20	25.00	2.00	1.80	1.10	0.700	1.00	1.10	1.00	9.00
10	1.40	1.10	1.20	28.00	2.00	1.70	1.10	0.700	0.900	1.20	10.00	3.30
11	1.30	1.10	1.20	30.00	2.00	1.70	1.10	1.10	0.900	1.30	3.30	2.20
12	1.30	1.10	1.20	29.00	2.00	1.60	1.10	1.10	0.900	1.20	3.10	2.20
13	1.30	1.10	1.20	29.00	2.00	1.60	1.00	1.00	0.900	1.10	1.80	2.40
14	1.30	1.10	1.20	30.00	2.00	1.60	0.900	1.10	0.900	1.00	1.70	2.40
15	1.30	1.10	1.20	27.00	2.00	1.60	1.00	1.10	0.900	0.900	1.40	2.40
16	1.30	1.10	1.30	12.00	2.00	1.50	1.00	1.60	0.900	1.00	1.40	3.30
17	1.30	1.00	1.50	6.00	2.00	1.50	1.00	1.30	0.900	1.00	1.30	2.90
18	1.30	1.00	1.50	2.00	1.90	1.50	1.10	1.10	1.00	1.10	1.20	2.40
19	1.30	1.00	1.20	2.40	1.90	1.30	1.10	1.20	1.10	1.00	1.20	2.00
20	1.30	1.00	1.20	3.10	1.90	1.20	1.00	1.30	1.20	1.00	1.10	2.20
21	1.20	1.10	1.50	3.10	1.90	1.10	1.00	1.30	1.00	0.900	1.00	1.90
22	1.10	1.10	1.70	2.40	1.90	1.10	0.900	1.30	0.900	0.900	1.10	1.90
23	1.10	1.10	1.80	6.00	1.90	1.10	0.800	1.00	0.900	0.900	1.00	5.50
24	1.00	1.10	8.00	8.00	1.90	1.20	0.700	0.800	0.900	0.900	1.00	1.90
25	1.00	1.10	3.10	3.10	1.90	1.20	0.700	0.700	0.900	0.900	1.00	1.40
26	0.900	1.10	33.00	2.40	1.80	1.20	0.700	0.600	0.900	0.900	0.900	1.40
27	0.900	1.10	94.00	2.00	1.80	1.30	0.700	0.600	0.900	0.900	0.900	1.30
28	1.10	1.10	85.00	2.00	1.70	1.30	0.700	0.500	1.00	0.900	0.900	1.20
29	1.10	1.20	64.00	2.00	1.60	1.30	0.700	0.500	1.00	1.90	0.900	1.20
30	1.10		36.00	2.20	1.70	1.50	0.700	0.700	1.00	1.70	0.900	1.20
31	1.10		6.00		1.80		0.700	0.900		1.30		1.10
Mean	1.39	1.11	11.63	14.54	1.94	1.49	1.02	0.897	0.990	1.06	1.49	2.23
Cnt	31	29	31	30	31	30	31	31	30	31	30	31
Min	0.900	1.00	1.20	2.00	1.60	1.10	0.700	0.500	0.900	0.900	0.800	0.800
Max	2.90	1.30	94.00	66.00	2.40	1.80	1.80	1.60	1.30	1.90	10.00	9.00
AF	85.49	64.07	715.1	865.4	119.4	88.86	62.48	55.14	58.91	65.06	88.86	137.3

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1925

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.20	1.00	1.20	6.50	2.00	1.60	1.60	1.90	0.700	0.700	0.700	0.900
2	1.20	1.00	1.20	3.80	2.90	1.60	1.30	1.90	0.700	0.700	0.700	0.900
3	1.20	1.00	1.20	3.10	2.00	1.70	1.30	1.80	0.700	0.700	0.800	0.900
4	1.20	0.900	1.10	16.00	2.00	3.10	1.30	1.60	0.700	7.50	1.40	0.900
5	1.30	1.00	1.00	20.00	2.40	1.60	1.20	1.40	0.700	23.00	0.900	0.900
6	1.20	1.10	1.00	15.00	1.80	1.30	1.20	1.30	0.700	5.50	0.800	0.900
7	1.20	1.30	8.50	9.50	1.70	0.900	1.10	1.30	0.700	1.70	0.800	0.900
8	1.20	1.20	2.90	6.50	1.70	0.900	1.10	1.40	0.700	1.40	0.800	0.800
9	1.20	1.10	2.20	3.80	1.70	0.800	1.00	1.30	0.700	1.10	0.800	0.800
10	1.20	1.00	1.80	2.70	1.70	0.800	0.900	1.20	0.700	1.00	0.800	0.700
11	1.20	1.00	1.80	2.00	1.60	0.900	0.900	1.10	0.600	1.10	0.800	0.700
12	1.20	1.10	1.70	1.80	1.40	0.700	1.00	1.00	0.700	1.00	0.800	0.700
13	1.20	1.20	1.70	1.80	1.70	0.800	0.900	0.900	0.800	0.900	0.700	0.700
14	1.20	1.20	1.60	1.60	1.70	1.10	0.900	0.900	0.700	0.900	0.700	0.700
15	1.10	1.20	1.60	1.40	1.60	1.20	0.900	0.900	0.700	0.900	0.700	0.800
16	1.10	1.20	1.60	1.40	1.40	1.10	0.900	0.900	0.700	0.800	0.700	0.800
17	1.10	1.10	1.40	1.60	1.40	1.20	30.00	0.900	0.700	0.800	0.700	0.800
18	1.10	1.10	1.40	1.70	1.30	1.10	57.00	0.800	0.800	0.800	0.700	0.900
19	1.10	1.20	1.30	1.70	1.60	0.900	61.00	0.800	0.800	0.700	0.700	1.20
20	1.10	1.20	1.30	1.80	1.90	0.900	61.00	0.800	0.800	0.700	0.700	1.10
21	1.10	5.50	1.30	2.00	1.60	0.900	61.00	0.900	0.700	0.700	0.700	0.900
22	1.10	1.30	1.30	2.40	1.40	0.800	64.00	1.10	0.700	0.700	0.700	0.800
23	1.10	1.30	1.30	6.50	1.60	0.800	61.00	1.00	0.600	0.700	0.700	0.800
24	1.10	1.30	1.30	2.90	1.40	0.800	58.00	0.900	0.600	0.700	0.900	0.800
25	1.10	1.30	1.20	2.00	1.60	0.800	50.00	0.800	0.600	0.700	0.900	0.700
26	1.00	1.30	1.30	1.80	1.40	0.900	28.00	0.800	0.600	0.700	0.900	0.600
27	1.00	1.30	1.80	1.80	1.30	1.20	5.00	0.900	0.600	0.700	0.900	0.600
28	1.00	1.30	1.60	1.90	1.20	12.00	4.00	0.800	0.600	0.700	0.900	0.600
29	1.00		3.10	1.90	1.20	5.50	2.90	0.800	0.600	0.700	0.900	0.700
30	0.900		4.00	1.90	1.30	3.80	2.20	0.700	0.600	0.700	0.900	0.700
31	1.00		6.50		1.60		2.00	0.700		0.700		0.700
Mean	1.13	1.31	2.01	4.29	1.65	1.72	18.21	1.08	0.683	1.92	0.803	0.803
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0.900	0.900	1.00	1.40	1.20	0.700	0.900	0.700	0.600	0.700	0.700	0.600
Max	1.30	5.50	8.50	20.00	2.90	12.00	64.00	1.90	0.800	23.00	1.40	1.20
AF	69.22	72.79	123.4	255.5	101.4	102.5	1120	66.45	40.66	118.2	47.80	49.39

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1926

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.700	2.20	2.70	36.00	96.00	2.20	1.80	1.20	1.30	1.10	0.900	5.50
2	0.800	1.20	2.20	36.00	96.00	2.00	1.80	1.20	1.30	1.10	1.00	4.90
3	0.800	4.00	1.90	36.00	95.00	1.90	1.90	1.20	1.30	1.10	1.00	4.90
4	0.800	1.80	1.80	36.00	94.00	1.90	1.90	1.20	1.20	1.10	1.10	5.50
5	0.800	1.70	1.80	646.0	97.00	1.90	1.80	1.30	1.10	1.00	1.00	5.50
6	0.800	1.50	2.00	1130	92.00	2.00	1.60	1.30	1.20	1.00	1.10	14.00
7	0.800	1.50	5.50	472.0	82.00	2.00	1.60	1.30	1.20	1.00	1.20	11.00
8	0.800	1.50	6.00	476.0	74.00	1.90	1.70	1.30	1.20	1.10	1.30	18.00
9	0.800	1.50	4.60	391.0	70.00	1.80	1.80	1.30	1.30	1.10	1.30	11.00
10	0.800	1.50	4.90	224.0	24.00	1.80	1.80	1.20	1.40	1.10	1.40	8.50
11	0.800	1.50	4.90	218.0	15.00	1.70	1.70	1.30	1.40	1.10	1.40	8.50
12	0.800	26.00	4.90	200.0	14.00	1.70	1.60	1.20	1.30	1.10	1.70	8.00
13	0.700	76.00	4.20	165.0	13.00	1.80	1.40	1.20	1.30	1.10	1.90	8.00
14	0.700	30.00	4.20	151.0	12.00	1.70	1.40	1.20	1.30	1.00	2.00	7.50
15	0.700	14.00	4.00	148.0	12.00	1.80	1.40	1.30	1.30	1.00	10.00	6.50
16	0.700	12.00	4.00	141.0	12.00	1.80	1.30	1.40	1.30	1.00	3.30	6.00
17	0.700	9.50	4.20	108.0	10.00	1.70	1.30	1.40	1.30	1.00	2.20	4.20
18	0.800	7.00	4.20	134.0	10.00	1.70	1.30	1.40	1.30	1.10	1.90	2.90
19	0.700	5.50	4.60	139.0	9.00	1.60	1.30	1.50	1.30	1.10	1.80	4.60
20	0.800	4.00	5.50	120.0	8.50	1.60	1.30	1.50	1.30	1.10	1.80	4.00
21	0.800	3.30	5.50	112.0	8.00	1.60	1.30	1.60	1.30	1.20	1.70	4.00
22	0.800	2.40	5.50	108.0	8.00	1.40	1.30	1.60	1.20	1.10	1.70	5.50
23	0.800	3.30	21.00	102.0	7.00	1.40	1.30	1.40	1.20	1.10	1.80	4.00
24	0.800	3.30	27.00	90.00	6.50	1.60	1.30	1.40	1.20	1.10	2.00	3.80
25	0.800	3.50	28.00	95.00	6.00	1.60	1.20	1.40	1.20	1.00	3.10	3.50
26	0.800	3.50	31.00	90.00	4.00	1.60	1.20	1.30	1.20	1.00	2.40	3.30
27	0.800	3.50	30.00	84.00	3.30	1.70	1.20	1.30	1.20	1.00	28.00	2.70
28	0.800	2.90	33.00	90.00	2.90	1.70	1.30	1.20	1.20	0.900	9.00	2.20
29	0.900		36.00	95.00	2.90	1.70	1.20	1.20	1.20	0.900	7.00	2.20
30	0.900		36.00	97.00	2.90	1.80	1.20	1.20	1.20	1.10	6.00	2.20
31	2.00		36.00		2.70		1.20	1.20		0.900		2.00
Mean	0.823	8.20	11.84	199.0	31.93	1.75	1.46	1.31	1.26	1.05	3.40	5.95
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0.700	1.20	1.80	36.00	2.70	1.40	1.20	1.20	1.10	0.900	0.900	2.00
Max	2.00	76.00	36.00	1130	97.00	2.20	1.90	1.60	1.40	1.20	28.00	18.00
AF	50.58	455.4	728.1	11841	1963	104.3	90.05	80.73	74.78	64.66	202.3	365.8

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1927

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.00	770.0	75.00	25.00	27.00	6.00	3.50	3.50	2.60	2.60	2.90	1.70
2	2.20	770.0	75.00	25.00	30.00	6.00	3.50	3.50	2.60	2.50	2.80	1.70
3	2.20	770.0	75.00	25.00	31.00	6.00	3.50	3.50	2.60	2.50	2.70	1.80
4	2.20	770.0	75.00	25.00	36.00	6.50	3.50	3.50	2.60	2.40	2.60	1.80
5	2.40	770.0	75.00	25.00	37.00	7.50	3.50	3.50	2.60	2.40	2.50	1.80
6	2.70	770.0	75.00	25.00	36.00	7.00	3.50	3.50	2.60	2.30	2.40	1.80
7	2.70	770.0	75.00	25.00	42.00	6.00	3.50	3.50	2.60	2.30	2.40	1.80
8	2.90	770.0	75.00	25.00	45.00	6.00	3.50	3.50	2.60	2.20	2.30	1.80
9	2.90	770.0	75.00	25.00	42.00	5.50	3.60	3.50	2.70	2.20	2.20	1.80
10	2.90	770.0	75.00	25.00	30.00	5.00	3.60	3.50	2.70	2.10	2.20	3.00
11	2.90	770.0	75.00	25.00	19.00	4.90	3.70	3.50	2.70	2.00	2.10	5.00
12	2.90	770.0	75.00	25.00	20.00	4.80	3.80	3.40	2.70	2.00	2.10	3.50
13	2.90	770.0	75.00	25.00	21.00	4.40	3.80	3.30	2.70	2.00	2.00	3.20
14	2.90	770.0	75.00	25.00	22.00	4.00	3.80	3.10	2.70	2.00	2.00	3.00
15	2.90	770.0	75.00	25.00	24.00	3.90	3.60	3.00	2.70	2.00	2.00	2.80
16	3.10	770.0	75.00	25.00	25.00	3.90	3.60	3.00	2.60	2.00	2.00	2.60
17	3.10	770.0	75.00	25.00	26.00	3.90	3.60	3.00	2.60	2.10	2.00	2.60
18	3.10	770.0	75.00	25.00	27.00	3.80	3.60	3.10	2.60	2.00	1.90	2.50
19	3.30	770.0	75.00	25.00	28.00	3.80	3.60	3.10	2.60	1.90	1.90	2.50
20	3.50	770.0	75.00	25.00	30.00	3.80	3.60	3.50	2.60	1.80	1.90	2.50
21	4.20	770.0	75.00	25.00	26.00	3.80	3.50	3.00	2.60	1.80	1.90	2.80
22	4.20	770.0	75.00	25.00	10.00	3.70	3.30	3.00	2.60	1.80	1.90	2.80
23	4.20	770.0	75.00	25.00	8.00	3.60	3.20	3.00	2.60	1.80	1.90	2.80
24	4.20	770.0	75.00	25.00	7.00	3.50	3.20	2.90	2.60	1.80	1.90	2.60
25	4.00	770.0	75.00	25.00	6.50	3.50	5.00	2.80	2.60	2.00	1.90	2.60
26	3.80	770.0	75.00	25.00	6.00	3.50	3.60	2.80	2.60	2.30	1.80	2.60
27	3.50	770.0	75.00	25.00	6.00	3.50	3.60	2.80	2.60	2.50	1.80	2.40
28	3.30	770.0	75.00	25.00	6.00	3.50	3.50	2.80	2.60	2.50	1.80	2.40
29	3.30		75.00	25.00	6.00	3.50	3.50	2.80	2.60	2.30	1.80	2.60
30	3.30		75.00	25.00	6.00	3.50	3.50	2.70	2.60	2.20	1.70	3.20
31	3.30		75.00		6.00		3.50	2.70		3.00		3.10
Mean	3.13	770.0	75.00	25.00	22.31	4.61	3.59	3.17	2.62	2.17	2.11	2.55
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	2.00	770.0	75.00	25.00	6.00	3.50	3.20	2.70	2.60	1.80	1.70	1.70
Max	4.20	770.0	75.00	25.00	45.00	7.50	5.00	3.50	2.70	3.00	2.90	5.00
AF	192.4	42764	4612	1488	1372	274.3	220.8	195.0	156.1	133.5	125.6	156.9

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1928

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	3.10	2.00	2.20	1.80	2.00	1.50	1.70	3.40	1.10	1.00	1.10	1.30
2	2.90	2.00	2.50	1.80	2.00	1.40	1.70	1.90	1.10	1.00	1.10	1.30
3	2.80	2.10	2.60	2.00	2.00	1.40	1.70	1.80	1.00	1.00	1.20	3.00
4	2.60	98.00	3.70	2.10	2.00	1.40	1.70	1.50	1.00	1.00	1.20	3.40
5	2.50	50.00	2.60	2.10	1.90	1.30	1.70	1.40	1.00	1.00	1.10	1.40
6	2.50	20.00	5.50	2.20	1.90	1.40	1.60	1.20	1.00	1.00	1.00	1.60
7	2.50	9.50	2.80	2.20	1.90	1.50	1.70	1.20	1.00	1.00	1.10	1.60
8	2.50	5.00	2.40	2.20	2.00	1.60	1.60	1.00	1.00	1.00	1.10	1.60
9	2.40	4.10	2.40	2.20	4.10	1.70	1.70	1.00	1.00	1.00	1.10	1.50
10	2.40	3.20	2.40	2.20	2.90	1.70	1.60	1.00	1.20	1.00	1.10	2.30
11	2.40	3.10	2.40	2.30	2.10	1.80	1.60	1.00	1.20	1.10	1.10	18.00
12	2.40	3.10	2.30	2.30	1.90	1.80	1.60	1.30	1.20	1.20	1.20	5.50
13	2.40	2.60	2.30	2.30	1.80	1.80	1.60	1.50	1.20	1.20	1.40	35.00
14	2.50	14.00	2.30	2.30	1.80	1.80	1.60	1.40	1.00	1.10	1.70	6.50
15	3.10	15.00	2.30	2.40	1.80	1.70	1.70	1.40	1.00	1.00	2.00	6.50
16	2.90	1.80	2.20	2.20	1.70	1.70	1.70	1.50	1.00	1.00	1.80	6.00
17	2.60	1.60	2.20	2.30	1.70	1.70	1.70	1.50	1.00	1.00	1.60	6.00
18	2.50	1.50	2.40	2.20	1.70	1.70	1.80	1.40	1.00	1.00	1.60	6.00
19	2.50	1.50	2.40	2.30	1.60	1.70	1.80	1.30	1.00	1.00	1.60	6.00
20	2.40	1.50	2.20	2.30	1.60	1.80	1.80	1.30	1.00	1.00	1.50	5.50
21	2.20	1.60	2.10	2.30	1.70	1.80	1.80	1.40	0.900	1.00	1.50	4.50
22	2.20	1.60	2.10	2.30	1.70	1.80	1.80	1.50	1.00	1.00	1.50	3.10
23	2.20	1.60	2.10	2.30	1.50	1.80	1.70	1.80	1.00	1.00	1.50	1.80
24	2.20	1.60	2.10	2.20	1.50	1.80	1.70	1.80	1.00	1.00	1.50	1.80
25	2.30	1.70	2.10	2.20	1.50	1.70	1.70	1.60	1.00	1.00	1.50	1.80
26	2.20	1.80	2.00	2.00	1.50	1.70	1.80	1.50	1.00	1.00	1.40	1.70
27	2.20	1.90	2.00	2.00	1.50	1.70	1.90	1.40	0.900	1.00	1.40	1.70
28	2.10	2.00	1.90	2.00	1.60	1.70	2.00	1.30	0.900	1.10	1.40	1.70
29	2.10	2.10	1.80	2.00	1.60	1.70	2.10	1.20	0.900	1.10	1.40	1.60
30	2.00		1.90	2.00	1.50	1.70	2.10	1.20	0.900	1.10	1.40	1.60
31	2.00		1.80		1.50		3.40	1.20		1.10		1.60
Mean	2.44	8.88	2.39	2.17	1.85	1.66	1.79	1.45	1.02	1.03	1.37	4.61
Cnt	31	29	31	30	31	30	31	31	30	31	30	31
Min	2.00	1.50	1.80	1.80	1.50	1.30	1.60	1.00	0.900	1.00	1.00	1.30
Max	3.10	98.00	5.50	2.40	4.10	1.80	3.40	3.40	1.20	1.20	2.00	35.00
AF	150.0	510.8	146.8	128.9	114.1	98.78	110.3	89.06	60.50	63.47	81.52	283.4

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1929

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.50	3.30	1.60	1.50	7.50	2.00	1.50	1.70	1.50	0.900	0.500	0.600
2	1.50	76.00	1.50	1.50	7.50	1.90	1.50	1.70	1.80	0.800	0.500	0.600
3	1.50	22.00	1.40	1.50	7.50	1.80	1.50	1.60	1.60	0.800	0.500	0.600
4	1.50	8.50	1.30	97.00	4.90	1.90	1.50	1.40	1.60	0.800	0.500	0.600
5	1.40	2.30	1.20	194.0	3.90	2.00	1.60	0.800	1.60	0.800	0.500	0.600
6	1.40	5.50	1.20	114.0	2.70	1.80	1.60	2.20	1.60	0.800	0.500	0.600
7	1.50	9.50	1.30	97.00	2.60	1.80	1.60	2.10	1.60	0.800	0.600	0.600
8	1.50	1.30	1.30	44.00	2.80	1.80	1.60	2.00	1.40	0.800	0.500	0.600
9	1.40	1.30	1.30	24.00	2.60	1.80	1.60	2.00	1.20	0.900	0.500	0.600
10	1.50	1.30	62.00	22.00	2.60	1.70	1.60	2.00	1.20	0.900	0.500	0.600
11	1.50	1.30	50.00	19.00	2.50	1.60	1.60	1.90	1.20	0.900	0.500	0.600
12	1.60	1.20	29.00	16.00	2.50	1.50	1.60	1.80	1.20	0.900	0.800	0.600
13	1.50	1.20	17.00	15.00	2.20	1.50	1.60	1.80	1.20	0.900	0.800	0.600
14	1.40	1.20	16.00	15.00	2.20	1.40	1.60	1.70	1.10	1.00	0.800	0.500
15	1.50	1.20	14.00	13.00	2.10	1.50	1.60	1.60	1.10	1.00	0.700	0.500
16	1.50	1.20	12.00	12.00	2.20	1.50	1.70	1.50	1.00	1.00	0.700	0.500
17	1.50	1.20	40.00	12.00	2.10	1.50	1.80	1.50	1.50	0.900	0.600	0.500
18	1.50	5.00	30.00	12.00	2.00	1.40	1.80	1.40	7.00	0.900	0.600	0.500
19	1.50	2.10	8.50	13.00	2.00	1.40	1.80	1.40	5.50	0.800	0.600	0.600
20	26.00	2.00	7.00	10.00	2.00	1.40	1.80	1.20	4.30	0.800	0.600	0.600
21	26.00	1.90	2.30	9.50	2.00	1.40	1.70	1.30	3.20	0.800	0.500	0.600
22	23.00	1.80	2.70	9.00	2.00	1.40	1.70	1.30	2.60	0.700	0.600	0.600
23	16.00	1.80	2.70	8.50	1.90	1.50	1.70	1.30	2.00	0.700	0.600	0.600
24	1.20	1.70	2.60	8.00	1.70	1.50	1.80	1.30	1.70	0.700	0.600	0.600
25	0.900	1.50	2.60	7.50	1.60	1.40	1.80	1.30	1.50	0.600	0.600	0.600
26	0.900	1.50	2.50	8.00	1.80	1.50	2.00	1.30	1.30	0.600	0.600	0.600
27	0.900	1.50	2.20	9.00	1.70	1.50	2.00	1.30	1.20	0.600	0.600	0.500
28	1.00	1.60	2.00	9.50	1.70	1.50	2.00	1.30	1.20	0.600	0.600	0.500
29	1.90		1.90	9.00	1.80	1.50	2.00	1.20	1.10	0.500	0.600	0.600
30	1.80		1.90	8.50	2.00	1.50	1.90	1.10	1.00	0.500	0.600	0.600
31	1.80		1.70		2.00		1.80	1.20		0.500		0.500
Mean	4.18	5.78	10.41	27.33	2.79	1.60	1.71	1.52	1.90	0.781	0.590	0.574
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0.900	1.20	1.20	1.50	1.60	1.40	1.50	0.800	1.00	0.500	0.500	0.500
Max	26.00	76.00	62.00	194.0	7.50	2.00	2.00	2.20	7.00	1.00	0.800	0.600
AF	257.1	321.1	640.1	1626	171.8	95.01	104.9	93.62	113.1	48.00	35.11	35.31

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1930

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.500	4.00	8.00	18.00	31.00	3.00	0.600	0.400	0.300	0.300	0.400	7.50
2	0.500	3.50	7.00	15.00	18.00	2.70	0.600	0.300	0.300	0.300	0.400	6.50
3	0.600	3.00	6.00	14.00	115.0	2.30	0.600	0.300	0.300	0.200	0.400	6.00
4	0.600	2.40	6.00	12.00	167.0	2.10	0.600	0.300	0.300	0.200	0.400	5.50
5	0.600	2.80	62.00	10.00	139.0	1.90	0.600	0.200	0.300	0.200	0.400	4.70
6	0.800	2.00	32.00	8.00	80.00	1.90	0.700	0.200	0.300	0.200	0.400	3.50
7	2.10	1.70	15.00	5.00	58.00	1.90	0.600	0.300	0.300	0.200	0.400	3.00
8	1.90	1.90	13.00	3.20	42.00	2.00	0.600	0.300	0.300	0.300	0.400	2.50
9	1.90	1.90	12.00	2.80	44.00	2.00	0.600	0.300	0.300	3.40	0.400	2.00
10	4.70	2.00	11.00	2.60	33.00	2.00	0.600	0.300	0.300	8.00	0.400	1.50
11	8.00	1.90	9.00	2.30	25.00	2.00	0.600	0.400	0.300	2.00	0.400	1.10
12	7.50	1.80	8.50	2.10	26.00	2.10	0.500	0.300	0.200	1.00	0.400	1.20
13	6.50	1.70	6.00	2.00	19.00	2.10	0.500	0.300	0.200	0.800	7.00	1.80
14	7.50	1.80	15.00	1.90	15.00	2.10	0.600	0.400	0.200	0.800	8.50	2.50
15	19.00	1.70	108.0	1.90	21.00	2.00	0.500	0.400	0.200	0.700	5.00	3.10
16	16.00	1.60	82.00	1.90	21.00	1.90	0.500	0.400	0.200	0.600	3.80	3.60
17	11.00	1.60	71.00	1.80	19.00	1.90	0.500	0.400	0.200	0.600	29.00	3.80
18	17.00	1.50	46.00	1.80	16.00	1.90	0.500	0.400	0.200	0.500	14.00	1.80
19	13.00	1.70	35.00	1.80	15.00	2.00	0.500	0.400	0.200	0.500	6.00	1.20
20	13.00	2.00	33.00	1.80	15.00	2.10	0.500	0.300	0.200	0.500	4.70	1.20
21	10.00	2.70	31.00	1.90	11.00	2.00	0.500	0.300	0.200	0.500	3.10	1.50
22	8.50	3.40	24.00	1.90	8.50	1.60	0.500	0.300	0.300	0.400	3.10	1.20
23	5.50	20.00	20.00	2.00	7.00	1.30	0.500	0.300	0.300	0.400	3.30	0.700
24	2.70	9.00	15.00	2.00	5.50	1.10	0.500	0.300	0.300	0.400	2.50	0.900
25	2.00	7.50	9.50	2.00	4.50	1.00	0.400	0.300	0.300	0.400	2.20	0.800
26	1.70	8.50	7.50	2.00	4.30	1.00	0.400	0.400	0.200	0.400	2.70	0.400
27	6.50	10.00	5.50	2.00	4.50	0.800	0.400	0.400	0.200	0.400	7.00	0.700
28	7.50	9.00	7.50	2.00	4.70	0.800	0.400	0.300	0.200	0.400	26.00	0.700
29	6.00		9.00	2.00	4.30	0.600	0.400	0.300	0.300	0.400	14.00	0.700
30	5.00		11.00	10.00	3.60	0.600	0.400	0.300	0.300	0.400	12.00	0.800
31	4.50		18.00		3.10		0.400	0.300		0.400		0.900
Mean	6.21	4.02	23.98	4.59	31.61	1.76	0.519	0.326	0.257	0.832	5.29	2.36
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0.500	1.50	5.50	1.80	3.10	0.600	0.400	0.200	0.200	0.200	0.400	0.400
Max	19.00	20.00	108.0	18.00	167.0	3.00	0.700	0.400	0.300	8.00	29.00	7.50
AF	382.0	223.3	1475	273.1	1944	104.5	31.93	20.03	15.27	51.17	314.8	145.4

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1931

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.900	5.50	5.50	1.40	8.50	1.00	0.100	0.100	3.00	0.200	0.400	5.00
2	5.50	5.00	4.40	1.30	5.50	0.900	0.100	0.100	10.00	0.200	0.300	5.00
3	6.50	5.50	3.60	1.20	4.80	0.700	0.100	0.100	3.00	0.200	0.200	4.00
4	3.10	74.00	3.40	1.80	4.00	0.600	0.200	0.100	2.50	0.200	0.200	4.00
5	1.80	72.00	3.30	1.30	2.20	0.600	0.100	0.100	2.00	0.100	0.100	4.00
6	1.70	50.00	3.30	1.30	11.00	0.600	0.200	0.100	1.80	0.100	0.100	3.00
7	2.70	36.00	3.30	0.900	29.00	0.500	0.200	0.100	1.50	0.100	0.100	3.00
8	5.50	34.00	2.90	0.800	8.50	0.500	0.100	0.100	1.40	0.100	0.100	3.00
9	3.30	26.00	2.70	1.30	4.00	0.500	0.100	0.100	1.30	0.100	0.100	94.00
10	3.30	18.00	2.20	1.30	4.00	0.500	0.100	0.100	1.20	0.100	0.100	50.00
11	2.40	13.00	2.20	1.00	2.70	0.400	0.100	0.100	1.00	0.100	0.100	20.00
12	2.00	14.00	2.00	0.800	2.70	0.400	0.200	0.300	0.900	0.100	0.500	10.00
13	1.80	12.00	1.90	0.700	2.20	0.300	0.200	2.80	0.600	0.100	1.00	9.00
14	1.80	9.50	2.00	0.700	1.30	0.300	0.200	1.00	0.500	0.100	5.00	8.00
15	1.80	22.00	1.90	0.700	1.30	0.400	0.200	0.800	0.300	0.100	10.00	8.00
16	1.20	22.00	1.80	0.600	0.600	0.400	0.200	0.600	0.100	0.100	4.90	7.00
17	1.20	21.00	1.60	0.600	0.400	0.400	0.200	0.500	0.100	0.100	2.50	7.00
18	1.50	18.00	1.60	0.700	0.400	0.300	0.200	0.400	0.100	30.00	2.00	6.50
19	1.50	14.00	1.60	0.600	0.300	0.300	0.100	0.300	0.100	5.00	2.00	6.50
20	1.00	12.00	1.60	0.600	0.500	0.200	0.100	0.300	0.100	2.00	1.00	6.50
21	1.00	10.00	1.50	0.500	0.700	0.200	0.100	0.200	0.100	1.00	10.00	6.50
22	1.10	9.00	1.50	0.700	0.400	0.200	0.100	0.100	0.100	1.00	2.50	6.50
23	1.10	8.00	1.60	1.00	0.500	0.200	0.100	0.100	0.100	0.800	1.80	6.50
24	1.10	7.00	1.60	6.80	0.400	0.200	0.100	0.100	0.100	0.800	1.00	6.00
25	1.00	7.00	4.00	2.80	5.00	0.200	0.100	0.100	0.100	0.700	1.00	6.00
26	1.10	6.00	3.00	24.00	2.20	0.200	0.100	0.100	0.100	0.600	1.00	7.00
27	1.10	7.50	2.20	56.00	2.70	0.100	0.100	0.100	0.100	0.600	15.00	7.00
28	1.10	7.00	2.00	38.00	2.80	0.100	0.100	0.200	0.100	0.500	6.00	300.0
29	1.00		1.80	16.00	1.70	0.100	0.100	35.00	0.100	0.500	6.00	200.0
30	1.00		1.60	11.00	1.30	0.100	0.100	8.00	0.100	0.500	5.00	80.00
31	4.70		1.50		1.20		0.100	5.00		0.500		42.00
Mean	2.12	19.46	2.42	5.88	3.64	0.380	0.132	1.84	1.08	1.50	2.67	30.03
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0.900	5.00	1.50	0.500	0.300	0.100	0.100	0.100	0.100	0.100	0.100	3.00
Max	6.50	74.00	5.50	56.00	29.00	1.00	0.200	35.00	10.00	30.00	15.00	300.0
AF	130.5	1081	149.0	349.9	223.7	22.61	8.13	113.3	64.46	92.43	158.7	1847

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1932

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	30.00	122.0	75.00	57.00	24.00	17.00	5.50	1.00	0.500	0.200	0.100	0
2	25.00	89.00	60.00	62.00	31.00	17.00	6.00	1.00	0.400	0.200	0.100	0
3	20.00	50.00	59.00	60.00	37.00	22.00	6.00	1.00	0.400	0.200	0.100	0
4	18.00	42.00	52.00	60.00	31.00	24.00	7.00	1.00	0.400	0.200	0.100	0
5	15.00	36.00	45.00	60.00	28.00	22.00	5.50	1.00	0.400	0.100	0.100	0
6	13.00	40.00	44.00	54.00	25.00	16.00	4.40	1.00	0.300	0.100	0.100	0
7	12.00	50.00	39.00	48.00	26.00	14.00	4.20	1.00	0.300	0.100	0.100	0
8	12.00	700.0	38.00	44.00	25.00	12.00	6.00	1.00	0.300	0.200	0.100	0
9	12.00	1740	36.00	44.00	23.00	10.00	5.50	1.00	0.400	0.200	0.100	0
10	12.00	1040	36.00	43.00	24.00	10.00	4.00	1.00	0.400	0.200	0.100	0
11	12.00	372.0	34.00	44.00	28.00	8.50	3.60	1.00	0.400	0.200	0.100	0
12	12.00	240.0	34.00	43.00	31.00	8.50	3.60	0.900	0.400	0.200	0.100	0.200
13	12.00	195.0	33.00	48.00	34.00	8.50	3.60	0.900	0.400	0.200	0.100	0
14	13.00	140.0	34.00	48.00	40.00	8.50	3.60	0.800	0.300	0.200	0.100	0
15	13.00	111.0	36.00	51.00	46.00	10.00	3.50	0.800	0.300	0.100	0.100	0
16	13.00	108.0	34.00	55.00	44.00	12.00	3.50	0.800	0.300	0.100	0.100	0
17	13.00	98.00	32.00	51.00	46.00	11.00	3.50	0.700	0.300	0.100	0.100	0
18	13.00	90.00	33.00	51.00	45.00	10.00	2.50	0.600	0.300	0.100	0.100	0
19	13.00	81.00	94.00	52.00	43.00	9.00	1.50	0.600	0.300	0.100	0.100	0
20	12.00	78.00	130.0	56.00	38.00	7.50	1.50	0.600	0.300	0.100	0.100	0
21	12.00	74.00	72.00	51.00	36.00	7.50	1.50	0.500	0.300	0.100	0	0
22	11.00	73.00	54.00	40.00	34.00	7.00	1.50	0.500	0.300	0.100	0	0
23	11.00	68.00	43.00	34.00	28.00	7.00	1.50	0.400	0.300	0.100	0	0
24	11.00	64.00	42.00	31.00	25.00	7.00	1.50	0.400	0.300	0.100	0	0
25	11.00	60.00	51.00	29.00	23.00	7.00	1.50	0.400	0.300	0.100	0	0
26	11.00	61.00	59.00	36.00	22.00	7.50	1.40	0.400	0.200	0.100	0	0
27	11.00	68.00	54.00	37.00	22.00	7.50	1.40	0.400	0.200	0.100	0	0
28	11.00	70.00	60.00	30.00	24.00	7.00	1.40	0.500	0.200	0.100	0	0
29	11.00	71.00	124.0	23.00	24.00	7.00	1.30	0.500	0.200	0.100	0	0
30	11.00		101.0	22.00	22.00	5.50	1.20	0.500	0.200	0.100	0	0.100
31	11.00		59.00		21.00		1.20	0.600		0.100		0.100
Mean	13.45	208.0	54.74	45.47	30.65	10.92	3.22	0.735	0.320	0.135	0.067	0.013
Cnt	31	29	31	30	31	30	31	31	30	31	30	31
Min	11.00	36.00	32.00	22.00	21.00	5.50	1.20	0.400	0.200	0.100	0	0
Max	30.00	1740	130.0	62.00	46.00	24.00	7.00	1.00	0.500	0.200	0.100	0.200
AF	827.1	11962	3366	2705	1884	649.6	198.2	45.22	19.04	8.33	3.97	0.793

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1933

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.100	12.00	2.70	1.00	16.00	1.00	0.400	0.100	0	0	0	0
2	0.200	8.00	2.70	1.00	42.00	1.00	0.400	0.100	0	0	0	0
3	0.300	6.00	2.70	1.00	40.00	1.00	0.400	0.100	0	0	0	0
4	0.600	5.50	2.70	1.10	39.00	1.00	0.300	0.100	0	0	0	0
5	1.00	5.00	2.60	1.10	41.00	1.00	0.300	0.100	0	0	0	0
6	1.20	5.00	2.60	1.10	24.00	0.900	0.300	0.100	0	0	0	0
7	1.40	4.50	2.70	1.10	3.20	0.800	0.300	0.100	0	0	0	0
8	1.60	4.00	2.70	1.10	2.80	0.800	0.200	0.100	0	0	0	0
9	1.60	4.00	2.70	1.00	2.80	0.600	0.200	0.100	0	0	0	0
10	1.60	3.80	2.70	1.00	3.30	0.600	0.200	0.100	0	0	0	0
11	1.60	3.80	2.70	1.00	4.40	0.600	0.200	0.100	0	0	0	0
12	1.60	3.80	2.70	1.00	3.20	0.600	0.200	0.100	0	0	0	0
13	1.60	4.60	2.70	1.00	2.80	0.600	0.200	0.100	0	0	0	62.00
14	1.60	3.80	2.70	1.00	2.60	0.600	0.200	0.100	0	0	0	12.00
15	1.60	3.80	2.70	1.00	2.40	0.500	0.200	0.100	0	0	0	6.00
16	8.00	3.60	2.70	1.00	2.60	0.500	0.200	0.100	0	0	0	11.00
17	18.00	3.60	2.40	1.10	2.60	0.500	0.200	0.100	0	0	0	3.20
18	8.50	3.60	2.00	1.20	2.40	0.500	0.200	0.100	0	0	0	1.90
19	7.00	3.30	1.80	1.20	2.00	0.500	0.100	0.100	0	0	0	0.900
20	16.00	3.20	1.50	1.20	1.60	0.500	0.100	0.100	0	0	0	0.300
21	8.50	3.20	1.50	1.20	1.60	0.500	0.100	0	0	0	0	0.200
22	8.50	2.80	1.40	1.20	3.30	0.400	0.100	0	0	0	0	0.200
23	10.00	2.80	1.40	1.10	1.60	0.500	0.100	0	0	0	0	0.200
24	9.00	3.00	1.30	1.20	1.30	0.500	0.100	0	0	0	0	0.100
25	8.00	2.80	1.20	1.20	1.20	0.400	0.100	0	0	0	0	0
26	7.50	2.80	1.20	1.10	1.10	0.400	0.100	0	0	0	0	0
27	6.50	2.70	1.20	1.20	1.00	0.400	0.100	0	0	0	0	0
28	8.00	2.70	1.10	1.70	1.00	0.400	0.100	0	0	0	0	0
29	22.00		1.10	1.40	1.00	0.400	0.100	0	0	0	0	0
30	33.00		1.00	1.70	1.00	0.400	0.100	0	0	0	0	5.00
31	20.00		1.00		1.00		0.100	0		0		718.0
Mean	6.97	4.20	2.07	1.14	8.25	0.613	0.190	0.065	0	0	0	26.48
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0.100	2.70	1.00	1.00	1.00	0.400	0.100	0	0	0	0	0
Max	33.00	12.00	2.70	1.70	42.00	1.00	0.400	0.100	0	0	0	718.0
AF	428.6	233.5	127.1	67.84	507.4	36.50	11.70	3.97	0	0	0	1628

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1934

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1020	1.20	2.40	0.600	0.100	0.100	0	0	0	0	0	0
2	144.0	1.20	2.10	0.600	0.100	0.100	0	0	0	0	0	0
3	75.00	1.40	2.10	0.400	0.100	0.100	0	0	0	0	0	0
4	31.00	1.40	2.10	0.400	0.100	0.100	0	0	0	0	0	0
5	20.00	1.40	2.10	0.400	0.100	0.500	0	0	0	0	0	0
6	15.00	1.40	2.10	0.400	0.100	0.500	0	0	0	0	0	0
7	8.50	1.40	2.10	0.400	0.100	0.200	0	0	0	0	0	0
8	5.50	1.40	2.10	0.400	0.100	0.100	0	0	0	0	0	0
9	1.90	1.60	2.10	0.400	0.100	0.100	0	0	0	0	0	0
10	1.40	1.60	2.10	0.400	0.100	0.100	0	0	0	0	0	0
11	1.40	1.60	2.10	0.400	0.100	0.100	0	0	0	0	0	0
12	1.40	1.40	1.90	0.400	0.100	0.100	0	0	0	0	0	0.600
13	1.40	1.20	1.90	0.400	0.100	0.100	0	0	0	0	0	24.00
14	1.40	1.10	1.90	0.400	0.100	0.100	0	0	0	0	0	214.0
15	1.20	1.10	1.90	0.400	0.100	0.100	0	0	0	0	0	55.00
16	1.10	1.10	1.90	0.400	0.100	0.100	0	0	0	0	0	1.00
17	1.10	0.900	1.80	0.300	0.100	0.100	0	0	0	0.200	0	0.500
18	1.10	0.900	1.60	0.300	0.100	0.100	0	0	0	107.0	0	0.100
19	1.10	0.900	1.60	0.300	0.100	0.100	0	0	0	7.00	0.900	0
20	1.10	1.80	1.60	0.300	0.100	0	0	0	0	0.600	2.40	0
21	1.10	1.20	1.80	0.300	0.100	0	0	0	0	0	0	0
22	1.10	1.20	1.80	0.300	0.100	0	0	0	0	0	0	0
23	1.10	18.00	1.90	0.200	0.100	0	0	0	0	0	0	0
24	1.20	14.00	2.10	0.200	0.100	0	0	0	0	0	0	0
25	1.20	6.00	1.20	0.200	0.100	0	0	0	0	0	0	0
26	1.10	4.00	0.900	0.200	0.100	0	0	0	0	0	0	0
27	1.10	3.40	0.700	0.200	0.100	0	0	0	0	0	0	0
28	1.20	2.90	0.400	0.200	0.100	0	0	0	0	0	0	0.200
29	1.20		0.400	0.200	0.100	0	0	0	0	0	0	0
30	1.20		0.400	0.100	0.100	0	0	0	0	0	0	0
31	1.20		0.400		0.100		0	0		0		0
Mean	43.46	2.74	1.66	0.337	0.100	0.093	0	0	0	3.70	0.110	9.53
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	1.10	0.900	0.400	0.100	0.100	0	0	0	0	0	0	0
Max	1020	18.00	2.40	0.600	0.100	0.500	0	0	0	107.0	2.40	214.0
AF	2672	152.1	102.2	20.03	6.15	5.55	0	0	0	227.7	6.55	585.9

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1935

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	3.00	3.30	1.90	16.00	1.80	1.00	0.200	0.100	0	0	0
2	0	2.80	9.00	1.70	20.00	1.80	0.900	0.200	0.100	0	0	0
3	0	1.50	11.00	1.70	15.00	1.90	0.800	0.200	0	0	0	0
4	0	9.50	11.00	1.50	11.00	1.90	0.700	0.200	0	0	0	0
5	30.00	53.00	14.00	1.50	8.00	1.90	0.700	0.200	0	0	0	0
6	11.00	145.0	6.00	1.40	4.70	1.90	0.700	0.200	0.100	0	0	0
7	1.90	63.00	14.00	1.40	3.20	1.90	0.700	0.200	0.200	0	0	0
8	0.500	68.00	25.00	190.0	4.20	1.80	0.600	0.200	0.200	0	0	0
9	112.0	50.00	12.00	128.0	3.00	1.70	0.500	0.200	0.200	0	0	0
10	200.0	35.00	6.50	74.00	2.70	1.60	0.400	0.200	0.100	0	0	0
11	74.00	28.00	4.80	56.00	2.70	1.50	0.400	0.200	0.100	0	0	0
12	32.00	21.00	4.30	45.00	2.70	1.40	0.400	0.200	0.100	0	0	0
13	15.00	20.00	3.30	32.00	2.70	1.40	0.500	0.200	0.100	0	0	0
14	11.00	18.00	3.10	25.00	2.50	1.60	0.400	0.100	0.100	0	0	0
15	77.00	14.00	3.10	24.00	2.40	1.80	0.700	0.100	0.100	0	0	0
16	79.00	11.00	2.70	22.00	2.30	1.80	4.40	0.100	0	0	0	0
17	58.00	7.00	2.40	16.00	2.60	1.50	1.00	0.100	0	0	0	0
18	34.00	6.00	2.40	13.00	4.70	1.30	0.500	0.100	0	0	0	0
19	54.00	6.00	2.50	12.00	5.50	1.00	0.400	0.100	0	0	0	0
20	25.00	5.00	2.20	13.00	5.50	0.800	0.300	0.100	0	0	0	0
21	19.00	3.30	2.20	12.00	5.00	1.00	0.200	0.100	0	0	0	0
22	20.00	2.90	2.40	11.00	3.80	1.00	0.200	0.100	0	0	0	0
23	17.00	3.50	1.90	10.00	2.70	1.00	0.200	0.100	0	0	0	0
24	12.00	3.30	1.90	8.00	2.50	1.00	0.200	6.00	0	0	0	0
25	9.50	2.50	1.40	5.00	2.40	1.00	0.200	11.00	0	0	0	0
26	8.00	3.30	1.60	6.50	2.00	0.900	0.200	0.800	0	0	0	0
27	5.50	2.90	2.20	6.50	2.00	1.00	0.200	0.600	0	0	0	0
28	3.20	2.90	2.40	6.00	2.00	1.00	0.200	0.500	0	0	0	0
29	1.70		2.40	16.00	2.20	1.00	0.200	0.400	0	0	0	10.00
30	3.20		2.20	18.00	2.20	1.00	0.200	0.200	0	0	0	15.00
31	3.20		2.00		1.80		0.200	0.200		0		0
Mean	29.57	21.12	5.33	25.34	4.84	1.41	0.587	0.752	0.050	0	0	0.806
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0	1.50	1.40	1.40	1.80	0.800	0.200	0.100	0	0	0	0
Max	200.0	145.0	25.00	190.0	20.00	1.90	4.40	11.00	0.200	0	0	15.00
AF	1818	1173	327.7	1508	297.5	83.70	36.10	46.22	2.98	0	0	49.59

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1936

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	9.00	16.00	8.00	2.50	0.300	0.200	0	0	0	4.60	0
2	0	60.00	14.00	4.90	2.20	0.300	0.200	0	0	0	1.10	0
3	0	6.00	9.40	3.50	1.80	0.300	0.200	0	0	0	0.200	0
4	0	1.80	7.00	104.0	1.50	0.300	0.100	0	0	0	0.100	0
5	0	1.40	6.00	75.00	1.40	0.300	0.100	0	0	0	0	0
6	0	1.00	4.90	20.00	1.40	0.300	0.100	0	0	0	0	0
7	0	0.700	3.20	14.00	1.20	0.300	0.100	0	0	0	0	0
8	0	0.100	3.20	16.00	1.10	0.300	0.100	0	0	0	0	0
9	0	0	3.50	9.50	1.20	0.300	0.100	0	0	0	0	0
10	0	0	3.00	9.00	1.10	0.300	0.100	0	0	0	0	0
11	0	237.0	2.50	27.00	0.800	0.300	0.100	0	0	0	0	0
12	0	585.0	2.20	75.00	0.700	0.300	0.100	0	0	0	0	0
13	0	482.0	2.00	62.00	0.600	0.300	0.100	0	0	0	0	0
14	0	107.0	1.80	55.00	0.500	0.200	0.100	0	0	0	0	0
15	0	223.0	1.60	49.00	0.700	0.200	0.100	2.20	0	0	0	212.0
16	0	193.0	1.50	47.00	0.600	0.200	0.100	1.80	0	0	0	177.0
17	0	138.0	1.30	46.00	0.600	0.200	0.100	0.200	0	0	0	91.00
18	0	200.0	1.20	50.00	0.600	0.200	0.100	0.100	0	0	0	29.00
19	0	162.0	1.20	25.00	0.600	0.200	0.100	0.100	0	1.10	0	1.50
20	0	74.00	1.10	5.00	0.500	0.200	0.100	0.100	0	0.100	0	0.200
21	0	68.00	1.20	5.00	0.500	0.200	0.100	0.100	0	0	0	0.100
22	0	62.00	15.00	3.80	0.500	0.200	0	0.100	0	0	0	0.100
23	0	130.0	9.00	3.80	0.500	0.200	0	0.100	0	0	0	0.100
24	0	86.00	8.00	3.80	0.500	0.200	0	0.100	0	0	0	0.100
25	0	60.00	7.50	5.50	0.600	0.200	0	0	0	0	0	0.200
26	0	33.00	8.50	6.50	0.600	0.200	0	0	0	0	0	1.50
27	0	18.00	9.00	5.00	0.600	0.200	0	0	0	0	0	36.00
28	0	17.00	7.50	3.50	0.500	0.200	0	0	0	0	0	70.00
29	0	16.00	6.00	3.20	0.500	0.200	0	0	0	4.10	0	53.00
30	0		5.00	3.00	0.500	0.200	0	0	0	2.50	0	49.00
31	0		16.00		0.500		0	0		12.00		289.0
Mean	0	102.4	5.78	24.93	0.884	0.243	0.077	0.158	0	0.639	0.200	32.57
Cnt	31	29	31	30	31	30	31	31	30	31	30	31
Min	0	0	1.10	3.00	0.500	0.200	0	0	0	0	0	0
Max	0	585.0	16.00	104.0	2.50	0.300	0.200	2.20	0	12.00	4.60	289.0
AF	0	5893	355.6	1484	54.35	14.48	4.76	9.72	0	39.27	11.90	2003

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1937

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	127.0	20.00	119.0	217.0	139.0	94.00	41.00	5.00	1.50	1.00	0.400	0.300
2	83.00	17.00	116.0	234.0	139.0	91.00	38.00	4.80	1.40	1.00	0.600	0.300
3	50.00	14.00	113.0	217.0	144.0	91.00	36.00	4.80	1.40	1.00	0.600	0.300
4	15.00	10.00	103.0	213.0	153.0	88.00	36.00	4.80	1.40	1.00	0.600	0.300
5	11.00	8.00	100.0	213.0	156.0	90.00	38.00	4.40	1.40	0.800	0.600	0.300
6	33.00	1750	103.0	221.0	182.0	85.00	35.00	4.00	1.20	0.600	1.00	0.300
7	20.00	2300	108.0	213.0	178.0	80.00	32.00	3.50	1.40	0.600	1.00	0.300
8	16.00	598.0	110.0	199.0	172.0	79.00	31.00	3.10	1.20	0.400	1.00	0.300
9	12.00	451.0	116.0	202.0	178.0	78.00	27.00	3.10	1.00	0.600	0.600	0.300
10	10.00	289.0	140.0	213.0	178.0	78.00	25.00	3.10	1.20	0.600	0.600	0.600
11	9.00	197.0	150.0	217.0	153.0	78.00	23.00	2.60	1.20	0.600	0.600	9.50
12	8.50	134.0	289.0	221.0	160.0	74.00	23.00	2.00	1.40	0.800	0.600	102.0
13	36.00	146.0	406.0	221.0	172.0	79.00	22.00	2.00	1.50	0.800	0.600	25.00
14	40.00	2180	218.0	246.0	185.0	76.00	21.00	2.20	1.40	1.00	0.600	5.00
15	28.00	1040	201.0	286.0	192.0	72.00	20.00	2.20	1.20	1.00	0.300	4.80
16	23.00	493.0	910.0	295.0	185.0	69.00	18.00	2.20	1.00	1.00	0.300	3.50
17	18.00	352.0	618.0	264.0	175.0	67.00	18.00	2.20	1.00	1.00	0.300	2.70
18	16.00	284.0	572.0	246.0	169.0	65.00	16.00	2.20	1.00	1.00	0.300	2.70
19	15.00	236.0	423.0	238.0	156.0	60.00	15.00	2.20	1.20	0.800	0.300	2.70
20	13.00	198.0	345.0	242.0	147.0	59.00	13.00	2.20	1.20	0.800	0.300	4.40
21	11.00	174.0	305.0	242.0	139.0	59.00	12.00	2.20	1.20	0.800	0.300	4.40
22	9.00	167.0	315.0	238.0	136.0	58.00	8.50	2.20	1.20	0.800	0.300	4.40
23	15.00	160.0	305.0	209.0	128.0	56.00	8.00	2.20	1.20	0.600	0.300	6.50
24	7.50	147.0	282.0	192.0	118.0	56.00	8.00	2.00	1.20	0.800	0.300	6.50
25	7.00	190.0	282.0	192.0	116.0	53.00	8.00	2.00	1.20	0.600	0.600	6.50
26	7.00	154.0	254.0	195.0	123.0	48.00	8.00	1.90	1.00	0.600	0.600	7.00
27	7.00	137.0	246.0	206.0	105.0	51.00	7.00	1.70	1.00	1.00	0.600	7.00
28	7.50	122.0	250.0	175.0	101.0	51.00	6.50	1.70	1.00	0.600	0.600	7.00
29	10.00		238.0	150.0	103.0	48.00	6.00	1.50	1.00	0.400	0.600	6.00
30	21.00		221.0	141.0	103.0	43.00	5.50	1.50	1.00	0.400	0.600	3.50
31	28.00		217.0		97.00		5.50	1.50		0.600		1.00
Mean	23.02	427.4	263.7	218.6	147.8	69.20	19.71	2.68	1.21	0.761	0.533	7.27
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	7.00	8.00	100.0	141.0	97.00	43.00	5.50	1.50	1.00	0.400	0.300	0.300
Max	127.0	2300	910.0	295.0	192.0	94.00	41.00	5.00	1.50	1.00	1.00	102.0
AF	1415	23739	16215	13008	9088	4118	1212	164.6	71.80	46.81	31.74	447.1

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1938

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.00	30.00	979.0	248.0	323.0	194.0	64.00	14.00	16.00	12.00	7.00	7.50
2	1.00	20.00	15500	250.0	321.0	194.0	64.00	14.00	16.00	12.00	6.50	7.50
3	1.30	31.00	8080	255.0	326.0	192.0	63.00	14.00	15.00	12.00	6.00	7.00
4	1.30	218.0	2550	266.0	304.0	191.0	60.00	13.00	15.00	8.00	5.50	7.00
5	1.00	46.00	1550	271.0	282.0	187.0	58.00	14.00	15.00	7.50	5.50	6.50
6	0.800	12.00	1000	259.0	280.0	180.0	63.00	14.00	14.00	6.50	6.50	6.50
7	1.00	2.70	800.0	250.0	275.0	157.0	48.00	46.00	14.00	6.50	7.00	6.00
8	1.30	1.70	670.0	246.0	259.0	124.0	58.00	31.00	14.00	7.50	6.50	6.00
9	1.50	10.00	600.0	250.0	239.0	120.0	81.00	19.00	14.00	12.00	6.50	6.00
10	1.70	35.00	550.0	255.0	242.0	115.0	50.00	17.00	13.00	9.00	6.50	6.50
11	2.00	46.00	500.0	264.0	253.0	110.0	47.00	17.00	13.00	6.50	7.50	6.50
12	2.00	133.0	1240	250.0	253.0	106.0	53.00	17.00	13.00	6.50	7.00	6.50
13	2.20	48.00	1970	280.0	246.0	102.0	53.00	24.00	12.00	6.50	11.00	6.50
14	2.00	30.00	1150	255.0	246.0	98.00	48.00	42.00	12.00	7.00	8.00	7.50
15	8.50	14.00	760.0	250.0	250.0	94.00	48.00	53.00	12.00	24.00	8.00	8.50
16	4.40	8.50	580.0	248.0	246.0	90.00	48.00	48.00	12.00	20.00	7.50	17.00
17	2.20	7.00	480.0	257.0	246.0	86.00	52.00	48.00	12.00	14.00	7.00	12.00
18	3.50	4.00	430.0	268.0	244.0	84.00	51.00	42.00	13.00	10.00	7.00	47.00
19	10.00	22.00	390.0	330.0	231.0	81.00	51.00	38.00	13.00	8.50	7.00	50.00
20	5.50	11.00	370.0	379.0	227.0	79.00	51.00	35.00	13.00	7.50	7.00	118.0
21	3.50	4.00	355.0	431.0	219.0	75.00	46.00	30.00	13.00	7.00	6.50	81.00
22	2.40	4.00	345.0	440.0	217.0	72.00	51.00	25.00	13.00	6.00	6.50	33.00
23	2.20	4.00	342.0	424.0	217.0	70.00	40.00	20.00	13.00	14.00	6.00	16.00
24	2.20	3.50	340.0	400.0	211.0	69.00	34.00	18.00	13.00	8.50	6.50	12.00
25	2.00	4.00	321.0	379.0	209.0	64.00	30.00	18.00	13.00	8.50	6.00	12.00
26	2.00	4.00	304.0	338.0	204.0	55.00	28.00	18.00	12.00	8.00	6.50	12.00
27	2.00	49.00	297.0	352.0	194.0	59.00	26.00	18.00	12.00	7.00	7.00	13.00
28	2.20	611.0	285.0	352.0	200.0	72.00	20.00	17.00	12.00	7.00	7.50	12.00
29	22.00		285.0	355.0	198.0	71.00	18.00	17.00	12.00	6.50	7.50	12.00
30	11.00		285.0	347.0	194.0	65.00	17.00	17.00	12.00	7.50	7.50	12.00
31	9.00		253.0		196.0		16.00	17.00		7.50		10.00
Mean	3.70	50.48	1405	305.0	243.6	108.5	46.35	25.00	13.20	9.39	6.93	18.42
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0.800	1.70	253.0	246.0	194.0	55.00	16.00	13.00	12.00	6.00	5.50	6.00
Max	22.00	611.0	15500	440.0	326.0	194.0	81.00	53.00	16.00	24.00	11.00	118.0
AF	227.5	2803	86403	18147	14979	6458	2850	1537	785.5	577.2	412.6	1133

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1939

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	11.00	13.00	18.00	11.00	11.00	3.50	1.40	1.10	1.00	0.800	2.10	1.70
2	11.00	10.00	20.00	74.00	9.00	3.50	1.50	1.10	0.800	1.50	1.90	1.10
3	11.00	15.00	17.00	84.00	8.00	3.40	1.90	23.00	0.600	4.20	2.30	0.900
4	12.00	22.00	16.00	59.00	6.00	3.40	1.70	2.00	0.900	3.00	1.60	0.800
5	29.00	22.00	22.00	53.00	6.00	3.40	1.60	1.40	0.800	4.80	1.70	0.700
6	38.00	20.00	10.00	50.00	6.00	3.40	1.50	1.20	0.700	3.70	1.40	0.600
7	14.00	22.00	8.00	37.00	6.00	3.40	1.50	1.00	0.500	6.50	1.00	0.600
8	12.00	27.00	7.50	31.00	5.50	3.20	1.50	0.900	0.400	3.70	1.60	0.500
9	12.00	23.00	7.50	35.00	5.00	3.00	1.60	0.900	0.400	5.50	2.10	0.600
10	10.00	20.00	15.00	28.00	5.00	2.90	1.60	0.800	0.900	4.20	1.40	0.500
11	8.00	18.00	13.00	24.00	5.50	2.80	1.50	0.800	2.70	1.20	1.20	2.40
12	8.00	18.00	13.00	25.00	5.00	2.70	1.50	0.700	5.50	2.00	1.10	0.800
13	8.00	18.00	11.00	31.00	5.00	2.50	1.50	0.600	2.90	0.400	1.00	0.800
14	8.00	18.00	13.00	38.00	12.00	2.60	1.70	0.600	1.20	4.80	3.90	0.700
15	8.50	18.00	13.00	64.00	7.50	2.70	1.90	3.10	0.800	3.10	1.70	0.700
16	8.50	18.00	10.00	57.00	6.50	2.70	2.00	4.60	1.00	3.40	1.30	0.600
17	8.50	15.00	12.00	44.00	5.50	2.70	1.80	3.60	0.800	1.90	1.10	0.600
18	8.50	15.00	13.00	35.00	5.00	2.60	1.80	2.70	0.700	0.500	1.00	0.600
19	8.00	14.00	13.00	26.00	4.80	2.50	1.70	2.40	0.700	3.80	0.800	0.500
20	8.00	14.00	12.00	24.00	4.80	2.40	1.60	2.30	0.600	1.70	0.900	0.400
21	13.00	14.00	10.00	13.00	4.80	2.20	1.40	4.20	0.500	1.20	0.800	0.400
22	14.00	14.00	10.00	12.00	4.80	2.10	1.30	1.40	0.400	2.50	0.700	0.300
23	11.00	15.00	10.00	16.00	4.80	2.00	1.30	1.30	0.800	7.00	0.600	6.50
24	8.50	13.00	8.00	12.00	4.80	2.10	1.40	1.10	4.90	5.50	0.600	4.60
25	8.50	12.00	7.00	12.00	4.60	2.00	3.20	1.30	248.0	3.00	0.600	1.40
26	8.00	11.00	13.00	11.00	4.60	2.00	2.00	1.00	100.0	1.00	0.600	1.30
27	8.00	11.00	47.00	10.00	4.40	2.00	1.80	1.20	80.00	1.60	1.20	0.900
28	12.00	10.00	28.00	10.00	4.40	1.80	2.20	0.800	10.00	0.500	14.00	0.500
29	8.00		20.00	8.50	4.30	1.60	2.90	1.20	4.00	1.10	4.00	0.600
30	8.50		15.00	19.00	4.30	1.40	1.50	1.30	2.00	0.300	4.90	0.600
31	12.00		13.00		3.80		1.30	0.700		4.20		0.600
Mean	11.40	16.43	14.35	31.78	5.76	2.62	1.71	2.27	15.82	2.86	1.97	1.09
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	8.00	10.00	7.00	8.50	3.80	1.40	1.30	0.600	0.400	0.300	0.600	0.300
Max	38.00	27.00	47.00	84.00	12.00	3.50	3.20	23.00	248.0	7.00	14.00	6.50
AF	701.2	912.4	882.7	1891	354.5	155.7	105.3	139.4	941.2	175.7	117.2	67.04

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1940

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.600	24.00	17.00	126.0	6.50	1.00	0.300	0.300	0.100	0	0.100	0
2	0.600	27.00	14.00	50.00	6.00	1.00	0.300	0.300	0.100	0	0	0
3	0.600	43.00	12.00	32.00	6.00	1.00	0.300	0.300	0.100	0	0	0
4	8.00	39.00	10.00	23.00	5.50	0.900	0.300	0.300	0.100	0	0	0
5	6.50	23.00	8.50	15.00	5.00	0.900	0.300	0.300	0.040	0	0	0
6	3.50	22.00	8.00	11.00	5.00	0.800	0.200	0.300	0.040	0	0	0
7	16.00	17.00	7.00	9.00	5.00	0.700	0.200	0.300	0.040	0	0	0
8	512.0	13.00	7.00	8.00	4.20	0.700	0.200	0.300	0.040	0	0	0
9	90.00	15.00	6.00	7.00	3.60	0.600	0.200	0.300	0.040	0	0	0
10	44.00	12.00	8.00	10.00	2.90	0.600	0.200	0.300	0.040	0	0	0
11	39.00	12.00	8.00	8.00	2.00	0.600	0.200	0.300	0.040	0	0	0
12	46.00	11.00	7.00	7.00	1.70	0.600	0.300	0.300	0.040	0	0	2.40
13	29.00	10.00	5.50	6.00	1.70	0.600	0.300	0.300	0.040	0	0	0.900
14	16.00	14.00	5.00	6.00	1.40	0.600	0.300	0.300	0.040	0	0	0.300
15	12.00	13.00	4.80	19.00	1.40	0.600	0.300	0.300	0.040	0	0	0.400
16	9.00	7.00	4.50	19.00	1.30	0.600	0.300	0.300	0.040	0	0	6.50
17	7.00	6.00	4.20	9.00	1.30	0.600	0.300	0.300	0.040	0	0	60.00
18	5.00	6.00	6.50	6.00	1.20	0.600	0.300	0.300	0.040	0	2.50	6.00
19	5.50	5.50	8.50	6.00	1.20	0.600	0.300	0.300	0.040	0	0.500	1.00
20	6.00	5.50	5.50	6.00	1.20	0.600	0.300	0.200	0.040	0	0.100	0.400
21	9.00	5.00	5.50	6.00	1.10	0.600	0.300	0.200	0.040	0	0.200	0.300
22	5.00	7.50	4.80	5.50	1.10	0.600	0.300	0.200	0.040	0	0.200	0.200
23	5.50	12.00	4.80	5.50	1.20	0.600	0.300	0.200	0.040	0	0.200	35.00
24	13.00	8.00	4.80	5.00	1.20	0.600	0.300	0.200	0.040	0	0.200	1150
25	7.00	102.0	5.00	5.50	1.20	0.500	0.300	0.200	0.040	0.100	0.100	397.0
26	7.50	364.0	5.50	31.00	1.20	0.500	0.300	0.200	0.040	4.60	0.100	136.0
27	8.00	99.00	7.50	14.00	1.20	0.400	0.300	0.200	0.040	0.900	0.100	31.00
28	7.00	21.00	6.50	9.50	1.20	0.400	0.300	0.200	0.040	0.200	0.100	6.00
29	7.00	23.00	4.50	8.50	1.10	0.400	0.300	0.100	0.040	0.200	0	5.50
30	6.00		4.20	7.00	1.10	0.400	0.300	0.100	0.040	0.100	0	3.50
31	5.50		79.00		1.10		0.300	0.100		0.100		7.00
Mean	30.22	33.33	9.33	16.02	2.48	0.640	0.281	0.252	0.048	0.200	0.147	59.66
Cnt	31	29	31	30	31	30	31	31	30	31	30	31
Min	0.600	5.00	4.20	5.00	1.10	0.400	0.200	0.100	0.040	0	0	0
Max	512.0	364.0	79.00	126.0	6.50	1.00	0.300	0.300	0.100	4.60	2.50	1150
AF	1858	1917	573.4	953.1	152.3	38.08	17.26	15.47	2.86	12.30	8.73	3668

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1941

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	4.20	7.50	342.0	208.0	110.0	58.00	23.00	5.00	2.00	0.500	2.20	1.20
2	3.90	6.00	349.0	269.0	103.0	57.00	22.00	4.80	2.00	0.600	2.40	1.20
3	3.10	5.50	176.0	165.0	115.0	54.00	20.00	5.00	2.20	0.700	2.20	3.80
4	6.50	4.60	269.0	173.0	126.0	57.00	18.00	5.00	2.00	0.700	2.60	9.00
5	5.50	4.20	222.0	410.0	138.0	53.00	17.00	6.50	2.20	0.700	2.90	3.30
6	5.50	8.50	156.0	230.0	169.0	51.00	17.00	6.50	3.60	0.800	3.30	2.40
7	5.00	9.00	119.0	195.0	169.0	56.00	15.00	6.00	2.20	0.800	3.10	2.00
8	4.60	7.50	100.0	167.0	169.0	54.00	13.00	5.50	2.00	0.800	3.10	2.00
9	4.60	6.00	85.00	156.0	167.0	50.00	13.00	5.00	1.80	0.800	3.30	3.50
10	7.00	6.50	73.00	163.0	165.0	46.00	13.00	13.00	1.80	0.800	3.30	22.00
11	5.00	55.00	65.00	224.0	165.0	41.00	12.00	14.00	1.80	0.800	3.30	16.00
12	5.00	80.00	73.00	205.0	138.0	40.00	11.00	6.00	1.50	0.800	6.00	5.50
13	4.20	30.00	123.0	181.0	138.0	40.00	9.00	4.80	1.30	0.800	4.00	4.70
14	3.90	23.00	269.0	167.0	119.0	40.00	8.00	4.20	1.20	0.700	3.50	4.00
15	5.00	45.00	203.0	156.0	104.0	40.00	7.50	5.50	1.20	0.800	3.50	3.30
16	5.00	44.00	169.0	148.0	94.00	38.00	6.00	5.00	1.00	0.800	3.50	3.10
17	5.00	68.00	119.0	142.0	93.00	38.00	6.00	3.90	0.900	0.700	3.70	2.90
18	5.50	69.00	106.0	144.0	90.00	39.00	13.00	3.60	0.600	0.700	3.50	2.90
19	6.50	48.00	96.00	123.0	81.00	40.00	7.00	3.60	0.800	1.00	3.50	3.10
20	22.00	86.00	87.00	109.0	69.00	40.00	5.50	3.40	0.800	14.00	3.50	3.30
21	12.00	353.0	78.00	102.0	65.00	40.00	4.80	3.40	0.900	4.20	3.50	4.50
22	7.00	256.0	68.00	94.00	62.00	39.00	4.50	3.10	0.800	6.00	3.30	4.20
23	5.50	142.0	60.00	93.00	62.00	39.00	5.00	3.10	0.600	4.70	3.10	4.70
24	78.00	126.0	54.00	90.00	63.00	39.00	6.00	2.60	0.500	4.50	2.90	6.00
25	27.00	81.00	50.00	93.00	62.00	36.00	8.00	3.10	0.400	2.70	2.70	4.70
26	20.00	62.00	48.00	90.00	62.00	35.00	7.50	3.10	0.400	2.40	2.00	11.00
27	16.00	48.00	45.00	96.00	62.00	33.00	7.00	3.40	0.400	2.40	1.80	9.00
28	14.00	58.00	45.00	102.0	62.00	38.00	6.00	2.90	0.400	2.60	1.60	8.00
29	12.00		140.0	110.0	61.00	29.00	6.00	2.40	0.400	2.40	1.50	15.00
30	10.00		74.00	132.0	60.00	27.00	5.50	2.40	0.400	1.90	1.30	18.00
31	9.00		87.00		59.00		5.50	2.20		1.90		20.00
Mean	10.56	62.12	127.4	157.9	103.3	42.90	10.38	4.77	1.27	2.06	3.00	6.59
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	3.10	4.20	45.00	90.00	59.00	27.00	4.50	2.20	0.400	0.500	1.30	1.20
Max	78.00	353.0	349.0	410.0	169.0	58.00	23.00	14.00	3.60	14.00	6.00	22.00
AF	649.6	3450	7835	9396	6351	2553	638.3	293.6	75.57	126.9	178.7	405.2

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1942

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	24.00	3.70	2.60	2.70	5.50	0.900	0.400	0.200	0.200	0.050	0.050	0
2	16.00	3.70	2.60	2.70	4.70	0.900	0.400	0.200	0.200	0.050	0.050	0
3	12.00	3.70	2.60	2.70	4.50	0.900	0.400	0.200	0.200	0.050	0.050	0
4	11.00	3.70	2.60	79.00	4.00	0.900	0.400	0.200	0.100	0.050	0.050	0
5	9.50	3.50	2.70	93.00	3.70	0.900	0.400	0.200	0.100	0.050	0.050	0
6	8.50	3.50	2.70	85.00	2.90	0.900	0.400	0.200	0.100	0.050	0.050	0
7	8.50	3.50	2.70	78.00	2.20	0.900	0.400	0.200	0.100	0.050	0.050	0
8	8.50	3.50	2.60	74.00	1.90	0.800	0.400	0.200	0.100	0.050	0.050	0
9	8.00	3.30	2.20	71.00	10.00	0.800	0.400	0.200	0.200	0.050	0.050	0
10	7.50	3.10	1.90	74.00	20.00	0.800	0.400	0.200	0.200	0.050	0.050	0
11	7.00	2.90	3.10	53.00	20.00	0.800	0.400	0.200	0.200	0.050	0.050	0
12	6.50	2.60	3.50	9.00	20.00	0.800	0.400	0.200	0.100	0.050	0	0
13	6.00	2.20	2.90	6.50	20.00	0.700	0.400	0.200	0.100	0.050	0	0
14	7.50	2.00	4.70	5.50	13.00	0.700	0.400	0.200	0.100	0.050	0	0
15	6.00	1.80	8.50	5.00	4.50	0.700	0.400	0.100	0.100	0.050	0	0
16	6.00	1.60	7.00	5.00	2.90	0.700	0.400	0.100	0.100	0.050	0	0
17	5.50	1.50	6.00	5.00	2.20	0.700	0.400	0.100	0.100	0.050	0	0
18	5.50	1.50	5.50	4.50	2.00	0.600	0.400	0.100	0.100	0.050	0	0
19	5.50	1.50	5.50	3.70	1.80	0.600	0.300	0.100	0.100	0.050	0	0
20	5.00	1.40	5.00	3.70	1.60	0.600	0.300	0.100	0.100	0.050	0	0
21	5.00	1.60	4.70	4.70	1.50	0.600	0.300	0.100	0.100	0.050	0	0
22	5.00	7.50	4.20	6.00	1.40	0.600	0.300	0.200	0.100	0.050	0	0
23	4.70	4.70	4.20	4.70	1.40	0.600	0.300	0.200	0.100	0.050	0	0
24	4.20	4.00	5.00	4.20	1.40	0.600	0.300	0.200	0.100	0.050	0	0
25	4.20	4.50	4.20	4.00	1.30	0.600	0.300	0.200	0.100	0.050	0	35.00
26	4.20	2.90	4.20	4.00	1.30	0.600	0.300	0.200	0.100	0.050	0	4.00
27	4.20	3.10	4.00	3.70	1.20	0.500	0.300	0.200	0.100	0.050	0	2.20
28	4.50	2.60	3.50	6.00	1.20	0.500	0.300	0.200	0.100	0.050	0	0.100
29	4.50		3.10	8.00	1.10	0.500	0.300	0.200	0.100	0.050	0	0
30	4.20		2.90	6.00	1.00	0.500	0.300	0.200	0.100	0.050	0	0
31	4.20		2.70		1.00		0.300	0.200		0.050		0
Mean	7.19	3.04	3.86	23.81	5.20	0.707	0.358	0.177	0.120	0.050	0.018	1.33
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	4.20	1.40	1.90	2.70	1.00	0.500	0.300	0.100	0.100	0.050	0	0
Max	24.00	7.50	8.50	93.00	20.00	0.900	0.400	0.200	0.200	0.050	0.050	35.00
AF	442.1	168.8	237.2	1417	319.7	42.05	22.02	10.91	7.14	3.07	1.09	81.92

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1943

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	15.00	40.00	33.00	33.00	7.00	1.40	0.600	0.600	0.400	0.200	0
2	0	12.00	35.00	31.00	30.00	7.50	1.30	0.600	0.600	0.400	0.100	0
3	0	10.00	51.00	32.00	28.00	7.50	1.40	0.600	0.600	0.400	0.100	0
4	0	10.00	693.0	32.00	27.00	7.50	1.20	0.600	0.600	0.400	0.100	0
5	0	9.00	1150	36.00	24.00	7.00	1.20	0.600	0.600	0.300	0.100	0
6	0	8.50	592.0	56.00	23.00	6.00	1.20	0.600	0.500	0.300	0.100	0
7	0	8.00	254.0	56.00	19.00	5.50	1.00	0.600	0.500	0.300	0.100	0
8	0	14.00	180.0	90.00	17.00	5.50	1.00	0.600	0.500	0.300	0.100	0
9	0	10.00	150.0	86.00	16.00	5.00	0.900	0.600	0.500	0.300	0.100	0
10	0	8.50	143.0	59.00	13.00	5.00	0.900	0.600	0.500	0.300	0.100	0
11	0	7.50	140.0	46.00	12.00	5.50	0.800	0.600	0.500	0.200	0.100	0.100
12	0	6.00	98.00	39.00	8.50	5.00	0.700	0.600	0.500	0.200	0.100	0.800
13	0	4.80	82.00	34.00	8.00	4.80	0.700	0.600	0.500	0.200	0.100	0.300
14	0	4.60	73.00	34.00	7.50	4.80	0.600	0.700	0.500	0.200	0.100	0.200
15	0	4.40	63.00	36.00	7.00	3.60	0.600	0.600	0.500	0.200	0.100	0.200
16	0	4.20	62.00	34.00	9.00	2.40	0.600	0.600	0.500	0.200	0	0.200
17	0	3.80	110.0	36.00	8.50	2.20	0.600	0.600	0.400	0.200	0	0.200
18	0	4.00	208.0	38.00	8.00	1.90	0.600	0.600	0.400	0.300	0	0.200
19	0	3.80	157.0	43.00	7.00	1.80	0.700	0.600	0.400	0.900	0	3.40
20	0	3.80	143.0	43.00	6.00	1.80	0.700	0.600	0.400	0.500	0	6.50
21	0	87.00	133.0	40.00	6.00	1.70	0.700	0.600	0.400	0.400	0	61.00
22	529.0	402.0	131.0	43.00	5.50	1.50	0.700	0.600	0.400	0.400	0	10.00
23	1730	458.0	125.0	46.00	5.50	1.50	0.700	0.600	0.400	0.300	0	4.60
24	300.0	206.0	115.0	48.00	5.50	1.40	0.700	0.600	0.500	0.300	0	3.10
25	142.0	123.0	113.0	48.00	5.50	1.30	0.600	0.600	0.500	0.200	0	2.40
26	81.00	85.00	113.0	40.00	6.00	1.30	0.600	0.600	0.500	0.200	0	2.40
27	147.0	62.00	113.0	37.00	6.00	1.30	0.600	0.600	0.500	0.200	0	2.00
28	75.00	48.00	117.0	37.00	6.00	1.30	0.600	0.600	0.500	0.200	0	0.800
29	46.00		123.0	38.00	6.00	1.30	0.600	0.600	0.500	0.200	0	0.800
30	32.00		111.0	35.00	6.00	1.30	0.600	0.600	0.400	0.200	0	0.800
31	26.00		69.00		7.00		0.600	0.600		0.200		3.10
Mean	100.3	57.96	183.5	43.53	12.15	3.71	0.810	0.603	0.490	0.300	0.053	3.33
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0	3.80	35.00	31.00	5.50	1.30	0.600	0.600	0.400	0.200	0	0
Max	1730	458.0	1150	90.00	33.00	7.50	1.40	0.700	0.600	0.900	0.200	61.00
AF	6165	3219	11280	2590	746.8	220.6	49.79	37.09	29.16	18.45	3.17	204.5

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1944

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.70	3.20	22.00	10.00	17.00	2.80	1.10	0.400	0	0	0	2.00
2	1.20	3.10	38.00	71.00	22.00	3.40	1.10	0.400	0	0	0	3.60
3	1.20	3.00	37.00	84.00	27.00	3.40	1.00	0.300	0	0	0	6.50
4	1.00	4.20	27.00	87.00	27.00	3.20	1.00	0.300	0	0	0	4.60
5	0.900	3.40	31.00	69.00	24.00	3.10	0.900	0.300	0	0	0	4.20
6	3.40	3.10	22.00	21.00	23.00	3.00	0.900	0.300	0	0	0	4.20
7	2.90	3.00	17.00	22.00	24.00	3.10	0.800	0.200	0	0	0	4.40
8	2.80	6.50	14.00	29.00	24.00	3.40	0.800	0.200	0	0	0	4.20
9	2.60	20.00	12.00	34.00	21.00	3.60	0.800	0.200	0	0	0	2.80
10	2.30	8.50	12.00	72.00	16.00	3.80	0.800	0.200	0	0	5.00	2.40
11	2.30	6.00	12.00	88.00	14.00	4.00	0.800	0.200	0	0	116.0	2.40
12	2.20	5.00	13.00	93.00	14.00	3.60	0.800	0.200	0	0	624.0	2.40
13	2.20	4.40	20.00	94.00	12.00	2.90	0.800	0.200	0	0	49.00	2.40
14	2.20	4.00	36.00	93.00	10.00	2.60	0.700	0.200	0	0	39.00	2.40
15	2.20	5.50	19.00	77.00	8.50	2.30	0.700	0.200	0	0	24.00	2.60
16	2.20	5.00	14.00	35.00	9.50	2.20	0.600	0.200	0	0	14.00	2.60
17	2.20	4.80	12.00	32.00	7.50	2.20	0.600	0.200	0	0	9.50	2.60
18	2.10	4.80	10.00	28.00	4.60	2.10	0.500	0.200	0	0	6.00	2.60
19	2.10	4.40	9.50	21.00	4.40	2.00	0.500	0.200	0	0	4.50	2.60
20	2.10	5.00	8.50	22.00	4.80	1.90	0.500	0.200	0	0	3.40	2.60
21	2.10	13.00	7.50	14.00	4.40	1.90	0.400	0.200	0	0	3.10	2.60
22	2.10	257.0	7.00	8.50	3.80	1.80	0.400	0.200	0	0	4.40	2.80
23	2.30	164.0	6.50	9.50	3.20	1.80	0.400	0.100	0	0	2.60	2.90
24	8.00	54.00	6.50	10.00	2.90	1.70	0.400	0.100	0	0	2.30	2.90
25	6.00	35.00	7.00	9.00	3.20	1.70	0.400	0.100	0	0	2.00	2.90
26	4.60	41.00	14.00	9.50	2.90	1.50	0.400	0.100	0	0	2.00	2.80
27	4.20	46.00	14.00	23.00	2.30	1.50	0.400	0.100	0	0	2.30	2.80
28	3.80	32.00	11.00	32.00	2.30	1.40	0.400	0.100	0	0	2.60	6.20
29	3.40	25.00	10.00	28.00	1.90	1.20	0.400	0	0	0	2.10	7.70
30	3.20		10.00	18.00	1.90	1.20	0.400	0	0	0	2.00	4.80
31	3.20		10.00		2.00		0.400	0		0		3.80
Mean	2.73	26.69	15.79	41.45	11.13	2.48	0.648	0.187	0	0	30.66	3.43
Cnt	31	29	31	30	31	30	31	31	30	31	30	31
Min	0.900	3.00	6.50	8.50	1.90	1.20	0.400	0	0	0	0	2.00
Max	8.00	257.0	38.00	94.00	27.00	4.00	1.10	0.400	0	0	624.0	7.70
AF	168.0	1535	970.9	2466	684.5	147.4	39.87	11.50	0	0	1824	210.8

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1945

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	3.40	145.0	7.70	60.00	24.00	6.20	1.70	36.00	3.20	4.20	2.40	1.40
2	3.20	1070	8.90	74.00	22.00	5.60	1.70	40.00	17.00	4.50	1.90	2.10
3	3.10	462.0	11.00	63.00	21.00	4.40	1.70	9.30	45.00	3.70	2.60	2.50
4	3.10	140.0	28.00	43.00	20.00	3.80	1.40	5.90	37.00	3.00	2.70	1.70
5	2.90	78.00	31.00	37.00	19.00	3.80	1.40	4.80	32.00	4.00	2.40	1.90
6	2.80	48.00	22.00	32.00	17.00	3.60	1.40	4.00	31.00	4.00	3.20	1.80
7	2.60	28.00	19.00	32.00	17.00	4.60	1.40	5.20	32.00	14.00	7.20	1.40
8	2.60	16.00	17.00	35.00	17.00	5.20	1.40	4.40	33.00	37.00	3.20	1.10
9	2.60	10.00	15.00	48.00	14.00	5.20	1.90	4.60	31.00	42.00	2.70	1.30
10	2.60	9.30	14.00	34.00	12.00	5.20	2.00	4.20	28.00	38.00	3.40	1.90
11	2.40	8.90	12.00	30.00	11.00	5.00	2.10	4.20	28.00	24.00	3.00	1.60
12	2.30	8.30	10.00	26.00	9.30	4.80	1.80	4.40	27.00	26.00	3.40	5.60
13	1.70	7.70	10.00	23.00	8.60	4.60	1.40	12.00	20.00	2.00	2.00	2.40
14	1.20	24.00	10.00	21.00	8.60	4.60	1.30	26.00	5.90	10.00	1.50	3.40
15	1.10	10.00	114.0	18.00	8.30	4.60	1.30	25.00	2.90	1.50	1.40	2.60
16	1.20	7.70	98.00	17.00	6.50	3.80	1.20	24.00	3.50	1.50	2.20	1.80
17	1.20	7.10	73.00	22.00	5.90	2.60	1.30	35.00	12.00	1.40	1.70	1.00
18	1.20	6.80	59.00	33.00	5.60	2.30	1.50	56.00	23.00	1.90	1.50	0.900
19	1.20	6.80	44.00	45.00	5.60	2.20	1.90	64.00	22.00	2.50	2.60	0.900
20	1.20	6.80	38.00	50.00	5.40	2.10	2.10	34.00	22.00	5.00	1.70	1.30
21	1.10	6.20	42.00	54.00	5.00	2.20	2.10	10.00	22.00	20.00	1.70	5.00
22	1.20	5.90	50.00	54.00	5.00	2.40	1.80	5.00	24.00	30.00	2.30	1120
23	1.00	5.90	66.00	48.00	4.80	2.30	1.80	4.80	28.00	30.00	1.90	1600
24	1.00	5.90	52.00	40.00	4.40	2.10	1.50	4.80	18.00	30.00	1.80	300.0
25	0.900	6.50	41.00	42.00	4.40	2.10	1.40	4.80	9.30	40.00	2.50	170.0
26	0.900	5.90	59.00	42.00	4.20	2.10	1.40	9.30	9.30	50.00	2.60	100.0
27	1.20	6.50	68.00	34.00	4.00	2.10	1.40	18.00	14.00	25.00	1.90	45.00
28	1.40	8.00	62.00	28.00	5.00	2.10	1.30	18.00	10.00	20.00	2.70	15.00
29	1.20		59.00	24.00	5.60	1.90	1.20	23.00	7.70	27.00	2.30	15.00
30	1.10		56.00	24.00	5.40	1.80	1.20	14.00	6.20	26.00	2.50	30.00
31	1.10		54.00		6.20		5.30	3.70		18.00		30.00
Mean	1.80	76.83	40.34	37.77	10.06	3.51	1.69	16.72	20.13	17.62	2.50	111.9
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0.900	5.90	7.70	17.00	4.00	1.80	1.20	3.70	2.90	1.40	1.40	0.900
Max	3.40	1070	114.0	74.00	24.00	6.20	5.30	64.00	45.00	50.00	7.20	1600
AF	110.5	4267	2481	2247	618.5	208.9	103.7	1028	1198	1083	148.6	6880

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1946

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	30.00	3.30	1.50	90.00	1.10	0.600	0.100	20.00	0.100	12.00	0	2.00
2	30.00	3.00	1.30	40.00	1.00	0.500	0.100	12.00	0	0.500	1.00	5.20
3	32.00	20.00	1.30	19.00	0.800	0.400	0.100	12.00	0	0	0.200	6.00
4	28.00	19.00	1.30	10.00	0.700	0.400	0.100	15.00	0	0	0.300	5.20
5	30.00	9.40	1.30	3.70	0.700	0.300	0.100	10.00	0	0	0	5.20
6	30.00	7.20	1.10	7.20	0.700	0.300	0.200	4.50	0	0	0	25.00
7	28.00	5.50	1.10	44.00	0.700	0.300	0.200	4.10	0	0	0	13.00
8	19.00	5.00	1.10	11.00	0.800	0.400	0.200	5.00	0	0	14.00	9.00
9	12.00	4.50	1.00	2.30	0.800	0.500	0.200	7.60	0	0	2.00	8.50
10	5.00	5.00	1.00	5.00	0.700	0.300	0.200	7.20	0	0	0.100	4.10
11	4.00	6.60	1.00	4.00	0.700	0.400	0.200	3.30	0	0	1.50	5.20
12	15.00	6.00	1.00	2.00	0.600	0.500	0.100	4.10	0	0	3.50	4.80
13	14.00	5.50	1.30	3.00	0.600	0.400	0.100	3.70	0	0	111.0	4.50
14	7.00	5.50	1.90	6.00	0.800	0.500	0.100	1.90	0	0	95.00	4.50
15	6.60	5.00	1.30	6.60	1.10	0.400	0.100	3.70	0	0	5.00	5.20
16	6.60	4.50	1.10	33.00	1.10	0.500	0.100	1.10	0	0	3.00	5.20
17	6.60	4.10	1.00	32.00	1.10	0.400	0.100	0.200	0	0	2.50	5.20
18	5.50	3.70	0.800	6.00	1.30	0.400	0.100	0.200	0	0	2.00	5.60
19	5.00	3.10	2.60	5.00	1.30	0.300	50.00	0.200	0	0	1.50	5.60
20	6.00	3.00	5.40	4.50	1.30	0.300	3.00	1.00	0	0	207.0	5.60
21	2.60	17.00	12.00	3.70	1.10	0.300	2.80	0.900	0	0	175.0	4.80
22	3.00	7.20	12.00	2.30	0.800	0.200	2.60	0.200	0	0	15.00	4.10
23	3.30	5.00	12.00	2.30	0.700	0.200	22.00	0.300	0	0	560.0	3.80
24	2.60	2.30	9.80	2.30	0.700	0.400	40.00	0.100	0	0	275.0	3.50
25	3.30	1.90	3.00	1.70	0.800	0.300	48.00	0.100	0	0	70.00	6.00
26	3.70	1.70	2.30	1.50	0.700	0.200	34.00	0.100	0	0	35.00	33.00
27	3.00	1.30	2.60	1.30	0.600	0.200	32.00	0.100	0	0	22.00	123.0
28	3.00	1.30	7.60	1.30	0.600	0.200	30.00	0.100	0	33.00	16.00	110.0
29	3.00		5.50	1.30	0.600	0.200	27.00	0.100	0	3.50	14.00	29.00
30	3.00		185.0	1.10	0.500	0.100	26.00	0.200	0	0	7.00	15.00
31	3.70		385.0		0.500		23.00	0.100		0		12.00
Mean	11.44	5.95	21.49	11.77	0.823	0.347	11.06	3.84	3.33E-03	1.58	54.62	15.45
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	2.60	1.30	0.800	1.10	0.500	0.100	0.100	0.100	0	0	0	2.00
Max	32.00	20.00	385.0	90.00	1.30	0.600	50.00	20.00	0.100	33.00	560.0	123.0
AF	703.2	330.5	1321	700.4	50.58	20.63	679.9	236.2	0.198	97.19	3250	949.7

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1947

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	11.00	6.40	33.00	22.00	0.700	0.300	0	0	0	0	0	0
2	10.00	6.10	33.00	1.00	0.600	0.300	0	0	0	0	0	0
3	9.00	5.60	33.00	1.00	0.600	0.200	0	0	0	0	0	0
4	8.00	5.30	39.00	1.00	0.600	0.200	0	0	0	0	0	5.20
5	7.00	4.80	36.00	1.00	0.600	0.200	0	0	0	0	0	34.00
6	7.00	4.60	38.00	1.00	0.600	0.200	0	0	0	0	0	8.50
7	6.00	4.40	38.00	1.00	0.600	0.200	0	3.50	0	0	0	2.80
8	5.60	4.40	35.00	1.00	0.600	0.200	0	1.20	0	0	0	0.300
9	5.30	4.40	35.00	1.00	0.600	0.200	0	1.10	0	0	0	0.100
10	4.80	5.30	34.00	1.00	0.600	0.100	0	0.300	0	0	0	0
11	4.60	4.60	39.00	0.900	0.600	0.100	0	0.200	0	0	0	0
12	4.60	4.40	42.00	0.900	0.600	0.100	0	0.200	0	0	0	0
13	4.40	4.20	40.00	0.900	0.600	0.100	0	0.200	0	0	0	0
14	4.20	4.20	40.00	0.900	0.700	0.100	0	0.100	0	0	0	0
15	4.20	4.00	36.00	0.800	0.700	0.100	0	0.100	0	0	0	0
16	4.60	4.00	29.00	0.800	0.600	0.100	0	0.100	0	0	0	0
17	4.40	29.00	30.00	0.800	0.500	0.100	0	0.100	0	0	0	0
18	4.40	44.00	33.00	0.800	0.400	0.100	0	0.100	0	0	0	0
19	4.60	44.00	33.00	0.800	0.400	0.100	0	0.100	0	0	0	0
20	4.40	42.00	35.00	0.800	0.400	0.100	0	0.100	0	0	0	0
21	4.40	44.00	36.00	0.800	0.400	0.100	0	0.100	0	0	0	0
22	4.60	42.00	35.00	0.800	0.400	0	0	0.100	0	0	0	0
23	4.80	42.00	35.00	0.800	0.300	0	0	0.100	0	0	0	0
24	4.40	36.00	34.00	0.800	0.300	0	0	0.100	0	0	0	0
25	4.20	31.00	34.00	0.900	0.300	0	0	0.100	0	0	0	0
26	4.20	31.00	33.00	0.900	0.300	0	0	0.100	0	0	0	0
27	4.00	33.00	34.00	0.800	0.400	0	0	0.100	0	0	0	0
28	34.00	33.00	44.00	0.800	0.300	0	0	0.100	0	0	0	0
29	21.00		39.00	0.800	0.300	0	0	0	0	0	0	0
30	13.00		35.00	0.700	0.300	0	0	0	0	0	0	0
31	9.50		31.00		0.300		0	0		0		0
Mean	7.30	18.85	35.52	1.58	0.490	0.107	0	0.265	0	0	0	1.64
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	4.00	4.00	29.00	0.700	0.300	0	0	0	0	0	0	0
Max	34.00	44.00	44.00	22.00	0.700	0.300	0	3.50	0	0	0	34.00
AF	448.7	1047	2184	94.22	30.15	6.35	0	16.26	0	0	0	101.0

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1948

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	0	0.200	6.90	0.500	0	0	0	0	0	0
2	0	0	0	0.400	2.70	0.600	0	0	0	0	0	0
3	0	0	0	46.00	9.30	0.500	0	0	0	0	0	0
4	0	0	0	53.00	33.00	0.500	0	0	0	0	0	0
5	0	4.30	0	13.00	2.80	0.400	0	0	0	0	0	0
6	0	7.40	0	8.00	1.40	0.400	0	0	0	0	0	0
7	0	1.10	0	5.00	1.20	0.400	0	0	0	0	0	0
8	0	0.500	0	2.70	1.00	0.400	0	0	0	0	0	0
9	0	0.200	0	1.90	0.900	0.400	0	0	0	0	0	0
10	0	0.100	0	1.90	0.900	0.400	0	0	0	0	0	0
11	0	0.100	0	2.10	0.900	0.400	0	0	0	0	0	0
12	0	0	0	1.90	0.800	0.300	0	0	0	0	0	0
13	0	0	0	1.30	0.700	0.300	0	0	0	0	0	0
14	0	0	1.50	1.00	0.700	0.300	0	0	0	0	0	0
15	0	0	8.20	0.800	0.700	0.200	0	0	0	0	0	0
16	0	0	2.50	0.800	0.700	0.200	0	0	0	0	0	0
17	0	0	3.30	0.700	0.700	0.200	0	0	0	0	0	0
18	0	0	2.00	0.700	0.800	0.200	0	0	0	0	0	0
19	0	0	2.00	0.700	0.900	0.200	0	0	0	0	0	0
20	0	0	6.40	0.700	0.800	0.200	0	0	0	0	0	0
21	0	0	2.50	0.900	0.700	0.100	0	0	0	0	0	0
22	0	0	1.30	0.900	0.600	0.100	0	0	0	0	0	0
23	0	0	0.700	0.900	0.600	0.100	0	0	0	0	0	0
24	0	0	6.90	0.800	0.600	0.100	0	0	0	0	0	0
25	0	0	11.00	0.700	0.600	0.100	0	0	0	0	0	0
26	0	0	4.00	0.600	0.600	0.100	0	0	0	0	0	0
27	0	0	2.10	0.600	0.600	0.100	0	0	0	0	0	0
28	0	0	1.60	0.800	0.600	0	0	0	0	0	0	0
29	0	0	1.30	23.00	0.500	0	0	0	0	0	0	0
30	0		1.00	5.10	0.500	0	0	0	0	0	0	0
31	0		0.600		0.500		0	0		0		0
Mean	0	0.472	1.90	5.90	2.39	0.257	0	0	0	0	0	0
Cnt	31	29	31	30	31	30	31	31	30	31	30	31
Min	0	0	0	0.200	0.500	0	0	0	0	0	0	0
Max	0	7.40	11.00	53.00	33.00	0.600	0	0	0	0	0	0
AF	0	27.17	116.8	351.3	147.2	15.27	0	0	0	0	0	0

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1949

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	1.80	14.00	5.70	1.00	0.500	0.100	0	0	0	0	0
2	0	2.00	10.00	5.70	0.900	0.500	0.100	0	0	0	0	0
3	3.10	2.20	8.80	5.40	0.900	0.500	0.100	0	0	0	0	0
4	12.00	2.00	8.00	5.00	0.900	0.500	0.100	0	0	0	0	0
5	13.00	1.80	12.00	5.00	0.700	0.500	0.100	0	0	0	0	0
6	15.00	1.80	10.00	5.00	0.700	0.400	0.100	0	0	0	0	0
7	15.00	2.60	8.80	4.80	0.800	0.400	0.100	0	0	0	0	0
8	14.00	3.20	8.40	4.80	0.800	0.400	0.100	0	0	0	0	0
9	18.00	3.00	6.60	4.80	0.900	0.400	0.100	0	0	0	0	0
10	19.00	3.00	6.30	4.80	0.900	0.400	0.100	0	0	0	24.00	0
11	20.00	4.50	7.60	4.80	0.800	0.400	0.100	0	0	0	4.00	0
12	20.00	8.80	6.30	4.80	0.800	0.400	0.100	0	0	0	0	0
13	22.00	4.80	6.90	4.80	0.800	0.400	0	0	0	0	0	0
14	22.00	4.00	6.30	4.80	1.50	0.300	0	0	0	0	0	0
15	22.00	3.50	5.40	4.80	1.60	0.300	0	0	0	0	0	0
16	21.00	3.00	5.40	4.50	1.30	0.200	0	0	0	0	0	0
17	21.00	3.20	5.00	4.20	1.20	0.300	0	0	0	0	0	0
18	22.00	3.70	5.00	4.20	1.20	0.300	0	0	0	0	0	15.00
19	23.00	4.20	6.00	4.20	2.40	0.300	0	0	0	0	0	134.0
20	60.00	4.50	6.90	3.70	3.20	0.300	0	0	0	0	0	22.00
21	17.00	4.00	4.80	3.70	1.80	0.200	0	0	0	0	0	1.80
22	8.00	4.00	4.80	4.50	1.30	0.200	0	0	0	0	0	0.100
23	9.20	4.20	6.60	4.80	1.00	0.200	0	0	0	0	0	0
24	6.30	6.00	5.70	4.80	0.800	0.200	0	0	0	0	0	0
25	4.80	11.00	5.40	4.20	0.800	0.200	0	0	0	0	0	0
26	3.70	9.20	5.00	3.00	0.700	0.300	0	0	0	0	0	0
27	3.20	15.00	4.80	2.20	0.700	0.300	0	0	0	0	0	0
28	3.00	18.00	7.30	1.60	0.700	0.200	0	0	0	0	0	0
29	2.80		7.30	1.30	0.600	0.200	0	0	0	0	0	0
30	2.60		6.90	1.20	0.600	0.100	0	0	0	0	0	0
31	2.20		6.90		0.500		0	0		0		0
Mean	13.71	4.96	7.07	4.24	1.06	0.327	0.039	0	0	0	0.933	5.58
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0	1.80	4.80	1.20	0.500	0.100	0	0	0	0	0	0
Max	60.00	18.00	14.00	5.70	3.20	0.500	0.100	0	0	0	24.00	134.0
AF	842.8	275.7	434.8	252.1	65.06	19.44	2.38	0	0	0	55.54	342.9

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1950

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0.300	3.10	2.50	0.900	0.200	0	0	0	0	0	0
2	0	0.400	2.60	1.80	0.900	0.200	0	0	0	0	0	0
3	0	0.300	2.60	1.80	1.00	0.200	0	0	0	0	0	0
4	0	0.200	2.50	2.00	0.900	0.200	0	0	0	0	0	0
5	0	0.200	2.60	2.10	0.800	0.100	0	0	0	0	0	0
6	0	97.00	3.10	2.10	0.700	0.300	0	0	0	0	0	0
7	0	207.0	2.80	2.10	0.700	0.200	0	0	0	0	0	0
8	1.00	46.00	2.60	2.10	0.600	0.100	0	0	0	0	0	0
9	5.90	26.00	2.60	4.90	0.600	0.100	0	0	0	0	0	0
10	0.700	19.00	2.80	1.40	0.600	0.100	0	0	0	0	0	0
11	2.00	16.00	2.80	1.20	0.600	0.100	0	0	0	0	0	0
12	7.30	13.00	2.60	1.20	0.600	0.100	0	0	0	0	0	0
13	3.70	12.00	2.80	1.20	0.600	0.100	0	0	0	0	0	0
14	1.30	9.00	2.60	1.40	0.400	0.100	0	0	0	0	0	0
15	0.400	6.70	2.80	1.70	0.400	0.100	0	0	0	0	0	0
16	3.20	5.40	2.50	1.50	0.400	0.100	0	0	0	0	0	0
17	12.00	4.20	2.00	1.10	0.400	0.100	0	0	0	0	0	0
18	25.00	4.00	1.10	1.10	0.400	0.100	0	0	0	0	0	0
19	21.00	4.00	1.10	1.10	0.300	0.100	0	0	0	0	0	0
20	0.500	3.80	1.00	1.10	0.300	0.100	0	0	0	0	0	0
21	0.200	3.80	0.900	1.10	0.300	0.100	0	0	0	0	0	0
22	0.100	3.80	1.20	1.20	0.300	0.100	0	0	0	0	0	0
23	0.100	3.80	1.00	1.20	0.300	0.100	0	0	0	0	0	0
24	0.100	3.50	1.10	1.40	0.300	0.100	0	0	0	0	0	0
25	0.100	3.50	14.00	1.40	0.200	0.100	0	0	0	0	0	0
26	0.200	3.10	6.10	1.40	0.200	0.100	0	0	0	0	0	0
27	0.200	2.80	4.20	1.40	0.200	0.100	0	0	0	0	0	0
28	0.200	2.80	2.50	1.40	0.200	0.100	0	0	0	0	0	0
29	1.90		2.60	1.10	0.200	0.100	0	0	0	0	0	0
30	1.80		2.60	1.10	0.200	0.100	0	0	0	0	0	0
31	0.500		2.60		0.200		0	0		0		0
Mean	2.88	17.91	2.82	1.60	0.474	0.123	0	0	0	0	0	0
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0	0.200	0.900	1.10	0.200	0.100	0	0	0	0	0	0
Max	25.00	207.0	14.00	4.90	1.00	0.300	0	0	0	0	0	0
AF	177.3	994.9	173.4	95.41	29.16	7.34	0	0	0	0	0	0

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1951

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	0	0	0.300	0.100	0	0	0	0	0	0
2	0	0	0	0	0.100	0.100	0	0	0	0	0	0
3	0	0	0	0	0	0.200	0	0	0	0	0	0
4	0	0	0	0	0	0.100	0	0	0	0	0	0
5	0	9.50	0	0	0	0.200	0	0	0	0	0	76.00
6	0	18.00	0	0	0	0.200	0	0	0	0	0	20.00
7	0	9.50	0	0	12.00	0.200	0	0	0	0	0	1.70
8	0	0	0	0	22.00	0.200	0	0	0	0	0	0
9	0	0	0	0	21.00	0.100	0	0	0	0	0	0
10	0	0	0	0	20.00	0.100	0	0	0	0	0	0
11	0	0	0	0	24.00	0.100	0	0	0	0	0	0
12	0	0	0	0	26.00	0	0	0	0	0	0	2.20
13	0	0	0	0	27.00	0	0	0	0	0	0	2.00
14	0	0	0	0	15.00	0	0	0	0	0	0	1.00
15	0	0	0	0	0.300	0	0	0	0	0	0	0
16	0	0	0	0	0.200	0	0	0	0	0	0	0
17	0	0	0	0	0.100	0	0	0	0	0	0	0
18	1.20	0	0	0	12.00	0	0	0	0	0	0	0
19	0	0	0	0	0.100	0	0	0	0	0	0	0.600
20	0	0	0	0	0.100	0	0	0	0	0	0	0.200
21	0	0	0	0	0.200	0	0	0	0	0	0	0
22	0	0	0	0	0.200	0	0	0	0	0	0	0
23	0	0	0	0	0.200	0	0	0	0	0	0	0
24	0	0	0	0	0.100	0	0	0	0	0	0	0
25	0	0	0	0	0.100	0	0	0	0	0	0	0
26	0	0	0	0	0.100	0	0	0	0	0	0	0
27	0	0	0	0	0.100	0	0	0	0	0	0	0
28	0	0	0	0	0.100	0	0	0	0	0	0	0
29	2.20		0	6.20	0.100	0	0	0	0	0	0	149.0
30	0		0	2.70	0.100	0	0	0	0	0	0	754.0
31	0		0		0.100		0	0		0		226.0
Mean	0.110	1.32	0	0.297	5.86	0.053	0	0	0	0	0	39.76
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0	0	0	0	0	0	0	0	0	0	0	0
Max	2.20	18.00	0	6.20	27.00	0.200	0	0	0	0	0	754.0
AF	6.74	73.39	0	17.65	360.2	3.17	0	0	0	0	0	2445

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1952

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	118.0	8.10	16.00	66.00	66.00	8.90	1.50	0.500	0.100	0	0	0
2	70.00	7.70	12.00	73.00	79.00	7.70	1.40	0.500	0.100	0	0	5.60
3	28.00	7.00	8.50	81.00	86.00	7.00	1.20	0.500	0.100	0	0	1.10
4	13.00	6.70	7.70	88.00	79.00	7.40	1.20	0.400	0.100	0	0	0.100
5	12.00	6.40	6.40	98.00	70.00	6.70	1.10	0.400	0	0	0	0
6	8.90	6.10	4.50	111.0	62.00	7.40	0.900	0.400	0	0	0	0
7	19.00	6.10	18.00	121.0	59.00	7.00	0.900	0.400	0	0	0	0
8	21.00	5.40	29.00	142.0	57.00	6.50	0.700	0.400	0	0	0	0
9	19.00	5.10	19.00	114.0	48.00	6.00	0.700	0.400	0	0	0	0
10	19.00	5.10	58.00	116.0	46.00	5.50	0.700	0.400	0.100	0	0	0
11	18.00	5.10	94.00	90.00	46.00	5.00	0.700	0.400	0.100	0	0	0
12	19.00	7.00	46.00	68.00	45.00	4.50	0.600	0.400	0.100	0	0	0
13	204.0	6.10	44.00	68.00	42.00	4.00	0.600	0.300	0.100	0	0	0
14	104.0	5.10	35.00	75.00	42.00	3.50	0.600	0.300	0.100	0	0.800	0
15	92.00	4.80	145.0	66.00	42.00	3.50	0.600	0.300	0.100	0	12.00	0
16	447.0	4.50	215.0	62.00	38.00	3.00	0.600	0.300	0.100	0	13.00	0
17	239.0	5.10	118.0	64.00	31.00	3.00	0.600	0.300	0.100	0	4.30	0
18	323.0	5.40	94.00	61.00	26.00	3.00	0.600	0.300	0.100	0	0.300	0
19	193.0	4.80	86.00	82.00	26.00	2.50	0.500	0.300	6.70	0	0.100	0
20	130.0	4.80	68.00	75.00	29.00	2.50	0.500	0.300	34.00	0	0	5.90
21	110.0	4.50	41.00	70.00	34.00	2.50	0.500	0.200	0.700	0	0	5.30
22	98.00	4.20	31.00	66.00	29.00	2.00	0.500	0.200	0.400	0	0	1.40
23	90.00	4.20	22.00	71.00	23.00	2.00	0.500	0.100	0.400	0	0.100	0.600
24	77.00	4.00	25.00	79.00	20.00	2.00	0.500	0.100	0.300	0	0.100	0.300
25	77.00	3.80	59.00	81.00	17.00	2.00	0.500	0.100	0.300	0	0	0.100
26	55.00	4.50	81.00	70.00	16.00	2.00	0.500	0.100	0.200	0	0	0.100
27	20.00	3.50	94.00	52.00	11.00	1.80	0.500	0.100	0.200	0	0	0
28	18.00	3.30	81.00	70.00	11.00	1.80	0.500	0.100	0.100	0	0	1.10
29	16.00	4.50	77.00	62.00	10.00	1.70	0.500	0.100	0.100	0	0	1.40
30	13.00		73.00	62.00	11.00	1.50	0.500	0.100	0	0	0	0.900
31	10.00		66.00		9.30		0.500	0.100		0		3.10
Mean	86.48	5.27	57.23	80.13	39.04	4.13	0.700	0.284	1.49	0	1.02	0.871
Cnt	31	29	31	30	31	30	31	31	30	31	30	31
Min	8.90	3.30	4.50	52.00	9.30	1.50	0.500	0.100	0	0	0	0
Max	447.0	8.10	215.0	142.0	86.00	8.90	1.50	0.500	34.00	0	13.00	5.90
AF	5318	303.3	3519	4768	2401	245.8	43.04	17.45	88.66	0	60.89	53.55

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1953

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.50	1.50	1.00	0.700	3.50	0.200	0	0	0	0	0	0
2	1.80	1.50	1.00	0.700	1.40	0.200	0	0	0	0	0	0
3	1.70	1.70	1.00	0.700	1.10	0.200	0	0	0	0	0	0
4	1.40	4.80	0.900	0.700	0.900	0.100	0	0	0	0	0	0
5	1.10	2.20	0.900	0.800	0.800	0.100	0	0	0	0	0	0
6	1.20	2.00	0.900	0.800	0.700	0.200	0	0	0	0	0	0
7	152.0	1.90	0.800	0.800	0.700	0.100	0	0	0	0	0	0
8	112.0	1.90	0.800	0.700	0.600	0.100	0	0	0	0	0	0
9	13.00	1.90	0.700	0.700	0.600	0.100	0	0	0	0	0	0
10	8.60	2.20	0.700	0.800	0.500	0.100	0	0	0	0	0	0
11	5.30	2.10	0.700	0.700	0.400	0.100	0	0	0	0	0	0
12	3.70	1.50	0.700	0.700	0.400	0.100	0	0	0	0	0	0
13	3.50	1.00	0.800	0.700	0.400	0.100	0	0	0	0	0	0
14	2.50	0.900	0.700	0.600	0.400	0	0	0	0	0	0	0
15	1.90	0.900	0.700	0.500	0.700	0	0	0	0	0	0	0
16	1.50	0.900	0.700	0.500	0.500	0	0	0	0	0	0	0
17	1.40	0.900	0.700	0.500	0.400	0	0	0	0	0	0	0
18	1.50	0.900	0.700	0.500	0.400	0.100	0	0	0	0	0	0
19	2.00	0.900	0.700	0.500	0.400	0	0	0	0	0	0	0
20	2.00	0.900	4.50	0.600	0.400	0	0	0	0	0	0	0
21	2.10	0.900	2.70	0.600	0.300	0	0	0	0	0	0	0
22	2.10	0.900	1.20	0.500	0.300	0	0	0	0	0	0	0
23	2.00	1.00	0.900	0.600	0.300	0	0	0	0	0	0	0
24	1.70	0.900	0.900	0.500	0.400	0	0	0	0	0	0	0
25	1.60	0.900	0.900	0.500	0.300	0	0	0	0	0	0	0
26	1.60	0.900	0.900	0.500	0.300	0	0	0	0	0	0	0
27	1.60	0.800	0.800	0.900	0.400	0	0	0	0	0	0	0
28	1.60	0.900	0.800	71.00	0.400	0	0	0	0	0	0	0
29	1.60		0.900	4.10	0.300	0	0	0	0	0	0	0
30	1.50		0.800	3.00	0.300	0	0	0	0	0	0	0
31	1.50		0.700		0.200		0	0		0		0
Mean	10.95	1.42	1.00	3.18	0.603	0.060	0	0	0	0	0	0
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	1.10	0.800	0.700	0.500	0.200	0	0	0	0	0	0	0
Max	152.0	4.80	4.50	71.00	3.50	0.200	0	0	0	0	0	0
AF	673.4	78.74	61.69	189.2	37.09	3.57	0	0	0	0	0	0

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA,
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1954

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0.500	3.10	51.00	6.60	0.700	0.200	0	0	0	0	0
2	0	0.500	2.80	40.00	5.00	0.700	0.200	0	0	0	0	0
3	0	0.400	2.50	37.00	4.10	0.700	0.100	0	0	0	0	0
4	0	0.400	2.50	37.00	3.90	0.700	0.100	0	0	0	0	1.80
5	0	0.400	2.50	44.00	3.50	0.600	0.100	0	0	0	0	1.10
6	0	0.400	2.50	54.00	3.50	0.500	0.100	0	0	0	0	0.300
7	0	0.400	2.40	48.00	3.00	0.500	0.100	0	0	0	0	0
8	0	0.400	2.50	46.00	3.00	0.500	0.100	0	0	0	0	0
9	0	0.400	2.50	46.00	2.50	0.500	0.100	0	0	0	0	0
10	0	0.400	2.50	46.00	2.50	0.500	0.100	0	0	0	0	0.600
11	0	0.400	2.50	42.00	2.00	0.500	0	0	0	0	100.0	0
12	0	0.400	2.40	37.00	2.00	0.500	0	0	0	0	12.00	0
13	0	8.30	2.40	34.00	1.50	0.500	0.100	0	0	0	2.00	0
14	0	182.0	2.40	31.00	1.50	0.400	0	0	0	0	0.500	0
15	0	50.00	2.20	31.00	1.50	0.400	0	0	0	0	0.200	0
16	0	20.00	2.70	32.00	1.40	0.400	0	0	0	0	0.200	0
17	0	10.00	4.60	31.00	1.30	0.400	0	0	0	0	0.100	0
18	0	13.00	3.70	35.00	1.20	0.400	0	0	0	0	0	0
19	488.0	8.60	3.70	32.00	1.10	0.400	0	0	0	0	0	0
20	100.0	7.20	13.00	28.00	1.10	0.400	0	0	0	0	0	0
21	1.10	6.60	39.00	23.00	1.10	0.300	0	0	0	0	0	0
22	0.100	6.30	635.0	19.00	1.10	0.200	0	0	0	0	0	0
23	0	5.00	528.0	17.00	1.00	0.200	0	0	0	0	0	0
24	210.0	3.90	131.0	15.00	0.900	0.200	0.100	0	0	0	0	0
25	980.0	3.50	132.0	13.00	0.900	0.300	0	0	0	0	0	0
26	116.0	3.50	92.00	11.00	0.900	0.300	0	0	0	0	0	0
27	6.60	3.30	79.00	11.00	0.900	0.300	0	0	0	0	0	0
28	2.40	3.10	62.00	7.80	0.900	0.300	0	0	0	0	0	0
29	0.900		48.00	7.20	0.900	0.200	0	0	0	0	0	0
30	0.700		111.0	7.20	0.800	0.200	0	0	0	0	0	0
31	0.600		73.00		0.700		0	0		0		0
Mean	61.50	12.12	64.37	30.44	2.01	0.423	0.045	0	0	0	3.83	0.123
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0	0.400	2.20	7.20	0.700	0.200	0	0	0	0	0	0
Max	980.0	182.0	635.0	54.00	6.60	0.700	0.200	0	0	0	100.0	1.80
AF	3781	673.0	3958	1811	123.6	25.19	2.78	0	0	0	228.1	7.54

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1955

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	29.00	14.00	1.10	4.30	0.400	0	0	0.100	0	0	0
2	0	17.00	9.00	1.00	2.00	0.400	0	0	0.100	0	0	0
3	0	15.00	6.70	1.00	0.900	0.200	0	0	0.100	0	0	2.10
4	0	14.00	5.60	0.900	0.800	0.200	0	0	0.100	0	0	0
5	0	14.00	5.30	0.900	0.700	0.200	0	0	0.100	0	0	0
6	0	14.00	4.70	0.900	0.700	0.200	0	0	0.100	0	0	0
7	0	14.00	4.40	0.800	1.10	0.200	0	0	0.100	0	0	0
8	0	17.00	3.80	0.800	2.10	0.100	0	0	0.100	0	0	0
9	0	12.00	3.60	0.800	1.00	0.100	0	0	0.100	0	0	0
10	0.200	12.00	3.60	0.800	0.800	0.100	0	0	0.100	0	0	0
11	0.300	6.80	5.60	0.700	0.700	0.100	0	0	0.100	0	0	0
12	0.200	1.20	4.10	0.600	0.600	0.100	0	0	0.100	0	0	0
13	0.100	1.10	3.60	0.600	0.600	0.200	0	0	0.100	0	0	0
14	0	0.900	3.10	0.600	0.600	0.100	0	0	0.100	0	0	0
15	0	0.900	3.10	0.600	0.500	0.100	0	0	0.100	0	0	0
16	1.40	0.900	2.90	0.600	0.500	0.100	0	0	0.100	0	0	0
17	1.00	12.00	2.60	0.600	0.500	0.100	0	0	0.100	0	0	0
18	6.60	9.00	2.40	0.600	0.400	0.100	0	0	0.100	0	0	0
19	22.00	5.00	2.40	0.700	0.400	0	0	0	0.100	0	0	0
20	25.00	4.10	2.30	0.700	0.400	0	0	1.10	0.100	0	0	0
21	16.00	3.10	2.10	0.700	0.400	0	0	0.400	0.100	0	0	0
22	13.00	2.30	2.10	0.700	0.400	0	0	0.300	0.100	0	0	0
23	13.00	1.90	2.10	0.600	0.400	0	0	0.200	0.100	0	0	0
24	13.00	1.80	1.80	0.600	0.400	0	0	0.900	0.100	0	0	0
25	13.00	1.60	1.60	0.600	0.400	0	0	0.200	0.100	0	0	0
26	13.00	1.60	1.20	0.500	0.400	0	0	0.200	0	0	0	0
27	13.00	18.00	1.20	0.500	0.400	0	0	0.100	0	0	0	0
28	13.00	35.00	1.20	0.400	0.300	0	0	0.100	0	0	0	0
29	14.00		1.20	0.400	0.300	0	0	0.100	0	0	0	0
30	14.00		1.20	0.700	0.300	0	0	0.100	0	0	0	0
31	14.00		1.20		0.400		0	0.100		0		0
Mean	6.64	9.47	3.54	0.700	0.765	0.100	0	0.123	0.083	0	0	0.068
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0	0.900	1.20	0.400	0.300	0	0	0	0	0	0	0
Max	25.00	35.00	14.00	1.10	4.30	0.400	0	1.10	0.100	0	0	2.10
AF	408.2	526.0	217.6	41.65	47.01	5.95	0	7.54	4.96	0	0	4.17

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1956

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	1.20	0.600	0.800	0.300	0.200	0	0	0	0	0	0
2	0	0.900	0.600	0.800	0.300	0.200	0	0	0	0	0	0
3	0	0.600	0.600	0.800	0.300	0.100	0	0	0	0	0	0
4	0	0.500	0.600	0.600	0.300	0.100	0	0	0	0	0	0
5	0	0.500	0.600	0.500	0.300	0.100	0	0	0	0	0	0
6	0	0.500	0.600	0.500	0.300	0.200	0	0	0	0	0	0
7	0	0.400	0.700	0.500	0.300	0.100	0	0	0	0	0	0
8	0	0.400	0.700	0.500	0.300	0.100	0	0	0	0	0	0
9	0	0.400	0.700	0.500	0.400	0.100	0	0	0	0	0	0
10	0	0.400	0.700	0.600	0.800	0	0	0	0	0	0	0
11	0	0.300	0.900	0.600	0.400	0	0	0	0	0	0	0
12	0	0.300	1.00	0.900	0.400	0	0	0	0	0	0	0
13	0	0.300	1.00	1.00	0.400	0	0	0	0	0	0	0
14	0	0.300	0.900	0.900	0.300	0	0	0	0	0	0	0
15	0	0.300	0.800	0.800	0.300	0	0	0	0	0	0	0
16	0	0.400	0.800	0.700	0.300	0	0	0	0	0	0	0
17	0	0.400	0.800	0.800	0.300	0	0	0	0	0	0	0
18	0	0.400	0.700	0.800	0.200	0	0	0	0	0	0	0
19	0	0.400	0.700	0.700	0.200	0	0	0	0	0	0	0
20	0	0.400	0.700	0.600	0.300	0	0	0	0	0	0	0
21	0	0.400	0.700	0.400	0.300	0	0	0	0	0	0	0
22	0	0.400	0.700	0.400	0.200	0	0	0	0	0	0	0
23	0	0.700	0.700	0.400	0.300	0	0	0	0	0	0	0
24	0	1.80	0.700	0.400	0.300	0	0	0	0	0	0	0
25	0	1.20	0.800	0.400	0.300	0	0	0	0	0	0	0
26	422.0	0.800	0.800	0.500	0.300	0	0	0	0	0	0	0
27	626.0	0.800	0.700	0.600	0.200	0	0	0	0	0	0	0
28	182.0	0.700	0.700	0.400	0.300	0	0	0	0	0	0	0
29	70.00	0.700	0.600	0.400	0.200	0	0	0	0	0	0	0
30	45.00		0.600	0.400	0.200	0	0	0	0	0	0	0
31	3.20		0.700		0.200		0	0		0		0
Mean	43.49	0.579	0.723	0.607	0.306	0.040	0	0	0	0	0	0
Cnt	31	29	31	30	31	30	31	31	30	31	30	31
Min	0	0.300	0.600	0.400	0.200	0	0	0	0	0	0	0
Max	626.0	1.80	1.00	1.00	0.800	0.200	0	0	0	0	0	0
AF	2674	33.32	44.43	36.10	18.84	2.38	0	0	0	0	0	0

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1957

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	23.00	2.20	0.700	0.900	0.400	0	0	0	0	0
2	0	0	11.00	1.80	0.700	0.800	0.300	0	0	0	0	0
3	0	0	5.40	1.60	0.600	0.700	0.300	0	0	0	1.70	0
4	0	0	4.50	1.40	0.500	0.700	0.200	0	0	0	0	0
5	0	0	3.80	1.00	0.500	0.700	0.200	0	0	0	0	1.20
6	0	0	3.20	1.00	0.500	0.700	0.200	0	0	0	6.20	0
7	5.10	0	2.70	1.00	0.600	0.700	0.100	0	0	0	0	0
8	1.70	0	2.70	1.00	0.600	0.700	0.200	0	0	0	0	0
9	0	0	5.80	1.00	0.700	0.700	0.100	0	0	0	0	0
10	2.60	0	6.20	1.00	0.700	0.700	0.100	0	0	0	0	0
11	0	0	3.20	1.00	0.900	0.600	0.100	0	0	11.00	0	0
12	0	0	2.40	1.00	0.800	0.600	0.100	0	0	0	0	0
13	661.0	0	2.40	1.00	0.700	0.700	0.100	0	0	0	0	0
14	117.0	0	2.70	1.00	0.900	0.800	0	0	0	11.00	0	0
15	2.90	0	2.70	0.900	0.900	0.800	0.100	0	0	9.00	0	24.00
16	0	0	3.80	0.900	0.700	0.700	0	0	0	0	0	53.00
17	0	0	3.20	0.900	0.600	0.600	0	0	0	0	0	123.0
18	0	0	2.40	0.900	0.700	0.600	0	0	0	0	0	3.80
19	0	0	2.20	0.900	17.00	0.600	0	0	0	0	0	0
20	0	0	1.80	1.40	5.30	0.600	0	0	0	0	0	0
21	0	0	1.60	1.30	9.80	0.500	0	0	0	0.200	0	0
22	0	0	2.00	1.20	4.60	0.500	0	0	0	0	0	0
23	0	34.00	2.00	1.20	6.10	0.500	0	0	0	0	0	0
24	0	7.40	2.00	1.20	3.60	0.500	0	0	0	0	0	0
25	0	2.40	2.00	1.20	2.40	0.400	0	0	0	0	0	0
26	0.200	0	2.00	1.20	1.60	0.400	0	0	0	0	0	0
27	0	0	2.00	1.00	1.30	0.400	0	0	0	0	0	0
28	0	7.50	1.80	0.800	1.20	0.500	0	0	0	0	0	0
29	0.800		2.20	0.800	1.20	0.500	0	0	0	0	0	0
30	0.500		2.20	0.600	1.00	0.400	0	0	0	0	0	0
31	0		2.40		1.00		0	0		0		0

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	25.54	1.83	3.78	1.11	2.21	0.617	0.081	0	0	1.01	0.263	6.61
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0	0	1.60	0.600	0.500	0.400	0	0	0	0	0	0
Max	661.0	34.00	23.00	2.20	17.00	0.900	0.400	0	0	11.00	6.20	123.0
AF	1571	101.8	232.7	66.25	135.7	36.69	4.96	0	0	61.89	15.67	406.6

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1958

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	8.90	444.0	146.0	32.00	4.20	4.00	0.500	0.300	0.200	0
2	0	0	8.00	438.0	146.0	30.00	4.20	3.10	0.500	0.200	0.100	0
3	0	24.00	7.30	881.0	139.0	28.00	4.00	2.70	0.500	0.200	0.100	1.00
4	0	315.0	6.40	334.0	134.0	27.00	4.00	2.20	0.500	0.200	0.100	0.200
5	0	175.0	5.20	246.0	134.0	26.00	3.80	2.10	0.400	0.200	0.100	0.100
6	0	90.00	7.90	248.0	134.0	23.00	3.60	14.00	0.400	0.200	0.100	0
7	0	10.00	8.90	218.0	134.0	20.00	3.60	37.00	0.600	0.200	0.100	0
8	0	3.00	7.00	215.0	115.0	18.00	3.60	8.00	7.90	0.200	0.100	0
9	0	3.00	7.30	167.0	120.0	17.00	3.40	4.60	2.40	0.200	0.100	0
10	0	3.00	6.70	141.0	120.0	16.00	2.90	3.80	2.00	0.100	0.100	0
11	0	3.00	8.90	144.0	118.0	15.00	2.90	2.90	1.30	0.100	0.100	0
12	0	2.90	10.00	136.0	100.0	14.00	2.90	2.70	1.00	0.100	0.100	0
13	0	2.10	10.00	129.0	66.00	15.00	2.90	3.10	1.30	0.100	0.100	0
14	0	1.60	9.30	127.0	71.00	12.00	3.10	11.00	1.00	0.100	0	0
15	0	1.40	14.00	118.0	53.00	10.00	3.10	7.30	1.00	0.100	0	0
16	0	1.30	729.0	129.0	66.00	11.00	3.10	4.00	0.800	0.100	0.700	0
17	0	1.20	326.0	151.0	63.00	10.00	3.10	2.90	0.600	0.100	0.200	0
18	0	1.20	164.0	186.0	65.00	10.00	3.10	2.40	0.600	0.100	0.100	0
19	0	88.00	100.0	230.0	62.00	9.30	3.10	1.80	0.400	0.100	0.100	0
20	0	49.00	70.00	251.0	55.00	8.40	3.10	1.70	0.400	0.100	0.100	0
21	0	5.00	150.0	286.0	53.00	7.60	3.10	1.60	0.400	0	0	0
22	0	3.00	357.0	282.0	59.00	7.60	3.10	1.20	0.400	0	0	0
23	0	2.00	198.0	234.0	53.00	7.30	3.10	1.20	0.600	0	0	0
24	0	2.00	141.0	244.0	58.00	6.70	2.90	1.00	1.40	3.20	0	0
25	0	30.00	88.00	230.0	60.00	6.40	2.90	1.00	1.00	6.20	0	0
26	52.00	30.00	59.00	189.0	56.00	5.50	2.70	0.800	0.700	1.40	0	0
27	15.00	16.00	92.00	175.0	51.00	4.60	2.50	0.800	0.500	0.800	0	0
28	6.40	10.00	80.00	160.0	55.00	4.40	1.70	0.800	0.400	0.500	0	0
29	5.50		70.00	146.0	42.00	4.20	31.00	0.700	0.300	0.400	0	0
30	0.900		60.00	146.0	38.00	4.20	40.00	0.700	0.300	0.300	0	0
31	0		60.00		37.00		6.70	0.600		0.200		0
Mean	2.57	31.17	92.57	234.2	83.97	13.67	5.40	4.25	1.00	0.516	0.087	0.042
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0	0	5.20	118.0	37.00	4.20	1.70	0.600	0.300	0	0	0
Max	52.00	315.0	729.0	881.0	146.0	32.00	40.00	37.00	7.90	6.20	0.700	1.00
AF	158.3	1731	5692	13934	5163	813.6	332.0	261.2	59.70	31.74	5.16	2.58

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1959

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	0.100	0	0	0	0	0.900	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	4.80	0	0	0	0	0	0	0	0	0	0	0
7	0.900	0	0	0	0	0	0	0	0	0	0	0
8	0.400	0.400	0	0	0	0	0	0	0	0	0	0
9	0.100	1.30	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	27.00	0	0	0	0	0	0	0	0	0	0
12	0	21.00	0	0	0	0	0	0	0	0	0	0
13	0	2.00	0	0	0	0	0	0	0	0	0	0
14	0	1.70	0	0	0	0	0	0	0	0	0	0
15	0	1.40	0	0	0	0	0	0	0	0	0	0
16	0	145.0	0	0	0	0	0	0	0	0	0	0
17	0	154.0	0	0	0	0	0	0	0	0	0	0
18	0	38.00	0	0	0	0	0	0	0	0	0	0
19	0	18.00	0	0	0	0	0	0	0	0	0	0
20	0	3.40	0	0	0	0	0	0	0	0	0	0
21	0	2.80	0	0	0	0	0	0	0	0	0	0
22	0	2.70	0	0	0	0	0	0	0	0	0	0
23	0	2.40	0	0	0	0	0	0	0	0	0	0
24	0	1.70	0	0	0	0	0	0	0	0	0	0
25	0	0.800	0	0	0	0	0	0	0	0	0	7.30
26	0	0.200	0	0	0	0	0	0	0	0	0	0
27	0	0.100	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0
29	0		0	0	0	0	0	0	0	0	0	0
30	0		0	0	0	0	0	0	0	0	0	0
31	0		0		0		0.500	0		0		0

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0.200	15.14	3.23E-03	0	0	0	0.016	0.029	0	0	0	0.235
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0	0	0	0	0	0	0	0	0	0	0	0
Max	4.80	154.0	0.100	0	0	0	0.500	0.900	0	0	0	7.30
AF	12.30	840.8	0.198	0	0	0	0.992	1.79	0	0	0	14.48

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1960

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	31.00	0.500	0.700	0.200	0.100	0	0	0	0	0
2	0	5.90	13.00	0.500	0.400	0.200	0	0	0	0	0	0
3	0	0.300	7.60	0.500	0.400	0.200	0	0	0	0	0	0
4	0	0	5.20	0.400	0.600	0.200	0	0	0	0	0	0
5	3.30	0	3.60	0.400	0.700	0.200	0	0	0	0	0	0
6	0	0	2.50	0.400	0.300	0.200	0	0	0	0	4.50	0
7	4.50	0	1.80	0.400	0.300	0.200	0	0	0	0	0	0
8	0	0	1.70	0.500	0.300	0.200	0	0	0	0	0	0
9	0	8.90	1.60	0.500	0.300	0.200	0	0	0	0	0	0
10	0	13.00	1.30	0.500	0.300	0.200	0	0	0	0	0	0
11	0	24.00	1.00	0.600	0.300	0.200	0	0	0	0	0	0
12	15.00	5.80	1.30	0.600	0.300	0.200	0	0	0	0	0	0
13	1.80	5.20	1.00	0.600	0.300	0.200	0	0	0	0	0	0
14	0	3.40	0.800	0.600	0.300	0.200	0	0	0	0	0	0
15	0	1.80	0.700	0.600	0.400	0.200	0	0	0	0	0	0
16	0	1.00	0.600	0.600	0.400	0.200	0	0	0	0	0	0
17	0	1.10	0.500	0.600	0.300	0.100	0	0	0	0	0	0
18	0	0.900	0.400	0.500	0.300	0.100	0	0	0	0	0	0
19	0	1.20	0.400	0.500	0.300	0.100	0	0	0	0	0	0
20	0	0.100	0.400	0.500	0.300	0.100	0	0	0	0	0	0
21	0	0	0.400	0.500	0.300	0.100	0	0	0	0	0	0
22	0	0	0.400	0.700	0.300	0.100	0	0	0	0	0	0
23	0	0	0.400	0.700	0.300	0.100	0	0	0	0	0	0
24	0	0	0.400	0.600	0.300	0.100	0	0	0	0	0	0
25	0	0.100	0.400	0.500	0.300	0.100	0	0	0	0	0	0
26	0	0	0.400	0.500	0.300	0.100	0	0	0	0	0	0
27	0	0	0.500	20.00	0.300	0.100	0	0	0	0	0	0
28	0	0	1.80	14.00	0.200	0.100	0	0	0	0	0	0
29	0	16.00	1.00	3.40	0.200	0.100	0	0	0	0	0	0
30	0		0.700	1.30	0.200	0.100	0	0	0	0	0	0
31	0		0.600		0.200		0	0		0		0
Mean	0.794	3.06	2.69	1.75	0.335	0.153	3.23E-03	0	0	0	0.150	0
Cnt	31	29	31	30	31	30	31	31	30	31	30	31
Min	0	0	0.400	0.400	0.200	0.100	0	0	0	0	0	0
Max	15.00	24.00	31.00	20.00	0.700	0.200	0.100	0	0	0	4.50	0
AF	48.79	175.9	165.4	104.1	20.63	9.12	0.198	0	0	0	8.93	0

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1961

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	151.0
3	0	0	0	0	0	0	0	0	0	0	0	51.00
4	0	0	0	0	0	0	0	0	0	0	0	23.00
5	0	0	0	0	0	0	0	0	0	0	0	0.100
6	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0
29	0		0	0	0	0	0	0	0	0	0	0
30	0		0	0	0	0	0	0	0	0	0	0
31	0		0		0		0	0		0		0
Mean	0	0	0	0	0	0	0	0	0	0	0	7.26
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0	0	0	0	0	0	0	0	0	0	0	0
Max	0	0	0	0	0	0	0	0	0	0	0	151.0
AF	0	0	0	0	0	0	0	0	0	0	0	446.5

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1962

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	12.00	9.30	2.50	1.00	0.400	0.100	0	0	0	0
2	0	0	11.00	8.90	2.50	1.00	0.400	0.100	0	0	0	0
3	0	0	11.00	8.90	2.40	1.00	0.400	0.100	0	0	0	0
4	0	0	10.00	8.40	2.40	1.00	0.400	0.100	0	0	0	0
5	0	0	12.00	8.00	2.40	1.00	0.400	0.100	0	0	0	0
6	0	0	27.00	8.00	2.40	1.00	0.400	0.100	0	0	0	0
7	0	0	20.00	11.00	2.20	1.00	0.400	0	0	0	0	0
8	0	172.0	10.00	8.40	2.20	1.00	0.400	0	0	0	0	0
9	0	258.0	10.00	52.00	1.60	1.00	0.300	0	0	0	0	0
10	0	204.0	10.00	94.00	1.40	1.00	0.300	0	0	0	0	0
11	0	481.0	10.00	109.0	1.30	1.00	0.300	0	0	0	0	0
12	0	353.0	10.00	109.0	1.20	1.00	0.300	0	0	0	0	0
13	0	194.0	10.00	109.0	1.10	1.00	0.300	0	0	0	0	0
14	0	102.0	11.00	102.0	1.60	1.00	0.300	0	0	0	0	0
15	0	112.0	10.00	109.0	1.40	1.00	0.300	0	0	0	0	0
16	0	177.0	9.70	96.00	7.50	1.00	0.300	0	0	0	0	0
17	0	35.00	10.00	77.00	5.50	0.900	0.200	0	0	0	0	0
18	0	20.00	9.70	11.00	1.40	0.700	0.200	0	0	0	0	0
19	0	32.00	11.00	7.30	1.10	0.700	0.200	0	0	0	0	0
20	50.00	24.00	13.00	4.60	1.00	0.700	0.200	0	0	0	0	0
21	11.00	10.00	11.00	3.80	1.00	0.600	0.200	0	0	0	0	0
22	7.00	5.50	12.00	3.60	1.00	0.600	0.200	0	0	0	0	0
23	2.10	3.60	21.00	3.40	1.00	0.600	0.200	0	0	0	0	0
24	20.00	2.90	19.00	3.10	1.00	0.600	0.200	0	0	0	0	0
25	31.00	2.70	16.00	3.10	1.00	0.600	0.200	0	0	0	0	0
26	16.00	2.00	12.00	2.90	1.00	0.600	0.200	0	0	0	0	0
27	2.00	6.10	11.00	2.90	1.00	0.400	0.200	0	0	0	0	0
28	2.40	13.00	10.00	3.10	1.00	0.400	0.200	0	0	0	0	0
29	1.20		10.00	2.90	1.00	0.400	0.200	0	0	0	0	0
30	0.100		10.00	2.70	1.00	0.400	0.200	0	0	0	0	0
31	0		9.70		1.00		0.100	0		0		0
Mean	4.61	78.92	12.23	32.74	1.81	0.807	0.274	0.019	0	0	0	0
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0	0	9.70	2.70	1.00	0.400	0.100	0	0	0	0	0
Max	50.00	481.0	27.00	109.0	7.50	1.00	0.400	0.100	0	0	0	0
AF	283.2	4383	751.9	1948	111.3	48.00	16.86	1.19	0	0	0	0

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1963

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0.300	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	3.00	0	0	0	0	0	0	0	0	0	0
10	0	224.0	0	0	0	0	0	0	0	0	0	0
11	0	6.60	0	0	0	0	0	0	0	0	0	0
12	0	2.60	0	0	0	0	0	0	0	0	0	0
13	0	0.100	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0.400	0
17	0	0	0.700	0	0	0	0	0	0	0	0	0
18	0	0	0.100	0	0	0	0	0	5.40	0	0	0
19	0	0	0	0	0	0	0	0	61.00	0	0	0
20	0	0	0	0	0	0	0	0	48.00	0	14.00	0
21	0	0	0	4.00	0	0	0	0	27.00	0	5.00	0
22	0	0	0	0.200	0	0	0	0	0	0	0.800	0
23	0	0	0	0	0	0	0	0	7.60	0	0.100	0
24	0	0	0	0	0	0	0	0	29.00	0	0.100	0
25	0	0	0	0	0	0	0	0	14.00	0	0	0
26	0	0	0	0.800	0	0	0	0	0	0	0	0
27	0	0	0	1.50	0	0	0	0	0	0	0	0
28	0	0	0	0.100	0	0	0	0	0	0	0	0
29	0		0	0	0	0	0	0	0	0	0	0
30	0		0	0	0	0	0	0	0	0	0	0
31	0		0		0		0	0		0		0
Mean	0	8.44	0.026	0.220	0	0	0	0	6.40	0	0.690	0
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0	0	0	0	0	0	0	0	0	0	0	0
Max	0	224.0	0.700	4.00	0	0	0	0	61.00	0	14.00	0
AF	0	468.7	1.59	13.09	0	0	0	0	380.8	0	41.06	0

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1964

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	0	10.00	0.200	0.300	0.200	0	0	0	0	0
2	0	0	0	19.00	0.200	0.300	0.200	0	0	0	0	0
3	0	0	0	4.60	0.200	0.300	0.200	0	0	0	0	0
4	0	0	0	1.90	0.200	0.300	0.200	0	0	0	0	0
5	0	0	0	1.10	0.200	0.300	0.200	0	0	0	0	0
6	0	0	0	0.800	2.20	0.300	0.200	0	0	0	0	0
7	0	0	0	0.400	2.60	0.300	0.200	0	0	0	0	0
8	0	0	0	0.300	2.00	0.300	0.200	0	0	0	0	0
9	0	0	0	0.300	2.40	0.300	0.100	0	0	0	0	0
10	0	0	0	0.300	0.400	0.300	0.100	0	0	0	0	0
11	0	0	0	0.300	0.400	0.300	0.100	0	0	0	0.100	0
12	0	0	0	0.200	0.400	0.300	0.100	0	0	0	0	0
13	0	0	0	0.200	0.400	0.300	0.100	0	0	0	0	0
14	0	0	0	0.200	0.400	0.300	0.100	0	0	0	0	0
15	0	0	0	0.200	0.400	0.300	0.100	0	0	0	0	0
16	0	0	0	0.200	0.400	0.300	0.100	0	0	0	0	0
17	0	0	0	0.200	0.400	0.300	0.100	0	0	0	0	0
18	0	0	0	0.200	0.300	0.300	0.100	0	0	0	0	0
19	0	0	0	0.200	0.300	0.300	0.100	0	0	0	0	0
20	0	0	0	0.200	0.300	0.300	0.100	0	0	0	0	0
21	6.90	0	0	0.200	0.300	0.300	0.100	0	0	0	0	0
22	14.00	0	0	0.200	0.300	0.300	0.100	0	0	0	0	0
23	2.40	0	3.10	0.200	0.300	0.300	0.100	0	0	0	0	0
24	0.200	0	1.00	0.200	0.300	0.300	0.100	0	0	0	0	0
25	0.100	0	1.60	0.200	0.300	0.300	0.100	0	0	0	0	0
26	0	0	9.90	0.200	0.300	0.300	0.100	0	0	0	0	0
27	0	0	3.50	0.200	0.300	0.300	0.100	0	0	0	0	13.00
28	0	0	2.70	0.200	0.300	0.300	0	0	0	0	0	41.00
29	0	0	0.800	0.200	0.300	0.200	0	0	0	0	0	13.00
30	0		0.400	0.200	0.300	0.200	0	0	0	0	0	0
31	0		0.200		0.300		0	0		0		0
Mean	0.761	0	0.748	1.43	0.568	0.293	0.113	0	0	0	3.33E-03	2.16
Cnt	31	29	31	30	31	30	31	31	30	31	30	31
Min	0	0	0	0.200	0.200	0.200	0	0	0	0	0	0
Max	14.00	0	9.90	19.00	2.60	0.300	0.200	0	0	0	0.100	41.00
AF	46.81	0	46.02	84.89	34.91	17.45	6.94	0	0	0	0.198	132.9

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1965

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	0	18.00	23.00	0.900	0.300	0.100	0	0	0	95.00
2	0	0	0	46.00	18.00	0.900	0.300	0.100	0	0	0	90.00
3	0	0	0	30.00	14.00	0.900	0.300	0.100	0	0	0	85.00
4	0	0	0	24.00	11.00	0.800	0.200	0.100	0	0	0	80.00
5	0	0	0	10.00	5.80	0.700	0.200	0.100	0	0	0	75.00
6	0	0.400	0	3.60	5.40	0.700	0.200	0.100	0	0	0	70.00
7	0.300	0.200	0	2.40	2.00	0.700	0.200	0.100	0	0	0	65.00
8	7.90	0	0	15.00	2.00	0.700	0.200	0.100	0	0	0	60.00
9	0	0	0	113.0	2.00	0.600	0.200	0.100	0	0	0	55.00
10	0	0	0	125.0	2.00	0.600	0.200	0.100	0	0	0	100.0
11	0	0	0	0.900	1.90	0.500	0.200	0.100	0	0	0	95.00
12	0	0	0	0.800	1.70	0.500	0.200	0.100	0	0	0	90.00
13	0	0	0	0.500	1.40	0.500	0.200	0.100	0	0	0	85.00
14	0	0	0	0.300	1.30	0.500	0.200	0.100	0	0	0	80.00
15	0	0	0	0.100	1.20	0.500	0.200	0.100	0	0	0	75.00
16	0	0	0	1.00	1.10	0.500	0.200	0.100	0	0	5.00	130.0
17	0	0	0	5.00	1.00	0.500	0.200	0.100	0	0	20.00	100.0
18	0	0	0	7.00	1.00	0.500	0.100	0.100	0	0	77.00	90.00
19	0	0	0	10.00	1.00	0.500	0.100	0.100	0	0	19.00	80.00
20	0	0	0	13.00	1.00	0.500	0.100	0.100	0	0	0	75.00
21	0	0	0	15.00	1.00	0.500	0.100	0.100	0	0	0	70.00
22	0	0	0	18.00	1.00	0.400	0.100	0	0	0	1480	65.00
23	0	0	0	21.00	0.900	0.400	0.100	0	0	0	2900	60.00
24	0.500	0	0	25.00	0.900	0.400	0.100	0	0	0	400.0	60.00
25	0.100	0	0	28.00	0.900	0.400	0.100	0	0	0	450.0	55.00
26	0	0	0	31.00	0.900	0.400	0.100	0	0	0	250.0	55.00
27	0	0	0	35.00	0.900	0.400	0.100	0	0	0	200.0	50.00
28	0	0	0	31.00	0.900	0.400	0.100	0	0	0	150.0	50.00
29	0		0	31.00	0.900	0.400	0.100	0	0	0	125.0	1500
30	0		0	29.00	0.900	0.400	0.100	0	0	0	100.0	1000
31	0		0		0.900		0.100	0		0		500.0
Mean	0.284	0.021	0	22.99	3.48	0.553	0.165	0.068	0	0	205.9	165.8
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0	0	0	0.100	0.900	0.400	0.100	0	0	0	0	50.00
Max	7.90	0.400	0	125.0	23.00	0.900	0.300	0.100	0	0	2900	1500
AF	17.45	1.19	0	1368	214.0	32.93	10.12	4.17	0	0	12250	10195

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1966

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	300.0	50.00	6.60	3.20	2.20	0.800	0.700	0.300	0.100	0	0	0
2	250.0	48.00	7.40	3.20	2.00	0.800	0.700	0.300	0.100	0	0	0
3	175.0	47.00	7.00	3.20	2.00	0.800	0.700	0.300	0.100	0	0	387.0
4	130.0	45.00	6.00	3.20	2.00	0.800	0.700	0.200	0.100	0	0	77.00
5	124.0	44.00	5.20	3.00	2.00	0.900	0.700	0.200	0.100	0	0	2460
6	127.0	110.0	4.70	2.90	2.00	0.900	0.700	0.200	0.100	0	0	5460
7	124.0	73.00	4.70	2.90	2.20	0.900	0.600	0.200	0.100	0	0	3680
8	104.0	30.00	4.40	2.80	2.30	0.900	0.600	0.200	0.100	0	0	910.0
9	86.00	30.00	4.40	2.80	2.30	0.900	0.600	0.200	0.100	0	0	530.0
10	79.00	26.00	4.20	2.80	2.30	0.900	0.600	0.200	0.100	0	0	350.0
11	79.00	30.00	4.20	2.80	2.30	0.800	0.600	0.200	0.100	0	0	296.0
12	83.00	22.00	4.00	2.80	2.20	0.800	0.600	0.200	0.100	0	0	270.0
13	83.00	20.00	4.00	2.80	2.00	0.800	0.600	0.200	0.100	0	0	240.0
14	88.00	22.00	4.00	2.60	2.00	0.800	0.600	0.200	0.100	0	0	196.0
15	86.00	22.00	4.00	2.40	2.00	0.800	0.600	0.200	0	0	0	156.0
16	76.00	21.00	3.80	2.40	2.00	0.800	0.500	0.200	0	0	0	135.0
17	74.00	20.00	3.60	2.60	2.00	0.800	0.500	0.100	0	0	0	120.0
18	74.00	14.00	3.40	2.80	2.00	0.800	0.500	0.100	0	0	0	115.0
19	72.00	12.00	3.60	3.00	1.80	0.800	0.500	0.100	0	0	0	110.0
20	70.00	10.00	3.40	2.80	1.80	0.800	0.500	0.100	0	0	0	105.0
21	63.00	10.00	3.40	2.80	1.70	0.800	0.500	0.100	0	0	0	100.0
22	63.00	10.00	3.40	2.60	1.50	0.800	0.400	0.100	0	0	0	97.00
23	62.00	9.60	3.60	2.40	1.10	0.800	0.400	0.100	0	0	0	96.00
24	63.00	8.80	3.60	2.30	1.10	0.800	0.400	0.100	0	0	0	96.00
25	56.00	8.00	4.00	2.30	0.900	0.800	0.400	0.100	0	0	0	93.00
26	56.00	7.70	3.60	2.30	0.900	0.800	0.400	0.100	0	0	0	91.00
27	50.00	7.40	3.40	2.30	0.900	0.800	0.400	0.100	0	0	0	88.00
28	40.00	6.90	3.20	2.30	0.900	0.800	0.400	0.100	0	0	0	88.00
29	30.00		3.00	2.30	0.900	0.800	0.400	0.100	0	0	0	88.00
30	50.00		2.90	2.30	0.900	0.800	0.400	0.100	0	0	0	88.00
31	60.00		2.80		0.900		0.400	0.100		0		86.00
Mean	92.81	27.30	4.18	2.70	1.71	0.820	0.535	0.161	0.047	0	0	535.7
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	30.00	6.90	2.80	2.30	0.900	0.800	0.400	0.100	0	0	0	0
Max	300.0	110.0	7.40	3.20	2.30	0.900	0.700	0.300	0.100	0	0	5460
AF	5707	1516	256.9	160.5	105.3	48.79	32.93	9.92	2.78	0	0	32942

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1967

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	83.00	112.0	56.00	67.00	130.0	34.00	12.00	11.00	64.00	33.00	5.60	60.00
2	81.00	102.0	62.00	79.00	130.0	30.00	12.00	10.00	64.00	9.20	5.40	31.00
3	70.00	83.00	63.00	76.00	133.0	26.00	12.00	10.00	54.00	8.80	5.70	20.00
4	70.00	76.00	74.00	97.00	113.0	23.00	12.00	9.20	51.00	8.80	5.40	7.00
5	70.00	72.00	65.00	130.0	58.00	26.00	12.00	9.20	40.00	8.40	5.10	6.60
6	67.00	70.00	63.00	107.0	56.00	32.00	12.00	9.20	29.00	8.40	5.40	6.30
7	67.00	60.00	62.00	115.0	58.00	33.00	11.00	9.60	49.00	8.00	5.10	6.00
8	62.00	60.00	62.00	115.0	67.00	32.00	10.00	9.60	46.00	7.70	4.80	6.30
9	60.00	60.00	60.00	102.0	86.00	31.00	10.00	16.00	42.00	7.70	5.10	6.60
10	60.00	60.00	56.00	96.00	130.0	31.00	10.00	9.60	42.00	7.70	5.10	6.60
11	62.00	62.00	60.00	166.0	102.0	30.00	10.00	9.20	29.00	7.70	5.10	6.60
12	62.00	72.00	79.00	139.0	91.00	30.00	10.00	9.20	26.00	7.70	4.80	6.60
13	55.00	74.00	169.0	127.0	81.00	30.00	29.00	9.20	49.00	7.70	4.80	7.00
14	55.00	65.00	215.0	130.0	79.00	26.00	81.00	19.00	48.00	7.70	5.10	6.00
15	55.00	65.00	150.0	130.0	72.00	24.00	63.00	51.00	48.00	7.70	4.80	5.70
16	58.00	65.00	139.0	115.0	74.00	24.00	62.00	47.00	48.00	7.70	4.80	5.70
17	58.00	64.00	139.0	112.0	74.00	24.00	42.00	63.00	48.00	7.70	4.60	5.70
18	56.00	64.00	139.0	127.0	74.00	24.00	18.00	63.00	48.00	7.70	4.30	17.00
19	55.00	64.00	133.0	150.0	74.00	24.00	16.00	63.00	46.00	14.00	104.0	20.00
20	55.00	63.00	133.0	150.0	74.00	24.00	15.00	58.00	40.00	19.00	106.0	13.00
21	53.00	63.00	133.0	172.0	72.00	20.00	14.00	58.00	31.00	14.00	59.00	12.00
22	127.0	63.00	130.0	235.0	72.00	16.00	18.00	30.00	18.00	7.00	46.00	12.00
23	153.0	60.00	112.0	205.0	79.00	16.00	48.00	52.00	10.00	6.30	39.00	14.00
24	255.0	62.00	115.0	176.0	79.00	16.00	45.00	88.00	8.80	5.40	27.00	14.00
25	318.0	62.00	102.0	150.0	76.00	16.00	37.00	74.00	9.20	5.10	7.70	14.00
26	133.0	60.00	96.00	163.0	76.00	15.00	15.00	63.00	8.00	5.40	6.30	13.00
27	127.0	58.00	81.00	168.0	67.00	15.00	14.00	63.00	8.80	5.40	15.00	11.00
28	124.0	58.00	81.00	168.0	63.00	14.00	12.00	60.00	14.00	4.80	29.00	11.00
29	121.0		81.00	158.0	55.00	13.00	13.00	34.00	13.00	4.80	27.00	9.70
30	104.0		67.00	145.0	47.00	12.00	11.00	33.00	41.00	5.10	52.00	9.20
31	106.0		65.00		40.00		10.00	52.00		5.10		8.80
Mean	92.97	67.82	98.13	135.7	80.06	23.70	22.45	35.55	35.76	8.73	20.30	12.21
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	53.00	58.00	56.00	67.00	40.00	12.00	10.00	9.20	8.00	4.80	4.30	5.70
Max	318.0	112.0	215.0	235.0	133.0	34.00	81.00	88.00	64.00	33.00	106.0	60.00
AF	5716	3767	6034	8073	4923	1410	1381	2186	2128	536.9	1208	750.6

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1968

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	8.40	5.70	7.00	6.60	4.10	2.40	0.800	1.20	0.400	0	0.200	0
2	8.40	5.10	6.00	23.00	4.10	2.40	0.800	0.800	0.300	0	0.100	0
3	8.40	4.80	5.70	12.00	4.10	2.20	0.800	0.400	0.400	0	0.100	0
4	8.40	4.80	5.10	9.70	4.10	2.20	0.800	0.400	0.400	0.100	0.100	0
5	8.00	4.80	5.10	8.00	4.10	2.40	0.900	0.400	0.300	0.100	0.100	0
6	7.70	4.80	5.70	7.70	4.10	2.50	0.900	0.400	0.300	0	0.200	0
7	6.60	4.80	7.40	7.40	4.10	2.70	0.800	4.30	0.300	0	0.100	0
8	6.30	4.80	139.0	7.00	4.10	2.90	0.600	9.70	0.200	0	0	0
9	6.30	5.10	100.0	7.00	4.10	2.70	0.600	6.80	0.200	0	0	0
10	5.70	5.10	81.00	7.00	4.10	2.40	0.600	1.40	0.200	0	0	0
11	5.70	5.10	58.00	6.60	4.10	2.20	0.600	1.10	0.200	0	0	0
12	5.40	5.10	13.00	6.60	4.80	2.20	0.600	1.00	0.200	0	0	0
13	4.80	6.00	13.00	6.60	4.80	2.10	0.600	0.800	0.200	0	0	0
14	4.80	6.00	12.00	6.30	4.30	2.10	0.600	0.800	0.200	0	0	0
15	4.80	5.70	11.00	6.30	4.10	2.00	0.600	0.800	0.200	0	0	0
16	4.60	5.40	9.70	6.30	4.10	1.90	0.600	0.600	0.200	0	0.100	0
17	4.60	5.10	9.20	7.00	3.70	1.90	0.600	0.600	0.100	0	0.200	0
18	4.10	5.10	8.80	6.60	3.50	1.70	0.700	0.700	0.100	0	0	0
19	4.10	4.80	8.00	6.30	3.50	1.60	0.800	0.600	0.100	0	0	0
20	4.10	4.80	7.40	5.70	3.50	1.50	0.800	0.600	0.100	0	0	0
21	4.10	4.60	7.00	5.70	3.50	1.30	0.800	0.600	0.100	0	0	0
22	4.10	4.60	7.00	5.40	3.30	1.30	0.800	0.700	0.100	0	0	0
23	4.10	4.60	7.00	5.10	3.30	1.20	0.800	0.600	0.100	0	0	0
24	4.10	4.30	6.30	5.10	3.10	1.20	3.40	0.600	0.100	0	0	0
25	4.10	3.90	6.00	5.10	2.90	1.10	0.800	0.400	0.100	0	0	0
26	5.10	13.00	6.00	5.10	2.50	1.00	0.600	0.400	0.100	0	0	0
27	7.40	36.00	8.00	5.10	2.50	1.00	0.600	0.400	0.100	0	0	0.600
28	8.40	38.00	6.30	4.80	2.50	0.900	0.600	0.400	0.100	0	0	0.500
29	6.30	31.00	6.00	4.60	2.90	0.800	0.400	0.400	0	0	0	0.200
30	6.30		6.00	4.40	2.70	0.700	0.300	0.400	0	0	0	0.100
31	5.70		5.70		2.50		9.70	0.400		0.100		0
Mean	5.84	8.38	18.82	7.00	3.65	1.82	1.06	1.25	0.180	9.68E-03	0.040	0.048
Cnt	31	29	31	30	31	30	31	31	30	31	30	31
Min	4.10	3.90	5.10	4.40	2.50	0.700	0.300	0.400	0	0	0	0
Max	8.40	38.00	139.0	23.00	4.80	2.90	9.70	9.70	0.400	0.100	0.200	0.600
AF	358.8	481.8	1157	416.7	224.3	108.1	65.26	76.76	10.71	0.595	2.38	2.98

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1969

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	300.0	1750	550.0	386.0	346.0	192.0	152.0	82.00	93.00	63.00	59.00
2	0	270.0	1000	500.0	420.0	364.0	192.0	150.0	104.0	91.00	62.00	57.00
3	0	250.0	600.0	470.0	490.0	337.0	192.0	147.0	155.0	88.00	61.00	56.00
4	0	450.0	520.0	440.0	600.0	302.0	192.0	144.0	155.0	87.00	60.00	56.00
5	0	600.0	480.0	410.0	960.0	302.0	192.0	141.0	155.0	87.00	59.00	55.00
6	0	620.0	440.0	390.0	880.0	298.0	192.0	144.0	168.0	87.00	70.00	55.00
7	0	620.0	420.0	440.0	774.0	290.0	192.0	141.0	170.0	85.00	114.0	55.00
8	0	540.0	400.0	500.0	640.0	286.0	186.0	165.0	155.0	85.00	70.00	54.00
9	1.00	450.0	380.0	390.0	560.0	282.0	180.0	180.0	150.0	82.00	70.00	54.00
10	0	360.0	365.0	335.0	500.0	274.0	173.0	158.0	147.0	82.00	74.00	54.00
11	0	340.0	350.0	325.0	450.0	274.0	170.0	150.0	147.0	81.00	70.00	54.00
12	0	320.0	340.0	315.0	400.0	270.0	167.0	147.0	144.0	81.00	66.00	54.00
13	0	310.0	330.0	310.0	370.0	258.0	167.0	138.0	147.0	80.00	64.00	53.00
14	91.00	400.0	325.0	400.0	340.0	254.0	164.0	132.0	147.0	80.00	62.00	53.00
15	46.00	520.0	320.0	600.0	320.0	272.0	164.0	129.0	147.0	79.00	64.00	52.00
16	0.800	500.0	320.0	550.0	305.0	364.0	164.0	120.0	136.0	79.00	67.00	52.00
17	0.140	470.0	325.0	520.0	290.0	364.0	167.0	116.0	138.0	78.00	64.00	52.00
18	0.080	440.0	330.0	490.0	285.0	337.0	180.0	112.0	138.0	77.00	64.00	52.00
19	1.00	410.0	335.0	460.0	275.0	328.0	198.0	108.0	138.0	76.00	65.00	51.00
20	409.0	390.0	340.0	440.0	270.0	309.0	257.0	106.0	138.0	75.00	64.00	51.00
21	1250	370.0	335.0	420.0	265.0	278.0	209.0	104.0	138.0	74.00	62.00	50.00
22	1010	350.0	330.0	400.0	262.0	254.0	167.0	102.0	135.0	73.00	61.00	50.00
23	314.0	330.0	325.0	380.0	262.0	240.0	161.0	100.0	129.0	72.00	61.00	50.00
24	1800	320.0	320.0	360.0	262.0	230.0	150.0	100.0	129.0	71.00	60.00	49.00
25	5720	4500	320.0	335.0	265.0	220.0	147.0	98.00	110.0	70.00	60.00	49.00
26	2320	4200	315.0	320.0	280.0	210.0	138.0	98.00	110.0	69.00	59.00	49.00
27	2760	3900	310.0	315.0	300.0	202.0	161.0	96.00	108.0	68.00	57.00	48.00
28	1180	2500	305.0	310.0	318.0	198.0	155.0	94.00	106.0	67.00	58.00	48.00
29	665.0		300.0	340.0	330.0	194.0	150.0	92.00	96.00	66.00	61.00	48.00
30	451.0		300.0	370.0	340.0	188.0	144.0	90.00	96.00	65.00	61.00	48.00
31	352.0		300.0		350.0		144.0	86.00		64.00		48.00
Mean	592.6	893.9	423.5	412.8	411.3	277.5	174.4	123.9	133.9	77.81	65.10	52.13
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0	250.0	300.0	310.0	262.0	188.0	138.0	86.00	82.00	64.00	57.00	48.00
Max	5720	4500	1750	600.0	960.0	364.0	257.0	180.0	170.0	93.00	114.0	59.00
AF	36439	49647	26043	24566	25288	16513	10725	7617	7970	4784	3874	3205

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1970

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	48.00	50.00	369.0	58.00	56.00	2.70	0.440	0.100	0.800	0.400	0.400	62.00
2	47.00	49.00	245.0	58.00	55.00	2.30	0.440	0.100	0.800	0.400	0.400	59.00
3	47.00	48.00	89.00	58.00	54.00	1.80	0.440	0.100	0.800	0.400	0.400	55.00
4	48.00	47.00	76.00	58.00	53.00	1.50	0.440	0.100	0.800	0.400	0.400	53.00
5	47.00	48.00	90.00	57.00	53.00	1.40	0.440	0.100	0.800	0.400	0.400	50.00
6	47.00	47.00	73.00	57.00	52.00	1.40	0.440	0.100	0.800	0.400	0.400	48.00
7	47.00	46.00	67.00	57.00	52.00	1.40	0.440	0.100	0.700	0.400	0.400	46.00
8	47.00	46.00	65.00	58.00	52.00	1.40	0.440	0.100	0.700	0.400	0.400	43.00
9	47.00	45.00	62.00	56.00	51.00	1.30	0.440	0.100	0.700	0.400	0.400	99.00
10	63.00	53.00	81.00	56.00	51.00	1.30	0.440	0.100	0.700	0.400	0.400	71.00
11	59.00	62.00	69.00	57.00	50.00	1.20	0.440	0.100	0.700	0.400	0.400	60.00
12	59.00	54.00	63.00	57.00	50.00	1.20	0.440	0.100	0.700	0.400	0.400	55.00
13	55.00	52.00	59.00	57.00	50.00	1.10	0.390	0.100	0.600	0.400	0.400	53.00
14	54.00	52.00	61.00	57.00	48.00	1.10	0.350	0.100	0.600	0.400	10.00	50.00
15	54.00	50.00	62.00	58.00	44.00	0.980	0.350	0.100	0.600	0.400	15.00	50.00
16	62.00	49.00	62.00	58.00	42.00	0.980	0.350	0.100	0.600	0.400	20.00	60.00
17	70.00	49.00	62.00	59.00	42.00	0.900	0.310	0.100	0.600	0.400	21.00	100.0
18	59.00	49.00	62.00	58.00	28.00	0.900	0.310	0.100	0.600	0.400	22.00	62.00
19	55.00	50.00	71.00	54.00	5.30	0.820	0.310	0.100	0.500	0.400	23.00	60.00
20	54.00	51.00	113.0	54.00	4.30	0.820	0.310	0.100	0.500	0.400	24.00	60.00
21	52.00	49.00	148.0	55.00	4.10	0.750	0.270	0.100	0.500	0.400	25.00	133.0
22	52.00	49.00	104.0	59.00	3.90	0.750	0.270	0.100	0.500	0.400	26.00	124.0
23	52.00	48.00	69.00	59.00	3.40	0.680	0.230	0.100	0.500	0.400	27.00	90.00
24	52.00	46.00	67.00	57.00	4.10	0.680	0.200	0.100	0.500	0.400	28.00	85.00
25	52.00	45.00	66.00	55.00	4.30	0.610	0.170	0.100	0.400	0.400	29.00	80.00
26	52.00	44.00	63.00	54.00	4.50	0.550	0.130	0.100	0.400	0.400	347.0	70.00
27	51.00	44.00	62.00	62.00	4.30	0.550	0.110	1.50	0.400	0.400	40.00	60.00
28	51.00	269.0	61.00	61.00	4.30	0.490	0.100	1.10	0.400	0.400	141.0	55.00
29	51.00		61.00	58.00	4.10	0.490	0.100	0.900	0.400	0.400	1270	55.00
30	50.00		63.00	58.00	3.20	0.490	0.100	0.900	0.400	0.400	102.0	50.00
31	50.00		64.00		2.90		0.100	0.900		0.400		45.00
Mean	52.71	56.82	88.03	57.33	30.18	1.08	0.314	0.255	0.600	0.400	72.51	65.90
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	47.00	44.00	59.00	54.00	2.90	0.490	0.100	0.100	0.400	0.400	0.400	43.00
Max	70.00	269.0	369.0	62.00	56.00	2.70	0.440	1.50	0.800	0.400	1270	133.0
AF	3241	3156	5413	3412	1856	64.54	19.32	15.67	35.70	24.60	4315	4052

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1971

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	48.00	44.00	34.00	15.00	9.50	7.20	3.90	2.60	2.30	2.80	3.80	3.10
2	50.00	44.00	34.00	15.00	9.50	7.20	3.80	2.50	2.30	2.80	3.60	3.30
3	50.00	42.00	37.00	15.00	9.50	7.10	3.70	2.50	2.30	2.80	3.60	3.60
4	47.00	42.00	37.00	15.00	10.00	7.00	3.60	2.50	2.20	2.80	3.60	3.30
5	45.00	42.00	35.00	15.00	11.00	6.80	3.50	2.50	2.20	2.80	3.60	3.20
6	44.00	42.00	37.00	15.00	38.00	6.60	3.30	2.40	2.20	2.70	3.60	3.10
7	43.00	42.00	37.00	14.00	15.00	6.50	3.20	2.40	2.20	2.70	3.50	3.10
8	43.00	41.00	37.00	14.00	12.00	6.40	3.10	2.40	2.20	2.70	3.50	3.70
9	45.00	40.00	36.00	15.00	10.00	6.20	3.00	2.40	2.20	2.70	3.50	5.60
10	45.00	40.00	36.00	16.00	9.50	6.10	2.80	2.30	2.10	2.70	3.50	6.50
11	45.00	40.00	35.00	17.00	9.00	6.00	2.70	2.30	2.10	2.60	3.50	2.50
12	48.00	40.00	34.00	19.00	8.50	5.80	2.60	2.30	2.10	2.60	3.40	2.60
13	50.00	39.00	76.00	21.00	8.00	5.60	2.50	2.20	2.10	2.60	3.40	3.10
14	50.00	39.00	68.00	22.00	8.00	5.30	2.40	2.20	2.10	2.60	3.40	2.70
15	47.00	39.00	52.00	21.00	7.80	4.80	2.30	2.10	2.10	2.60	3.40	2.60
16	45.00	39.00	41.00	21.00	7.80	4.30	2.30	3.40	2.10	2.50	3.40	2.50
17	59.00	39.00	36.00	21.00	7.60	3.70	2.20	4.40	2.10	2.50	3.30	2.60
18	93.00	38.00	33.00	21.00	7.60	3.70	2.20	4.00	2.10	2.50	3.30	2.50
19	112.0	38.00	31.00	21.00	7.60	3.70	2.20	7.60	2.10	2.50	3.30	2.50
20	100.0	38.00	30.00	21.00	7.60	3.70	2.20	3.00	2.10	2.50	3.20	2.40
21	84.00	38.00	29.00	17.00	7.60	3.70	3.80	2.90	7.00	2.40	3.20	2.50
22	72.00	37.00	28.00	15.00	7.60	3.70	4.30	2.80	5.00	2.40	3.20	133.0
23	62.00	37.00	26.00	13.00	7.40	3.70	4.10	2.70	3.00	2.40	3.00	115.0
24	57.00	37.00	24.00	11.00	7.40	3.80	3.80	2.60	3.00	4.00	3.10	986.0
25	52.00	36.00	23.00	11.00	7.40	3.80	3.60	2.50	2.90	3.70	3.20	1420
26	50.00	36.00	22.00	10.00	7.40	3.80	3.30	2.50	2.90	3.40	3.20	315.0
27	48.00	35.00	20.00	10.00	7.40	3.80	3.10	2.40	2.90	3.30	3.20	200.0
28	48.00	34.00	19.00	10.00	12.00	3.80	3.00	2.40	2.80	3.20	3.20	150.0
29	48.00		18.00	10.00	10.00	3.90	2.90	2.30	2.80	3.10	3.10	130.0
30	46.00		17.00	10.00	7.60	3.90	2.70	2.30	2.80	4.50	3.10	120.0
31	45.00		16.00		7.20		2.60	2.30		4.00		100.0
Mean	55.52	39.21	33.48	15.70	9.76	5.05	3.05	2.76	2.61	2.88	3.36	120.5
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	43.00	34.00	16.00	10.00	7.20	3.70	2.20	2.10	2.10	2.40	3.00	2.40
Max	112.0	44.00	76.00	22.00	38.00	7.20	4.30	7.60	7.00	4.50	3.80	1420
AF	3414	2178	2059	934.2	600.0	300.7	187.8	170.0	155.3	177.3	200.1	7410

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1972

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	83.00	6.40	2.60	3.10	2.00	4.70	0.300	0	0.160	24.00	0	0.250
2	73.00	6.70	2.40	2.90	2.00	4.40	0.300	0	0.160	25.00	0	0.320
3	67.00	6.70	2.20	2.90	2.00	4.40	0.300	0	0.200	16.00	0	0.440
4	54.00	6.70	2.00	2.90	2.10	3.70	0.300	0	0.160	5.30	0	64.00
5	46.00	6.70	1.70	2.90	2.20	2.50	0.300	0.600	0.090	5.30	0	55.00
6	46.00	6.70	1.80	2.90	3.30	4.60	0.250	0.200	0.120	1.60	0	28.00
7	45.00	6.70	1.90	2.90	3.40	6.10	0.200	0.200	0.120	0.630	0	44.00
8	48.00	6.40	1.90	2.80	3.50	4.10	0.200	0.200	0.120	0.030	0	49.00
9	44.00	6.40	1.90	2.80	3.20	3.20	0.160	0.250	0.120	0.030	0	29.00
10	40.00	6.40	1.90	2.70	2.90	2.60	0.120	0.490	0.120	0.300	0	22.00
11	40.00	6.40	1.90	3.00	2.90	2.10	0.090	1.20	0.090	0.630	20.00	22.00
12	31.00	6.40	1.90	3.00	2.90	2.10	0.090	0.630	0.120	0.420	8.60	15.00
13	15.00	6.40	1.90	3.80	2.60	1.40	0.090	0.560	0.090	0.360	8.10	12.00
14	12.00	6.40	1.90	3.60	2.80	1.40	0.060	0.560	0.090	0.040	28.00	18.00
15	10.00	6.40	1.80	3.20	2.80	1.10	0.060	0.490	2.40	0	22.00	14.00
16	9.60	6.40	1.90	2.80	2.80	0.970	0.060	0.420	19.00	0	70.00	13.00
17	9.10	6.40	2.10	3.00	2.80	0.970	0.060	0.360	18.00	0	61.00	12.00
18	8.80	6.40	2.60	5.30	3.40	1.40	0.040	0.360	18.00	0	25.00	10.00
19	8.40	6.40	3.10	6.40	5.10	1.10	0.040	0.360	19.00	0.650	15.00	6.10
20	8.10	6.40	3.30	5.10	6.00	0.970	0.030	0.300	20.00	4.40	6.00	7.00
21	7.80	5.30	3.50	3.80	5.10	1.40	0.020	0.250	20.00	4.10	8.00	6.00
22	7.50	4.50	3.70	3.20	4.30	0.970	0.020	0.200	20.00	1.20	3.40	5.00
23	7.30	3.70	3.90	2.80	3.80	0.880	1.00E-02	0.200	21.00	0.360	1.40	7.40
24	7.00	3.60	2.90	2.60	3.40	0.790	1.00E-02	0.250	22.00	0	0.860	8.40
25	6.80	3.40	2.60	2.60	3.40	0.630	1.00E-02	0.490	24.00	0	0	16.00
26	6.60	3.30	2.60	1.60	1.60	0.560	1.00E-02	0.560	24.00	0	0	11.00
27	6.40	3.20	2.90	1.90	0.110	0.490	1.00E-02	0.630	23.00	0	0	5.70
28	6.30	3.00	3.70	2.00	1.20	0.420	1.00E-02	0.560	23.00	0	0.130	4.60
29	6.20	2.80	3.70	2.10	1.20	0.360	0	0.560	23.00	0	0	5.50
30	6.10		3.30	2.00	1.20	0.360	0	0.020	22.00	0	0	4.90
31	6.00		3.20		4.00		0	0.140		0		5.70
Mean	24.90	5.61	2.54	3.09	2.90	2.02	0.102	0.356	10.67	2.91	9.25	16.17
Cnt	31	29	31	30	31	30	31	31	30	31	30	31
Min	6.00	2.80	1.70	1.60	0.110	0.360	0	0	0.090	0	0	0.250
Max	83.00	6.70	3.90	6.40	6.00	6.10	0.300	1.20	24.00	25.00	70.00	64.00
AF	1531	322.5	156.1	183.7	178.5	120.3	6.25	21.90	635.0	179.2	550.4	994.3

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1973

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	9.00	4.70	128.0	118.0	46.00	82.00	4.20	1.90	0.780	0.640	0.520	4.70
2	5.70	5.10	112.0	116.0	48.00	81.00	4.90	2.10	1.10	0.640	0.440	4.50
3	5.10	5.70	108.0	112.0	37.00	79.00	4.60	1.70	1.20	0.700	0.470	3.90
4	5.90	4.70	105.0	110.0	39.00	77.00	3.70	1.10	1.60	0.610	0.490	3.80
5	5.30	4.00	101.0	108.0	51.00	75.00	2.50	1.60	1.10	0.550	0.490	3.50
6	5.30	60.00	191.0	105.0	50.00	73.00	2.40	1.60	1.30	0.640	0.420	3.30
7	4.10	61.00	228.0	103.0	64.00	72.00	2.30	1.40	0.670	0.780	0.340	3.20
8	2.80	19.00	231.0	102.0	118.0	72.00	2.40	1.30	0.700	0.820	0.320	3.20
9	2.50	14.00	221.0	100.0	112.0	71.00	2.40	1.40	0.640	0.860	0.280	3.20
10	2.50	12.00	208.0	99.00	110.0	69.00	2.10	1.10	1.10	0.820	0.260	3.10
11	2.50	445.0	292.0	97.00	110.0	75.00	2.40	1.00	0.780	0.780	0.260	3.00
12	2.40	415.0	239.0	96.00	110.0	75.00	1.90	0.940	0.520	0.740	0.260	3.10
13	2.40	284.0	233.0	94.00	110.0	74.00	2.20	1.40	0.640	0.610	0.280	3.00
14	2.40	183.0	180.0	93.00	75.00	67.00	2.20	0.900	1.10	0.490	0.340	2.90
15	2.40	150.0	165.0	90.00	74.00	67.00	2.40	1.40	0.550	0.520	0.360	3.20
16	17.00	125.0	155.0	90.00	72.00	63.00	2.40	0.980	0.980	0.470	0.320	3.00
17	102.0	109.0	150.0	89.00	69.00	64.00	2.00	0.940	0.610	0.440	0.530	2.80
18	61.00	98.00	140.0	86.00	48.00	61.00	1.90	1.30	1.30	0.820	83.00	2.90
19	118.0	94.00	135.0	86.00	43.00	57.00	2.10	1.60	1.80	1.00	57.00	2.90
20	42.00	94.00	144.0	85.00	68.00	56.00	1.90	1.30	1.70	1.20	50.00	2.90
21	31.00	85.00	145.0	86.00	107.0	54.00	2.20	2.10	0.670	0.580	32.00	2.90
22	26.00	57.00	139.0	85.00	102.0	52.00	1.60	1.00	0.580	0.670	6.70	2.90
23	21.00	61.00	134.0	83.00	99.00	52.00	1.70	1.00	0.610	2.60	5.70	2.90
24	15.00	69.00	130.0	80.00	98.00	51.00	2.10	1.10	0.700	4.40	5.00	3.00
25	12.00	72.00	127.0	80.00	69.00	33.00	1.00	1.30	0.520	1.60	4.50	3.00
26	10.00	76.00	122.0	68.00	44.00	4.00	1.40	1.10	0.520	2.10	4.30	3.00
27	11.00	83.00	120.0	63.00	57.00	3.00	2.20	1.20	1.60	0.740	4.10	3.00
28	8.00	194.0	130.0	47.00	47.00	3.90	2.10	0.940	0.700	0.550	4.10	2.90
29	7.00		130.0	42.00	41.00	5.20	1.30	1.10	0.520	0.440	3.90	2.80
30	5.00		128.0	44.00	28.00	5.20	1.80	1.00	0.550	0.900	3.90	2.80
31	5.10		124.0		78.00		2.10	1.00		1.30		2.80
Mean	17.79	103.0	157.9	88.57	71.74	55.78	2.34	1.28	0.905	0.968	9.02	3.16
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	2.40	4.00	101.0	42.00	28.00	3.00	1.00	0.900	0.520	0.440	0.260	2.80
Max	118.0	445.0	292.0	118.0	118.0	82.00	4.90	2.10	1.80	4.40	83.00	4.70
AF	1094	5721	9709	5270	4411	3319	143.6	78.94	53.83	59.52	536.7	194.6

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1974

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	33.00	5.50	6.90	6.30	4.30	1.10	0.250	1.10	0.250	0	21.00	3.20
2	32.00	5.30	79.00	73.00	4.40	1.10	0.300	5.20	0.020	0.030	8.30	3.20
3	28.00	5.10	100.0	72.00	4.10	0.970	0.200	3.30	0.090	0.090	5.40	2.20
4	33.00	5.90	74.00	41.00	3.60	0.970	0.160	22.00	0.090	0.120	5.40	168.0
5	50.00	5.70	25.00	9.10	3.50	0.970	0.160	18.00	0.090	0.630	5.40	130.0
6	76.00	5.70	18.00	8.60	3.00	0.970	0.160	4.10	0.090	1.00E-02	5.30	25.00
7	158.0	5.90	20.00	8.10	2.80	1.20	0.160	2.60	0.090	0.030	5.30	4.50
8	155.0	5.30	81.00	8.90	2.40	1.20	0.160	2.70	0.090	0.060	5.30	4.30
9	85.00	4.60	94.00	10.00	2.40	0.970	0.160	2.70	0.090	1.00E-02	5.20	4.40
10	68.00	4.30	66.00	12.00	2.30	0.970	0.160	2.60	0.090	0.060	5.20	4.00
11	45.00	4.30	34.00	9.20	2.10	0.970	0.160	2.20	0.090	0.040	5.10	4.00
12	30.00	4.70	27.00	7.70	2.00	0.880	0.120	2.10	0.090	0.060	4.80	4.40
13	20.00	4.00	26.00	7.30	2.00	0.630	0.120	2.20	1.00E-02	0.420	4.60	3.80
14	15.00	4.00	24.00	6.70	2.60	0.560	0.090	0.790	1.00E-02	0.560	4.60	3.40
15	12.00	3.90	21.00	6.50	2.00	0.560	0.060	0.790	0.790	0.200	4.30	2.90
16	10.00	3.70	16.00	6.10	1.70	0.630	0.070	0.970	0.020	1.50	3.30	2.60
17	14.00	3.70	13.00	5.90	1.60	0.710	0.070	0.630	1.00E-02	0.490	1.60	2.40
18	13.00	3.90	13.00	5.90	1.50	0.790	0.060	0.970	1.00E-02	0.330	1.30	2.40
19	11.00	3.90	12.00	7.10	1.60	0.790	0.060	1.10	1.00E-02	0	1.20	2.30
20	11.00	3.90	11.00	8.80	1.60	0.630	0.090	1.40	0	0	1.20	2.70
21	36.00	3.70	8.30	5.40	1.50	0.560	0.090	1.40	0	0	1.20	0.440
22	16.00	3.70	7.60	7.30	1.60	0.450	0.090	1.70	0.060	0	1.20	0.250
23	16.00	3.60	7.60	5.50	1.40	0.340	0.060	0.630	0	0	2.00	0.290
24	12.00	3.60	7.20	4.90	1.20	0.330	3.10	0.560	0	0	2.20	0.330
25	11.00	3.60	6.80	4.70	1.10	0.330	5.40	0.560	0	0	2.10	0.610
26	9.80	3.60	6.80	4.70	1.00	0.320	1.20	0.560	0	0	2.10	0.910
27	9.20	3.30	6.80	4.60	0.950	0.240	0.630	0.560	0	0	1.90	0.330
28	7.50	3.40	6.80	4.40	0.910	0.300	0.480	0.790	0	5.00	1.90	0.380
29	6.30		6.60	4.60	0.980	0.300	0.900	0.420	0	17.00	2.00	1.20
30	5.90		6.30	4.40	0.980	0.300	1.40	0.090	0	16.00	2.00	1.00
31	5.70		6.30		1.10		1.20	0.160		30.00		0.170
Mean	33.37	4.35	27.03	12.36	2.07	0.701	0.559	2.74	0.070	2.34	4.08	12.44
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	5.70	3.30	6.30	4.40	0.910	0.240	0.060	0.090	0	0	1.20	0.170
Max	158.0	5.90	100.0	73.00	4.40	1.20	5.40	22.00	0.790	30.00	21.00	168.0
AF	2052	241.6	1662	735.3	127.4	41.73	34.35	168.4	4.15	144.1	242.8	764.9

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1975

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.570	0.050	1.00	15.00	7.20	2.10	0	0.880	0.110	0	0	13.00
2	0.700	0.200	1.00	9.50	7.20	1.60	0	0.790	0.100	0	0	0.270
3	0.240	6.10	1.00	6.60	4.10	1.40	0	0.790	0.100	0	0	0
4	0.120	5.80	1.10	5.90	0	1.30	0.220	13.00	0.080	0	0	0
5	0.060	5.60	1.60	6.60	0	1.20	0.420	27.00	0.070	0	0	0
6	0.050	5.40	15.00	13.00	0	1.20	0.360	29.00	0.070	0	0	0
7	0.050	2.60	13.00	12.00	0	1.10	0.360	32.00	0.050	0	0	0
8	0.080	2.20	153.0	17.00	0	1.10	0.360	29.00	0.050	1.40	0	0
9	2.30	34.00	101.0	28.00	0	1.10	0.530	25.00	0.050	0	0	0
10	0.430	102.0	112.0	19.00	0	1.10	0.210	30.00	0.050	0	0	0
11	0.410	20.00	79.00	13.00	0	0.970	0.200	33.00	0.040	0	0	0
12	0.850	7.20	53.00	13.00	0	0.880	0.190	33.00	0.040	0	0	0
13	0.710	6.40	37.00	13.00	0	0.880	0.200	29.00	0.030	0	0	14.00
14	0.050	4.20	39.00	11.00	0	0.970	0.190	30.00	0	0	0	17.00
15	0.020	3.00	23.00	8.20	0	0.970	0.180	20.00	0	0	0	20.00
16	0.040	2.40	19.00	7.00	1.90	1.10	0.150	3.40	0	0	0	21.00
17	0.220	2.60	15.00	7.00	3.00	1.20	0.140	1.10	0	0	0	16.00
18	1.60	2.60	9.90	4.90	3.00	1.20	0.140	0.400	0	0	0	6.60
19	0.120	1.90	8.00	4.80	3.20	1.20	0.120	0.250	0	0	0	9.30
20	0.050	1.60	7.60	4.40	4.90	1.20	0.120	0.210	0	0	0	0.430
21	0.020	2.60	7.60	4.40	3.80	1.10	0.100	0.170	0	0	0	0
22	1.00E-02	7.20	10.00	4.90	3.30	0.970	0.100	0.140	0	0	0	0
23	0.020	8.90	8.90	4.20	3.10	0.880	0.100	0.140	0	0	0	0
24	0.020	8.00	8.40	3.60	3.00	0.880	1.90	0.140	0	0	0	0
25	0	1.60	12.00	4.90	2.80	0.880	0.710	0.140	0	0	0	0
26	0	1.40	10.00	5.30	2.70	0.710	0.560	0.140	0	0	0	0
27	0	1.10	8.00	5.60	2.70	0.880	0.630	0.110	0	0	0	0
28	0.380	1.10	7.20	7.10	2.60	0.880	0.880	0.110	0	0	0	0
29	0.140		6.40	7.00	2.40	0.880	0.970	0.110	0	0	0	0
30	0.050		6.00	6.80	2.40	0.880	0.970	0.110	0	0	7.20	0
31	0.090		7.20		2.20		0.880	0.110		2.50		0
Mean	0.303	8.85	25.22	9.09	2.11	1.09	0.384	10.94	0.028	0.126	0.240	3.79
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0	0.050	1.00	3.60	0	0.710	0	0.110	0	0	0	0
Max	2.30	102.0	153.0	28.00	7.20	2.10	1.90	33.00	0.110	2.50	7.20	21.00
AF	18.64	491.4	1551	540.9	129.9	64.88	23.58	672.9	1.67	7.74	14.28	233.3

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1976

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	144.0	2.60	2.10	0.080	0	0	0	5.00	0.680	0
2	0	0	141.0	2.40	2.00	0.070	0	0	0	5.00	0.200	0
3	0	0	92.00	2.40	2.60	0.080	0	0	0	5.00	0.100	0
4	0	0	20.00	3.10	0.490	0.080	0	0	0	5.00	0.100	0
5	0	4.30	17.00	3.60	0	0.080	0	0	0	5.00	0.100	0
6	0	12.00	14.00	2.90	0	0.130	0	0	0	4.80	0.150	0
7	0	25.00	12.00	2.60	0.580	0.260	0	0	16.00	4.50	0.300	0
8	0	91.00	14.00	2.90	0.020	0.070	0	0	72.00	4.20	0.050	0
9	0	355.0	14.00	2.90	0.090	0.050	0	0	88.00	3.90	0.050	0
10	0	103.0	14.00	2.60	0.030	0.080	0	0	308.0	4.40	0.050	0
11	0	59.00	14.00	2.30	0.030	0.070	0	0	646.0	3.90	0.050	0
12	0	48.00	12.00	2.60	0.030	0.040	0	0	122.0	3.20	0.050	0
13	0	32.00	15.00	4.00	0.060	0.030	0	0	59.00	3.20	0.050	0
14	0	7.10	12.00	3.80	0.120	0.020	0	0	40.00	3.90	0.040	0
15	0	5.90	11.00	5.80	0.120	0.020	0	0	29.00	3.20	0.040	0
16	0	5.00	8.50	5.60	0.120	0	0	0	24.00	3.20	0.040	0
17	0	4.00	7.90	4.00	0.120	0	0	0	22.00	3.70	0.040	0
18	0	3.80	7.90	2.60	0.100	0	0	0	18.00	2.60	0.040	0
19	0	3.80	7.60	2.30	0.100	0	0	0	16.00	3.40	0.040	0
20	0	3.80	6.60	2.20	0.100	0	0	0	13.00	5.30	0.040	0
21	0	3.40	5.40	5.90	0.100	0	0	0	6.80	4.70	0.030	0
22	0	3.20	5.20	2.80	0.100	0	0	0	6.60	7.50	0.030	0
23	0	2.90	5.60	2.60	0.100	0	0	0	6.30	2.20	0.030	0
24	0	2.60	5.00	2.40	0.080	0	0	0	44.00	1.20	0.020	0
25	0	2.20	4.20	2.50	0.080	0	0	0	35.00	0.340	0.020	0
26	0	2.20	4.00	2.50	0.080	0	0	0	11.00	0.750	0.010	0
27	0	2.00	2.90	2.50	0.080	0	0	0	9.30	0.920	0	0
28	0	2.00	2.80	2.50	0.080	0	0	0	7.90	0.750	0	0
29	0	2.00	2.60	2.50	0.060	0	0	0	5.00	0.610	0	0.050
30	0		2.60	2.50	0.060	0	0	0	4.80	0.750	0	0.100
31	0		2.60		0.060		0	0		0.550		0.160
Mean	0	27.08	20.24	3.06	0.313	0.039	0	0	53.66	3.31	0.078	0.010
Cnt	31	29	31	30	31	30	31	31	30	31	30	31
Min	0	0	2.60	2.20	0	0	0	0	0	0.340	0	0
Max	0	355.0	144.0	5.90	2.60	0.260	0	0	646.0	7.50	0.680	0.160
AF	0	1557	1244	182.3	19.22	2.30	0	0	3193	203.6	4.66	0.615

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1977

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.100	0.380	1.40	0.700	0.060	1.80	0.380	0	0	0	0	0
2	0.050	0.280	1.10	0.650	0.120	1.70	0.030	0	0	0	0	0
3	78.00	0.200	1.00	0.650	0.060	1.60	0.010	0	0	0	0	0
4	37.00	0.170	0.980	0.650	0.070	1.50	0.010	0	0	0	0	0
5	33.00	0.170	0.960	0.650	0.090	2.10	0.010	0	0	0	0	0
6	24.00	0.170	0.930	0.600	0.070	1.10	0.010	0	0	0	0	0
7	15.00	0.100	0.910	0.600	0.090	0.890	0.010	0	0	0	0	0
8	12.00	0.100	0.900	0.600	65.00	0.920	0.020	0	0	0	0	0
9	9.40	0.100	0.890	0.550	169.0	1.00	0.020	0	0	0	0	0
10	8.90	0.200	0.880	0.550	76.00	0.680	0.020	0	0	0	0	0
11	6.80	0.170	0.860	0.550	59.00	0.830	0.020	0	0	0	0	0
12	5.30	0.200	0.860	0.500	45.00	0.380	0.020	0	0	0	0	0
13	3.90	0.200	0.840	0.500	22.00	0.200	0.020	0	0	0	0	0
14	2.40	0.200	0.840	0.450	7.00	0.120	0.020	0	0	0	0	0
15	3.40	0.100	0.820	0.450	4.00	0.070	0.020	0.030	0	0	0	0
16	2.60	0.100	0.820	0.400	1.00	0.050	0.010	0	0	0	0	0
17	2.60	0.100	0.800	0.400	4.00	0.040	0.010	25.00	0	0	0	0
18	2.10	0.100	0.800	0.350	3.00	0.040	0	41.00	0	0	0	0.010
19	1.90	0.100	0.800	0.350	4.00	0.030	0	0.500	0	0	0	0
20	1.80	0.100	0.780	0.300	4.00	0.040	0	0	0	0	0	0
21	1.20	0.100	0.780	0.250	4.00	0.030	0	0	0	0	0	0
22	1.00	41.00	0.760	0.200	5.00	0.050	0	0	0	0	0	0
23	0.750	105.0	0.760	0.150	4.00	0.140	0	0	0	0	0	0
24	0.680	108.0	0.740	0.100	2.00	0.090	0	0	0	0	0	0
25	0.550	26.00	0.740	0.050	7.00	0.140	0	0	0	0	0	0
26	0.500	7.60	0.740	0.050	3.00	0.170	0	0	0	0	0	2.20
27	0.450	2.80	0.720	0.050	2.00	0.170	0	0	0	0	0	16.00
28	0.380	1.40	0.720	0.050	1.00	0.170	0	0	0	0	0	329.0
29	0.300		0.700	0.050	2.00	0.170	0	0	0	0	0	172.0
30	0.250		0.700	0.050	3.00	0.170	0	0	0	0	0	116.0
31	0.200		0.700		2.00		0	0		0		65.00
Mean	8.27	10.54	0.846	0.382	16.08	0.546	0.021	2.15	0	0	0	22.59
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0.050	0.100	0.700	0.050	0.060	0.030	0	0	0	0	0	0
Max	78.00	108.0	1.40	0.700	169.0	2.10	0.380	41.00	0	0	0	329.0
AF	508.8	585.4	52.03	22.71	988.9	32.51	1.27	132.0	0	0	0	1389

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1978

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	60.00	50.00	900.0	485.0	235.0	127.0	96.00	36.00	8.00	6.40	5.50	22.00
2	45.00	49.00	758.0	460.0	230.0	128.0	93.00	35.00	7.80	6.40	5.50	23.00
3	45.00	48.00	313.0	479.0	205.0	130.0	89.00	33.00	7.80	6.40	5.50	9.90
4	91.00	47.00	330.0	406.0	203.0	127.0	90.00	34.00	7.80	5.50	4.80	8.30
5	83.00	46.00	526.0	376.0	223.0	130.0	90.00	33.00	8.20	5.20	4.80	9.30
6	30.00	45.00	333.0	360.0	208.0	128.0	89.00	33.00	25.00	4.80	4.80	16.00
7	27.00	44.00	244.0	300.0	185.0	127.0	88.00	34.00	13.00	4.80	4.40	9.90
8	24.00	47.00	185.0	280.0	175.0	125.0	84.00	32.00	11.00	4.80	4.00	12.00
9	41.00	55.00	147.0	260.0	169.0	127.0	82.00	31.00	10.00	4.80	4.00	7.80
10	79.00	1900	115.0	250.0	169.0	139.0	81.00	22.00	10.00	4.80	22.00	15.00
11	33.00	800.0	131.0	240.0	173.0	133.0	78.00	16.00	10.00	4.40	58.00	7.80
12	14.00	350.0	128.0	240.0	171.0	133.0	76.00	17.00	9.20	4.00	60.00	6.40
13	8.40	310.0	88.00	240.0	177.0	130.0	76.00	16.00	8.40	4.00	25.00	6.40
14	183.0	235.0	82.00	240.0	179.0	130.0	74.00	15.00	10.00	3.70	20.00	6.40
15	186.0	210.0	75.00	600.0	175.0	127.0	69.00	14.00	10.00	4.00	8.30	6.40
16	90.00	185.0	58.00	400.0	173.0	123.0	68.00	14.00	10.00	4.00	13.00	6.40
17	216.0	165.0	42.00	340.0	163.0	118.0	66.00	14.00	10.00	4.00	12.00	30.00
18	223.0	165.0	37.00	290.0	156.0	120.0	63.00	14.00	10.00	4.00	12.00	305.0
19	237.0	150.0	35.00	270.0	151.0	115.0	58.00	14.00	10.00	4.40	14.00	151.0
20	175.0	137.0	35.00	250.0	147.0	113.0	57.00	14.00	9.00	5.10	14.00	107.0
21	80.00	128.0	42.00	240.0	142.0	116.0	57.00	14.00	8.50	4.40	20.00	114.0
22	76.00	118.0	74.00	220.0	144.0	108.0	53.00	16.00	8.00	4.40	43.00	114.0
23	72.00	105.0	65.00	220.0	144.0	105.0	53.00	11.00	7.60	4.40	16.00	61.00
24	68.00	94.00	49.00	220.0	135.0	103.0	51.00	11.00	7.20	4.80	14.00	43.00
25	64.00	80.00	49.00	220.0	127.0	108.0	51.00	11.00	6.80	4.80	13.00	27.00
26	61.00	74.00	52.00	220.0	124.0	109.0	40.00	10.00	6.50	5.10	11.00	20.00
27	59.00	105.0	58.00	220.0	123.0	108.0	41.00	10.00	6.50	4.80	9.30	14.00
28	56.00	709.0	52.00	225.0	123.0	105.0	39.00	9.20	6.50	4.40	15.00	12.00
29	54.00		54.00	230.0	123.0	98.00	37.00	10.00	6.50	4.80	8.80	11.00
30	53.00		60.00	235.0	124.0	102.0	37.00	8.70	6.50	5.10	17.00	10.00
31	51.00		613.0		123.0		37.00	8.40		5.50		9.90
Mean	83.37	230.4	184.8	300.5	164.5	119.7	66.55	19.04	9.19	4.77	15.62	38.77
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	8.40	44.00	35.00	220.0	123.0	98.00	37.00	8.40	6.50	3.70	4.00	6.40
Max	237.0	1900	900.0	600.0	235.0	139.0	96.00	36.00	25.00	6.40	60.00	305.0
AF	5126	12796	11365	17883	10114	7125	4092	1171	547.0	293.6	929.7	2384

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1979

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	9.30	218.0	77.00	400.0	165.0	59.00	29.00	5.50	9.30	9.30	14.00	4.80
2	10.00	173.0	70.00	302.0	165.0	59.00	29.00	11.00	9.30	8.80	8.80	5.10
3	12.00	125.0	71.00	213.0	143.0	58.00	26.00	5.50	21.00	8.80	7.80	4.40
4	9.90	131.0	70.00	163.0	146.0	58.00	26.00	5.10	13.00	8.80	6.80	4.40
5	107.0	137.0	70.00	156.0	153.0	58.00	28.00	5.10	12.00	8.30	4.80	4.40
6	296.0	131.0	71.00	168.0	137.0	58.00	23.00	5.10	10.00	8.30	4.40	4.00
7	125.0	128.0	71.00	168.0	159.0	61.00	21.00	7.30	9.30	8.30	5.50	4.00
8	76.00	131.0	71.00	165.0	663.0	58.00	19.00	5.50	6.40	8.30	28.00	4.00
9	57.00	121.0	71.00	178.0	550.0	52.00	16.00	5.10	6.00	8.80	11.00	4.00
10	30.00	69.00	68.00	218.0	390.0	46.00	14.00	4.80	6.00	8.30	8.30	5.50
11	12.00	61.00	73.00	195.0	275.0	39.00	12.00	5.10	5.50	8.30	7.80	4.40
12	30.00	53.00	75.00	198.0	240.0	38.00	11.00	5.50	6.00	8.80	7.80	4.40
13	23.00	49.00	95.00	195.0	220.0	39.00	9.90	5.50	6.40	8.80	6.80	4.40
14	10.00	182.0	78.00	195.0	235.0	40.00	9.90	5.50	6.80	8.80	5.10	4.80
15	20.00	161.0	71.00	208.0	208.0	42.00	8.80	5.10	6.80	9.30	4.40	4.40
16	36.00	146.0	80.00	213.0	200.0	41.00	7.80	6.40	6.40	9.30	4.00	4.40
17	36.00	125.0	78.00	213.0	192.0	42.00	7.80	43.00	6.80	9.30	4.00	4.00
18	99.00	88.00	73.00	360.0	184.0	43.00	7.30	24.00	6.80	9.90	4.20	4.00
19	69.00	80.00	75.00	1030	176.0	42.00	7.80	75.00	6.80	9.90	4.20	5.50
20	27.00	57.00	72.00	1230	168.0	42.00	21.00	23.00	6.80	495.0	4.40	6.40
21	23.00	237.0	65.00	1050	160.0	39.00	21.00	14.00	7.30	171.0	4.40	8.30
22	12.00	170.0	65.00	614.0	152.0	39.00	14.00	12.00	7.30	128.0	4.50	9.90
23	10.00	109.0	68.00	188.0	152.0	39.00	10.00	12.00	7.30	111.0	4.50	6.00
24	9.90	80.00	70.00	135.0	144.0	35.00	9.30	16.00	8.30	65.00	4.50	15.00
25	9.90	80.00	68.00	127.0	136.0	34.00	7.30	16.00	8.30	25.00	4.60	42.00
26	26.00	80.00	73.00	128.0	128.0	27.00	6.00	16.00	8.30	22.00	4.60	33.00
27	107.0	76.00	721.0	168.0	120.0	25.00	6.40	10.00	8.30	19.00	4.80	13.00
28	110.0	75.00	1300	163.0	112.0	24.00	6.00	9.30	8.30	17.00	4.80	7.30
29	101.0		894.0	165.0	104.0	25.00	5.50	9.30	8.30	17.00	4.80	6.80
30	140.0		527.0	168.0	96.00	28.00	5.50	9.30	8.80	12.00	4.80	6.40
31	201.0		432.0		67.00		5.50	9.30		18.00		5.10
Mean	59.48	116.9	185.9	302.5	198.1	43.00	13.90	12.62	8.26	40.92	6.61	7.87
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	9.30	49.00	65.00	127.0	67.00	24.00	5.50	4.80	5.50	8.30	4.00	4.00
Max	296.0	237.0	1300	1230	663.0	61.00	29.00	75.00	21.00	495.0	28.00	42.00
AF	3658	6492	11431	17998	12179	2559	854.5	776.1	491.7	2516	393.5	484.2

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1980

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	4.40	637.0	549.0	274.0	303.0	197.0	107.0	63.00	24.00	54.00	24.00	9.80
2	3.70	265.0	662.0	258.0	305.0	185.0	101.0	60.00	22.00	56.00	23.00	9.20
3	3.70	242.0	1140	252.0	305.0	166.0	99.00	58.00	22.00	56.00	23.00	8.40
4	3.70	225.0	877.0	243.0	305.0	144.0	98.00	56.00	21.00	53.00	19.00	8.80
5	3.70	208.0	738.0	223.0	309.0	136.0	95.00	53.00	20.00	53.00	11.00	17.00
6	3.70	192.0	1150	226.0	316.0	134.0	94.00	48.00	20.00	53.00	9.20	12.00
7	3.70	184.0	967.0	258.0	327.0	130.0	92.00	43.00	20.00	53.00	8.80	11.00
8	4.80	179.0	911.0	258.0	327.0	124.0	91.00	42.00	20.00	53.00	8.60	12.00
9	264.0	162.0	850.0	258.0	322.0	126.0	89.00	40.00	20.00	53.00	8.60	11.00
10	351.0	155.0	850.0	270.0	401.0	134.0	86.00	39.00	20.00	52.00	8.80	11.00
11	474.0	146.0	716.0	311.0	344.0	134.0	83.00	39.00	20.00	51.00	8.80	12.00
12	338.0	144.0	678.0	383.0	313.0	132.0	81.00	45.00	19.00	51.00	8.80	12.00
13	295.0	350.0	647.0	304.0	303.0	134.0	80.00	43.00	18.00	50.00	8.80	11.00
14	548.0	1190	617.0	340.0	305.0	134.0	78.00	40.00	18.00	53.00	9.00	11.00
15	560.0	1910	599.0	613.0	320.0	129.0	75.00	39.00	18.00	55.00	8.80	11.00
16	480.0	1870	582.0	725.0	318.0	137.0	73.00	39.00	41.00	48.00	9.80	12.00
17	469.0	2840	544.0	413.0	320.0	132.0	72.00	38.00	50.00	37.00	9.60	11.00
18	492.0	2350	477.0	363.0	327.0	144.0	70.00	37.00	51.00	35.00	9.20	10.00
19	341.0	1980	458.0	344.0	333.0	126.0	70.00	39.00	52.00	31.00	9.20	10.00
20	309.0	2930	431.0	348.0	338.0	126.0	75.00	37.00	51.00	30.00	8.80	10.00
21	267.0	3840	426.0	359.0	342.0	124.0	68.00	35.00	52.00	27.00	8.40	10.00
22	208.0	2240	400.0	414.0	352.0	121.0	66.00	33.00	52.00	28.00	8.40	12.00
23	222.0	1320	383.0	507.0	342.0	118.0	68.00	32.00	51.00	28.00	8.20	11.00
24	173.0	1100	367.0	542.0	329.0	115.0	78.00	30.00	62.00	26.00	9.20	11.00
25	80.00	911.0	355.0	494.0	313.0	113.0	73.00	40.00	65.00	25.00	9.20	11.00
26	61.00	806.0	351.0	378.0	298.0	107.0	73.00	32.00	64.00	24.00	9.20	11.00
27	39.00	770.0	321.0	371.0	288.0	105.0	79.00	29.00	64.00	33.00	9.00	11.00
28	424.0	703.0	290.0	373.0	222.0	108.0	75.00	29.00	56.00	28.00	8.80	10.00
29	2630	659.0	280.0	327.0	204.0	111.0	66.00	25.00	48.00	26.00	9.20	10.00
30	1400		267.0	320.0	202.0	113.0	66.00	23.00	50.00	26.00	10.00	10.00
31	900.0		264.0		199.0		68.00	23.00		24.00		10.00
Mean	366.3	1052	585.4	358.3	307.5	131.3	80.29	39.65	37.03	41.03	10.81	10.88
Cnt	31	29	31	30	31	30	31	31	30	31	30	31
Min	3.70	144.0	264.0	223.0	199.0	105.0	66.00	23.00	18.00	24.00	8.20	8.40
Max	2630	3840	1150	725.0	401.0	197.0	107.0	63.00	65.00	56.00	24.00	17.00
AF	22525	60513	35995	21321	18907	7813	4937	2438	2204	2523	643.4	668.8

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1981

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	10.00	18.00	39.00	9.20	6.60	4.90	1.50	0.810	0.420	0.370	0.330	0.180
2	10.00	14.00	87.00	10.00	6.50	4.90	1.50	0.810	0.410	0.370	0.330	0.120
3	10.00	13.00	72.00	10.00	6.50	4.80	1.60	0.810	0.400	0.370	0.320	0.080
4	10.00	13.00	69.00	9.40	8.00	4.50	1.60	0.780	0.390	0.370	0.300	0.100
5	11.00	13.00	76.00	9.40	6.60	4.50	1.60	0.760	0.380	0.370	0.290	0.060
6	10.00	12.00	67.00	8.60	6.50	4.50	1.40	0.760	0.380	0.360	0.280	4.70
7	11.00	12.00	27.00	8.40	6.50	4.40	1.30	0.740	0.370	0.360	0.270	19.00
8	10.00	12.00	23.00	8.20	6.10	4.30	1.40	0.720	0.360	0.360	0.260	21.00
9	12.00	53.00	21.00	8.20	6.10	4.40	1.40	0.700	0.360	0.360	0.250	22.00
10	11.00	62.00	20.00	8.00	5.70	4.30	1.40	0.690	0.360	0.360	0.240	23.00
11	11.00	61.00	18.00	7.80	5.80	4.40	1.40	0.680	0.360	0.360	0.230	24.00
12	11.00	60.00	18.00	7.80	5.70	4.40	1.40	0.660	0.360	0.360	0.220	15.00
13	11.00	46.00	18.00	7.80	5.50	4.40	1.40	0.640	0.370	0.350	0.210	2.40
14	11.00	12.00	18.00	7.80	5.70	4.30	1.40	0.630	0.370	0.350	0.210	2.00
15	11.00	11.00	18.00	7.70	5.70	4.00	1.40	0.620	0.370	0.350	0.180	1.50
16	11.00	12.00	17.00	20.00	5.50	3.90	1.40	0.600	0.370	0.350	0.180	1.20
17	11.00	13.00	17.00	8.00	5.20	3.40	1.40	0.580	16.00	0.350	0.150	1.10
18	10.00	15.00	17.00	12.00	5.20	2.70	1.40	0.580	4.00	0.350	0.210	0.920
19	10.00	14.00	18.00	12.00	4.90	2.00	1.30	0.560	2.00	0.350	0.210	0.850
20	9.80	12.00	34.00	9.40	5.70	1.70	1.10	0.560	3.00	0.350	0.210	0.770
21	9.60	14.00	27.00	8.80	5.40	1.60	1.10	0.540	2.00	0.350	0.180	0.700
22	9.40	15.00	21.00	8.00	5.10	1.50	1.00	0.520	10.00	0.350	0.180	0.700
23	9.60	13.00	19.00	7.70	5.10	1.50	0.990	0.520	0.380	0.340	0.150	1.10
24	9.80	13.00	18.00	7.30	4.90	1.50	0.990	0.500	0.380	0.340	0.120	0.770
25	9.60	12.00	17.00	7.30	4.90	1.50	0.940	0.490	0.380	0.340	0.100	0.640
26	9.60	14.00	21.00	7.30	4.90	1.40	0.900	0.480	0.380	0.340	0.120	0.640
27	9.60	14.00	14.00	7.10	5.20	1.40	0.850	0.470	0.380	0.340	0.240	0.570
28	9.60	12.00	10.00	6.80	6.00	1.40	0.850	0.460	0.380	0.340	0.230	0.520
29	55.00		9.40	6.80	5.40	1.40	0.850	0.450	0.380	0.340	0.210	0.520
30	58.00		9.10	6.80	5.20	1.60	0.850	0.440	0.390	0.340	0.200	0.480
31	29.00		9.00		4.90		0.810	0.430		0.330		0.480
Mean	13.89	20.89	28.02	8.79	5.71	3.18	1.24	0.613	1.54	0.352	0.220	4.75
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	9.40	11.00	9.00	6.80	4.90	1.40	0.810	0.430	0.360	0.330	0.100	0.060
Max	58.00	62.00	87.00	20.00	8.00	4.90	1.60	0.810	16.00	0.370	0.330	24.00
AF	854.1	1160	1723	522.9	351.1	189.4	76.23	37.67	91.40	21.66	13.11	291.8

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1982

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.440	6.70	5.20	226.0	49.00	8.80	5.60	4.80	1.80	3.80	3.10	148.0
2	0.440	5.90	6.40	194.0	48.00	8.80	5.60	4.40	1.80	2.70	2.70	104.0
3	0.400	5.70	7.80	131.0	46.00	8.30	5.20	3.70	1.40	2.30	2.70	83.00
4	0.400	5.50	6.40	109.0	49.00	7.80	5.20	2.80	1.00	2.50	2.50	66.00
5	11.00	5.50	5.60	95.00	46.00	7.30	4.80	2.40	0.850	2.30	2.70	47.00
6	14.00	5.70	5.20	85.00	42.00	7.30	4.80	2.10	0.770	2.10	2.30	32.00
7	9.10	5.70	5.20	80.00	40.00	6.90	4.40	1.90	0.700	2.10	2.30	15.00
8	5.40	5.70	6.00	80.00	39.00	6.90	4.10	1.50	0.770	2.10	2.30	13.00
9	4.10	5.00	5.20	66.00	38.00	6.90	4.10	1.40	0.770	2.10	13.00	17.00
10	3.20	158.0	4.40	70.00	37.00	6.40	4.10	1.20	0.700	2.90	25.00	18.00
11	3.00	352.0	4.40	145.0	35.00	6.40	3.70	1.10	0.700	2.30	12.00	13.00
12	2.90	123.0	7.80	262.0	34.00	6.40	4.10	1.00	0.850	2.10	6.80	13.00
13	3.00	47.00	6.90	186.0	33.00	6.90	3.70	0.920	1.00	2.10	5.10	13.00
14	2.60	39.00	26.00	124.0	32.00	6.90	3.70	0.920	1.10	2.70	4.80	12.00
15	2.40	35.00	49.00	122.0	31.00	6.40	3.70	0.850	1.10	2.70	4.60	8.40
16	2.30	32.00	48.00	98.00	30.00	6.40	4.10	0.850	1.10	2.30	3.80	5.50
17	2.30	28.00	650.0	98.00	29.00	6.40	4.10	0.770	1.40	2.70	3.50	4.80
18	2.30	22.00	321.0	92.00	28.00	8.30	4.10	0.770	1.50	2.30	3.80	4.60
19	2.10	20.00	180.0	92.00	27.00	11.00	4.10	0.700	1.50	2.50	24.00	4.30
20	34.00	16.00	155.0	93.00	26.00	8.80	4.10	0.640	1.50	2.10	18.00	4.00
21	52.00	12.00	143.0	87.00	22.00	6.90	4.10	0.570	1.50	2.50	6.10	3.80
22	21.00	9.30	133.0	75.00	21.00	6.90	4.10	0.570	1.40	2.30	5.80	370.0
23	18.00	7.30	98.00	68.00	19.00	6.40	4.10	0.570	1.30	2.10	6.80	499.0
24	19.00	6.90	78.00	66.00	17.00	6.40	4.10	0.640	1.20	2.30	5.50	227.0
25	18.00	6.90	57.00	63.00	18.00	6.40	4.10	0.860	1.10	2.10	4.60	189.0
26	14.00	6.40	61.00	59.00	17.00	6.00	19.00	1.30	8.30	22.00	4.60	159.0
27	11.00	5.60	58.00	57.00	17.00	6.00	16.00	1.40	13.00	46.00	7.20	141.0
28	12.00	5.60	60.00	55.00	17.00	5.60	11.00	1.40	6.00	5.50	5.10	133.0
29	14.00		70.00	53.00	17.00	5.60	8.30	1.50	4.10	4.30	4.30	114.0
30	9.10		110.0	52.00	14.00	5.60	7.30	1.50	4.10	3.80	491.0	90.00
31	7.60		77.00		12.00		5.60	1.80		3.50		54.00
Mean	9.71	35.12	79.05	102.8	30.00	7.04	5.65	1.51	2.14	4.68	22.87	84.05
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0.400	5.00	4.40	52.00	12.00	5.60	3.70	0.570	0.700	2.10	2.30	3.80
Max	52.00	352.0	650.0	262.0	49.00	11.00	19.00	4.80	13.00	46.00	491.0	499.0
AF	597.2	1951	4861	6115	1845	418.7	347.1	92.89	127.6	287.8	1361	5168

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1983

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	90.00	350.0	1300	371.0	608.0	340.0	114.0	41.00	18.00	112.0	9.70	13.00
2	88.00	208.0	1200	367.0	536.0	331.0	111.0	41.00	16.00	82.00	9.20	12.00
3	84.00	182.0	1010	362.0	475.0	294.0	109.0	39.00	17.00	68.00	8.60	53.00
4	64.00	176.0	755.0	344.0	492.0	282.0	104.0	38.00	18.00	68.00	8.60	112.0
5	62.00	156.0	589.0	323.0	519.0	278.0	104.0	36.00	14.00	78.00	8.60	79.00
6	80.00	109.0	525.0	302.0	367.0	270.0	99.00	36.00	14.00	68.00	8.60	25.00
7	122.0	46.00	503.0	274.0	310.0	251.0	97.00	42.00	13.00	64.00	8.20	23.00
8	122.0	312.0	503.0	231.0	362.0	200.0	95.00	45.00	20.00	64.00	12.00	18.00
9	122.0	248.0	470.0	211.0	367.0	176.0	92.00	45.00	25.00	62.00	11.00	17.00
10	114.0	159.0	331.0	211.0	371.0	166.0	88.00	46.00	25.00	61.00	8.60	15.00
11	36.00	90.00	294.0	211.0	362.0	166.0	82.00	38.00	25.00	57.00	8.60	13.00
12	17.00	78.00	239.0	204.0	344.0	162.0	80.00	37.00	28.00	56.00	46.00	13.00
13	12.00	70.00	219.0	176.0	340.0	156.0	74.00	33.00	49.00	54.00	41.00	11.00
14	6.70	64.00	200.0	156.0	323.0	150.0	72.00	32.00	33.00	56.00	26.00	9.20
15	5.90	59.00	189.0	144.0	327.0	147.0	70.00	34.00	48.00	54.00	18.00	8.60
16	5.50	52.00	226.0	141.0	335.0	144.0	70.00	62.00	48.00	54.00	18.00	8.60
17	5.50	49.00	282.0	144.0	331.0	141.0	68.00	79.00	49.00	54.00	18.00	7.70
18	5.20	48.00	371.0	200.0	323.0	141.0	66.00	141.0	49.00	54.00	24.00	7.70
19	8.60	46.00	340.0	176.0	323.0	141.0	62.00	107.0	51.00	56.00	18.00	7.70
20	5.90	41.00	353.0	251.0	331.0	156.0	62.00	57.00	54.00	54.00	28.00	7.70
21	4.80	37.00	254.0	376.0	340.0	138.0	61.00	51.00	66.00	52.00	42.00	7.70
22	67.00	34.00	235.0	306.0	349.0	133.0	61.00	43.00	56.00	52.00	26.00	7.70
23	144.0	34.00	251.0	314.0	358.0	130.0	57.00	38.00	56.00	54.00	22.00	8.20
24	110.0	38.00	449.0	306.0	362.0	127.0	56.00	33.00	54.00	48.00	25.00	8.60
25	140.0	45.00	353.0	298.0	358.0	127.0	54.00	31.00	52.00	22.00	280.0	589.0
26	122.0	125.0	254.0	290.0	358.0	130.0	54.00	30.00	54.00	16.00	110.0	468.0
27	668.0	952.0	235.0	282.0	353.0	119.0	52.00	26.00	36.00	14.00	85.00	376.0
28	620.0	755.0	316.0	286.0	349.0	116.0	49.00	24.00	33.00	12.00	25.00	265.0
29	655.0		531.0	506.0	358.0	114.0	46.00	23.00	37.00	11.00	19.00	208.0
30	497.0		475.0	692.0	358.0	114.0	45.00	21.00	54.00	11.00	16.00	149.0
31	454.0		385.0		353.0		43.00	20.00		10.00		121.0
Mean	146.4	163.0	439.9	281.8	375.5	178.0	74.10	44.16	37.07	50.90	32.96	86.11
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	4.80	34.00	189.0	141.0	310.0	114.0	43.00	20.00	13.00	10.00	8.20	7.70
Max	668.0	952.0	1300	692.0	608.0	340.0	114.0	141.0	66.00	112.0	280.0	589.0
AF	9001	9051	27049	16770	23092	10592	4556	2715	2206	3130	1961	5295

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1984

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	107.0	7.20	5.20	5.20	3.90	1.20	0.860	9.20	0.970	2.40	1.10	4.50
2	97.00	7.20	5.20	4.90	3.90	1.20	0.770	5.20	0.770	2.10	1.10	4.90
3	84.00	6.80	5.20	4.50	3.60	1.20	0.680	3.60	0.680	2.10	2.20	4.90
4	74.00	6.40	4.90	4.20	3.10	1.20	0.680	3.40	0.600	1.60	8.20	4.20
5	66.00	6.00	4.90	4.20	3.10	1.10	0.600	3.10	0.470	1.60	3.90	3.90
6	57.00	6.00	4.90	4.50	3.10	1.10	0.520	2.80	0.470	1.30	3.90	3.90
7	51.00	6.40	4.90	4.50	2.80	0.970	0.520	2.20	0.470	0.940	3.90	3.60
8	45.00	6.00	4.90	4.20	2.80	0.860	0.470	1.80	0.410	0.830	8.50	4.20
9	39.00	6.00	4.90	4.20	2.80	0.770	0.470	1.60	0.370	0.730	3.90	3.90
10	34.00	6.00	4.90	3.90	2.60	0.770	0.520	1.60	0.410	0.730	2.60	3.90
11	32.00	6.00	4.90	3.90	2.60	0.770	0.520	1.50	0.410	0.630	2.20	34.00
12	34.00	6.00	4.90	3.90	2.60	0.770	0.520	1.30	0.470	0.630	2.00	32.00
13	31.00	6.00	4.90	4.50	2.60	0.770	0.600	1.30	0.410	0.540	4.80	10.00
14	32.00	6.00	5.60	4.20	2.60	0.860	0.770	1.30	0.370	0.460	3.90	9.70
15	28.00	6.00	5.60	4.20	2.60	1.10	2.20	1.20	0.320	4.30	2.60	7.20
16	26.00	6.00	5.20	5.20	2.80	1.20	4.90	1.10	25.00	1.60	2.40	11.00
17	24.00	6.80	4.90	4.20	2.80	1.30	5.60	1.10	34.00	2.20	2.40	9.20
18	22.00	6.40	4.90	4.20	2.80	1.30	9.20	2.40	34.00	2.10	2.60	32.00
19	19.00	6.40	4.50	4.50	2.60	1.30	19.00	2.40	36.00	1.50	2.60	316.0
20	18.00	6.00	4.20	4.50	2.60	1.60	11.00	2.40	37.00	1.30	2.60	90.00
21	18.00	6.00	4.20	4.20	2.60	1.80	4.20	2.20	35.00	1.30	2.40	28.00
22	17.00	6.00	4.20	3.90	2.60	2.00	3.90	2.00	36.00	1.20	3.10	19.00
23	17.00	6.00	4.20	3.60	2.40	2.00	3.90	2.00	36.00	1.10	2.80	16.00
24	18.00	6.00	3.90	3.40	2.20	1.80	3.90	2.00	37.00	1.10	9.30	16.00
25	14.00	6.00	3.90	3.60	2.20	1.80	3.60	1.80	35.00	1.10	50.00	15.00
26	13.00	5.60	3.90	3.90	2.20	1.60	3.40	1.30	36.00	1.10	24.00	14.00
27	17.00	5.60	4.20	4.20	2.00	1.20	3.40	1.20	38.00	1.10	9.70	45.00
28	11.00	5.60	4.20	4.50	1.80	1.10	11.00	0.970	24.00	1.10	6.00	77.00
29	10.00	5.60	4.20	4.20	1.60	0.970	58.00	0.860	4.40	1.10	5.20	49.00
30	9.20		3.90	4.20	1.50	0.860	51.00	0.970	3.30	1.10	4.50	46.00
31	7.20		4.20		1.30		35.00	1.10		1.10		44.00
Mean	34.56	6.14	4.66	4.24	2.60	1.22	7.80	2.16	15.28	1.35	6.15	31.03
Cnt	31	29	31	30	31	30	31	31	30	31	30	31
Min	7.20	5.60	3.90	3.40	1.30	0.770	0.470	0.860	0.320	0.460	1.10	3.60
Max	107.0	7.20	5.60	5.20	3.90	2.00	58.00	9.20	38.00	4.30	50.00	316.0
AF	2125	353.1	286.6	252.5	160.1	72.34	479.4	132.7	909.0	83.29	365.8	1908

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1985

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	59.00	4.10	3.00	10.00	1.90	0.420	0.120	0.170	0.010	0	0	64.00
2	57.00	5.20	3.20	9.00	1.90	0.420	0.080	0.160	0.010	0	0	62.00
3	55.00	4.80	3.50	7.90	1.90	0.620	0.060	0.140	0.010	0	0	78.00
4	52.00	4.50	3.20	7.40	1.90	0.420	0.060	0.140	0	0	0	42.00
5	53.00	6.10	3.00	7.40	1.90	0.310	0.060	0.140	0	0	0	9.60
6	52.00	9.40	3.00	7.90	1.90	0.310	0.060	0.130	0	0	0	2.50
7	68.00	7.40	2.70	6.90	1.90	0.260	0.050	0.120	0	0	0	2.00
8	100.0	4.50	2.70	5.20	1.70	0.240	0.040	0.120	0.010	0	0	1.10
9	64.00	20.00	2.70	3.80	1.50	0.210	0.060	0.120	0	0	0	1.70
10	62.00	17.00	2.70	3.50	1.40	0.240	0.060	0.130	0.010	0	0	1.10
11	53.00	12.00	2.70	3.20	1.40	0.240	0.050	0.120	0	0	4.00	1.10
12	57.00	6.90	2.50	3.00	1.20	0.240	0.050	0.120	0	0	14.00	0.660
13	53.00	6.00	2.50	2.70	1.10	0.210	0.040	0.120	0	0	1.90	0.400
14	23.00	5.20	2.50	2.50	1.00	0.210	0.040	0.120	0	0	0	0.480
15	7.40	4.80	2.50	2.50	0.880	0.210	0.040	0.100	0	0	0	0.270
16	6.90	4.50	2.50	2.30	0.880	0.190	0.020	0.120	0	0	0	0.150
17	6.50	4.50	2.50	2.30	0.880	0.170	0.010	0.100	0	0	0	0.120
18	6.00	4.10	3.50	3.50	0.780	0.160	0	0.100	0.020	0	0	0.100
19	6.00	4.10	4.10	3.20	0.780	0.160	0.180	0.100	0	0	0	0.080
20	5.60	4.10	3.20	3.20	0.780	0.160	0.980	0.100	0	0	0	0.070
21	5.60	3.80	3.00	3.00	0.780	0.160	0.540	0.100	0	0	0	0.060
22	5.20	3.80	2.70	3.00	0.700	0.160	0.480	0.090	0	0	0	0.050
23	5.20	3.80	2.50	2.70	0.700	0.160	0.420	0.090	0	0	0	0.040
24	4.80	3.50	2.50	2.50	0.700	0.170	0.360	0.070	0	0	0	0.040
25	4.80	3.20	2.50	2.50	0.620	0.160	0.360	0.070	0	0	7.30	0.030
26	4.80	3.20	2.50	3.00	0.620	0.140	0.310	0.060	0	0	2.00	0.020
27	4.80	3.20	14.00	2.50	0.620	0.170	0.260	0.050	0	0	0	0.030
28	7.40	3.00	48.00	2.70	0.540	0.190	0.240	0.040	0	0	0	0.020
29	6.90		34.00	2.30	0.540	0.160	0.240	0.040	0	0	119.0	0.010
30	6.00		18.00	2.10	0.540	0.130	0.210	0.030	0	0	126.0	0
31	4.10		20.00		0.480		0.190	0.030		0		0.010
Mean	29.23	5.95	6.71	4.12	1.11	0.233	0.183	0.101	2.33E-03	0	9.14	8.64
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	4.10	3.00	2.50	2.10	0.480	0.130	0	0.030	0	0	0	0
Max	100.0	20.00	48.00	10.00	1.90	0.620	0.980	0.170	0.020	0	126.0	78.00
AF	1797	330.6	412.4	245.4	68.27	13.88	11.25	6.23	0.139	0	543.9	531.1

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1986

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.010	62.00	5.80	59.00	2.80	1.50	0.300	0.020	0	0.660	0	0
2	0	38.00	5.90	17.00	2.40	1.60	0.270	0.020	0	0.470	0	0
3	0	15.00	4.90	13.00	2.40	1.50	0.260	0.020	0	0.190	0	0
4	0	14.00	4.20	12.00	2.40	1.50	0.260	0.020	0	0.100	0	0
5	0	5.10	4.10	11.00	2.50	1.50	0.240	0.010	0	0.040	0	0
6	0	3.20	3.90	15.00	2.50	1.50	0.250	0.010	0	0.010	0	12.00
7	0.030	2.70	3.60	12.00	2.60	1.60	0.200	0.010	0	0	0	20.00
8	0.020	2.80	68.00	7.30	2.40	1.50	0.190	0.010	0	0	0	9.80
9	0.010	2.40	113.0	6.80	2.30	1.40	0.160	0.010	0	0	0	0.820
10	0.010	1.90	206.0	6.00	2.20	1.30	0.150	0	0	0	0	0.120
11	0	1.90	228.0	5.60	2.20	1.50	0.130	0	0	0	0	0
12	0	1.80	155.0	5.20	2.30	1.60	0.120	0	0	0	0	0
13	0.010	2.40	145.0	5.00	2.30	1.50	0.110	0	0	0	0	0
14	0	3.80	135.0	4.90	2.30	1.30	0.100	0	0	0	0	0
15	0	665.0	129.0	4.60	2.40	1.30	0.100	0	0	0	0	0
16	0	342.0	208.0	4.80	2.40	1.20	0.080	0	0	0	0	0
17	0	231.0	179.0	4.70	2.10	1.20	0.090	0	0	0	0	0
18	0	193.0	155.0	4.50	2.00	1.10	0.070	0	0	0	63.00	0
19	0	268.0	143.0	4.30	1.80	1.10	0.060	7.70	0	0	33.00	0
20	0.010	228.0	114.0	3.90	1.90	1.10	0.050	0.500	0	0	5.80	0
21	0.010	137.0	54.00	3.90	1.90	1.00	0.310	0.100	0	0	0.050	0
22	0.010	55.00	47.00	3.80	1.90	0.880	0.180	0.060	0	0	0	0
23	0.010	38.00	46.00	3.40	2.00	0.770	0.120	0.030	0	0	0	0
24	0.010	49.00	45.00	3.60	2.10	0.730	0.100	0.020	0	0	0	0
25	0.010	36.00	41.00	3.60	1.70	0.620	0.080	0.010	64.00	0	0	0
26	0.020	28.00	36.00	3.70	1.60	0.590	0.070	0	30.00	0	0	0
27	0.020	13.00	35.00	3.40	1.60	0.460	0.060	0	8.60	0	0	0
28	0.020	7.60	44.00	3.20	1.50	0.400	0.050	0	4.30	0	0	0
29	0.030		97.00	3.20	1.50	0.400	0.040	0	2.90	0	0	0
30	73.00		95.00	3.30	1.50	0.320	0.030	0	2.20	0	0	0
31	74.00		92.00		1.50		0.030	0		0		0
Mean	4.75	87.41	85.24	8.06	2.10	1.13	0.137	0.276	3.73	0.047	3.40	1.38
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0	1.80	3.60	3.20	1.50	0.320	0.030	0	0	0	0	0
Max	74.00	665.0	228.0	59.00	2.80	1.60	0.310	7.70	64.00	0.660	63.00	20.00
AF	292.1	4855	5241	479.4	128.9	67.38	8.45	16.96	222.2	2.92	202.0	84.77

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1987

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	1.70	2.80	3.40	0.670	0.010	0	0	0	0	41.00	0
2	0	1.50	2.80	3.20	0.610	0	0	0	0	0	35.00	0
3	0	1.30	2.70	4.40	0.550	0	0	0	0	0	9.80	0
4	12.00	0.790	2.70	6.60	0.520	0	0	0	0	0	0.100	0.050
5	48.00	0.640	2.70	4.30	0.480	0	0	0	0	0	32.00	9.10
6	13.00	0.600	50.00	4.00	0.460	0	0	0	0	0	26.00	0.270
7	11.00	0.530	67.00	3.50	0.510	0	0	0	0	0	0.770	0
8	7.30	0.590	40.00	3.00	0.510	0	0	0	0	0	0.030	0
9	4.50	0.640	11.00	2.90	0.490	0	0	0	0	0	0	0
10	3.40	0.730	5.40	2.70	0.470	0	0	0	0	0	0	0
11	2.80	0.870	4.60	2.70	0.380	0	0	0	0	0	0	0
12	2.40	0.740	4.10	2.60	0.330	0	0	0	0	0	0	0
13	2.20	0.810	3.80	2.40	0.310	0	0	0	0	0	0	0
14	2.20	0.960	3.70	2.30	0.300	0	0	0	0	0	0	0
15	2.00	0.870	11.00	2.00	0.310	0	0	0	0	0	0	0
16	1.90	0.940	9.50	1.90	0.270	0	0	0	0	0	0	0
17	2.70	0.870	6.50	1.80	0.230	0	0	0	0	0	0	2.10
18	3.00	0.900	5.00	1.90	0.180	0	0	0	0	0	0	0.160
19	2.30	0.960	6.10	1.80	0.170	0	0	0	0	0	0	0
20	0.880	0.850	6.10	1.70	0.170	0	0	0	0	0	0	0
21	1.20	0.850	6.90	1.60	0.150	0	0	0	0	0	0	0
22	1.30	0.870	10.00	1.20	0.090	0	0	0	0	0	0	0
23	1.20	1.30	9.80	1.00	0.080	0	0	0	0	51.00	0	0
24	1.30	2.30	7.20	0.900	0.070	0	0	0	0	31.00	0	0
25	1.10	2.50	6.10	0.880	0.080	0	0	0	0	18.00	0	0
26	0.950	2.30	5.30	0.790	0.090	0	0	0	0	0.900	0	0
27	0.940	2.20	4.80	0.740	0.080	0	0	0	0	0	0	0
28	13.00	2.60	4.50	0.680	0.050	0	0	0	0	0	0	0
29	11.00		4.10	0.700	0.030	0	0	0	0	0	0	0.020
30	2.00		4.00	0.740	0.030	0	0	0	0	0	0	0.020
31	1.70		3.70		0.010		0	0		7.10		0
Mean	5.07	1.17	10.13	2.28	0.280	3.33E-04	0	0	0	3.48	4.82	0.378
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0	0.530	2.70	0.680	0.010	0	0	0	0	0	0	0
Max	48.00	2.60	67.00	6.60	0.670	0.010	0	0	0	51.00	41.00	9.10
AF	311.9	64.88	622.6	135.5	17.22	0.020	0	0	0	214.2	287.0	23.25

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1988

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	1.60	0.630	0.360	2.20	0.490	0.060	0	0	0	0	0
2	0	2.20	6.40	0.390	2.10	0.440	0.050	0	0	0	0	0
3	0	2.10	2.00	0.370	1.80	0.390	0.050	0	0	0	0	0
4	0	1.80	1.50	0.300	1.60	0.380	0.050	0	0	0	0	0
5	0.020	1.60	1.10	0.240	1.50	0.390	0.040	0	0	0	0	0
6	2.00	1.50	0.930	0.220	1.60	0.370	0.030	0	0	0	0	0
7	0.530	1.50	0.870	0.200	1.50	0.360	0.030	0	0	0	0	0
8	0.200	1.50	0.780	0.180	1.50	0.300	0.030	0	0	0	0	0
9	0.120	1.40	5.70	0.200	1.20	0.300	0.020	0	0	0	0	0
10	0.090	1.40	1.50	0.200	1.00	0.360	0.020	0	0	0	0	0
11	0.100	1.40	1.10	0.150	0.980	0.360	0.020	0	0	0	0	0
12	0.120	1.40	0.950	0.140	0.900	0.420	0.010	0	0	0	0	0
13	0.120	1.40	0.820	0.160	0.860	0.330	0.020	0	0	0	0	0
14	0.130	1.40	0.780	0.410	0.810	0.290	0.010	0	0	0	0	0
15	0.150	1.20	0.760	4.80	0.730	0.290	0.010	0	0	0	0	0
16	0.160	1.30	0.660	2.10	0.700	0.260	0.010	0	0	0	0	0
17	52.00	1.30	0.680	1.90	0.690	0.290	0.010	0	0	0	0	0
18	67.00	1.30	0.660	1.70	0.660	0.260	0.010	0	0	0	0	0
19	41.00	1.30	0.620	1.40	0.630	0.230	0.010	0	0	0	0	0
20	12.00	1.20	0.610	73.00	0.570	0.210	0	0	0	0	0	0
21	5.00	1.20	0.600	63.00	0.520	0.200	0	0	0	0	0	42.00
22	3.70	1.20	0.620	12.00	0.510	0.150	0	0	0	0	0	27.00
23	3.30	0.940	0.590	6.50	0.510	0.130	0	0	0	0	0	14.00
24	2.70	0.780	0.530	6.50	0.520	0.150	0	0	0	0	0	6.30
25	2.40	0.660	0.470	4.80	0.450	0.170	0	0	0	0	0	132.0
26	2.20	0.620	0.450	3.50	0.500	0.140	0	0	0	0	0	56.00
27	2.00	0.490	0.450	3.10	0.540	0.100	0	0	0	0	0	43.00
28	1.90	0.420	0.440	2.90	0.560	0.090	0	0	0	0	0	39.00
29	1.90	0.430	0.440	2.70	0.810	0.080	0	0	0	0	0	35.00
30	1.90		0.470	2.20	0.720	0.070	0	0	0	0	0	31.00
31	1.90		0.410		0.520		0	0		0		22.00
Mean	6.60	1.26	1.11	6.52	0.958	0.267	0.016	0	0	0	0	14.43
Cnt	31	29	31	30	31	30	31	31	30	31	30	31
Min	0	0.420	0.410	0.140	0.450	0.070	0	0	0	0	0	0
Max	67.00	2.20	6.40	73.00	2.20	0.490	0.060	0	0	0	0	132.0
AF	405.9	72.48	68.47	388.0	58.89	15.87	0.972	0	0	0	0	887.2

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1989

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.40	0.590	2.70	1.30	0.560	0.250	0.150	0.130	0	0	0	0
2	0.310	0.660	3.10	1.20	0.390	0.290	0.140	0.090	0	0	0	0
3	0.060	0.840	13.00	1.20	0.360	0.320	0.130	0.080	0	0	0	0
4	1.60	121.0	7.10	1.20	0.340	0.300	0.110	0.070	0	0	0	0
5	2.60	134.0	4.00	1.20	0.320	0.300	0.100	0.060	0	0	0	0
6	18.00	81.00	3.80	1.10	0.300	0.310	0.110	0.060	0	0	0	0
7	11.00	45.00	3.00	1.00	0.320	0.320	0.110	0.050	0	0	0	0
8	3.10	22.00	2.70	1.10	0.310	0.360	0.120	0.050	0	0	0	0
9	17.00	58.00	2.60	1.00	0.400	0.340	0.140	0.040	0	0	0	0
10	24.00	130.0	2.20	1.20	0.380	0.420	0.150	0.040	0	0	0	0
11	2.20	62.00	2.20	1.40	0.560	0.370	0.160	0.020	0	0	0	0
12	1.80	35.00	2.00	1.50	0.420	0.340	0.120	0.040	0	0	0	0
13	1.50	28.00	1.90	1.30	0.360	0.310	0.130	0.020	0	0	0	0
14	1.30	26.00	1.90	1.10	0.370	0.300	0.120	1.00E-02	0	0	0	0
15	1.10	25.00	1.90	1.00	0.530	0.280	0.150	1.00E-02	0	0	0	0
16	0.710	25.00	1.80	0.920	1.10	0.270	0.150	1.00E-02	0	0	0	0
17	0.660	10.00	1.50	0.830	0.500	0.260	0.120	0.020	0	0	0	0
18	0.630	8.00	1.50	0.790	0.340	0.260	0.110	1.00E-02	0	0	0	0
19	0.590	6.70	1.40	0.600	0.320	0.250	0.090	1.00E-02	0	0	0	0
20	0.590	8.10	1.40	0.560	0.270	0.220	0.070	1.00E-02	0	0	0	0
21	0.590	6.60	1.40	0.520	0.260	0.240	0.120	0	0	0	0	0
22	0.590	4.60	1.30	0.510	0.250	0.260	0.120	0	0	0	0	0
23	0.590	4.20	1.40	0.430	0.260	0.310	0.110	0	0	0	0	0
24	0.590	3.80	1.20	0.420	0.270	0.340	0.100	0	0	0	0	0
25	0.590	3.40	8.00	0.490	0.260	0.360	0.100	0	0	0	0	0
26	0.590	3.10	9.00	0.940	0.260	0.380	0.080	0	0	0	0	0
27	0.590	3.10	4.10	0.540	0.260	0.330	0.080	0	0	0	0	0
28	0.590	2.70	3.20	0.380	0.270	0.280	0.090	0	0	0	0	0
29	0.590		2.60	0.330	0.290	0.290	0.100	0	0	0	0	0
30	0.590		1.70	0.340	0.310	0.210	0.090	0	0	0	0	0
31	0.590		1.20		0.310		0.070	0		0		0
Mean	3.12	30.66	3.12	0.880	0.369	0.302	0.114	0.027	0	0	0	0
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0.060	0.590	1.20	0.330	0.250	0.210	0.070	0	0	0	0	0
Max	24.00	134.0	13.00	1.50	1.10	0.420	0.160	0.130	0	0	0	0
AF	191.7	1703	192.0	52.36	22.71	17.99	7.02	1.65	0	0	0	0

Station: **SANTA ANA R NR MENTONE CA**
Parameter: Streamflow (cfs)
Year: 1896-1993
State: CALIFORNIA
County: SAN BERNARDINO

ID: 11051500
Statistic: Mean
Latitude: 34:06:30
Longitude: 117:05:30
Elevation: 1984.28
Drainage Area: 210.00

Daily Data: 1990

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	0	1.60	0.110	0	0	0	0	0	0	0
2	0	0	0	1.30	0.070	0	0	0	0	0	0	0
3	0	0	0	0.340	0.050	0	0	0	0	0	0	0
4	0	0	0	0.260	0.030	0	0	0	0	0	0	0
5	0	0	0	0.270	0.020	0	0	0	0	0	0	0
6	0	0	0	0.330	1.00E-02	0	0	0	0	0	0	0
7	0	0	3.10	0.300	0.020	0	0	0	0	0	0	0
8	0	0	0.900	0.310	0.020	0	0	0	0	0	0	0
9	0	0	0	0.290	1.00E-02	0	0	0	0	0	0	0
10	0	0	0	0.290	1.00E-02	0	0	0	0	0	0	0
11	0	0	0.040	0.280	1.00E-02	0	0	0	0	0	0	0
12	0	0	0.030	0.190	0	0	0	0	0	0	0	0
13	0	0	1.00E-02	0.170	0	0	0	0	0	0	0	0
14	10.00	0	1.60	0.160	0	0	0	0	0	0	0	0
15	14.00	0	0.550	0.160	0	0	0	0	0	0	0	0
16	4.50	0	0	0.270	0	0	0	0	0	0	0	0
17	0.050	26.00	0	1.30	0	0	0	0	0	0	0	0
18	1.10	36.00	0	0.850	0	0	0	0	0	0	0	0
19	0	14.00	0	0.310	0	0	0	0	0	0	0	0
20	0	6.30	0	0.260	0	0	0	0	0	0	0	0
21	0	1.40	0	0.220	0	0	0	0	0	0	0	0
22	0	0.470	0	0.260	0	0	0	0	0	0	0	0
23	0	0.150	0	0.240	0	0	0	0	0	0	0	0
24	0	0	0	0.270	0	0	0	0	0	0	0	0
25	0	0	0	0.170	0	0	0	0	0	0	0	0
26	0	0	0	0.130	0	0	0	0	0	0	0	0
27	0	0	0.250	0.100	0	0	0	0	0	0	0	0
28	0	0	1.10	0.080	0	0	0	0	0	0	0	0
29	0		1.60	0.110	0	0	0	0	0	0	0	0
30	0		1.30	0.130	0	0	0	0	0	0	0	0
31	0		5.60		0		0	0		0		0
Mean	0.956	3.01	0.519	0.365	0.012	0	0	0	0	0	0	0
Cnt	31	28	31	30	31	30	31	31	30	31	30	31
Min	0	0	0	0.080	0	0	0	0	0	0	0	0
Max	14.00	36.00	5.60	1.60	0.110	0	0	0	0	0	0	0
AF	58.81	167.2	31.89	21.72	0.714	0	0	0	0	0	0	0

US Army Corps
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Los Angeles District

Feasibility Report

Seven Oaks Dam Water Conservation
Santa Ana River Basin, California

Appendix B. Hydraulics

June 1997

HYDRAULICS APPENDIX

1 GENERAL

This appendix summarizes the impacts of the four proposed water conservation alternatives on the hydraulic performance of the existing Seven Oaks Dam outlet works. All of the alternatives involve various storage volumes of water during the dry season. Briefly, the four alternatives are: (1) storage of 16,000 acre-feet at a pool elevation 2300 feet NGVD; (2) storage of 35,000 acre-feet at a pool elevation of 2378 feet NGVD; (3) storage of 50,000 acre-feet at a pool elevation of 2418 feet NGVD; and (4) storage of 10,270 acre-feet at a pool elevation of 2265 feet NGVD. The above storage information applies to present conditions. The potential impacts of all of the proposed alternatives would be: (1) an increase of the hydrostatic loading on hydraulic structures, and (2) a change of the depth of sediment deposition at the intake structure and the distribution of sediment deposition within the reservoir. Five design options were developed for alternatives 2 and 3. The additional head losses caused by the structural modifications to the intake structure or the outlet tunnel for the proposed options could possibly change the rating curves for the main regulating outlet (RO) gates and the low flow gate. As discussed in the main report, the recommended plan for the Seven Oaks Water Conservation Feasibility study is Alternative 1.

2 PERTINENT HYDRAULIC DESIGN DATA FOR EXISTING CONDITIONS

2.1 HYDROSTATIC LOADING

The maintenance bulkhead gates were designed for a hydrostatic head of 202 feet. Normal operation of the 15-inch cone valve at the end of the minimum discharge line ranges from 10 to 90 cfs at a pool elevation of 2100 to 2300 feet, NGVD. However, the valve was designed to operate under the worst condition of 130 cubic feet per second (cfs) at a pool elevation of 2400 feet, NGVD.

2.2 SEDIMENT DEPOSITION

The estimated elevation of sediment deposition at the intake structure at the end of the project life is 2265 feet NGVD. The procedures and assumptions used to determine this elevation are documented in *Design Memorandum No. 1, Phase II GDM on the Santa Ana River Mainstem Project including Santiago Creek, Volume 1 -*

Seven Oaks Dam Outlet Works (Ref. 1). This report also provides information on the distribution of the sediment deposition within the reservoir throughout the life of the project.

2.3 MAIN RO GATE RATING

The gate rating loss coefficient for the existing main RO gates is presented in table 4-4 of *Design Memorandum No. 4, Feature Design - Seven Oaks Dam Outlet Works, Volume 1 - Report & Plates* (Ref. 2). This table provides the loss coefficient of the main RO gate for the velocity, rating, and capacity conditions. The rating curves were developed based on the loss coefficient for the rating condition. As shown in table 4-4 of Ref. 2, the existing main RO gate rating loss coefficient is 0.8302. The design rating curves for the main RO gate are provided in figure 4-1 of Ref. 2. To pass the 8000 cfs design discharge at a pool elevation of 2580 feet NGVD using a balanced gate operation, the main RO gates must be opened approximately 6.4 feet. The corresponding head loss through the existing outlet works was computed to be approximately 110.5 feet. One main RO gate opened at 80 percent would pass approximately 54.5 percent of the 8000 cfs design discharge at a pool elevation of 2580 feet NGVD. This information is summarized in table 1.

2.4 LOW FLOW GATE RATING

The gate rating loss coefficient for the existing low flow gates is presented in table 4-5 of Ref. 2. From this table, the existing low flow gate rating loss coefficient is 0.5307. The design rating curves for the low flow gate are illustrated in figures 4-2 and 4-3 of Ref. 2. The existing low flow gate was designed to pass the 500 cfs design discharge at a pool elevation of 2580 feet NGVD. For this condition, the maximum head loss was computed to be approximately 42 feet and the low flow gate must be opened approximately 1.9 feet. This information is summarized in table 2.

3 ALTERNATIVE ONE

3.1 GENERAL

Since the conservation pool would always be below the top of the maintenance deck on the intake structure, the outlet tunnel could be inspected without losing the pool by lowering the maintenance bulkhead gate. Thus, the intake structure and outlet works would not require any structural modifications for hydraulic reasons. However, as discussed in the Design Appendix, the intake structure will require additional anchors and support for seismic reasons.

3.2 IMPACT ON HYDROSTATIC LOADING

None of the hydraulic structures would have to be redesigned for this alternative, since the conservation pool would below the design pool elevation of the hydraulic structures.

3.3 IMPACT ON SEDIMENT DEPOSITION

This alternative would not significantly influence the estimated sediment deposition at the intake structure or the distribution of deposition within the reservoir throughout the project life. The reason is because the proposed plan involves the conservation pool to be maintained only during the dry season when the inflow of sediment is negligible.

4 ALTERNATIVE TWO

4.1 GENERAL

This alternative would require modifications to the maintenance bulkheads and guides as well as the intake structure in order to inspect the outlet tunnel without losing the conservation pool.

4.2 IMPACT ON HYDROSTATIC LOADING

The maintenance bulkhead gates would have to be redesigned for the additional 76 feet of hydrostatic head.

4.3 IMPACT ON SEDIMENT DEPOSITION

For the same reason discussed in paragraph 3.3, the proposed conservation plan would not significantly impact the estimated sediment deposition at the intake structure or the distribution of deposition within the reservoir throughout the project life.

4.4 DESIGN OPTIONS

Five design options were developed for this alternative. These options were analyzed to determine the impacts on the hydraulic performance of the existing outlet works. The impacts of the five design options are discussed in the following paragraphs and summarized in tables 1 and 2.

4.4.1 Design Option 1 (No Structural Modifications)

This design option involves no modifications to the existing outlet works. Thus, this option would not impact the hydraulic performance of the existing project.

4.4.2 Design Option 2 (Steel Frame)

This design option is comprised of an 80-foot-high steel frame constructed on top of the existing intake structure and a concrete deck to support a crane used to install the maintenance bulkhead. As determined from the seismic analysis, the existing trash rack structure with the added steel frame extension does not meet seismic requirements, and approximately 25 percent of the existing trash rack structure members would therefore require modification and/or replacement. As explained in the Design Appendix, the modification and/or replacement of the members would be difficult and economically unfeasible. Thus, a design for a new trash rack structure was not developed for this option. The modification to the existing trash rack structure would increase the head loss through the structure, possibly resulting in increased gate openings.

4.4.3 Design Option 3 (Concrete Wetwell Extension)

Design Option 3 is comprised of an 80-foot extension of the concrete wetwell and construction of a new trash rack structure similar to the existing trash rack structure. The 80-foot extension of the concrete wetwell could cause an increase in the head loss, which could result in increased gate openings.

4.4.3.1 Main RO Gates

The main RO gates rating loss coefficient for this option was computed to be 0.8304. Since the new loss coefficient is only 0.0002 greater then the existing loss coefficient, the main RO gate rating curve and the gate opening required to release the 8000 cfs design discharge at a pool elevation of 2580 feet NGVD would not change.

4.4.3.2 Low Flow Gate

The low flow gate rating loss coefficient or this option was computed to be 0.5307, which is the same as the existing loss coefficient. Thus, the low flow gate rating curve and the gate opening required to release the 500 cfs design discharge at a pool elevation of 2580 feet NGVD would not change.

4.4.4 Design Option 4 (Bulkhead Positioning Frame)

This design option involves the construction of a 80-foot-high steel frame on top of the existing intake structure. The steel frame would store and position the new bulkhead gate. An analysis of this option indicates that it would not impact the hydraulic performance of the existing outlet works.

4.4.5 Design Option 5 (Hydraulically Operated Bulkhead)

Design Option 5 includes the construction of a remotely- and hydraulically-operated bulkhead gate. The proposed gate would be located in a gate room 216 feet downstream of the intake structure. The construction of the gate room would require modifications to the outlet tunnel. The required modifications include a 216-foot extension of the 7-foot-wide by 13.5-foot-high passage, an additional gate slot, and a transition from a 7-foot-wide by 13.5-foot-high passage to a 18-foot diameter conduit. The proposed modifications to the outlet tunnel could cause increased head loss, resulting in increased gate openings.

4.4.5.1 Main RO Gates

The rating loss coefficient for the main RO gates was computed to be 0.9699. To release the maximum discharge of 8000 cfs at a pool elevation of 2580 feet NGVD using a balanced gate operation, the main RO gates would have to be opened approximately 0.2 feet more than required for the existing outlet works due to the additional 23 feet of head loss. The resulting gate opening of 6.6 feet is acceptable since the it is less then 80 percent of the maximum gate opening, i.e., the maximum allowable gate opening. One main RO gate opened at 80 percent would pass approximately 53.1 percent of the 8000 cfs design discharge at a pool elevation of 2580 feet NGVD, which is a 1.4% reduction from the discharge computed for the existing outlet works. Thus, this option would still satisfy guidance in EM 1110-2-1602, *Hydraulic Design of Reservoir Outlet Works* (Ref. 3), paragraph 3-12(a), which indicates that "for two gate passages a reasonable flow regulation as pertains to project purposes is obtained if one gate is inoperable."

4.4.5.2 Low Flow Gate

The rating loss coefficient for the low flow gate was computed to be 0.5317. The low flow rating curve and the gate opening required to release the 500 cfs design discharge at a pool elevation of 2580 feet NGVD would not change from the existing outlet works because the additional head losses computed for this option are insignificant.

5 ALTERNATIVE THREE

5.1 GENERAL

As for Alternative 2, this alternative would require modifications to the maintenance bulkheads and guides as well as the intake structure in order to inspect the outlet tunnel without losing the conservation pool.

5.2 IMPACT ON HYDROSTATIC LOADING

The maintenance bulkhead gates would have to be redesigned for the additional 116 feet of hydrostatic loading. In addition, the regulating control valve for the minimum discharge line might have to be replaced to accommodate the additional hydrostatic head.

5.3 IMPACT ON SEDIMENT DEPOSITION

For the reason discussed in paragraph 3.3, this alternative would not significantly impact the estimated elevation of sediment deposition at the intake structure or the distribution of deposition within the reservoir throughout the project life.

5.4 DESIGN OPTIONS

The same five design options developed for Alternative 2 were considered for Alternative 3. As for Alternative 2, the design options were analyzed to determine the impacts on the hydraulic performance of the existing outlet works. The impacts of the five options are discussed in the following paragraphs and summarized in tables 1 and 2.

5.4.1 Design Option 1 (No Structural Modifications)

As explained in paragraph 4.4.1, this option would not impact the hydraulic performance of the existing outlet works.

5.4.2 Design Option 2 (Steel Frame)

As discussed in paragraph 4.4.2, this option would require modifications to the existing trash rack structure in order to satisfy the seismic requirements. The trash rack structure modifications would result in the same impacts as those presented in paragraph 4.5.2.

5.4.3 Design Option 3 (123-foot Concrete Wetwell Extension)

The 123-foot extension of the concrete wetwell could cause an increase in head loss that could possibly affect the rating for the main RO gates and low flow gate, and result in higher gate openings.

5.4.3.1 Main RO Gates

The main RO gates rating loss coefficient was computed to be 0.8304. As in Alternative 2 Option 3, the loss coefficient is only 0.0002 greater then the existing loss coefficient. Thus, the main RO gates rating curve would not significantly change.

5.4.3.2 Low Flow Gate

As in paragraph 4.4.3.2, this option would not impact the low flow gate rating curve.

5.4.4 Design Option 4 (Bulkhead Positioning Frame)

This design option would not impact the hydraulic performance of the existing outlet works.

5.4.5 Design Option 5 (Hydraulically Operated Bulkhead)

As explained in paragraph 4.4.5, modifications to the outlet tunnel are required for this design option. The required modifications include a 270-foot extension of the 7-foot-wide by 13.5-foot-high passage, an additional gate slot, and a transition from a 7-foot-wide by 13.5-foot-high passage to a 18-foot diameter conduit. These modifications could cause increased head loss and an adjustment to the rating for the main RO gates and low flow gate, thus resulting in increased gate openings.

5.4.5.1 Main RO Gates

The main RO gates rating loss coefficient was computed to be 1.0148. To release the maximum discharge of 8000 cfs at a pool elevation of 2580 feet NGVD using a balanced gate operation, the main RO gates would have to be opened 0.3 feet more than required for the existing outlet works due to the additional 29.1 feet of head loss. The resulting gate opening of 6.7 feet is acceptable since the it is less then 80 percent of the maximum gate opening, i.e., the maximum allowable gate opening. One main RO gate opened at 80 percent would pass approximately 52.7 percent of the 8000 cfs design discharge at a pool elevation of 2580 feet NGVD. Although the discharge would be 1.8% less than the discharge computed for the existing outlet works, this option would still satisfy guidance in Ref. 3, paragraph 3-12(a).

5.4.5.2 Low Flow Gate

The rating loss coefficient for the low flow gate was computed to be 0.5320. As in Alternative 2 Option 5, the additional head losses are insignificant. Thus, the low flow gate rating would not change.

6 ALTERNATIVE FOUR

6.1 GENERAL

The intake structure and outlet works would not require any structural modifications for Alternative 4, since the conservation pool would always be below the top of the maintenance deck, and it would also be below the design pool elevation of the anchors/supports for the intake structure.

6.2 IMPACT ON HYDROSTATIC LOADING

None of the hydraulic structures would have to be redesigned for this alternative, since the conservation pool would below the design pool elevation of the hydraulic structures.

6.3 IMPACT ON SEDIMENT DEPOSITION

For the same reason discussed in paragraph 3.3, the recommended conservation plan would not significantly impact the estimated sediment deposition at the intake structure or the distribution of deposition within the reservoir throughout the project life.

7 REFERENCES

1. *Design Memorandum No. 1, Phase II GDM on the Santa Ana River Mainstem Project including Santiago Creek, Volume 1 - Seven Oaks Dam Outlet Works*, August 1988.

2. *Design Memorandum No. 4, Feature Design - Seven Oaks Dam Outlet Works, Volume 1 - Report & Plates*, April 1991.

3. EM 1110-2-1602, *Hydraulic Design of Reservoir Outlet Works*, U.S. Army Corps of Engineers, 15 October 1980.

Table 1 - Impacts of Alternatives on Performance of Main RO Gates

Alternative	Total Loss Coefficient	Head Loss (ft)	Gate Opening (ft)	Discharge for One Gate Open 80% (cfs)	Percent of Total Design Discharge
Existing	0.8302	110.5	6.4	4358	54.5
Alternative 1	*	*	*	*	*
Alternative 2					
Option 1	*	*	*	*	*
Option 2	*	*	*	*	*
Option 3	0.8304	110.5	*	*	*
Option 4	*	*	*	*	*
Option 5	0.9699	133.4	6.6	4244	53.1
Alternative 3					
Option 1	*	*	*	*	*
Option 2	*	*	*	*	*
Option 3	0.8034	110.5	*	*	*
Option 4	*	*	*	*	*
Option 5	1.0148	139.6	6.7	4215	52.7
Alternative 4	*	*	*	*	*

* Indicates no changes from the existing design

Note: Data corresponds to design release of 8000 cfs at a pool elevation of 2580 feet NGVD with a balanced gate operation.

Table 2 - Impact of Alternatives on Performance of Low Flow Gate

Alternative	Total Loss Coefficient	Head Loss (ft)	Gate Opening (ft)
Existing	0.5307	42.0	1.9
Alternative 1	*	*	*
Alternative 2			
Option 1	*	*	*
Option 2	*	*	*
Option 3	*	*	*
Option 4	*	*	*
Option 5	0.5317	42.1	*
Alternative 3			
Option 1	*	*	*
Option 2	*	*	*
Option 3	*	*	*
Option 4	*	*	*
Option 5	0.5320	42.2	*
Alternative 4	*	*	*

* Indicates no changes from the existing design

Note: Data corresponds to design release of 500 cfs at a pool elevation of 2580 feet NGVD.

US Army Corps
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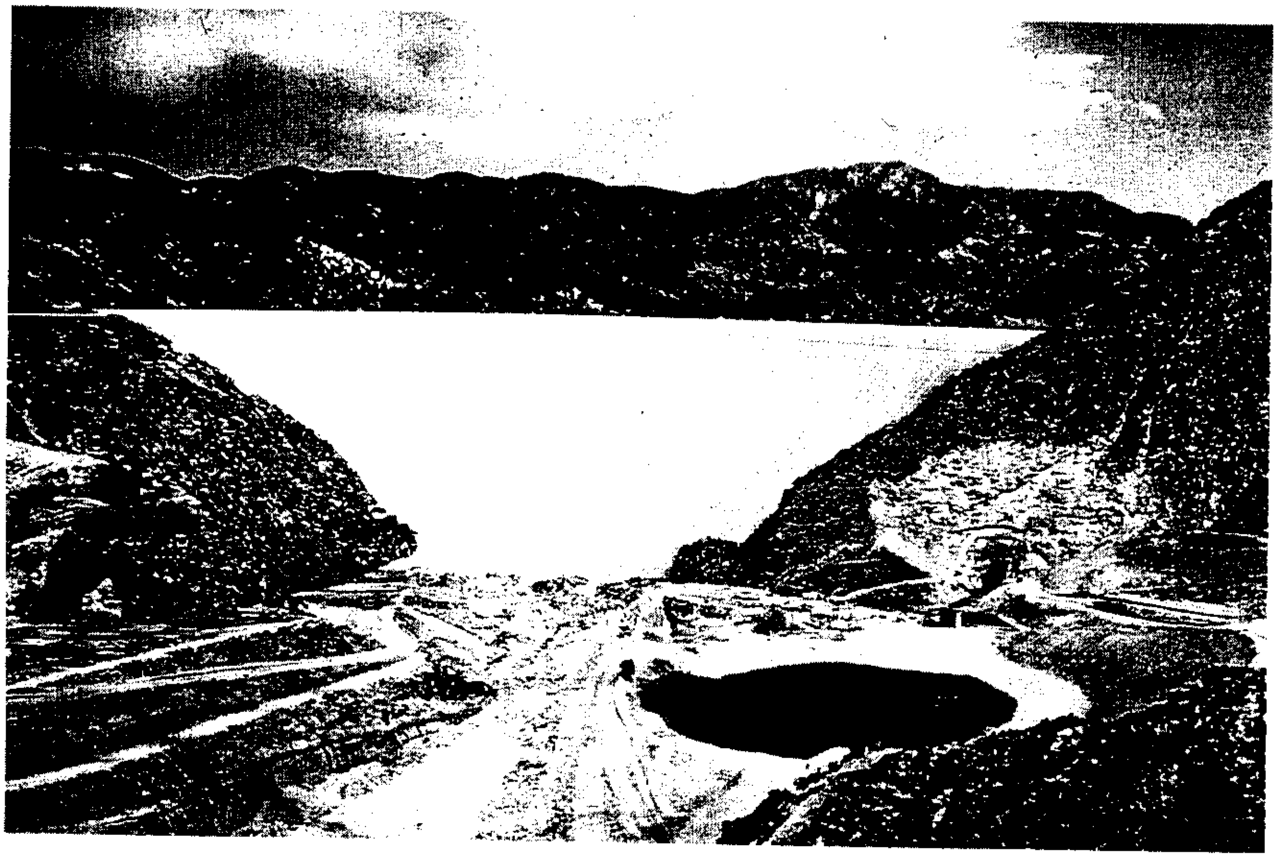
Los Angeles District

Feasibility Report

Seven Oaks Dam Water Conservation
Santa Ana River Basin, California



Appendix C. Geotechnical

June 1997

Seven Oaks Dam
Water Conservation Feasibility Report
Geotechnical Assessment

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Seven Oaks Dam
Water Conservation Feasibility Report
Geotechnical Assessment

I. INTRODUCTION

PURPOSE AND SCOPE

1-01 The objective of this study is to determine the geotechnical feasibility of seasonal (non-flood season) water storage at Seven Oaks Dam. A similar analysis for flood control purposes was performed in a previous report, the Design Memorandum No. 8, Feature Design, Volume 2 - Appendix A - Geotechnical Supplement/Dynamic Analysis, dated December 1992. In the 1992 FDM report, two loading conditions were evaluated: (1) a maximum credible earthquake (MCE) occurring with the water level at debris pool elevation of +2300 feet, and (2) a maximum probable earthquake (MPE) occurring with the water level at spillway flood elevation of +2580 feet. Four water surface elevations for conservation storage are discussed. The water surface elevation of +2300 feet that was analyzed in the 1992 study is the locally preferred plan, and has been identified as conservation storage alternative No. 1. The objective of the present study is to evaluate the seismic stability of the embankment, as currently designed, for three additionally proposed water conservation pool levels at +2265 feet (alternative No. 4), +2375 feet (alternative No. 2) and +2418 feet (alternative No. 3). The conservation pool level of +2265 feet has now been identified by the Planning Division as the only elevation that is consistent with the original flood control objectives of Seven Oaks Dam. Finite element analyses similar to those described in the December 1992 report were performed for the more critical conservation pool levels of +2375 feet (alternative No. 2) and +2418 feet (alternative No. 3). The maximum credible earthquake was used as the design earthquake for both pool levels. This report provides the results of the seismic stability evaluation for the proposed conservation pool levels, and addresses other pertinent issues such as the potential for hydraulic fracturing, drain and filter capacities. For the selected plan conservation pool elevation of +2265 feet (NED plan), this report also discusses the possible need for additional grouting of the foundation, reservoir triggered seismicity, and stability of the rockmass around the outlet tower. The effects of modifications to the embankment, foundation, and materials are also evaluated for storage feasibility.

PROJECT DESCRIPTION

1-02 The project is described in detail in the FDM no. 8, Appendix A, Geotechnical, dated November 1992. Following is a brief description of the project for easy reference. Seven Oaks Dam will be a zoned earth and rockfill embankment with a crest length of 2,630 feet and a maximum height above the existing streambed of approximately 550 feet. After excavation of the streambed alluvium in the canyon and the preparation for the core cutoff to bedrock is completed, the maximum embankment height will exceed 650 feet. Approximately 36,000,000 cubic yards of soil and rock will be required for construction of the embankment. These materials will come from required excavation in the foundation, spillway, Government Canyon ridge, designated borrow areas, and from off-site sources. The embankment is arched upstream and will include a moderately inclined upstream sloping core, single upstream filter, chimney and blanket drains, wide transition zones, and rockfill shells with a 1V on 2.2H upstream slope and a 1V on 1.8H downstream slope. The dam will retain flood flows on the Santa Ana River and its mountain tributaries with a gross flood storage capacity of 145,600 acre-feet at spillway crest. A concrete-lined outlet tunnel through the left (east) abutment will be used during construction of the embankment for diversion of groundwater and river flows, and subsequently to control releases of floodwaters from behind the completed structure. A detached, unlined 500-foot wide spillway with a control concrete sill will be excavated through a saddle on the east side of the canyon. Excavation through a ridge immediately upstream of the embankment will provide for drainage from Government canyon and produce additional borrow materials.

METHOD OF ANALYSIS

1-03 The stability of the foundation and embankment for Seven Oaks Dam under earthquake loading is evaluated using a dynamic analysis procedure developed by Seed, Lee, and Idriss (1969). This procedure (Seed, 1979) involves the following steps:

a. Determine the cross-section of the dam to be used for analysis.

b. Determine, with the cooperation of geologists and seismologists, the maximum time history of the base excitation to which the dam and its foundation might be subjected.

c. Determine, as accurately as possible, the stresses existing in the embankment before the earthquake; this is probably done most effectively at the present time using finite element analysis procedures.

d. Determine dynamic properties of the soils comprising the dam such as shear modulus, damping characteristics, bulk modulus or Poisson's ratio, which determine its response to dynamic excitation. Since the material characteristics are non-linear, it is also necessary to determine how the properties vary with strain.

e. Compute, using an appropriate dynamic finite element analysis procedure, the stresses induced in the embankment by the selected base excitation.

f. Subject representative samples of the embankment materials to the combined effects of the initial static stresses and the superimposed dynamic stresses and determine their effects in terms of the generation of pore water pressures and the development of strains. Perform a sufficient number of these tests to permit similar evaluations to be made, by interpolation, for all elements comprising the embankment.

g. From the knowledge of the pore pressures generated by the earthquake, the soil deformation characteristics and the strength characteristics, evaluate the factor of safety against failure of the embankment either during or following the earthquake.

h. If the embankment is found to be safe against failure, evaluate the potential for permanent deformation induced by the earthquake using appropriate procedures.

1-04 The embankment and foundation conditions are modeled using the information and data obtained from design and test fill investigations. Static material properties are based on field and laboratory testing of representative samples. Adopted stress - strain and strength parameters for analysis of per-earthquake stresses in Seven Oaks Dam are based on values recommended by Dr. J. M. Duncan in a report dated October 20, 1992, a copy of the report is presented in Attachment S-3. Dynamic properties are based on laboratory cyclic shear tests and geophysical field testing. The cross-section of the embankment and foundation and the conditions assumed for the seismic stability analyses are presented on plate S-1. The cross-section selected for the dynamic analysis is based on evaluation of the topography within the footprint of the dam and evaluation of foundation conditions as presented in the FDM Appendix A, Geotechnical. The cross section at Station 16+00 was used to model the embankment/foundation response. The selected cross-section is representative of the maximum height and critical foundation conditions. As stated in the FDM, loose foundation materials will be removed from the upstream and downstream foundation areas, leaving foundation materials that are at least as dense as the compacted embankment fill. In addition, due to topography the foundation bedrock at the upstream toe area is such that it acts as a buttress and would confine any movement of the embankment material which may occur due to settlement or consolidation of the foundation. Bedrock generally buttresses the upstream embankment mass except between Station 20+50 to Station 23+00. Between Station 20+50 and Station 23+00 all looser foundation materials to a maximum depth of about 15 feet will be removed and recompacted. The dynamic response of a shorter embankment section was not required, because shorter embankment sections located near the abutments would be mostly dry at the proposed pool elevations of +2375 feet and +2418 feet. Under the maximum credible earthquake loading the maximum section being analyzed represents the most severe loading condition expected to exist.

II. GEOLOGY

GEOLOGY AND TOPOGRAPHY

2-01 The Seven Oaks damsite is located within the Upper Santa Ana River Canyon along the southern margin of the San Bernardino Mountains in Southern California. This area is in the eastern part of the Transverse Ranges. The principal geomorphic and structural features of the Transverse Ranges lie across the grain of adjacent physiographic provinces, which are strongly influenced by the northwest trending San Andreas fault system. The complexity of the San Andreas in Southern California varies markedly. In the San Bernardino area, the fault is a relatively continuous and linear feature which follows the southwest facing margin of the San Bernardino Mountains before it splits into northern and southern branches about 10 miles northwest of the damsite.

2-02 More specifically, the damsite is about one mile upstream from the mouth of Upper Santa Ana River Canyon at the confluence of the Santa Ana River and Government Canyon, a minor tributary drainage. The elevation of the canyon floor at the damsite is 2060. Several "hanging valleys" and alluvial terraces, probably created by the rapid uplift of the San Bernardino Mountains and equally rapid down-cutting by the Santa Ana River, can be identified on the steep walls of the canyon.

2-03 In the vicinity of the damsite, which lies between the north and south branches of the San Andreas fault, the major rock units are gneiss and quartz diorite. Recent streambed alluvium fills the canyon bottom to depths in excess of 100 feet and colluvium mantles parts of the canyon walls. The gneissic rocks are foliated and often highly sheared. Intruding the gneissic rocks, is a biotite-rich, quartz diorite of Cretaceous age. These rocks, which form the left abutment and a portion of the streambed foundation for the dam, are moderately to strongly jointed and fractured, and also slightly foliated. Like the gneissic rocks, the quartz diorite outcrops occur only within the fault-bounded wedge between the north and south branches of the San Andreas fault, the Wilson Creek structural block.

2-04 Dissected remnants of several generations of Quaternary-age stream terrace deposits occur at the site. Each deposit occurs as patches of boulder conglomerate "hanging" on the walls of the canyon. These terrace deposits proved useful in constraining the age and amount of fault displacement in the vicinity of the dam. Santa Ana River Canyon is floored by unconsolidated sand, gravel, cobble, and boulder-size clasts randomly deposited within the 500 to 1000-foot wide main channel of the canyon.

GEOLOGY DURING CONSTRUCTION

2-05 During the below streambed construction for the dam, the alluvium was removed to bedrock in the central portion of the dam under the core and upstream filter zones of the embankment. The bedrock surface was discovered to be very irregular, with abrupt and steep erosional surfaces. These slopes were shaped not to exceed 45 degrees where in contact with core material. The inherent low permeability of the foundation bedrock, which averaged less than 0.1 ft/day in permeability tests, was verified by exploratory grouting. The single-line curtain was constructed to a standard of 0.1 ft/day (approximately 4 Lugeons) which is appropriate for a wide-core embankment dam when the loss of reservoir water due to underseepage is not a consideration (Houlsby, 1990).

GROUNDWATER

2-06 At the damsite, the horizontal permeability of the alluvium was calculated from pumping test data to be range from 100 to 260 ft/day and the saturated cross-sectional area of the alluvium was determined to be approximately 30,000 ft^2. Using these variables and the hydraulic gradient of 0.03 ft/ft, the estimated outflow from the canyon was calculated to be 2200 acre-feet/year. Subsurface water levels in the alluvium respond to flows down the river channel. Water levels measured several years prior to initiation of construction were generally within 5 to 20 feet of the ground surface.

FAULTING AND SEISMICITY

2-07 Seven Oaks dam is in Seismic Zone 4. The region is seismically active due to the tectonic interaction of the North American Plate and the Pacific Plate. Relative movement between the plates has formed the San Andreas fault system, the predominant structural feature in the vicinity of the dam. Geologic evidence suggests that the San Andreas fault in Southern California is characterized by infrequent great earthquakes, the last being the magnitude 8+ Fort Tejon event in 1857. The San Andreas fault is expected to rupture within the life of the project. The maximum credible earthquake is a magnitude 8+ event along the south branch of the fault, with the main release of seismic energy occurring at the mouth of the canyon. Realistically, however, the predicted great earthquake could occur anywhere along the "locked" San Bernardino Mountains segment of the fault.

2-08 Secondary faulting associated with the design event on the south branch of the San Andreas fault can probably be expected. Sympathetic movement on random shears within bedrock is likely, however, the amounts of displacement are speculative. The dam has been designed on the assumption that as much as 4 feet of surficial fault displacement in any direction can take place arbitrarily beneath the facility.

2-09 Within the immediate damsite vicinity, several structural features have been identified as faults. The most continuous feature is Fault "L", first encountered during excavation of the left abutment. A fault study by Rasmussen and Associates concluded that Fault L may have moved within the past 35,000 years and should be considered capable of moving again. Future displacement may be in response to a small earthquake generated along the fault itself or, more likely, in response to major movement occurring along the south branch of the San Andreas fault. An estimated maximum of 8 inches of slip could occur on Fault L from a single earthquake (Rasmussen, 1991).

III. STATIC FINITE ELEMENT ANALYSES

GENERAL

3-01 The behavior of an earth-rockfill dam during an earthquake is significantly influenced by the static stress conditions existing in the embankment and foundation prior to the event. The static stress conditions affect the performance of the dam in two ways. They affect dynamic properties of the embankment materials and thus the dynamic response of the dam. The initial static stresses affect cyclic strength of the embankment materials and thus seismic stability of the embankment. To determine the per-earthquake stress distribution, a static finite element analysis is performed using the computer program FEADAM84 (Duncan, Seed, Wong, and Ozawa, 1984) for the appropriate cross section of the dam.

ANALYTICAL PROCEDURE

3-02 FEADAM84 is an incremental finite element program for two-dimensional plane strain analysis of earth and rockfill dams and slopes. The analysis procedure employed in the program FEADAM84 represents the state-of-the-art procedure for static stress analysis of dams. The program calculates the stresses, strains, and displacements due to incremental embankment construction and/or load application. The nonlinear and stress history dependent stress-strain and volumetric strain properties of soils are approximated using a hyperbolic model developed by Duncan, et al. (1980), as modified by Seed and Duncan (1983). The nonlinear, stress-dependent and stress-history-dependent soil behavior model used in FEADAM84 is a modified version of the hyperbolic stress-strain, strength, and volumetric strain model proposed by Duncan, et al. (1980) used in the earlier program FEADAM.

The program FEADAM84 calculates the stresses, strains, and displacements in embankments, simulating the actual construction sequences and seepage through the dam. The nonlinear and stress-dependent stress-strain properties of the soils are approximated by performing the analysis in increments. An increment may consist of the placement of a new layer on the embankment, or of application of loads to a completed embankment. Each increment is analyzed twice (a two-iteration process), the first time using modulus values based on the stresses at the beginning of the increment, and the second time using modulus values based on the average stresses during the increment. The changes in stress, strain, and displacement calculated during the second iteration of each increment are added to the stresses, strains, and displacements at the beginning of the increment to give the total or cumulative values up to that stage of the analysis.

DEVELOPMENT OF STATIC PROPERTIES

3-03 The static properties of the embankment and foundation materials required in the static stress analyses using the program FEADAM84 include unit weights, hyperbolic stress/strain parameters. and strength parameters. The parameters used to describe the hyperbolic stress-strain relations include the following:

- K modulus number and n, modulus exponent (these parameters relate variations of E_i, initial tangent modulus with confining pressure);
- R_f failure ratio (the parameter relates the asymptotic value of stress difference to the compressive strength or stress difference at failure);
- K_{ur} unloading-reloading modulus number (the parameter relates variations of E_{ur}, unloading-reloading modulus with confining pressure);
- K_b bulk modulus number and m, bulk modulus exponent (these parameters relate the bulk modulus with confining pressure);
- C cohesion
- ϕ friction angle
- $\Delta\phi$ change in friction angle with confining pressure

The parameters were developed based on the results of static triaxial tests from remolded/reconstituted samples obtained during design investigations. Adopted values are based on recommendations from Dr. J. M. Duncan, Attachment S-3.

3-04 Consolidated-drained triaxial tests for the alluvial materials were used to determine non-linear stress-strain, strength properties for the static stress analyses. The results of these tests were interpreted by Dr. J.M. Duncan (1992, 1993, 1994) and are presented in Table S-1

ANALYSIS RESULTS

3-05 Finite element representation of the cross section selected for static analyses (Plate S-1) is shown in Plate S-2. The mesh consists of 926 elements and 968 nodes. The additional static analyses were conducted for the more critical conservation pool levels of +2375 feet (alternative No. 2) and +2418 feet (alternative No. 3 - which was modeled at elevation +2420 feet). The analyses were conducted by simulating construction of the zoned embankment in 29 layers, and then applying the seepage forces in 4 increments. Gravity loads were applied to simulate placement of embankment materials for each layer using the buoyant unit weights for the materials below the phreatic surface and the total unit weights above the phreatic surface.

3-06 Seepage analyses. The Corps of Engineers finite element seepage analysis program X8202-CSEEP (Tracy, 1983) was used for seepage analyses of the two additional pool levels at elevations +2375 feet, and +2418 feet (which was modeled at elevation +2420 feet). The finite element meshes for the two pool levels are shown in the following plates: S-3 (pool elevation at +2375 feet), and S-4 (pool elevation at +2420 feet). Hydraulic conductivity values (permeability) of each embankment material used were presented in Design Memorandum No. 8 - Appendix A - Geotechnical. Results of the seepage analyses expressed in terms of water pressure heads are shown on Plate S-5. The pressure head contours shown in Plate S-5 are superimposed over the FEADAM finite element mesh to compute the average hydraulic gradient and its direction at each nodal point. The seepage forces (both horizontal and vertical forces) at each nodal point were computed by multiplying the average hydraulic gradient and the tributary area around each node.

A thorough seepage analysis was done previously and presented in Design Memorandum No. 8 - Appendix A - Geotechnical, November 1992. Plate S-51 shows the results of that analysis, and presents relevant assumptions and calculations.

3-07 Static stresses. Results of static stress analyses are shown in Plates S-6 through S-11. Plates S-6, and S-7 show the vertical and shear to vertical stress ratio profiles along four selected elevations (elevations 2112.5, 2165, 2225, and 2285) for pool elevation +2375 feet; similar plots are shown on Plates S-8 and S-9 for pool elevation +2420 feet. Stress contours of vertical, horizontal and shear stresses (σ_x, σ_y, and τ_{xy}) are shown on Plates S-10 and S-11 for pool elevations +2375 feet and +2420 feet, respectively.

3-08 Hydraulic fracturing and potential for cracking of the core. The results and recommendations of the analysis of safety against cracking and hydraulic fracturing, by Dr. Duncan and Dr. Makdisi, are shown in Attachment S-8. Dr. Duncan and Dr. Makdisi have concluded that their conservative analysis indicates an unlikely potential for hydraulic fracturing within the Seven Oaks Dam core. Further, they state that the safety of Seven Oaks Dam rests on the ability of the filter zones within the embankment to control and seal possible leaks within the embankment that could result from any hydraulic fractures or other types of cracks. Finally, Dr. Duncan and Dr. Makdisi state that the zones within the embankment are graded so that they afford this degree of security.

IV. DESIGN EARTHQUAKE MOTION

GENERAL

4-01 Earthquake parameters were recommended by Dr. Bruce Bolt (1987) for Magnitudes 8+ and 7.5 to 8.0 earthquake events occurring along the South Branch of the San Andreas fault. The recommended seismic parameters are presented in Table S-2.

4-02 An additional seismic design criterion is the assumption that as much as 4 feet of surficial fault displacement in any direction could take place arbitrarily beneath the structure, albeit as an exceedingly unlikely " Maximum Credible Event".

DESIGN EARTHQUAKES

4-03 Table S-2 shows a maximum credible earthquake (MCE) with a magnitude 8+ and a maximum probable event (MPE) of magnitude 7½-8. The MCE was used as the design event to analyze a cross-section of the embankment with a water level at pool elevations of +2375 feet and +2418 feet (which was modeled at elevation +2420 feet). The value of peak rock acceleration associated with the MCE is 0.7g.

ACCELERATION TIME-HISTORIES AT BEDROCK

4-04 Two synthetic acceleration time-histories (north-south and east-west components) were provided by Dr. Bruce Bolt for use in the dynamic finite element analyses. The time-histories are representative of ground motions generated by a magnitude 8+ earthquake. Plates S-12 and S-13 show the time-histories of acceleration, the 5 percent damped acceleration response spectra, and the Husid cumulative energy plots for each of the two records. A comparison of the response spectral shapes for the two records is presented on Plate S-14. The comparison shows that the two components have essentially similar spectral shapes, however, the east-west component record provides slightly higher spectral amplification over the entire frequency range. Accordingly, the east-west component was selected for use in the dynamic analyses.

4-05 The time-history of acceleration shown on Plate S-12 was scaled to provide peak accelerations of 0.7 g corresponding to the MCE event presented in Table S-2.

DURATION OF SIGNIFICANT SHAKING

4-06 Dr. Bolt recommends a bracketed duration (based on accelerations greater than 0.05g) of 40 to 50 seconds for the MCE. The Husid plots (shown on Plates S-12 and S-13) provide an indication of the buildup of energy and have been used to estimate the duration of significant shaking of the accelerograms. The duration is defined as the time between the buildup of 5% and 95% energy on the Husid plot (Trifunac and Brady, 1975; Dobry, Idriss, and Ng, 1978). Using this definition, the duration of the synthetic time-histories selected for the analyses are about 25 to 27 seconds. These durations are about 2/3 those that would be estimated for a magnitude 8+ earthquake (see Idriss, Attachment S-4). Dr. Idriss recommended that the number of cycles of equivalent uniform induced stress (obtained from the response analyses) be increased by about 50% when used in conjunction with the magnitude 8+ MCE.

V. DYNAMIC FINITE ELEMENT ANALYSES

GENERAL

5-01 The principal purpose for performing dynamic response analyses is to calculate the dynamic shear stresses in the embankment and foundation that would be induced by a large earthquake. The second purpose for performing the dynamic response analyses is to obtain the distribution of peak ground acceleration in the embankment and foundation in order to perform supplemental deformation analyses (earthquake-induced permanent deformation analyses). To evaluate earthquake-induced permanent deformations, pseudo-static slope stability calculations together with the concept of yield acceleration are used.

5-02 The seismic stability of the embankment and foundation was evaluated for a maximum credible earthquake and the following two pool elevations: +2375 feet and +2418 feet (which was modeled at elevation +2420 feet). The cross-section of the embankment and foundation and the conditions assumed for seismic stability analyses are presented in plate S-1.

DEVELOPMENT OF DYNAMIC PROPERTIES

5-03 The dynamic material properties used in the dynamic FEM analysis are based upon laboratory tests on remolded samples, field tests, and geophysical data. The dynamic material properties developed were shear modulus (G) and damping ratio. Resonant column and strain-controlled cyclic triaxial tests were conducted for the core, alluvial, and rock transition material. The resonant column tests provide an estimate of the shear modulus and damping of the material at small strain levels. The strain-controlled cyclic triaxial tests provide an estimate of the variation of modulus and damping ratio with strain. The resonant column testing programs for the core, alluvial, and rock transition materials are summarized on Tables S-3, S-4, and S-5, respectively. Summary of the strain-controlled testing conducted for the core, alluvial and rock transition materials are shown on Tables S-6, S-7, and S-8 respectively. Core materials were compacted to 98 percent maximum density (ASTM

D698) and were tested at the optimum and 2 percent above optimum moisture to simulate as constructed embankment conditions. The minus one-inch matrix alluvial and rock transition material were tested at relative densities of 80 and 100 percent, corresponding to the minimum and maximum densities achieved in the test fills and in-situ foundation investigations. The results of these investigations were presented in the Test Fills and Abutment Excavation Report. The selected dynamic testing program was recommended by Dr. I.M. Idriss in the attached report by Dr. J.M. Duncan (see Attachment S-3), dated October 20, 1992. Although resonant column tests were planned at relative density, D_r = 100% for alluvial and rockfill materials, 100 percent relative density was not achieved in the laboratory. Details of the dynamic laboratory tests are presented in Attachment S-1. Summary of the dynamic test results are shown on plates S-15, S-26, and S-17 for the core, alluvial, and rock transition materials, respectively.

MODULUS AND DAMPING RELATIONSHIPS

5-04 To perform dynamic finite element response analyses, an estimate is required for the dynamic modulus and damping characteristics of the embankment and foundation materials. The shear moduli and damping ratios of soils exhibit significant nonlinear behavior when subjected to strong earthquake shaking. The properties needed in the analyses are the values of maximum dynamic shear modulus at low strain, and the variation of modulus and damping ratio with strain level.

Dynamic shear modulus values at low strain can be measured in the laboratory using resonant column tests or can be estimated from field shear wave velocity measurements. When available, estimates of modulus values based on field shear wave velocity measurements are more reliable than laboratory tests data.

5-05 Studies by Seed and Idriss (1970) have shown that the dynamic shear modulus of granular soils is related to the effective mean normal stress as follows:

$$G = 1000\ K_2\ (\sigma_m')^{1/2},$$

where: K_2 = parameter relating G and σ_m', and

σ_m' = effective mean normal stress (lb/ft^2).

K_2 is a function of strain level and void ratio. K_{2max} is the maximum value of K_2, obtained at low shear strain (10^{-4} percent).

5-06 Values of K_2 versus shear strain obtained from laboratory resonant column and strain-controlled triaxial tests are summarized on Plates S-15 through S-17 for the core material, alluvial material, and the rock transition material, respectively. Plate S-15 for the core material shows that, for samples compacted to densities that are 98 percent of the maximum densities according to ASTM Standard D698, the value of K_{2max} is about 60. The variation of K_2 with strain is similar to the average relationship of Seed and Idriss (1970) for sands. Values of the damping ratio are also shown on the same plate and are compared with the Seed and Idriss average relationship. At the high strain level, the measured damping ratios compare reasonably well with the Seed-Idriss relationship.

5-07 Variation of K_2 and damping ratio with strain for the alluvial material are presented on Plate S-16 Samples of the alluvial material, that were tested in the resonant column test, were compacted to relative densities (D_r) between 80 and 92 percent. Those used in the strain-controlled triaxial tests were compacted to relative densities between 72 and 78%.

5-08 Values of K_{2max} for the alluvial material, obtained from the resonant column tests, ranged between about 60 and 75. The variation of K_2 and damping ratio with shear strain are compared with the Seed-Idriss (1970) relationships for sands on Plate S-16.

5-09 Samples from the rock transition material were compacted to relative densities between 80 and 92 percent. The results of the resonant column and strain-controlled tests are presented on Plate S-17 Estimated K_{2max} values from the resonant column tests ranged between about 60 and 70. The variation of K_2 and damping ratio with shear strain is similar to that shown by the Seed-Idriss (1970) relationship for sands.

MODULUS VALUES FROM SHEAR WAVE VELOCITY MEASUREMENTS

5-10 Two test embankments were constructed using alluvial material and rock transition materials. The test embankments were built using different compaction procedures and compactive efforts. In situ relative densities of the compacted material in the two test embankments ranged between 95 and 100 percent. Shear wave velocities were measured in both test embankments and the foundation alluvium using cross-hole, downhole, and surface refraction methods. Details of the geophysical survey program and results of the shear wave velocity measurements are presented in Attachment S-2 to this report.

5-11 Measured shear wave velocities were used to estimate the maximum shear modulus at low strain for the alluvial material, rock transition material, and the dense foundation alluvium. The maximum shear modulus is related to the shear wave velocity by the following relationship:

$$G_{max} = \frac{\gamma}{g} (V_s)^2$$

where: G_{max} = shear modulus at low strain
γ = unit weight of material
g = acceleration due to gravity
V_s = shear wave velocity at low strain

5-12 Using the values of shear wave velocities measured in the field and the relationship between modulus and confining pressure described earlier, values of K_{2max} were estimated for the alluvial material, the rock transition, and the dense foundation alluvium. A value of K_{2max} of 130 was estimated for the compacted alluvial material, 110 for the rock transition material, and 150 for the foundation alluvium.

5-13 It should be noted that the values of maximum shear modulus estimated from measured shear wave velocities in the test fill embankments were substantially higher than those estimated from laboratory resonant column tests. This is because: (a) the relative densities of the materials in the compacted test fills were higher than those achieved in the laboratory specimens, (b) the materials tested in the laboratory contained maximum particle sizes of less than 1 inch in diameter while materials used in the test fill embankments contained particle sizes of up to 15 inches in diameter, and (c) the vibratory compaction procedure in the field may have created different material fabric than obtained in the laboratory compacted samples.

5-14 As mentioned earlier in this section, shear modulus values obtained on the basis of measured shear wave velocities in the test fill embankments are considered more representative of the in situ properties of the fill materials and thus were selected for use in the dynamic response analyses. The values of K_{2max} for the various zones in the embankment and foundation that were selected for use in the dynamic response analyses are presented on Table S-9. Table S-9 also shows the corresponding unit weights of the various material types.

5-15 The variations of modulus and damping ratio with shear strain were represented by the average relationships of Seed and Idriss (1970) for sands. These relationships are shown on Plate S-18 Studies by Hardin and Drnevitch (1972) have shown that the variation of modulus and damping with strain is affected by the depth of the soil deposit and the level of confining pressure. A review of a number of studies on modulus and damping relationships for soils (Geomatrix, 1992) has indicated that the midrange relationships of Seed and Idriss (1970) are applicable to soil deposits with depths of up to 200 to 300 feet. For deeper soil deposits, the upper-bound relationship for modulus and the lower-bound relationship for damping appear to be more applicable. Accordingly, the midrange relationships shown on Plate S-18 were specified for the zones in the embankment where the vertical effective confining pressure was less than about 15 tons/sq.ft. For zones where the effective confining pressure was higher than about 15 tons/sq.ft., the upper-bound relationship for modulus and the lower-bound relationship for damping were selected for use in the dynamic analysis.

DYNAMIC FINITE ELEMENT ANALYSES

5-16 To determine the earthquake-induced stresses within the embankment due to bedrock motion associated with the design earthquake, it is necessary to perform a dynamic finite element analysis for a typical cross-section of the embankment. Although the embankment responds as a three-dimensional structure, it has been shown that for reasonably wide canyons, where the crest length to height ratio is about 5 or higher, the response of the embankment can be approximated by using a two-dimensional plane strain section. The crest length to height ratio at Seven Oaks Dam is about 4.8.

For this evaluation, a maximum section through the embankment was selected. This section corresponds to the same finite element mesh that was used for evaluating the initial static stresses within the embankment.

5-17 A modification of the computer program QUAD-4M (Hudson et al., 1994) was used to evaluate the response of the embankment. This is a modified version of the program QUAD-4 that was originally developed by Idriss et al. (1973). The program is a two-dimensional dynamic finite element analysis procedure using equivalent linear strain-dependent modulus and damping properties. The program is a time-step analysis that uses the Raleigh damping approach and allows for variable damping to be used in different elements. The program uses an iterative procedure to estimate the nonlinear strain-dependent properties. Initially, the shear modulus and damping ratios are estimated for each element in the finite element model. The system is analyzed using these initial properties. After each iteration, values of effective shear stain are computed for each element, and the corresponding modulus and damping properties, at the computed strain level, are compared with those estimates from the previous iteration. The analysis is repeated until convergence is achieved.

5-18 The finite element mesh used for the dynamic response analysis is presented in Plate S-19. The maximum shear modulus for each element was estimated using the relationship between modulus and mean effective confining pressure. Values of K_{2max} for each zone were specified on Table S-9, and the mean effective confining pressure was estimated using the following relationship:

$$\sigma_m' = \left(\frac{1+2K_o}{3}\right) \sigma_y'$$

where K_o = 0.7

σ_y' = effective vertical stress obtained from the static finite element analysis

5-19 As mentioned earlier the response of the embankment was computed using bedrock accelerations associated with the maximum credible earthquake for two water levels at elevations +2375 feet and +2418 feet (which was modeled at elevation +2420 feet).

The east-west component of the Bolt/Idriss synthetic 8+ accelerogram was used as base input motion for the two analyses. The record was scaled to a peak ground acceleration of 0.7 g for the maximum credible earthquake.

5-20 The shear wave velocity for the foundation bedrock was measured at about 4300 fps. Common practice in response analyses computations is to assume the foundation bedrock to be rigid and specify the input ground motion at the rigid boundary. As mentioned previously, the recently developed version, QUAD4M, allows for a compliant base and treats the rock foundation as an elastic half space. This option was used in the current analysis and the foundation bedrock was treated as an elastic half space instead of a rigid boundary.

RESULTS OF DYNAMIC RESPONSE ANALYSES

5-21 Earthquake-induced accelerations and shear stresses within the embankment were computed for the two water elevations using the QUAD4M analyses with the elastic half-space option. A summary of the results is presented below.

Loading Condition	Maximum Input Base Base Acceleration	Embankment Natural Period	Maximum Crest Acceleration
Water Level @ 2375 feet (maximum credible earthquake)	0.7 g	2.1 sec	1.94 g
Water Level @ 2418 feet (maximum credible earthquake)	0.7 g	2.2 sec	1.94 g

A plot showing the variation of peak accelerations with depth below the crest of the embankment is presented on Plate S-20. The time-histories of input base acceleration and computed crest acceleration for the case of water level at +2375 feet are shown on Plate S-21. Time histories of horizontal shear stresses at selected 24 elements distributed throughout the embankment are shown on Plates S-22(a) through S-22(d). Similarly, plots of input and crest acceleration time histories and element shear stresses for the case of water level at +2418 (+2420) feet are presented on Plates S-23 and Plates S-24(a) through S-24(d),respectively.

5-22 The time history of horizontal shear stress for each of the 24 representative elements was converted into an equivalent number of uniform stress cycles at a fraction of the maximum shear stress for that element. The procedure used is that of Seed, et al. (1975). The number of equivalent stress cycles was chosen at 30 cycles. The computed reduction factor (as a fraction of maximum shear stress) to convert to 30 uniform stress cycles was based on an average of the 24 elements considered. In estimating the reduction factors (using the computed shear stress time history), the short duration of the record used in the analysis was accounted for by increasing the number of equivalent uniform cycles by 50% for stress time histories corresponding to the maximum credible earthquake. The computed reduction factors for the two design loading conditions considered are as follows:

MCE Earthquake Water-level @ +2375	Reduction Factor = 0.56
MCE Earthquake Water-level @ +2418	Reduction Factor = 0.55

The equivalent uniform horizontal shear stress induced by the earthquake is compared with the cyclic strength of the embankment material to estimate the potential for strain and pore pressure buildup due to earthquake shaking.

VI. ASSESSMENT OF SEISMIC STABILITY

EVALUATION OF CYCLIC STRENGTH

6-01 The cyclic shear strength for the embankment and foundation materials are based upon the results of cyclic stress controlled triaxial tests conducted on remolded samples. The cyclic shear strength is defined as the cyclic shear stress required to cause 5 percent peak-to-peak axial strain for isotropically consolidated samples, and 5 percent axial compression strain for anisotropically consolidated samples. The cyclic shear strength envelopes for the materials are based on the results of laboratory tests conducted by the Division Laboratory. Stress-controlled cyclic triaxial tests conducted on the core, alluvial and rock transition materials, are summarized on Tables S-10, S-11, and S-12, respectively. Testing criteria were selected to simulate stress conditions expected to occur within the embankment zones, and per recommendations of Dr. I.M. Idriss. Interpretations of dynamic properties and cyclic strength results by Dr. R. Pyke are presented in Attachment S-5.

6-02 Cyclic strength data for the core material obtained from stress-controlled triaxial tests are presented on Plate S-15. The results are presented in terms of the cyclic stress ratio ($\sigma_{dp}/2\sigma_{3c}$) required to cause 5 percent peak-to-peak or total axial strain, versus number of cycles. The results are presented for various confining pressures between 2.5 and 15 tons/sq. feet. Samples for the core materials were compacted to densities that are 98% of the maximum densities in accordance with ASTM Standard D-698. Samples were compacted at optimum moisture content and at 2% above optimum. Results of the cyclic strength tests on the alluvial material are presented on Plate S-16. The results are shown for samples compacted at relative densities of 80% and 100%. The samples were tested under confining pressures between 2.5 and 15 tons/sq. feet and consolidated under isotropic conditions (K_c = 1.0) and anisotropic conditions (K_c = 1.5 and 2.0). Cyclic strength test results for the rock transition material are similarly presented on Plate S-17. Samples of the rock transition materials were compacted to relative densities of 80% and 100% and were tested under the same confining pressures and consolidation ratios as described for the alluvial materials above.

6-03 It is convenient for the purposes of the analysis to interpret the results of the cyclic strength tests described above to estimate the superimposed cyclic shear stress along a potential failure plane (for initial per-earthquake static stresses) causing a specified strain level. The primary direction of the failure may be taken as the horizontal plane. For samples initially consolidated under isotropic stress conditions, representing soil elements in the field with zero initial shear stress on the horizontal planes, the superimposed cyclic shear stress in the field can be obtained from the maximum shear stress in the laboratory by applying a correction factor C_r (DeAlba, Seed, and Chan, 1976). A value of $C_r = 0.8$ was used to obtain the field superimposed cyclic shear stress. For anisotropically consolidated samples, it is reasonable to assume that the primary direction of failure will be along planes inclined at $45 + \phi'/2$ to the horizontal, and thus the superimposed cyclic shear stress applied along such plane may be determined as shown on Plate S-25.

6-04 Following the above procedure the cyclic strength test data shown on Plates S-15 through S-17 were repleaded in the form presented on Plates S-26 through S-30. In this form the initial static stress conditions for a soil element before the earthquake are expressed by the value of σ_{fc}, the normal stress on the potential failure plane, and $\alpha = \tau_{fc}/\sigma_{fc}$, where τ_{fc} is the initial shear stress on the same plane. The results are presented for the superimposed cyclic shear stress causing 5% axial strain in 30 cycles for different initial stress conditions. Plate S-26 shows the cyclic strength for the core material. Plates S-27 and S-28 show the cyclic strength of the alluvial material at 80% and 100% relative densities. Plates S-29 and S-30 show the cyclic strength of the rock transition material at 80% and 100% relative densities.

6-05 It should be noted that cyclic strength data presented on Plates S-26 through S-30 do not include any corrections to the laboratory test results to obtain field strength. Freshly made samples in the laboratory typically show an increase in cyclic strength with sustained application of confining pressure. Banerjee et al. (1979) found an increase of about 25% in cyclic strength as a result of 10 weeks application of sustained confining pressure. In addition to the time effect, correction can be made to the stress-controlled tests to account for the substantial differences in the shear modulus (at small strains) observed in the test fill embankments and those measured in the laboratory resonant column tests. The differences may be due to different gradations between the laboratory specimens and the test fill soils as well as differences in the initial fabric of the laboratory and field compacted material.

It was recommended by Drs. I.M. Idriss and R. Pyke to increase the cyclic laboratory strength values for the alluvial material and the rock transition material by 50 percent to account for the time effects, gradation, and initial fabric differences between the laboratory samples and field conditions. Accordingly, the cyclic strength values shown on Figures S-29 and S-30 were increased by 50 percent. No correction was made to the cyclic strength of the core material.

As stated in Design Memorandum No. 8, Volume 2, Appendix A, Geotechnical, the foundation alluvium will be excavated to a minimum depth of 15 feet leaving in place materials that are at least as dense or denser than the compacted embankment fill. Accordingly, the cyclic strength of the foundation alluvium was assumed to be similar to that of the compacted alluvial materials.

ESTIMATE OF STRAIN AND PORE PRESSURE BUILD-UP

6-06 The seismic stability of the embankment was assessed by comparing the earthquake-induced stresses (within the saturated zones of the embankment) to the cyclic stresses required to cause 5% strain in 30 cycles of shaking. Values of the cyclic shear strength for an element of soil under given initial normal stress and initial shear stress ratio are estimated from Plates S-26 through S-30. The initial static normal and shear stress ratios are estimated from the results of finite element static stress analyses presented on Plates S-10 and S-11.

6-07 For the maximum credible design earthquake with a pool elevation at +2375 feet, the earthquake-induced shear stresses along selected horizontal planes are compared with the cyclic shear stresses required to cause 5% strain in 30 cycles. These plots are shown on Plates S-31 through S-34 for four typical levels within the embankment. A factor of safety against the development of 5% strain is computed from the ratio of the cyclic strength to the induced stress. The factors of safety along the four elevations shown on Plates S-31 through S-34 are presented on Plate S-35. A contour plot showing the factors of safety within the saturated zones of the embankment is shown on Plate S-36. The contours shown on Plate S-36 were not extended into the upstream shell zone, since this material was considered highly permeable and should not have any appreciable excess pore pressures due to earthquake shaking. The contour plot shows a limited zone within the core and a small portion of the rock transition with a factor of safety of 1.0 or less. All other zones (below the phreatic surface) within the embankment show factors of safety above 1.0.

Downstream of the embankment, the foundation alluvium in the free field shows a zone with factors of safety less than 1.0. This finding is based on assuming that the cyclic strength of the foundation alluvium is similar to that of the compacted alluvial transition materials. However, the results of in situ density tests and Becker hammer data (presented in Design Memorandum No. 8, Volume 2, Appendix A - Geotechnical) showed the foundation alluvium to have much higher densities than the test fill embankment material. Thus the assumption that the downstream foundation material will develop zones of strain potential higher than 5% may be a conservative one.

6-08 Similar plots were prepared for the embankment with a pool elevation at +2420 feet. The comparison of earthquake-induced stresses with the cyclic strength values for the four typical elevations are presented on Plates S-37 through S-40. A summary of the computed factors of safety along these elevations is presented on Plate S-41. A contour plot of the factors of safety throughout the saturated zones of the embankment is presented on Plate S-42. The contour plot in this case shows a similar zone within the core with factors of safety less than 1.0. Downstream of the embankment, the foundation alluvium shows a zone with factors of safety less than 1.0.

6-09 To provide an approximate estimate of the buildup of residual pore pressure in the saturated zones of the embankment due to earthquake shaking, it was assumed that an excess pore pressure ratio of 1.0 was reached when the peak-to-peak axial strain reached a value of 5% (for $\alpha = o$) or when the total axial strain reached a value of 5% (for $\alpha > o$). This may be a conservative assumption for locations in the embankment with initial static shear stresses ($\alpha > o$). Laboratory tests results by Banerjee et al. (1979) on samples of Oroville gravel showed that maximum residual pore pressure ratios developed during cyclic triaxial tests did not exceed 0.85 for $K_c = 1.5$, and 0.75 for $K_c = 2.0$.

6-10 The contours of factors of safety against development of 5% strain (or excess pore pressure ratio of 1.0) were converted to residual excess pore pressure ratios, R_u, using the relationships presented by Marcuson and Hynes (1990) and are shown on Plate S-55. An average curve shown by the thick solid line was used for this study. The contours of residual excess pore pressure ratios for the saturated zones of the embankment are shown on Plate S-44 for the pool elevation at +2375 feet and on Plate S-45 for the pool elevation at +2418 feet (which was modeled at elevation +2420 feet).

6-11 These values are used to provide a basis for conservatively reducing the shear strength of the saturated zones of the embankment as a result of earthquake shaking. The reduced undrained strength is used in estimating the earthquake-induced permanent deformations using the Makdisi-Seed (1977) approach, and the excess pore pressure ratios are used in evaluating the post earthquake stability using effective stress limit equilibrium analysis.

EARTHQUAKE-INDUCED DEFORMATION ANALYSES

6-12 Pseudo-static slope stability analyses are not suitable to quantitatively predict the performance of an embankment during an earthquake. The evaluation of the seismic stability of the embankment may be addressed by estimating permanent deformations. Shaking-induced permanent deformations may be analyzed by either nonlinear numerical modeling or simplified methods of analysis.

6-13 The earthquake-induced permanent deformations of Seven Oaks Dam were estimated using both the results of the finite element QUAD-4M analyses and the simplified procedure of estimating permanent deformations proposed by Makdisi and Seed (1977).

6-14 Makdisi and Seed's simplified procedure for estimating deformations uses the concept originally proposed by Newmark (1965), but takes into consideration the dynamic response of the embankment rather than assuming a rigid body behavior. Newmark's concept for computing permanent displacements of slopes subjected to earthquake shaking used an idealized model of a rigid block sliding on an inclined plane to represent the displaced part of the slope.

6-15 Makdisi and Seed's method (similar to Newmark's) involves using static limit equilibrium slope stability procedures to obtain a yield acceleration, k_y (an acceleration at which a potential sliding surface would develop a factor of safety of unity). Undrained strengths for the embankment materials below the phreatic surface were reduced to account for earthquake shaking as follows: alluvial transition was reduced by 10%; upstream filter by 20%; the core material was reduced by 50%, and the rock transition by 15%. The yield acceleration was assumed to be constant throughout the earthquake and the direction of motion for the potential sliding plane was assumed to be along a horizontal plane.

6-16 The amplification of peak ground motions at centroids of various sliding masses vary with slope height (Sarma and Ambrayseys, 1967). Because the amplified accelerations vary over the height of the slope, yield accelerations were determined for possible sliding masses whose bases lie at various elevations within the section (0.25H, 0.50H, 0.75H, and 1.0H).

6-17 The earthquake accelerations for the potential sliding masses were also determined for each depth of the sliding surface. Earthquake-induced accelerations in the embankment were determined using the QUAD-4M dynamic response analyses.

6-18 For a potential sliding mass, when the induced acceleration exceeds the calculated yield acceleration, movements are assumed to occur along the direction of the failure plane. Using the charts of Makdisi and Seed (1977), an estimate is made for the earthquake-induced permanent deformations for the various potential sliding masses. The potential sliding masses at four levels within the embankment together with their corresponding yield accelerations are presented on Plate S-46 for the pool elevation at +2375 feet and Plate S-47 for the pool elevation at +2420 feet. The estimated permanent deformations are presented on Tables S-13 and S-14.

6-19 As can be seen in Tables S-13 and S-14, estimates of permanent displacements for the maximum credible earthquake for the two conservation pool levels were very similar. The estimated values for the pool level at elevation +2420 feet were slightly higher than those for elevation +2375 feet. Maximum estimated deformations were for slip surfaces located within the top 1/4 height of the embankment. The estimated maximum deformations (for the pool level at elevation +2420 feet) range from 11 feet, for slip surfaces within the upstream slope, to 30 feet for slip surfaces within the downstream slope. For slip surfaces extending through the mid height of the embankment, the estimated deformations are between 2 and 4 feet. For slip surfaces extending deeper than the mid-height of the embankment the estimated deformations were negligible.

It should be noted that the high crest acceleration (1.94g) (and consequently the high seismic coefficient, 1.07g, towards the top of the embankment) were computed using the QUAD4M program with its new Raleigh damping algorithm. As mentioned previously, this recent version of the program provides peak accelerations at the embankment crest that are higher than the earlier QUAD-4 version, and other programs such as FLUSH and SHAKE that employ frequency independent damping. Thus in addition to the QUAD4M analysis described above, the embankment response was computed using both, an earlier QUAD-4 version (Hudson, 1992) and the program FLUSH. The results of these analyses, in terms of the peak accelerations at the crest of the embankment, are compared as follows:

Program Used	Peak Crest Acceleration (MCE, Water Level @2418')
QUAD4M (Hudson et al., 1994)	1.94g
QUAD4TB (Hudson, 1992)	1.22g
FLUSH (Lysmer et al., 1975)	1.59g

The results from the FLUSH analysis were used to estimate the permanent deformations for potential slip surface within the top 1/4 height of the embankment. These values are shown in parentheses on Table S-13 and S-14. The estimated maximum permanent deformations, using the results of the FLUSH response analyses, ranged between 5 feet (for surfaces located within the upstream slope) and 15 feet (for surfaces located within the downstream slope). Because the FLUSH program uses frequency independent damping, it is considered to provide more realistic estimates of ground motions.

POST-EARTHQUAKE STABILITY ANALYSIS

6-20 To estimate the stability of the embankment after the earthquake, the residual excess pore pressure distribution presented on Plates S-44 and S-45 was used together with an effective stress slope stability analysis. This approach is considered rather conservative because: (a) it neglects any reduction in pore pressures (along the failure surface) due to dilation of the dense embankment materials; and (b) it neglects any dissipation or redistribution of excess pore pressures during earthquake shaking or immediately after the earthquake.

6-21 The post-earthquake stability was assessed for the maximum credible earthquake with flood pool elevation at +2420 feet. A cross-section through the embankment showing the distribution of excess pore pressure zones in presented on Plate S-48. An effective stress analysis was used to evaluate the stability of two circular failure surfaces and a wedge-shaped surface. The effective stress parameters used in the analysis for the various embankment zones are based on the results provided by Duncan et al. (1992), Attachment S-3. The computed factors of safety for these failure surfaces ranged between 1.45 and 1.62.

6-22 It is reasonable to assume that the post-earthquake factors of safety for the downstream slope of the embankment would be higher than those estimated for the upstream slope, since most of the slip surfaces would be located in the unsaturated zones of the embankment above the phreatic surface.

The same reasoning applies to the case for the maximum credible earthquake with the water level at elevation +2375 feet.

VII. SURFACE FAULT DISPLACEMENTS

7-01 Seven Oaks Dam may be affected by secondary surface fault offsets and ground cracking triggered by an event along the San Andreas fault zone. Any cracking within the embankment as a result of the secondary surface fault offsets would not affect the safety of the dam based upon the following design considerations:

a. The embankment core consists of materials that are highly resistant to cracking. Therefore, continuous transverse cracking through the embankment would be highly unlikely.

b. The embankment consists of materials moderately (Zone 4A) to highly (Alluvial, Rock Transition and Rockfill Zones) resistant to piping.

c. Under the maximum storage conditions, (debris pool at Elevation +2418 feet) approximately 200 feet of freeboard is available should cracking and differential movements occur.

d. Minimum widths and thicknesses of the critical embankment zones such as core, inclined, and blanket drains are several times the maximum postulated seismic displacement of 4 feet, to insure that these elements function adequately and withstand differential displacements.

e. The safety of the dam rests on the ability of the filter zones within the embankment to control and seal possible leaks within the embankment that could result from hydraulic fractures or other types of cracks. The zones within the embankment are grades so that they provide this degree of security.

VIII. RISK ANALYSIS

GENERAL

8-01 Combined risk is defined as the probability of the simultaneous occurrence of an earthquake and flood storage at least once during the lifetime of the dam. The probability of an earthquake and flood-storage occurring simultaneously during the lifetime of a dam depends upon the return periods (frequency of occurrence) of the earthquake and the flood events, the duration of floodwater storage, and the expected design life of the dam. Based on a paper by Hynes (1978) entitled "Notes on the Joint Occurrence of Earthquakes and Floods", the combined risk is computed using the following equation:

$$\text{Combined Risk} = 1 - \left\{ 1 - \frac{1}{T_j} \left[1 - \left(1 - \frac{1}{52T_i}\right)^n \right] \right\}^k$$

where:

T_i=Annual return period of an earthquake exceeding magnitude i.

T_j=Annual return period of a flood exceeding storage level j.

n =Duration of floodwater storage (weeks).

k =Design lifetime of dam (years)

SEVEN OAKS DAM

8-02 Under the proposed operating conditions, Seven Oaks Dam will be used for flood control, water conservation, and sediment storage. Normal debris pool would be at elevation +2300 feet and spillway crest would be at elevation +2580 feet. The design lifetime of the dam is assumed to be 100 years. The analysis of Seven Oaks Dam under seismic loading conditions will consist of evaluating the embankment response to the following conditions:

(a) Maximum credible earthquake event under normal debris pool.

(b) Maximum credible earthquake event under intermediate reservoir pool conditions.

EARTHQUAKE EVENT

8-03 The maximum credible event was postulated by Bolt as a magnitude 8+ earthquake with a recurrence rate of 150 plus or minus 30 years.

FLOOD EVENTS

8-04 The frequency of floodwater storage was based on filling frequency curves presented on Plate S-49 (plate 7-30 of the Phase II GDM Hydrology Volume 7). The duration of floodwater storage was based on the elevation-duration-frequency curves presented on Plate S-50 (plate 7-29 of Volume 7). The normal debris pool would be at elevation +2300 feet and spillway crest would be at elevation +2580 feet. Reservoir pool elevations of +2300 feet (alternative No. 1), +2375 feet (alternative No. 2) and +2418 feet (alternative No. 3) were selected for risk calculations. The reservoir pool elevation of +2265 feet (alternative No. 4) was not selected for risk calculations since it is below the normal debris pool elevation.

COMBINED RISK

8-05 In order to present comparative levels of risk, different earthquake return periods and reservoir pool elevations were used to compute combined risks. The results are summarized in the following table.

Seven Oaks Dam

Combined Risk of Occurrance of Combined Storage and Earthquake During 100-year Project Life

Flood Event	Pool Elevation (feet)	Flood Return Period (Years)	Storage Duration (Weeks)	Earth-quake Event	Earth-quake Return Period (Years)	Combined Risk*	Free Board
debris	2300	2 2 2	52 52 52	MCE	120 150 180	3.40E-01 2.83E-01 2.42E-01	310
debris	2300	2 2 2	0.8571 0.8571 0.8571	MCE	120 150 180	6.84E-03 5.48E-03 4.57E-03	310
Inter-mediate	2375	6 6 6	26 26 26	MCE	120 150 180	6.70E-02 5.40E-02 4.52E-02	235
Inter-mediate	2375	6 6 6	0.7143 0.7143 0.7143	MCE	120 150 180	1.91E-03 1.53E-03 1.27E-03	235
Inter-mediate	2418	15 15 15	26 26 26	MCE	120 150 180	2.73E-02 2.19E-02 1.83E-02	190
Inter-mediate	2418	15 15 15	0.5714 0.5714 0.5714	MCE	120 150 180	6.10E-04 4.88E-04 5.50E-06	190

*Combined risk per design life of 100 years.
*Top of dam elevation = 2610 feet.
*Return interval of MCE is 150 years, plus or minus 30 years.

IX. RESERVOIR TRIGGERED SEISMICITY

9-01 Reservoir-triggered seismicity (RTS) is defined as the occurrence of earthquakes which are triggered by or through the operation of a reservoir. The phenomena was first documented in 1936. During the last 60 years, approximately 100 cases of suspected RTS have occurred worldwide. The seismicity can range from various levels of micro-earthquake activity to damaging earthquakes. Although the theoretical most probable maximum magnitude of reservoir triggered earthquakes (RTE) is M7.5 (Baoqi, 1992), the maximum worldwide RTE to date was the 1967 magnitude 6.5 event at Koyna, India.

9-02 A statistical relationship between the size [scale] of a reservoir and the theoretical maximum magnitude (M) of triggered earthquakes has been proposed by Baoqi (1992). Using his relationship, the maximum magnitude of a triggered event at Seven Oaks Dam at the maximum proposed conservation pool elevation would be M4.2. This is significantly less than what can be expected due to naturally occurring earthquakes in the area.

X. EVALUATION OF EXISTING EMBANKMENT DESIGN

CRACKING AND HYDRAULIC FRACTURING EVALUATION

10-01 A finite element analysis was performed by Geomatrix Consultants to assess the potential for cracking and hydraulic fracturing at two cross sections of the embankment. The report presented in attachment S-9 indicates that hydraulic fracturing would not occur for a permanent storage pool at elevation +2375 feet or elevation +2418 feet.

FILTER EVALUATION

10-02 Concerns were expressed by the State Division of Safety of Dams related to the cracking and Hydraulic fracturing study. The District's Technical experts, Prof. J.M. Duncan and Dr. F. Makdisi, were requested to perform an independent review of the embankment design and ability of the embankment materials to resist and control leaks. The final report concludes that the safety of the Seven Oaks Dam will not be threatened by hydraulic fracturing or other forms of cracking or internal erosion in the embankment, because filter zones within the embankment are designed properly to control and seal possible leaks.

FOUNDATION GROUTING

10-03 As a part of the dam foundation treatment, curtain grouting was conducted in the bedrock under the core zone. The grouting program was essentially exploratory in nature and was intended to verify the overall low permeability of the rock mass. The pre-construction exploratory pressure testing of the foundation rock indicated essentially tight conditions below a depth (including alluvial overburden) of 75 feet.

Pre-Construction Pressure Test Summary
Foundation Bedrock
Table 1

Number of Records	Depth Interval in feet	Average K in ft/day
13	0-50	.284
20	50-75	.178
17	75-100	.048
29	100-150	.040
20	150-200	.011
14	200-300	.005
8	>300	.008

10-04 The curtain as constructed consists of a single-line, maximum 4-zone curtain with a 20-foot primary hole spacing. Drilling and grouting was done in zones using stage grouting, split-spacing methods to a maximum depth of 150 feet. The curtain was constructed to a standard of 0.1 ft/day (approximately 4 Lugeons) which is appropriate for a wide-core embankment dam when the loss of reservoir water due to underseepage is not a consideration. (Houlsby, 1990) Based upon a grout deferral criteria of 0.1 ft/day, it was estimated that 40 percent of the grout stages would be deferred from grouting. As constructed, 60 percent of the total zone intervals drilled were deferred. Table 2 presents a brief grouting summary by zone.

Foundation Grouting Summary
Table 2

Zone	Zone Depth	Average K value	Maximum bags/ft	Percent Deferred
1	0-15/25	.438	1.32	41%
2	15/25-50	.189	1.27	59%
3	50-100	.045	1.14	79%
4	100-150	.027	.1	89%

10-05 The exploratory grouting program served to verify the tight bedrock foundation conditions at the Seven Oaks Damsite and significant underseepage is not anticipated. Even though prolonged storage of a water conservation pool would likely increase the amount of underseepage, from the perspective of dam safety, the grout curtain as constructed is judged to be adequate for the water conservation alternatives considered.

INTAKE PORTAL SLOPES

10-06 The northeast and northwest facing rock slopes on the Intake Tower Ridge were analyzed by Nicholson and Wibowo. The results of that analysis are in the report titled "Rock Slope Stability Analysis at Seven Oaks Dam in the Vicinity of the Intake Structure." The slopes were analyzed using seismic or pore pressure loads consistent with flood control operation of Seven Oaks Dam. Flood control operation of the reservoir, with its short inundation periods, was not expected to cause extensive water saturation into rock joints. Residual pore pressures would only effect stability after flood events when the reservoir was being rapidly emptied. The low probability of an earthquake occurring during reservoir draw down combined with the short duration of inundation and resultant low joint saturation is why combined pore pressure and seismic loads were not considered in the flood control analysis.

10-07 A water conservation pool will force water into rock joints under hydrostatic pressures during several months of the year. This will increase the extent of joint saturation. This increase will lead to higher residual pore pressures and higher probabilities of combined loading. The following is a description of how changes in loading parameters will affect slopes on the Intake Tower Ridge.

10-08 The northwestern facing ridge on the southeastern side of the Intake Tower was analyzed in the report by Nicholson and Wibowo. The report concluded that for flood control operation the slope was stable for all assumed loading conditions. The high factors-of-safety calculated for conservative loading parameters implies factors-of-safety for load combinations will also be acceptable.

10-09 A portion of the northeastern facing Intake Tower Ridge Slope northwest of the Intake Tower will also be inundated by the conservation pool. This is a portion of the ridge, below the Intake Tower Access Road, which has not been altered by a benched slope system. The approximately 250 feet long exposed natural slope topography consists of a lower portion, 100 feet tall that dips approximately 45 degrees and an upper portion 50 feet tall that dips approximately 55 degrees. A preliminary rock slope stability analysis using ROCKPACII was conducted to determine the sensitivity of factor-of-safety to water conservation loading conditions. Stability on this portion of the slope is controlled by two joint sets (called A and E in the Nicholson report) whose line of intersection plunges out of the slope at 56 degrees. Scars of previous wedge failures involving these joint sets are obvious on the slope face. Previous analysis concluded that slopes dipping greater than the plunge of the line of intersection of the predominate joint set were unstable under all loading considerations and the slopes above the access road were excavated not to exceed 56 degrees. Slopes that dip less than the plunge of intersection of the joint set are stable for all load considerations because the failure surface is geometrically constrained or not formed. Localized areas of slope below the proposed conservation pool elevation dip greater than 55 degrees, however, most of the slope dips less than 56 degrees.

10-10 The slope mentioned above is also subject to wedge failures formed by the intersection of two other joint sets (called L/G and A in the report). Analysis of this portion of the slope indicates that wedges formed from the intersection of these joint planes are unstable for slopes greater than 55 degrees when they are subject to low levels of joint saturation, with or without combined seismic loads.

10-11 Additional, detailed joint mapping is required for this portion of the slope to determine if and where joints L/G and A or other potentially unstable wedges occur. The sensitivity of these joints to the pore pressures induced by a conservation pool will also need further analysis. Remediation, consisting of drain holes and pattern rock bolts, may be required to maintain stability of the Intake Tower Access Road and reduce the occurrence of debris producing rock falls.

SUDDEN DRAWDOWN ANALYSIS

10-12 A two-stage sudden drawdown slope stability analysis was performed. Strength parameters were recommended by J.M. Duncan, et al. and are included on plate S-53. The analysis addresses the situation where water is stored at elevation +2418 feet and rapidly drawn down to three water surface elevations: +2300 feet, +2200 feet, and +2100 feet. Results indicate that the factor of safety for all cases is in the range of 1.3 to 1.4. See plate S-52. This analysis indicates that the embankment, as designed, does not appear to be in danger of instability due to sudden drawdown.

ZONE 3/5 ANALYSIS

10-13 Additional stability evaluations were performed for the embankment, as a part of the report: Geotechnical Assessment for Combining Zones 3 and 5 of the (Seven Oaks Dam) Embankment into One Zone 3/5, dated July 1995. The seismic stability was evaluated using the maximum credible earthquake motions with permanent pool at the proposed maximum elevation of +2418 feet (which was modeled at elevation +2420 feet) for the water conservation study. The sudden drawdown analysis assumed that the spillway crest elevation of +2580 feet and the reservoir is subjected to rapid drawdown to the controlled intake at elevation +2150 feet. Based upon the analysis, the embankment is expected to perform safely during earthquake and rapid drawdown conditions. See Attachment S-7. Zones 3 and 5 will not be combined, and the shell (Zone 5) will consist of minus 12-inch crushed rock, or 12 to 30-inch size cobbles and boulders as originally designed.

OTHER ISSUES

10-14 The embankment cross-section as presented in the Feature Design Memorandum No. 8, Volume 2, Appendix A. Geotechnical has been slightly modified during construction. Modifications are as follows:

(a) The foundation at the core contact has been flared both upstream and downstream to increase safety against hydraulic fracturing.

(b) Multi-layered filters have been installed around the rock toe to preclude piping of the embankment materials.

(c) A formal slope protection consisting of a 3-foot thick layer of zone 5 material will be placed on the downstream slope.

(d) Shaping of the right abutment was directed to help correct a diverging slope.

(e) Foundation excavation in the central contact area has been reduced to help provide safer cut slopes.

(f) Zone 3 material was placed within the Zone 4B region below elevation 2100 feet.

(g) Zone 5 material has been allowed to be placed with the Zone 3 material within the overbuild area.

XI. SUMMARY AND CONCLUSIONS

11-01 The stability of the embankment and foundation of Seven Oaks Dam under earthquake loading was evaluated using currently used dynamic analysis procedures. The dynamic stability of the dam was analyzed for the following pool conditions and earthquake loads: conservation pool at elevations +2375 feet and +2418 feet (which was modeled at elevation +2420 feet); and a maximum credible earthquake (8+) on the San Andreas fault.

11-02 The foundation was extensively investigated and sampled. Field testing consisted of large-scale insitu density testing, Becker penetration, pumping tests, and geophysical surveys. Sampling consisted of obtaining disturbed samples. The results of the investigations indicated the embankment will be founded on competent dense to very dense gravels increasing in coarseness with depth, as covered in Design Memorandum No. 8, Appendix A, Geotechnical, dated November 1992.

11-03 The materials for the various zones of the embankment were also extensively investigated and tested in the field and in the laboratory. Results of the laboratory and field tests on the alluvial transition, rock transition, and rockfill materials were used to estimate static strength, dynamic properties, and cyclic strength of the materials.

11-04 Due to the limitations of the testing equipment, samples used for static and dynamic laboratory testing are representative of the finer portions of the embankment and foundation materials. Using the results of the in-situ density tests and field geophysical measurements on test fill embankments and foundation materials, the results of the laboratory data were corrected to closely represent actual field conditions.

11-05 Static finite element analyses were performed to estimate pre-earthquake initial static stresses. The results of these analyses were used in estimating dynamic material properties for use in the dynamic finite element analyses and in evaluating the cyclic shear strength of the embankment materials.

11-06 The seismic stability of the embankment and the foundation was assessed using the results of dynamic finite element analyses and the cyclic strength of the materials. Factors of safety were computed against the development of potential strains and the build-up of residual excess pore pressures with the saturated zones of the embankment. The results of these analyses were used to estimate reductions in the undrained strength for use in permanent deformation analyses. The residual excess pore pressures were used in effective stress slope stability analyses to evaluate the post-earthquake stability of the embankment.

11-07 Results of the earthquake-induced deformation analyses indicated estimated maximum deformations on the order of about 5 to 15 feet for the maximum credible earthquake with a water level at an elevation of +2375 feet or +2418 feet. These estimates were for potential slip surfaces located within top 1/4 height of the embankment.

11-08 The post-earthquake stability of the embankment was evaluated using an effective stress analysis together with the estimated residual excess pore pressure at the end of the earthquake. Reductions in pore pressure due to dilation of the dense embankment materials was neglected, as well as any reduction due to dissipation or re-distribution of pore pressures during or after the earthquakes. With these conservative assumptions, the minimum computed post-earthquake stability factor of safety for the maximum probable earthquake loading for pool elevation at +2418 (+2420) feet was about 1.45. Factors of safety for the lower pool elevations of +2265 feet and +2375 feet, are expected to be higher than 1.45

11-09 On the basis of the seismic stability evaluations summarized above and because of the dense nature of both embankment materials and the in-place alluvial foundation (at depths below 15 feet), it is reasonable to conclude that the strength of these materials will not undergo significant loss due to earthquake shaking associated with the design earthquakes.

11-10 Even with conservative reductions in the shear strength of these materials, the estimated earthquake-induced deformations are within tolerable limits (i.e. sufficient freeboard remains to avoid an uncontrolled, catastrophic breach of the dam) and the computed factors of safety for post-earthquake slope stability are adequate.

11-11 Proposed and approved modifications to the embankment for the design have been on the conservative side to insure safety of the dam for the authorized purpose.

11-12 Independent review by the District Technical Advisors conservatively assumes that hydraulic fracturing may occur within the core for pool at the spillway crest elevation +2580 feet, but embankment materials downstream are graded to seal cracks and preclude leaks that could result from the hydro fractures or other types of cracks. In addition, the core of the embankment flared in both upstream and downstream directions to provide further defense. These views need the District's review and concurrence of DSOD whose requirements for storage may be more demanding than those designed for the authorized flood control purpose. The views of other technical specialist to assess the risk associated with the conservation pool at elevations higher than the +2265 feet needs to be sought. Stability of the rock slope mass above the outlet and adequacy of the foundation grouting for conservation pools above elevation 2265 need to be thoroughly evaluated.

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TABLE S-1

STRESS-STRAIN AND STRENGTH PARAMETERS FOR ANALYSIS OF PRE-EARTHQUAKE STRESSES IN SEVEN OAKS DAM

Parameter	Core	Alluvium[1]	GR Rockfill[2]
Υm (moist) (t/ft^3)	0.068	0.073	0.071
Υb (buoyant) (t/ft^3)	0.038	0.043	0.042
K	140	1000	650
K_{ur}	200	1500	1000
n	0.45	0.30	0.50
C (t/ft^2)	0.35	NA	NA
ϕ (degrees)	30	47	40
$\Delta\phi$	NA	7	0
R_f	0.70	0.70	0.70
K_b	130	600	200
m	0.20	0.00	0.45

[1] Shell, transition and filter zones derived from alluvium.
[2] Rock transition and rockfill zones derived from GR soils.

Reference: J.M. Duncan (1992).

TABLE S-2 ESTIMATED (MEAN) GROUND MOTION PARAMETERS ON ROCK AT SITE		
	Max. Credible Event (Adjacent San Andreas)	Max. Probable Event (in 50 years)
Source Distance to Damsite (km)	2	20
Magnitude (Ms)	8+	7.5-8.0
Seismic Moment (dyne-cm)	10^{28}	10^{27}
Recurrence Rate	150 +/- 30 years	1 percent chance/yr
Peak Horizontal Acceleration	0.7g	0.5g
Peak Horizontal Velocity (cm/sec)	90-105	70-80
Peak Horizontal Displacement (cm)	50-80	40-70
Bracketed Duration at 0.05 g (sec)	40-50	35
Predominant Period in Ground Velocity (sec)	0.2-10.0	0.3-8.0

TABLE S-3 CORE MATERIAL - RESONANT COLUMN TESTS					
Relative Compaction (698)	Compaction Moisture Content	Effective Confining Pressure (TSF)	Consol. Ratio Kc	No. of Tests	Specimen Size (in.)
98%	Optimum + 2%	0.5 2.5 5.0 10.0 20.0	1 1 1 1 1	1 1 1 1 1	2.8
98%	Optimum	2.5 5.0	1 1	1 1	2.8
			TOTAL	7	

TABLE S-4

ALLUVIAL MATERIAL - RESONANT COLUMN TESTS

Relative Density	Dry Unit Weight	Specimem Size (in.)	Maximum Particle Size (in.)	Effective Confining Pressure	Consol. Ratio Kc	No. of Tests
80%	122*	6.0	1	0.5 2.5 5.0	1 1 1	1 1 1
100%	126*	6.0	1	0.5 2.5 5.0	1 1 1	1 1 1
					TOTAL	6

* Specimen target density.

TABLE S-5

ROCK TRANSITION MATERIAL RESONANT COLUMN TESTS

Relative Density	Dry Unit Weight	Specimem Size (in.)	Maximum Particle Size (in.)	Effective Confining Pressure	Consol. Ratio Kc	No. of Tests
80%	125	6.0	1	0.5 2.5 5.0	1 1 1	1 1 1
100%	130	6.0	1	0.5 2.5 5.0	1 1 1	1 1 1
					TOTAL	6

TABLE S-6

CORE MATERIAL - STRAIN-CONTROLLED CYCLIC TRIAXIAL TESTS

Relative Compaction (698)	Compaction Moisture Content	Effective Confining Pressure (TSF)	Consol. Ratio Kc	No. of Tests	Specimen Size (in.)
98%	Optimum + 2%	2.5 5.0	1 1	2 1	2.8
			TOTAL	3	

TABLE S-7

ALLUVIAL MATERIALS - STRAIN CONTROLLED CYCLIC TRIAXIAL TESTS

Relative Density	Dry Unit Weight	Specimem Size (in.)	Maximum Particle Size (in.)	Effective Confining Pressure	Consol. Ratio Kc	No. of Tests
80%	122*	6.0	1	2.5	1	1
				10.0	1	2
					TOTAL	3

* Specimen target density.

TABLE S-8

ROCK TRANSION - STRAIN CONTROLLED CYCLIC TRIAXIAL TESTS

Relative Density	Dry Unit Weight	Specimem Size (in.)	Maximum Particle Size (in.)	Effective Confining Pressure	Consol. Ratio Kc	No. of Tests
80%	119*	6.0	1	2.5	1	1
				5.0	1	1
					TOTAL	2

* Specimen target density.

TABLE S-9

VALUES OF K_{2MAX} USED IN DYNAMIC FINITE ELEMENT ANALYSIS

Material	Moist Unit Weight (lb/ft³)	Saturated Unit Weight (lb/ft³)	K_{2max}
Core	136	138	70[1]
Alluvial Transition	146	148	130*
Rock Transition	142	146	110*
Rockfill	140	145	110*
Alluvial Foundation	142	146	150*
Rock Foundation	165	170	Rigid or V_S = 4300

[1] Based on resonant column tests
* Based on geophysical data and recommendation of Dr. I.M. Idriss

TABLE S-10

CORE MATERIAL - STRESS-CONTROLLED CYCLIC TRIAXIAL TESTS

Relative Compaction (698)	Compaction Moisture	Effective Confining (TSF)	Consol. Ratio Kc	No. of Tests	Specimen Diameter (in.)
98% of (698)	Optimum + 2%	2.5 10.0	1 1	3 3	2.8
		2.5 5.0 15.0	1.5 1.5 1.5	3 3 3	
98% of (698)	Optimum	5.0	1.5	3	
			TOTAL	18	

TABLE S-11 ALLUVIAL MATERIAL - STRESS-CONTROLLED CYCLIC TRIAXIAL TESTS						
Relative Density	Dry Unit Weight (pcf)	Specimem Size (in.)	Maximum Particle Size (in.)	Effective Confining Pressure (TSF)	Consol. Ratio Kc (TSF)	No. of Tests
80%	122*	6.0	1	2.5 5.0 15.0	1 1 1	3 3 3
				2.5 5.0 10.0 15.0	1.5 1.5 1.5 1.5	3 3 3 3
				2.5 5.0	2 2	3 3
100%	126*	6.0	1.0	2.5 5.0 15.0	1.5 1.5 1.5	3 3 3
					TOTAL	36

* Specimen target density.

TABLE S-12 ROCK TRANSITION MATERIAL STRESS-CONTROLLED CYCLIC TRIAXIAL TESTS						
Relative Density	Dry Unit Weight (pcf)	Specimem Size (in.)	Maximum Particle Size (in.)	Effective Confining Pressure (TSF)	Consol. Ratio Kc	No. of Tests
80%	119*	6	1.0	2.5 5.0 15.0	1 1 1	3 3 3
				2.5 5.0 10.0	1.5 1.5 1.5	3 3 3
100%	124*	6	1.0	2.5 5.0 10.0	1.5 1.5 1.5	3 3 3
					TOTAL	27

* Specimen target density.

TABLE S-13

ESTIMATES OF EARTHQUAKE-INDUCED PERMANENT DEFORMATIONS
MAXIMUM CREDIBLE EARTHQUAKE
WATER LEVEL @ ELEVATION +2375 FEET
(M = 8+, Bedrock PGA = 0.7 g, T_o, = 2.14 sec)

Sliding Mass Depths	k_y	k_{max}	k_y/k_{max}	$U/k_{max}gT_o$	U (ft)
UPSTREAM					
¼ height	0.44	1.06 (0.87)	0.42 (0.51)	0.17 (0.08)	12 (5)
½ height	0.32	0.89	0.54	0.06	2
¾ height	0.23	0.28	0.82	0.004	0
Full height	0.22	0.20	1.10	0.00	0
DOWNSTREAM					
¼ height	0.29	1.06 (0.87)	0.27 (0.33)	0.40 (0.25)	29 (15)
½ height	0.30	0.59	0.51	0.07	3
¾ height	0.30	0.28	1.03	0.00	0
Full height	0.34	0.20	1.70	0.00	0

k_y = yield horizontal acceleration in g.
k_{max} = induced maximum horizontal acceleration in g.
U = Displacement in feet.
T_o = Predominant natural period of embankment in seconds.

Note: Values in parentheses are based on dynamic response computations using the program FLUSH.

TABLE S-14

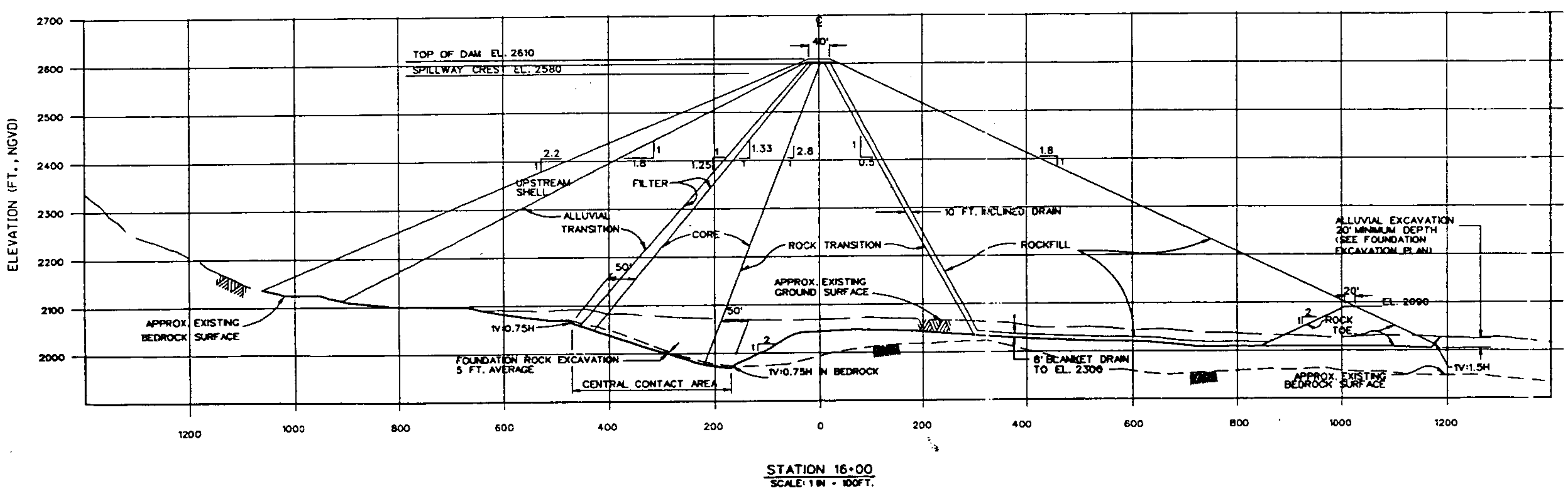
ESTIMATES OF EARTHQUAKE-INDUCED PERMANENT DEFORMATIONS
MAXIMUM CREDIBLE EARTHQUAKE
WATER LEVEL @ ELEVATION +2420 FEET
(M = 8+, Bedrock PGA = 0.7 g, T_o = 2.17 sec)

Sliding Mass Depths	k_y	k_{max}	k_y/k_{max}	$U/k_{max}gT_o$	U (ft)
UPSTREAM					
¼ height	0.44	1.07 (0.88)	0.41 (0.50)	0.15 (0.08)	11 (5)
½ height	0.26	0.57	0.46	0.10	4
¾ height	0.21	0.27	0.78	0.006	0
Full height	0.21	0.20	1.05	0.00	0
DOWNSTREAM					
¼ height	0.29	1.07 (0.88)	0.27 (0.33)	0.40 (0.25)	30 (15)
½ height	0.30	0.57	0.53	0.06	2
¾ height	0.30	0.27	1.10	0.00	0
Full height	0.34	0.20	1.70	0.00	0

k_y = yield horizontal acceleration in g.
k_{max} = induced maximum horiontal acceleration in g.
U = Displacement in feet.
T_o = Predominant natural period of embankment in seconds.

Note: Values in parentheses are based on dynamic response computations using the program FLUSH.

VALUE ENGINEERING PAYS



NOTES (1):

1. EMBANKMENT ZONE DEFINITION:
   CORE (ZONE 1)
   FILTER (ZONE2)
   ALLUVIAL TRANSITION (ZONE 3)
   ROCK TRANSITION (ZONE 4A)
   ROCKFILL (ZONE4B)
   U/S SHELL (ZONE 5)

NOTES (2):

1. EMBANKMENT SECTIONS ARE DRAWN LOOKING EAST
2. BEDROCK SURFACE APPROXIMATED AND SMOOTHED.

DATUM IS NATIONAL GEODETIC VERTICAL DATUM OF 1929

REVISIONS

U.S. ARMY ENGINEER DISTRICT
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CORPS OF ENGINEERS

SANTA ANA RIVER MAINSTEM, CALIFORNIA
WATER CONSERVATION STUDY

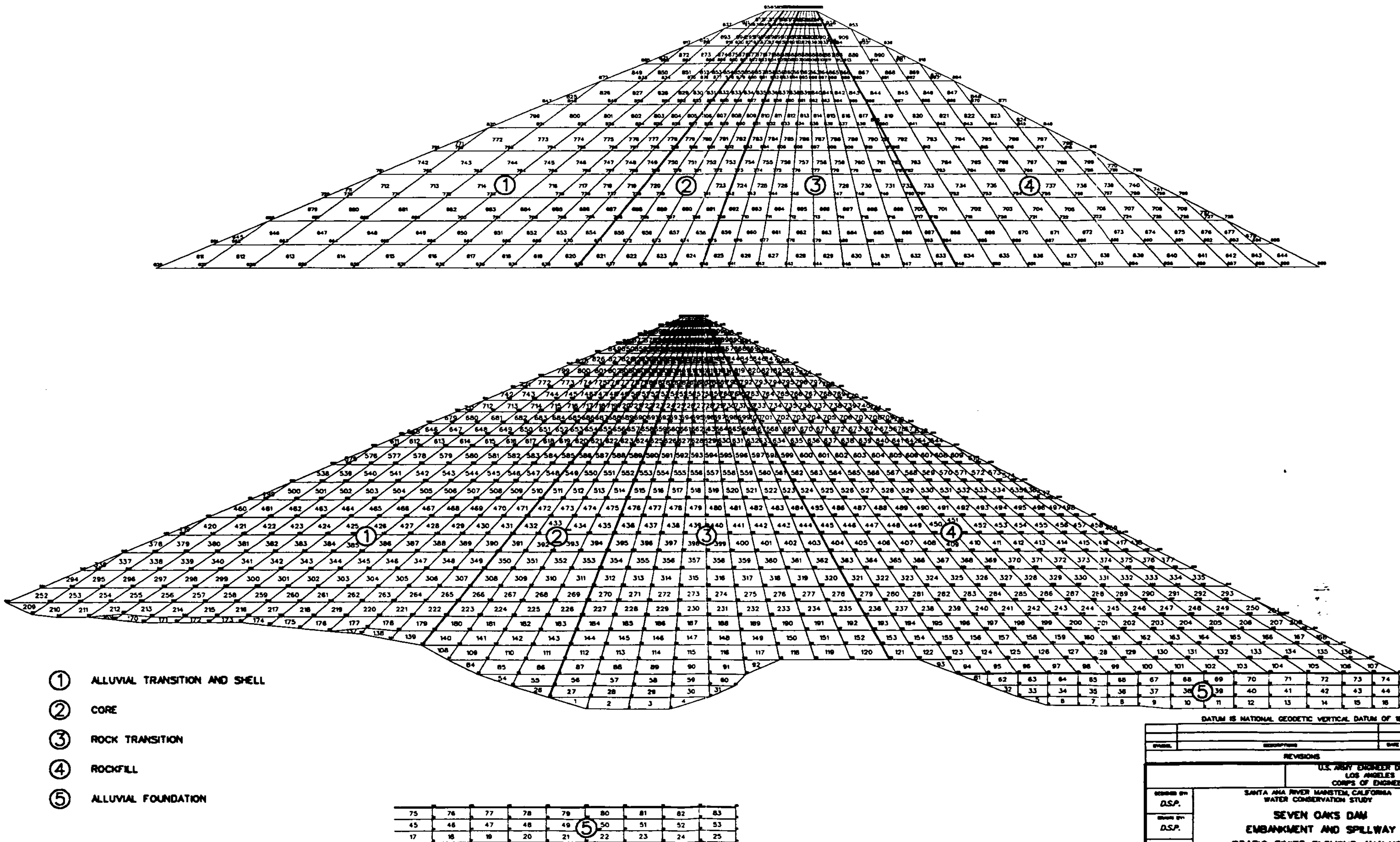
SEVEN OAKS DAM
EMBANKMENT AND SPILLWAY
EMBANKMENT SECTION

DESIGNED BY: D.S.P.
DRAWN BY: D.S.P.
CHECKED BY: R.R.
SUBMITTED BY:
DATE APPROVED:
SPEC. NO. DACW09-
DISTRICT FILE NO.
SHEET

SAFETY PAYS

PLATE S-1

VALUE ENGINEERING PAYS



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SANTA ANA RIVER MAINSTEM, CALIFORNIA
WATER CONSERVATION STUDY

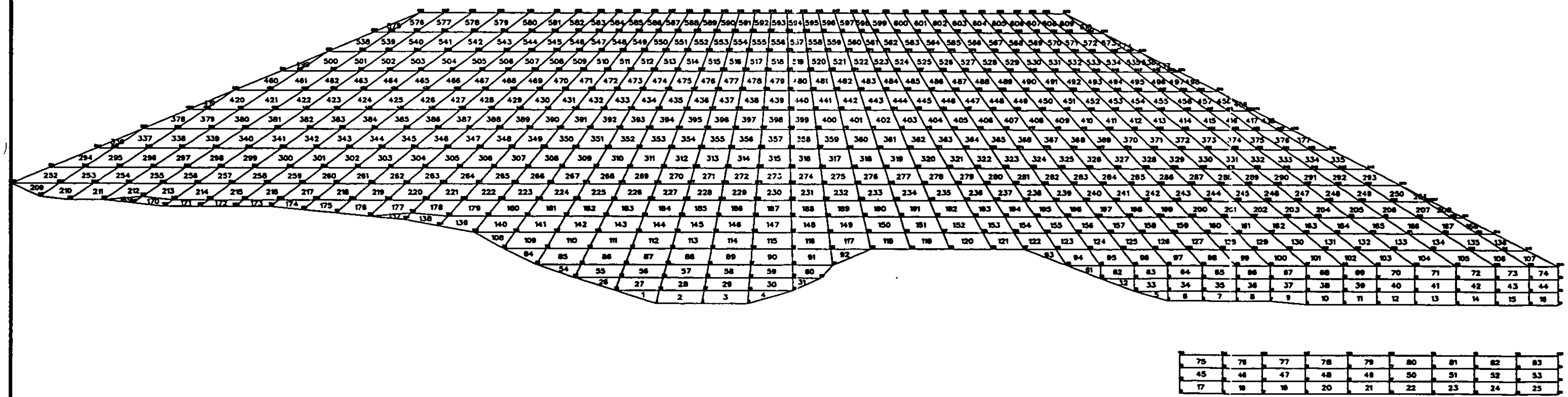
SEVEN OAKS DAM
EMBANKMENT AND SPILLWAY
STATIC FINITE ELEMENT ANALYSIS
FEDAM MESH

DESIGNED BY: D.S.P.
DRAWN BY: D.S.P.
CHECKED BY: R.R.
SUBMITTED BY:
DATE APPROVED:
SPEC. NO. DACW09-
DISTRICT FILE NO.
SHEET

SAFETY PAYS

PLATE S-

VALUE ENGINEERING PAYS



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SANTA ANA RIVER MAINSTEM, CALIFORNIA
WATER CONSERVATION STUDY

SEVEN OAKS DAM

EMBANKMENT AND SPILLWAY

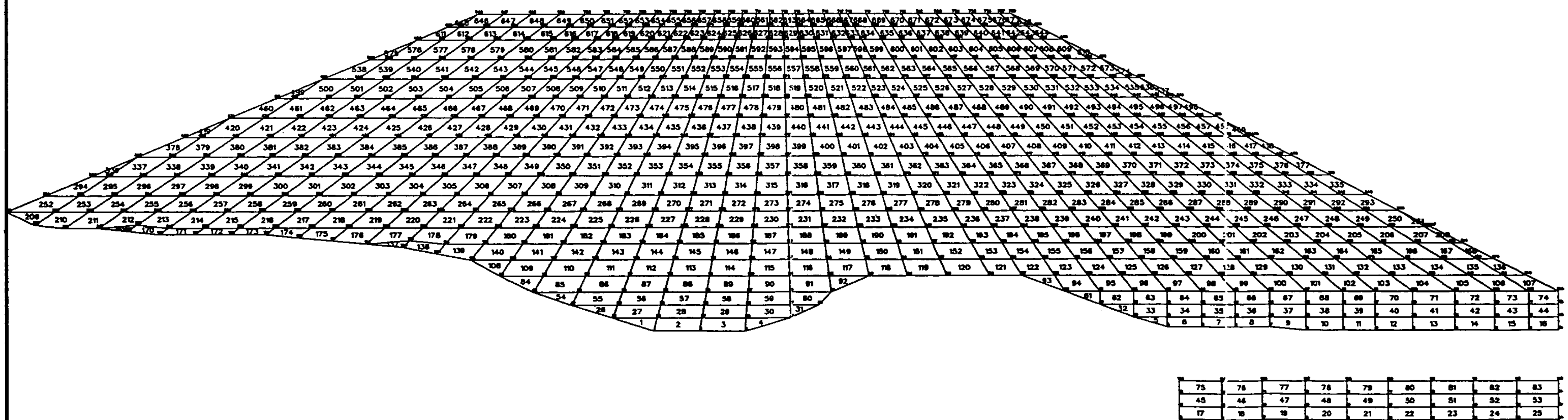
SEEPAGE FEM MESH POOL AT 2375 FT.

DESIGNED BY: D.S.P.
DRAWN BY: D.S.P.
CHECKED BY: R.R.
SUBMITTED BY:
DATE APPROVED:
SPEC. NO. DACW09-
DISTRICT FILE NO.

SAFETY PAYS

PLATE S-

VALUE ENGINEERING PAYS



DATUM IS NATIONAL GEODETIC VERTICAL DATUM OF 1929

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CORPS OF ENGINEERS

SANTA ANA RIVER MAINSTEM, CALIFORNIA
WATER CONSERVATION STUDY

SEVEN OAKS DAM

EMBANKMENT AND SPILLWAY

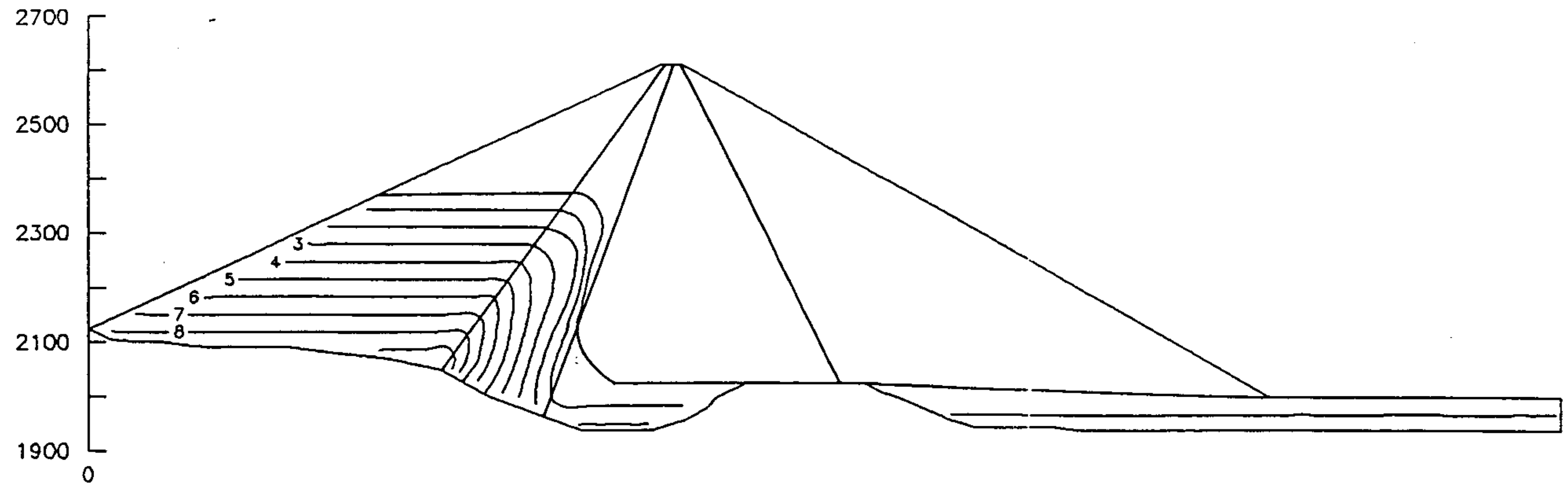
SEEPAGE FEM MESH POOL AT 2418 FT.

DESIGNED BY: D.S.P.
DRAWN BY: D.S.P.
CHECKED BY: R.R.

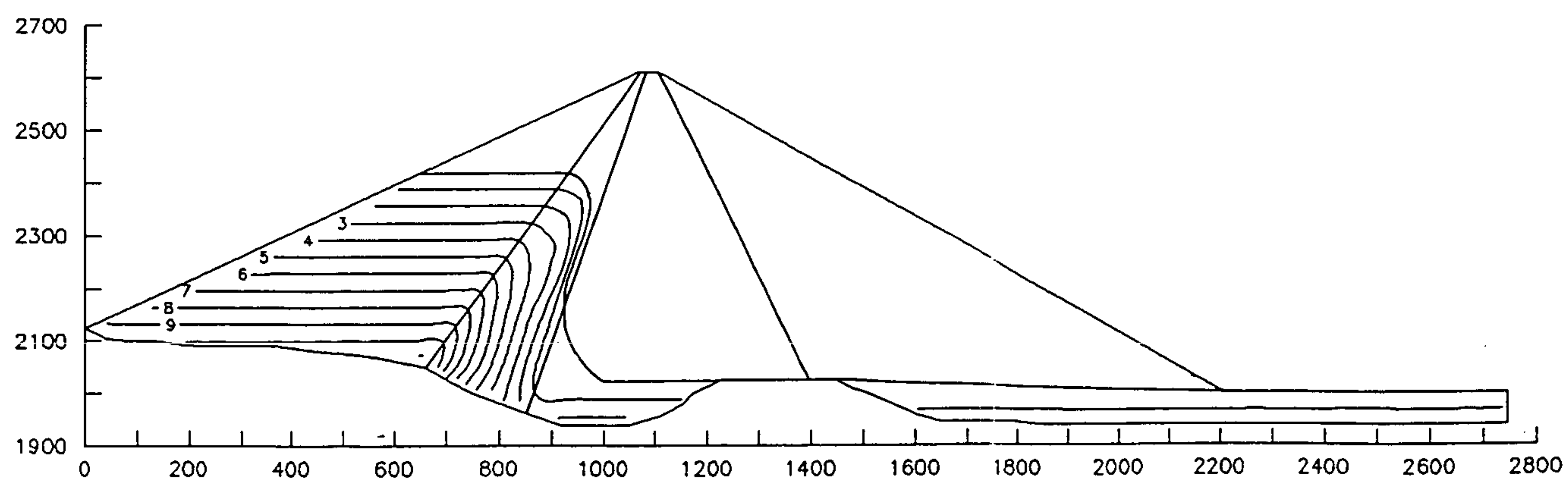
SUBMITTED BY:
DATE APPROVED:
SPEC. NO. DACW09-
DISTRICT FILE NO.

PLATE S

SAFETY PAYS



WATER LEVEL AT 2375 FEET



WATER LEVEL AT 2420 FEET

Plate S-5
Seven Oaks Dam
Embankment and Spillway
Pressure Head Contours (Tons/Sq. Ft.)
WSEL 2375 and 2420 Phreatic

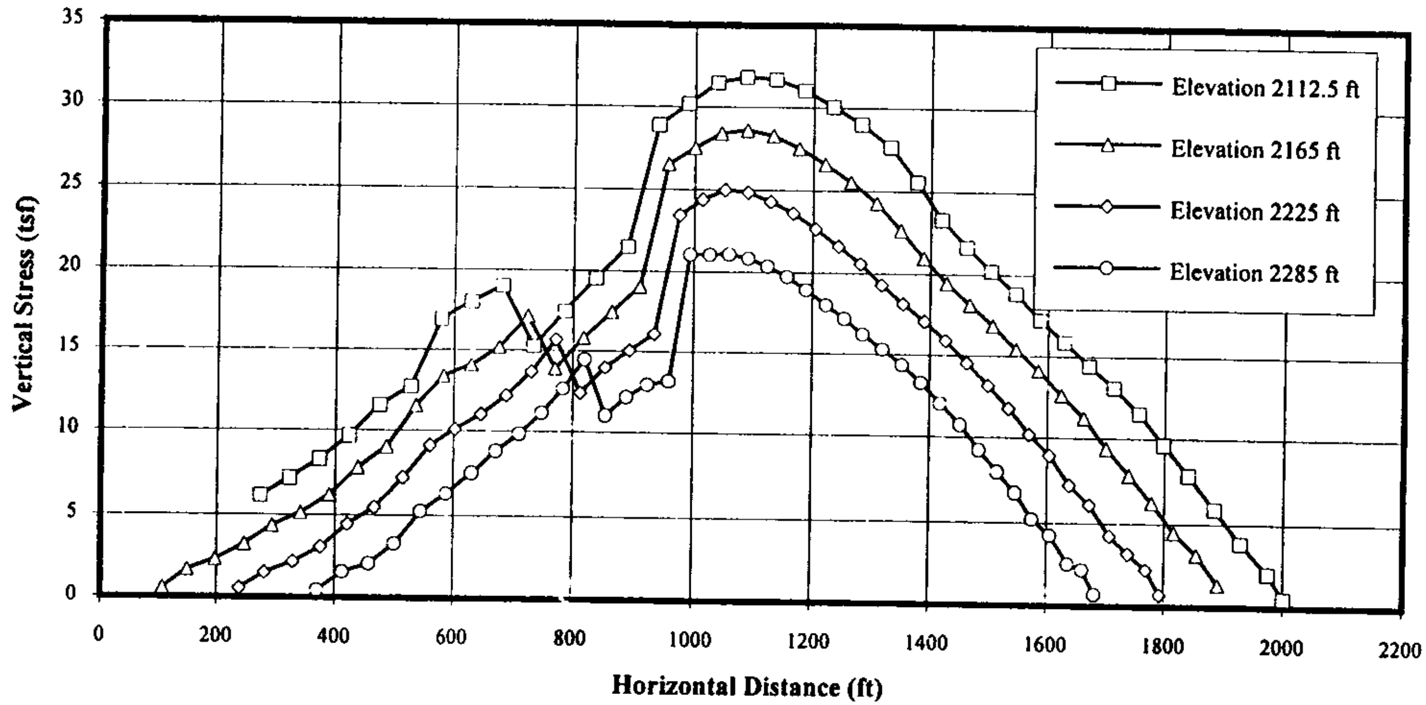


Plate S-6: Initial Static Vertical Stress Along Typical Elevations – Seven Oaks Dam (Water Level at Elevation +2375 Feet)

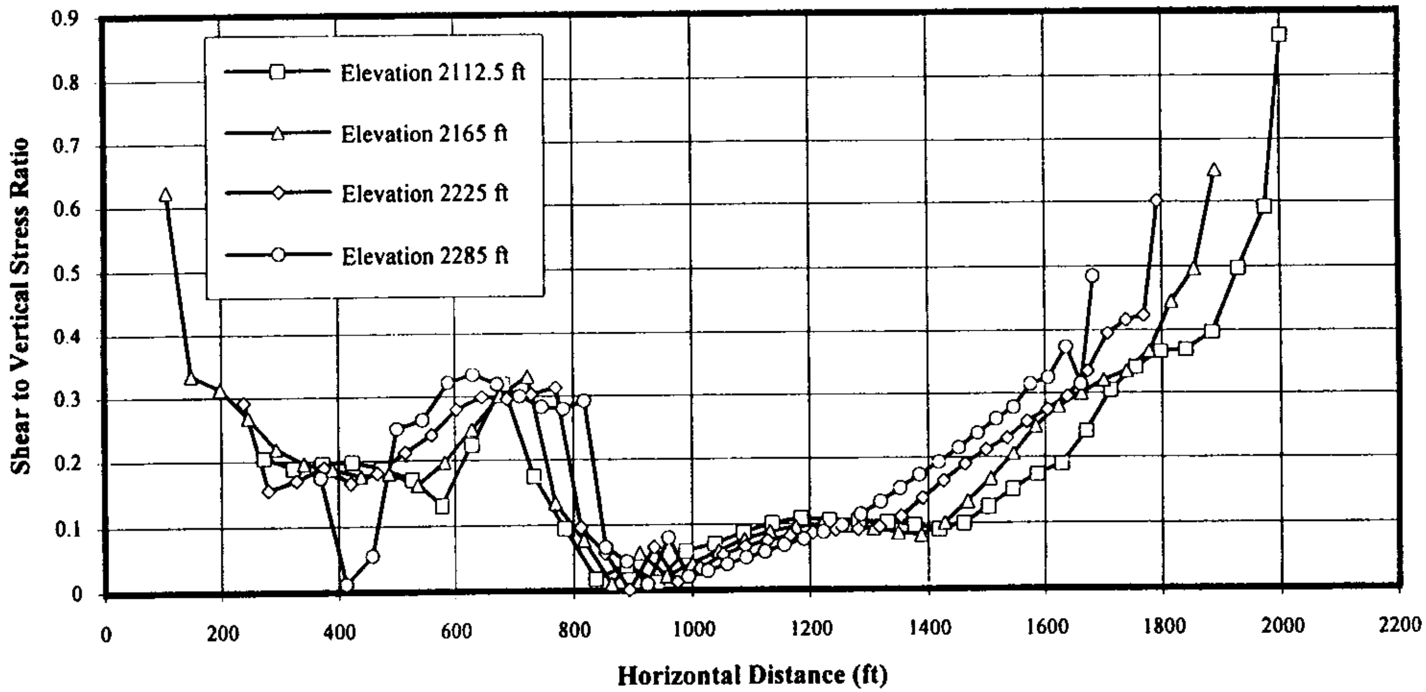


Plate S-7: Initial Shear Stress to Vertical Ratio Along Typical Elevations – Seven Oaks Dam (Water Level at Elevation +2375 Feet)

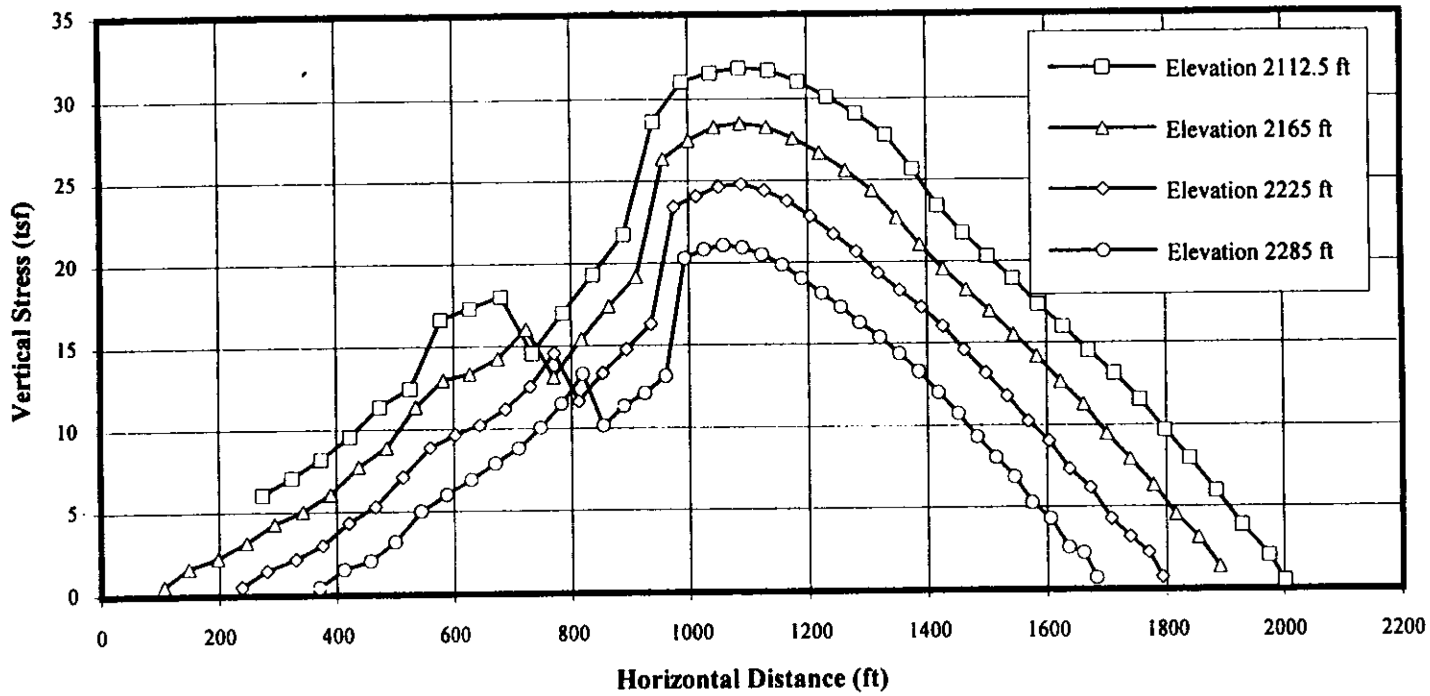


Plate S-8: Initial Static Vertical Stress Along Typical Elevations – Seven Oaks Dam (Water Level at Elevation +2420 Feet)

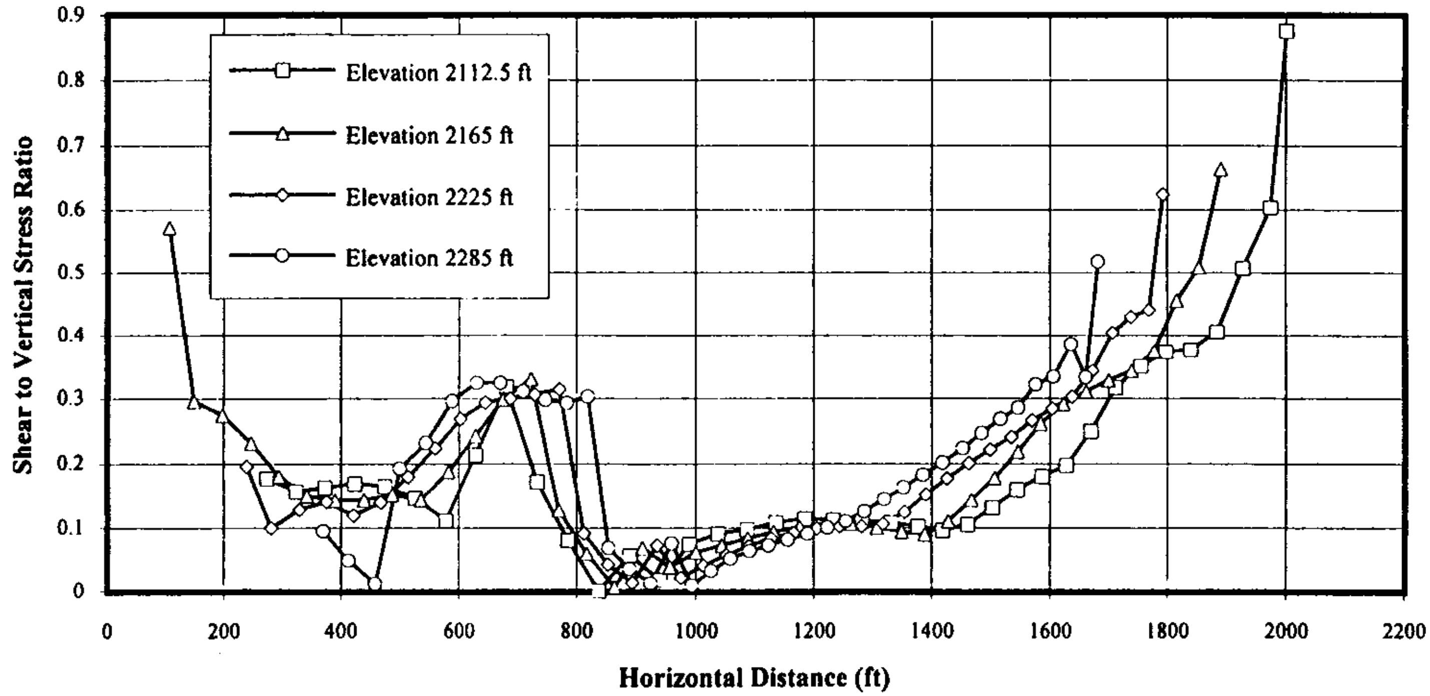
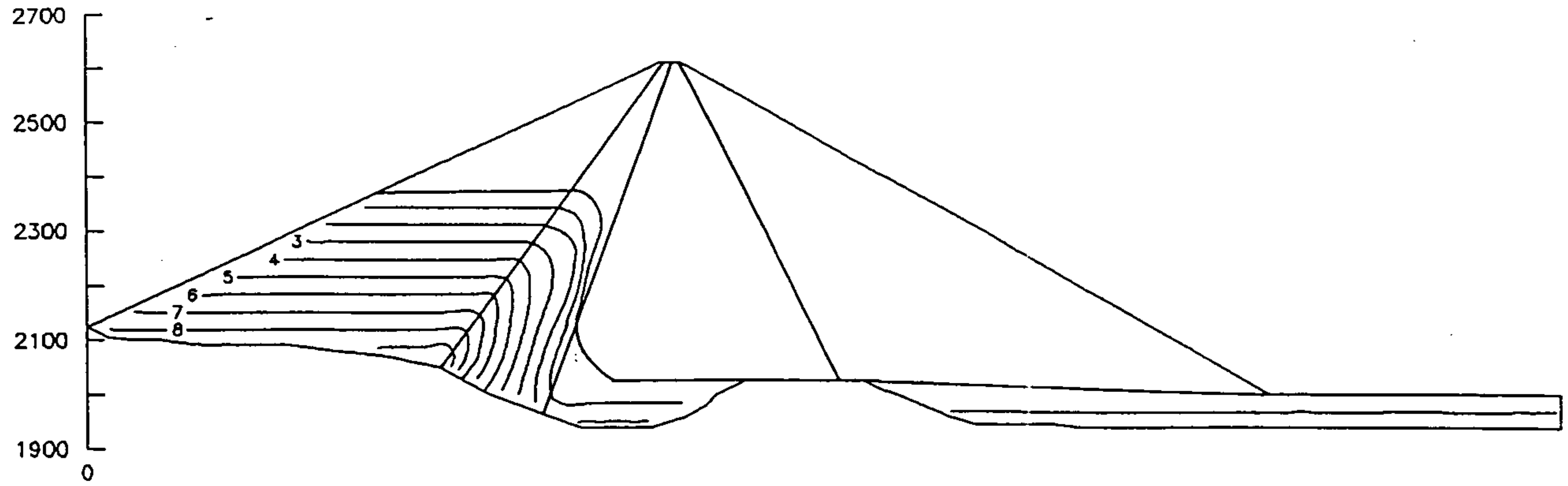
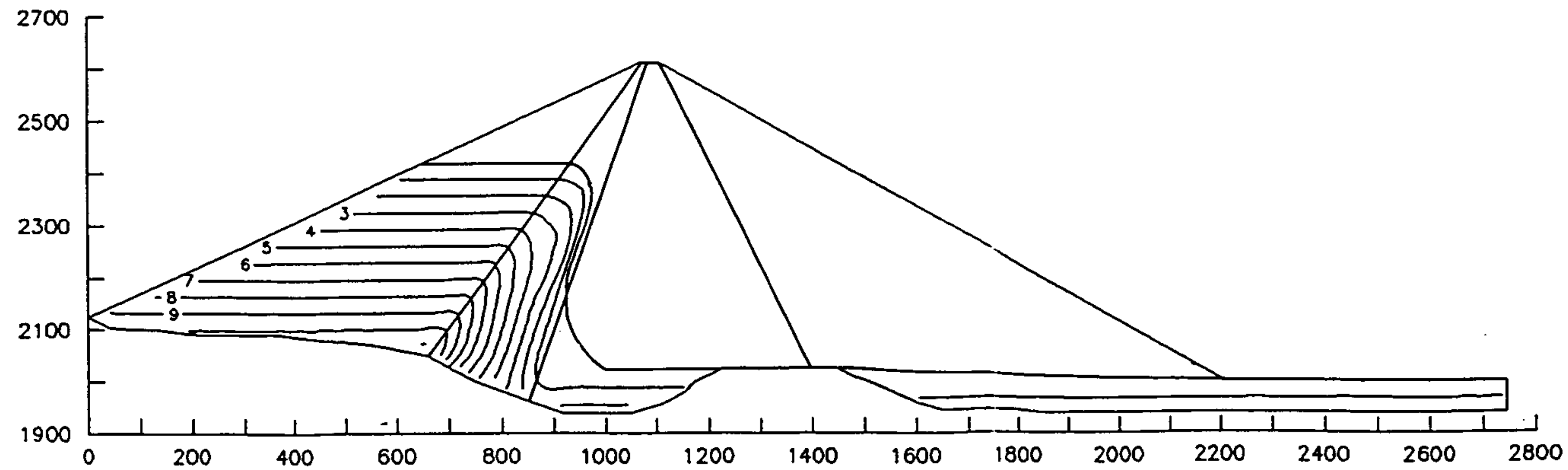


Plate S-9: Initial Shear Stress to Vertical Ratio Along Typical Elevations – Seven Oaks Dam (Water Level at Elevation +2420 Feet)



WATER LEVEL AT 2375 FEET



WATER LEVEL AT 2420 FEET

Plate S-5
Seven Oaks Dam
Embankment and Spillway
Pressure Head Contours (Tons/Sq. Ft.)
WSEL 2375 and 2420 Phreatic

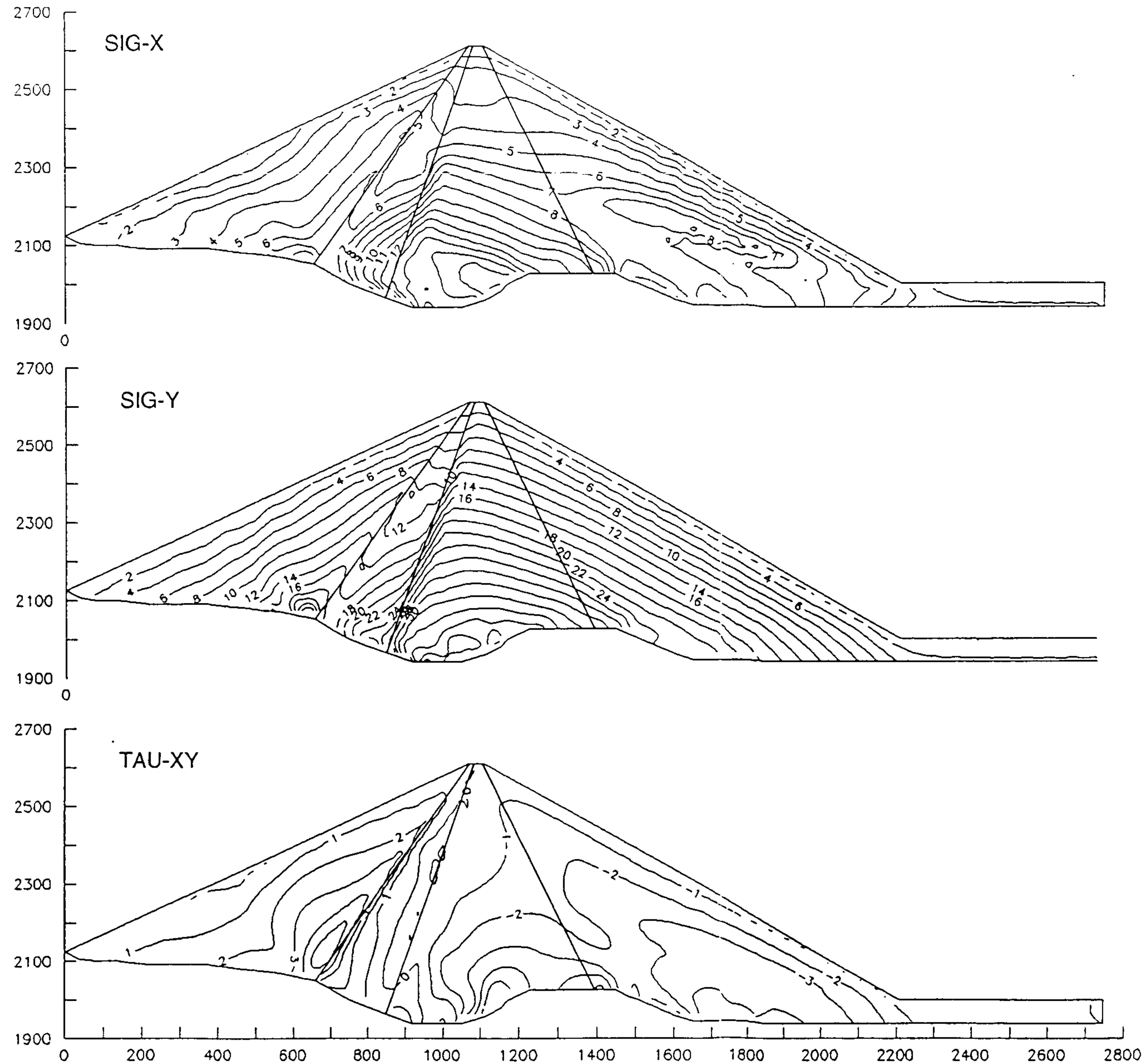


Plate S-10
Seven Oaks Dam
Embankment and Spillway
Initial Static Stress Contours (Tons/Sq. Ft.)
WSEL 2375

2271

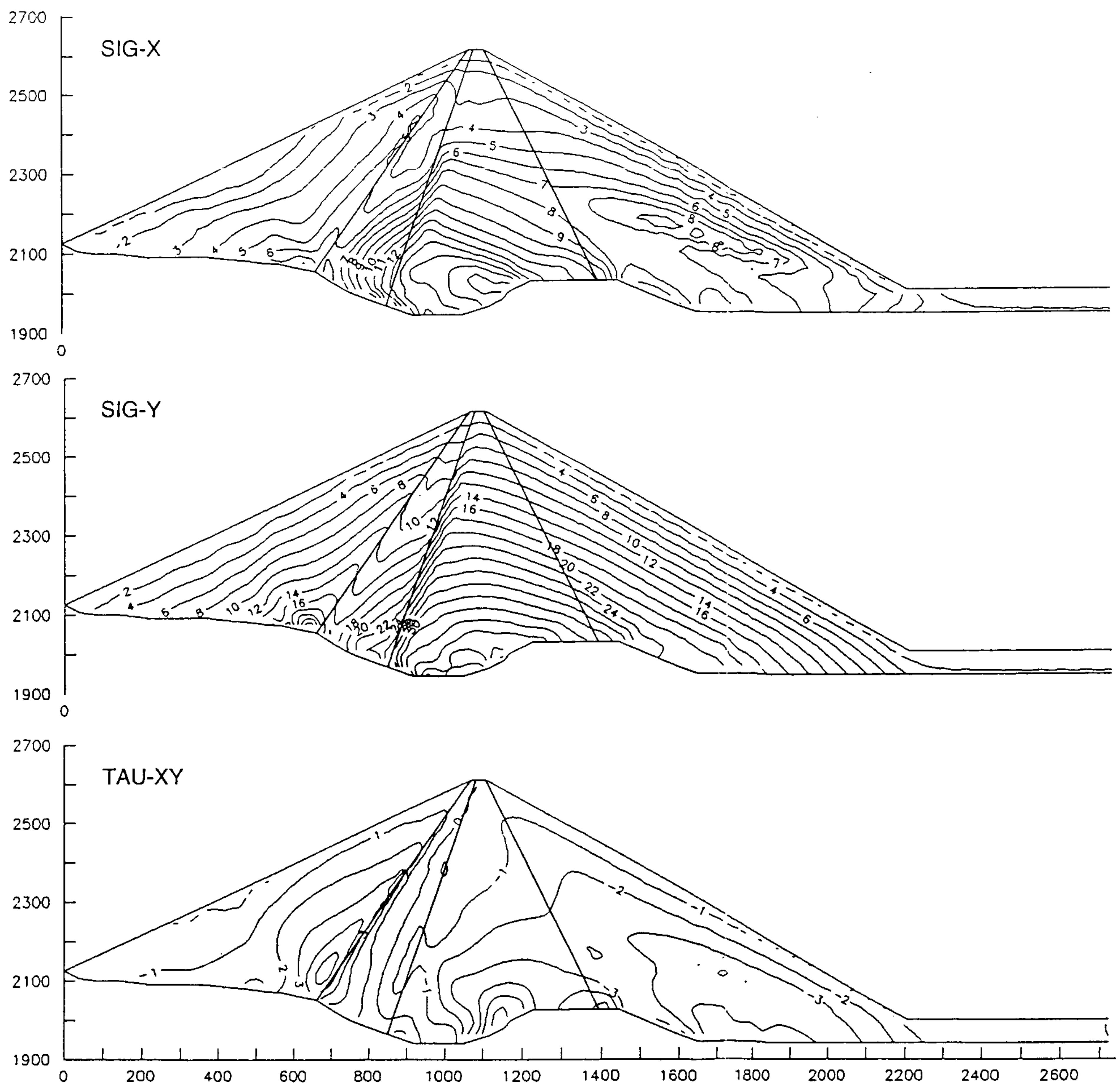


Plate S-11
Seven Oaks Dam
Embankment and Spillway
Initial Static Stress Contours (Tons/Sq. Ft.)
WSEL 2420

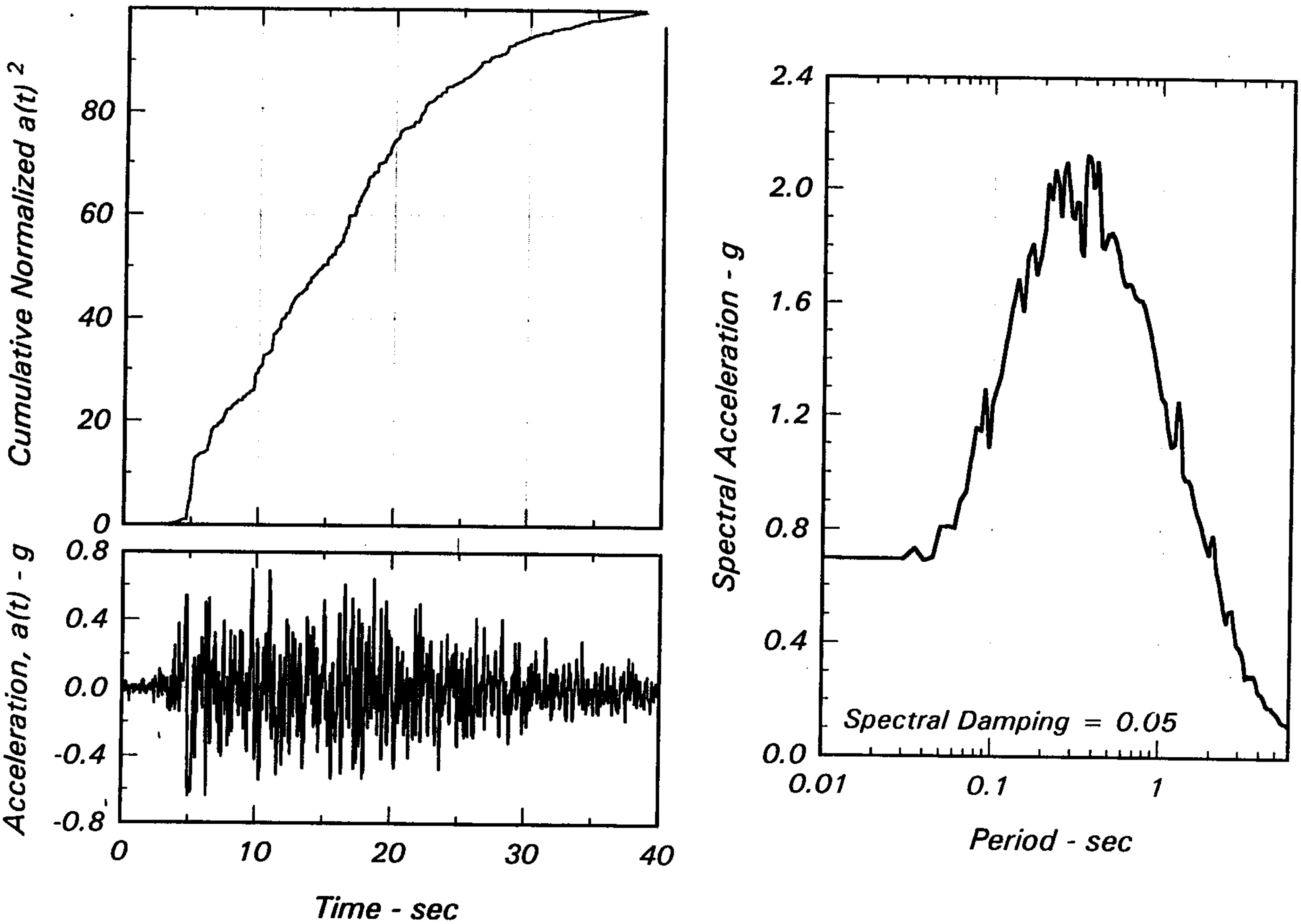


Plate S-12: **East-West Component of Selected Accelerogram**

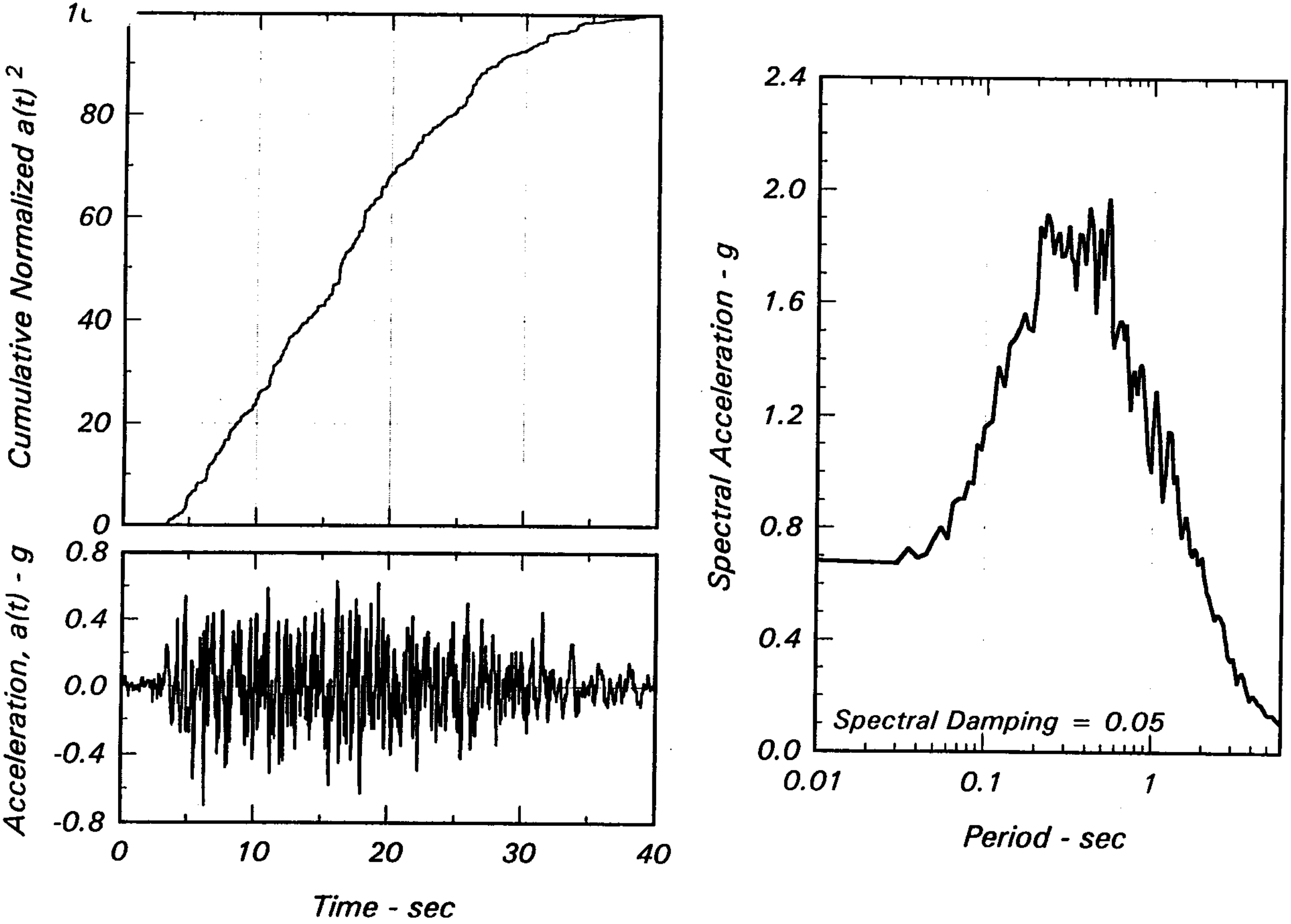


Plate S-13: **North-South Component of Selected Accelerogram**

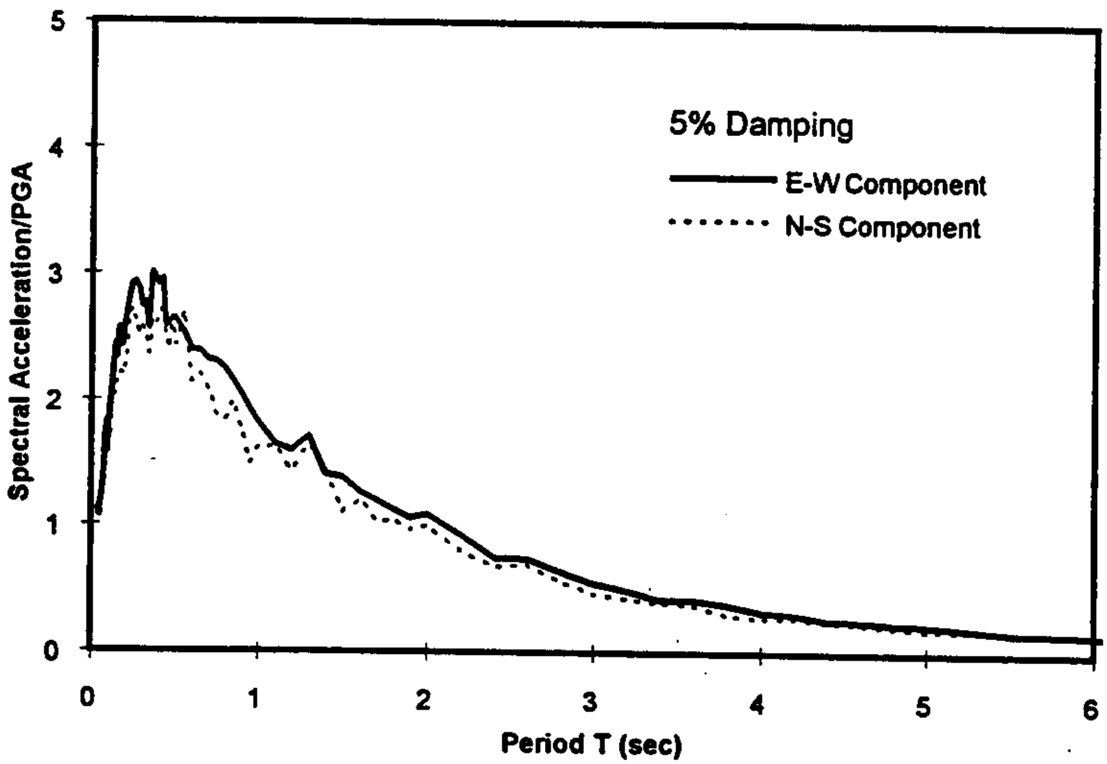


Plate S-14: **Normalized Response Spectra - Seven Oaks Dam Time_Histories (Bolt/Idriss)**

RESONANT COLUMN

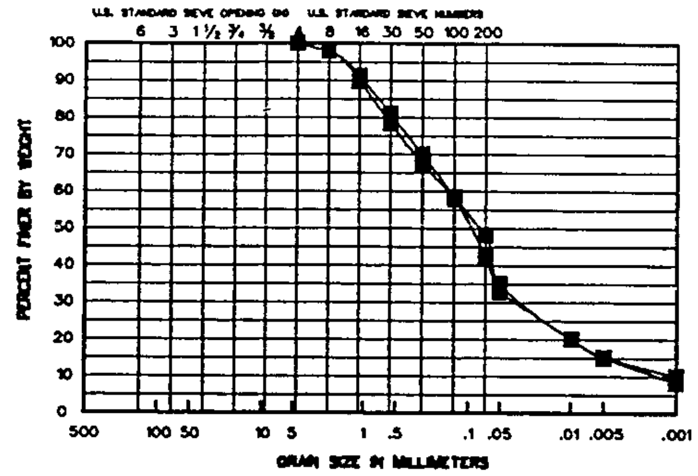
RELATIVE COMPACTION (698)	COMPACTION MOISTURE CONTENT	EFFECTIVE CONFINING PRESSURE (TSF)	CONSOL. RATIO Ko	SPECIMEN SIZE (IN)	NUMBER OF (IN)
98%	OPTIMUM + 2%	0.5	1	2.8	1
		2.5	1		1
		5.0	1		1
		10.0	1		1
		CAPACITY	1		1
	OPTIMUM	2.5	1		1
		5.0	1		1
				TOTAL	7

STRAIN CONTROLLED CYCLIC TRIAXIAL TESTS

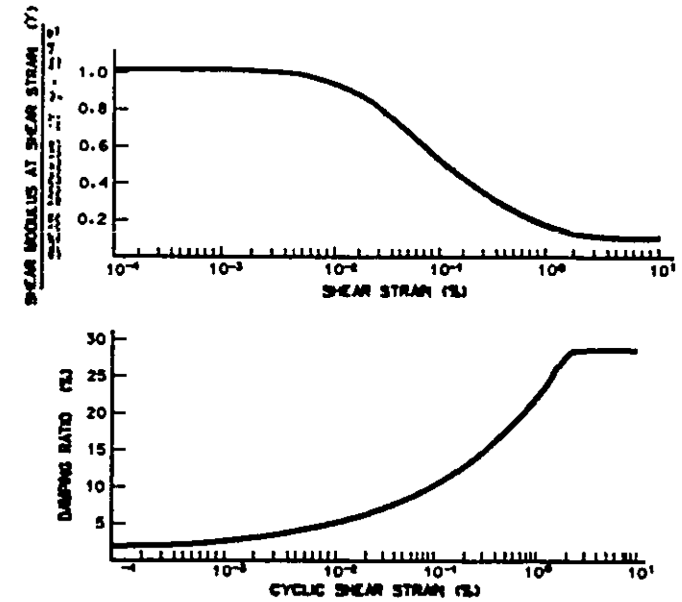
RELATIVE COMPACTION (698)	COMPACTION MOISTURE CONTENT	EFFECTIVE CONFINING PRESSURE (TSF)	CONSOL. RATIO Ko	SPECIMEN SIZE (IN)	NUMBER OF (IN)
98%	OPTIMUM + 2%	2.5	1	2.8	1
		5.0	1		1
				TOTAL	2

STRESS CONTROLLED CYCLIC TRIAXIAL TESTS

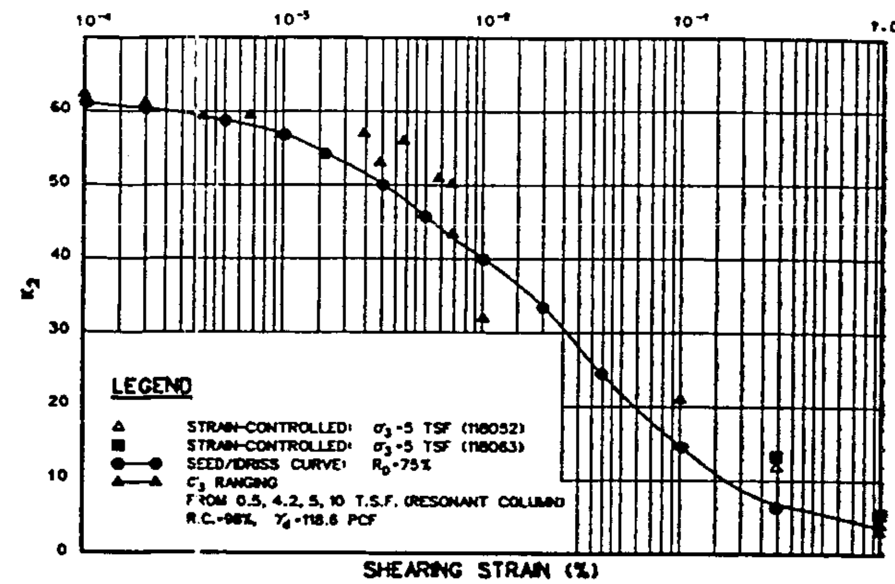
RELATIVE COMPACTION (698)	COMPACTION MOISTURE CONTENT	EFFECTIVE CONFINING PRESSURE (TSF)	CONSOL. RATIO Ko	SPECIMEN SIZE (IN)	NUMBER OF (IN)
98%	OPTIMUM + 2%	2.5	1	2.8	3
		10.0	1		3
		2.5	1.5		3
		5.0	1.5		3
		CAPACITY	1.5		3
	OPTIMUM	5.0	1.5		3
				TOTAL	18

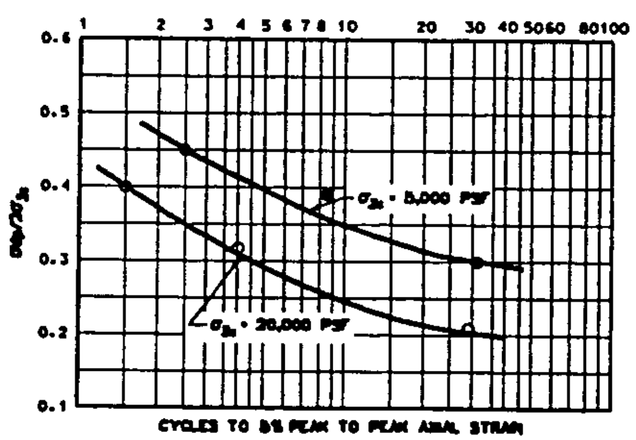


TEST GRADATIONS

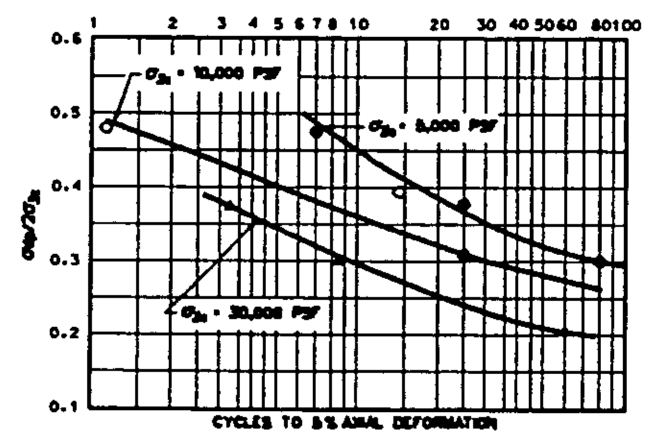


DYNAMIC PROPERTIES
SEED/IDRISS, EERC 70-10, 1970

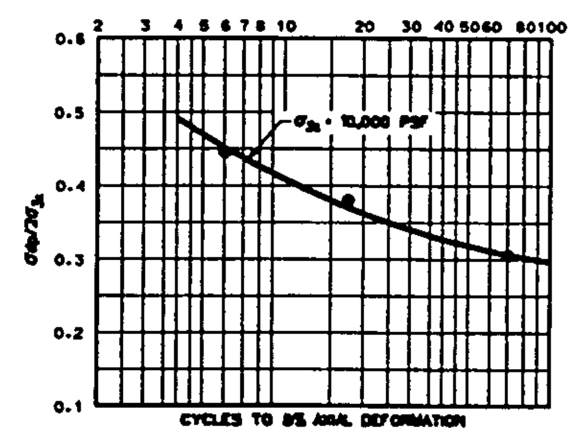




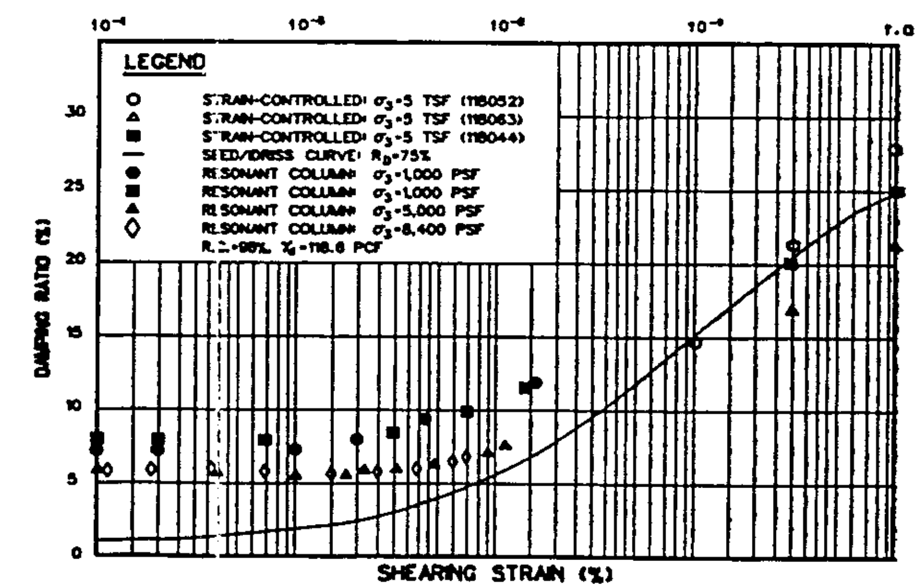
K_c = 1.0
γ = 117.4 PCF
ω = OPTIMUM +2%



K_c = 1.5
γ = 117.4 PCF
ω = OPTIMUM +2%



K_c = 1.0
γ = 117.4 PCF
ω = OPTIMUM



SYMBOL	DESCRIPTION	DATE	APPROVAL
REVISIONS			

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: R.R.
DRAWN BY: A.C.
CHECKED BY: R.R.

SANTA ANA RIVER MAINSTEM, CALIFORNIA
WATER CONSERVATION STUDY
SEVEN OAKS DAM
EMBANKMENT AND SPILLWAY
CORE MATERIAL
DYNAMIC TESTS RESULTS

SUBMITTED BY: | DATE APPROVED: | SPEC. NO. DACW09- | SHEET
DISTRICT FILE NO.

PLATE S-15

RESONANT COLUMN

RELATIVE DENSITY	DRY UNIT WEIGHT (PCF)	SPECIMEN SIZE (IN.)	MAX. PARTICLE SIZE	EFFECTIVE CONFINING PRESSURE (TSF)	CONSOL. RATIO Kc	NUMBER OF TESTS
80%	122*	6	1	0.5 2.5 5.0	1 1 1	1 1 1
100%	126*	6		0.5 2.5 5.0	1 1 1	1 1 1
					TOTAL:	6

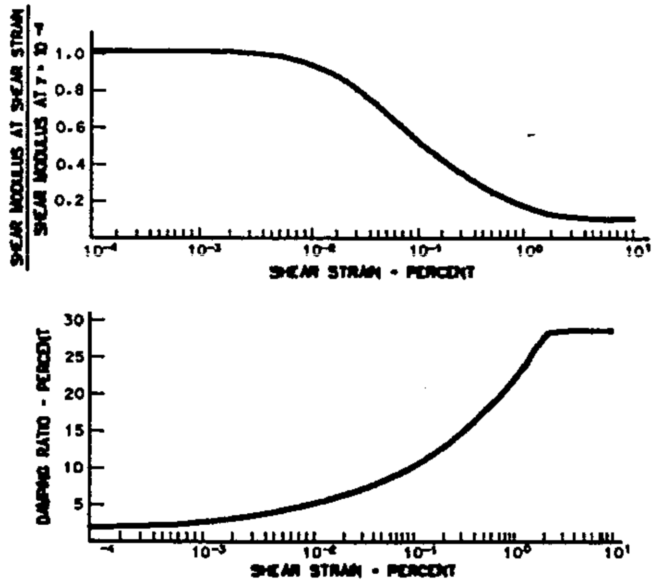
STRAIN CONTROLLED CYCLIC TRIAXIAL TESTS

RELATIVE DENSITY	DRY UNIT WEIGHT (PCF)	SPECIMEN SIZE (IN.)	MAX. PARTICLE SIZE	EFFECTIVE CONFINING PRESSURE (TSF)	CONSOL. RATIO Kc	NUMBER OF TESTS
80%	122*	6	1	2.5 10.0	1 1	1 2
					TOTAL:	3

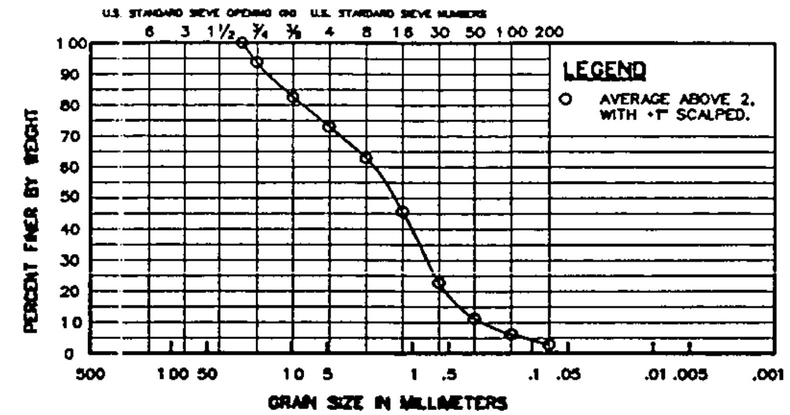
STRESS CONTROLLED CYCLIC TRIAXIAL TESTS

RELATIVE DENSITY	DRY UNIT WEIGHT	SPECIMEN SIZE (IN.)	MAX. PARTICLE SIZE	EFFECTIVE CONFINING PRESSURE (TSF)	CONSOL. RATIO Kc	NUMBER OF TESTS
80%	122*	6	1	2.5 5.0 15.0	1 1 1	3 3 3
				2.5 5.0 10.0 15.0	1.5 1.5 1.5 1.5	3 3 3 3
				2.5 5.0	2 2	3 3
100%	126*	6	1	2.5 5.0 15.0	1.5 1.5 1.5	3 3 3
					TOTAL:	36

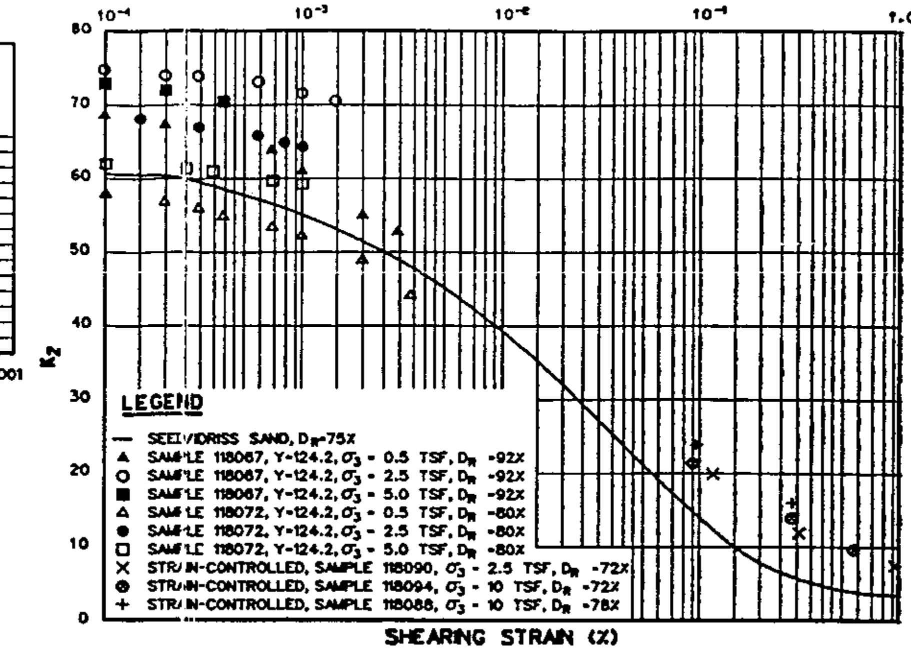
*TARGET DENSITY

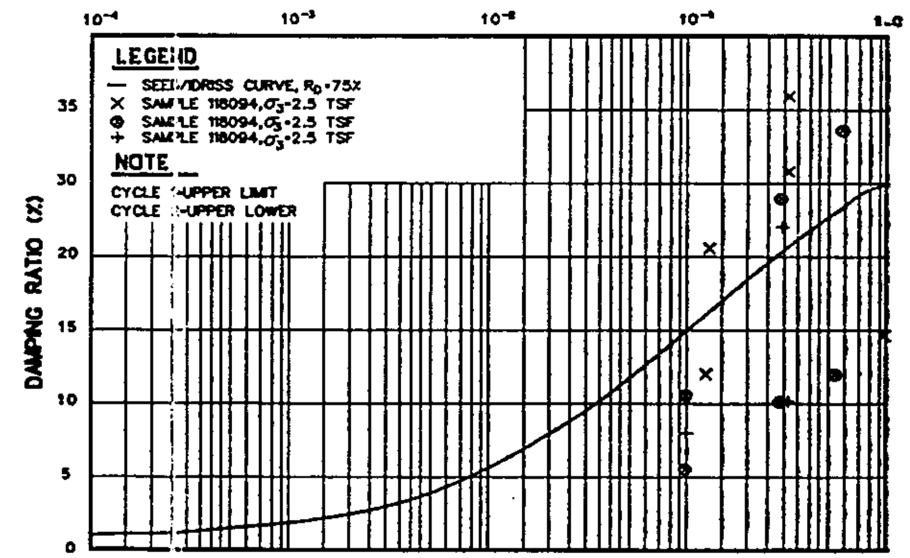


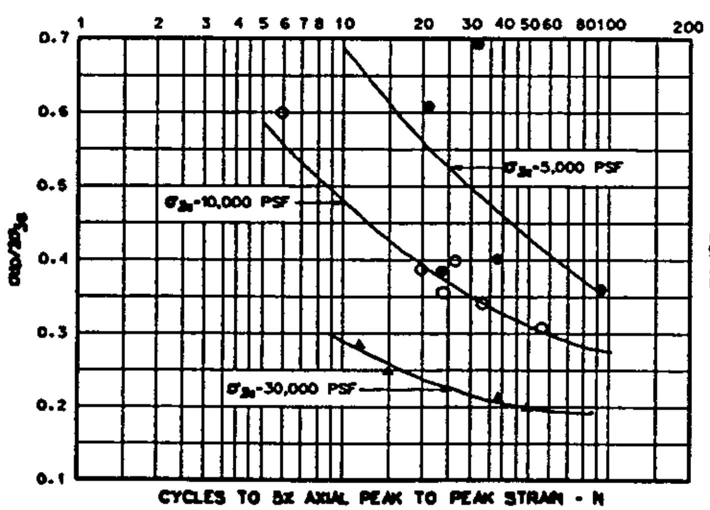
SEED/IDRISS, EERC 70-10, 1970



GRADATION CURVE







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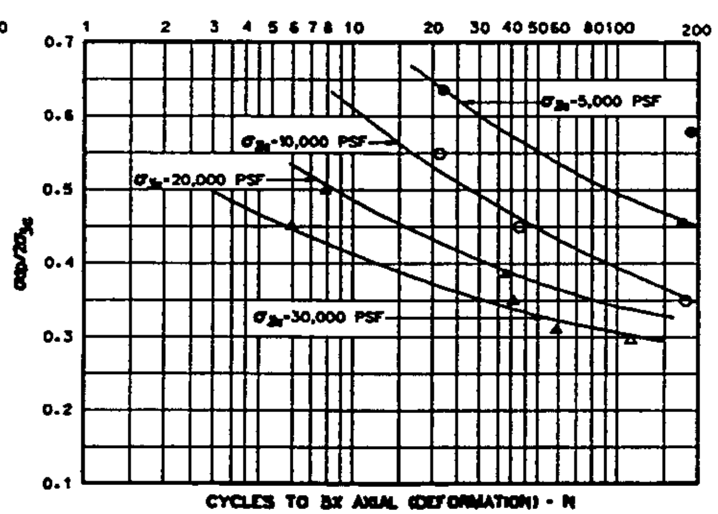
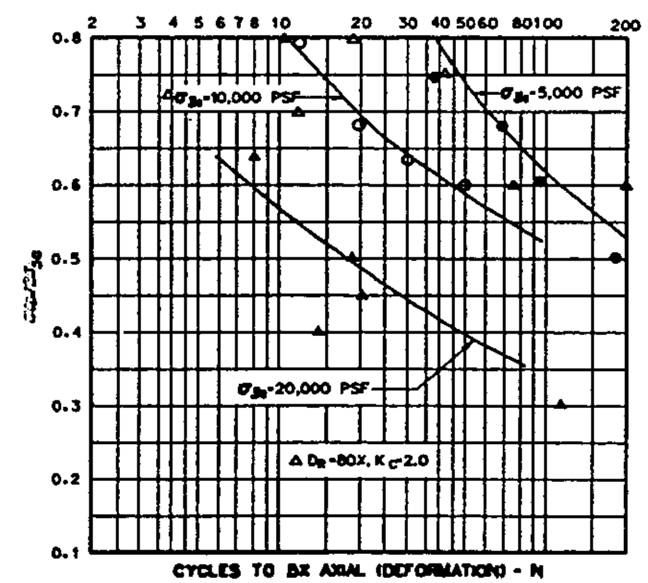


$K_c = 1.5$



$K_c = 1.5$

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SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: D.S.P.
DRAWN BY: D.S.P.
CHECKED BY: R.R.

SANTA ANA RIVER MAINSTEM, CALIFORNIA
WATER CONSERVATION STUDY

SEVEN OAKS DAM
EMBANKMENT AND SPILLWAY
ALLUVIAL MATERIAL
DYNAMIC TESTS RESULTS

SUBMITTED BY: | DATE APPROVED: | SPEC. NO. DACW09- | SHEET
DISTRICT FILE NO.

RESONANT COLUMN

RELATIVE DENSITY	DRY UNIT WEIGHT (PCF)	SPECIMEN SIZE (IN.)	MAX. PARTICLE SIZE	EFFECTIVE CONFINING PRESSURE (TSF)	CONSOL. RATIO Kc	NUMBER OF TESTS
80%	119*	6	1	0.5 2.5 5.0	1 1 1	1 1 1
100%	124*	6	1	0.5 2.5 5.0	1 1 1	1 1 1
					TOTAL:	6

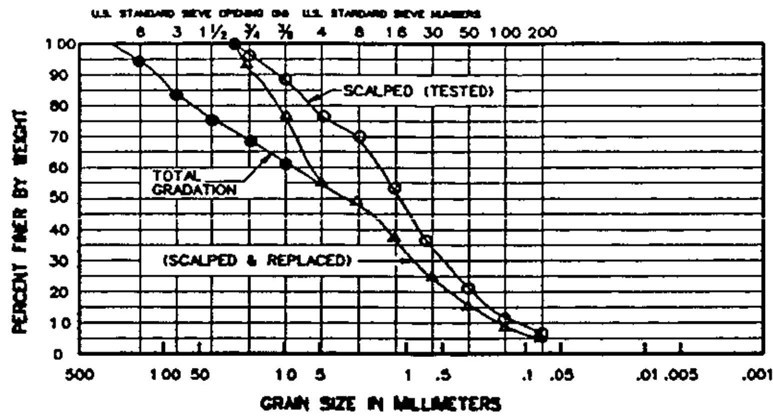
*SPECIMEN TARGET DENSITY

STRAIN CONTROLLED CYCLIC TRIAXIAL TESTS

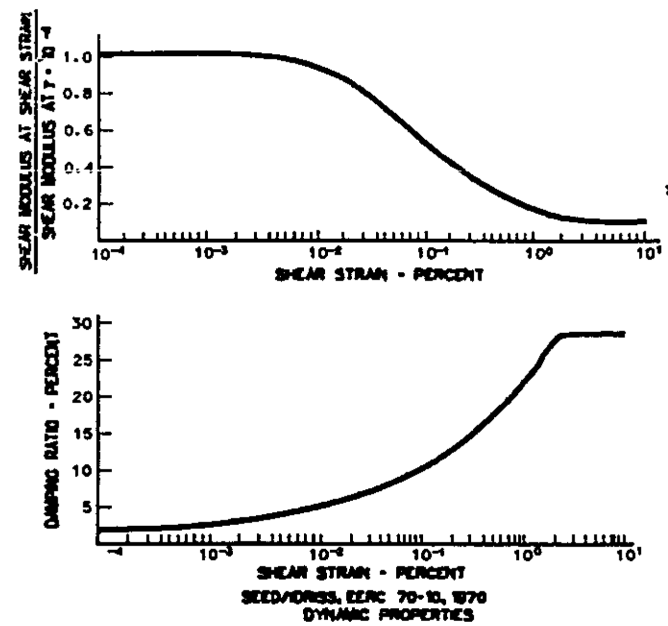
RELATIVE DENSITY	DRY UNIT WEIGHT	SPECIMEN SIZE (IN.)	MAX. PARTICLE SIZE	EFFECTIVE CONFINING PRESSURE (TSF)	CONSOL. RATIO Kc	NUMBER OF TESTS
80%	119*	6	1	2.5 5.0	1 1	1 1
					TOTAL:	2

STRESS CONTROLLED CYCLIC TRIAXIAL TESTS

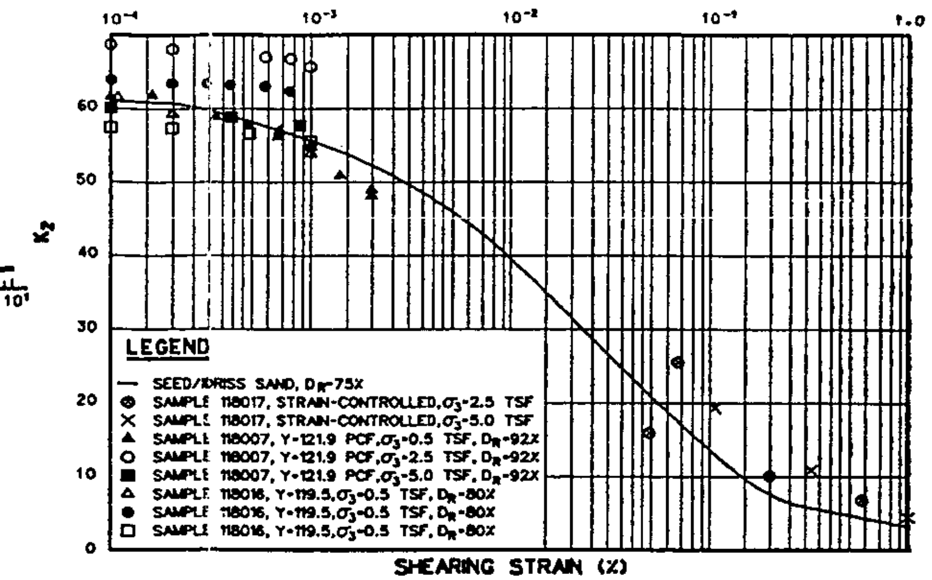
RELATIVE DENSITY	DRY UNIT WEIGHT	SPECIMEN SIZE (IN.)	MAX. PARTICLE SIZE	EFFECTIVE CONFINING PRESSURE (TSF)	CONSOL. RATIO Kc	NUMBER OF TESTS
80%	119*	6	1	2.5 5.0 15.0	1 1 1	3 3 3
				2.5 5.0 10.0	1.5 1.5 1.5	3 3 3
100%	124*	6	1	2.5 5.0 10.0	1.5 1.5 1.5	3 3 3
					TOTAL:	27

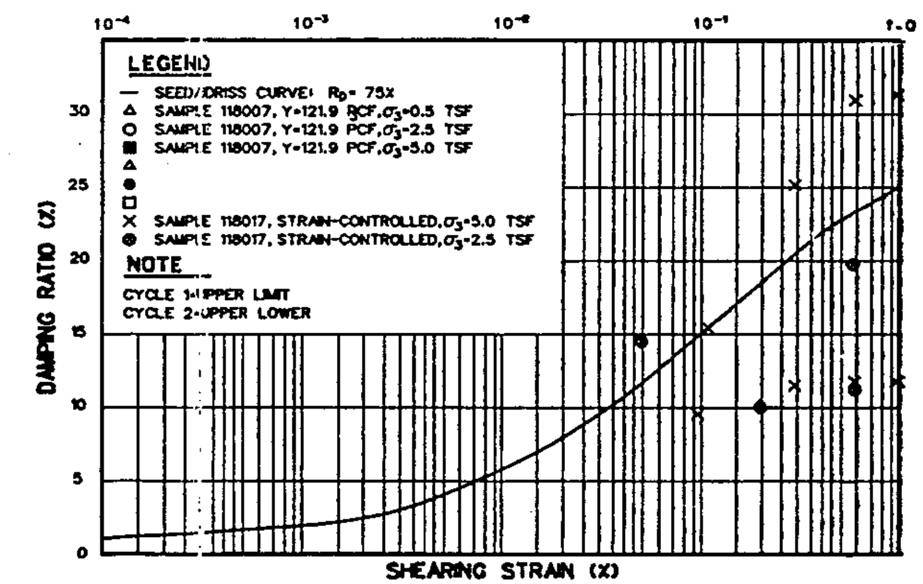


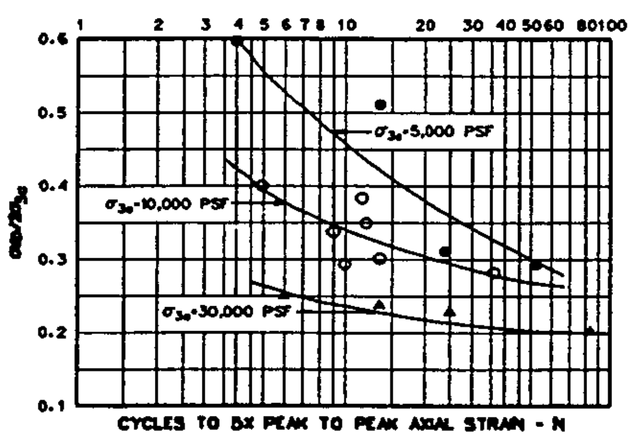
GRADATION CURVE



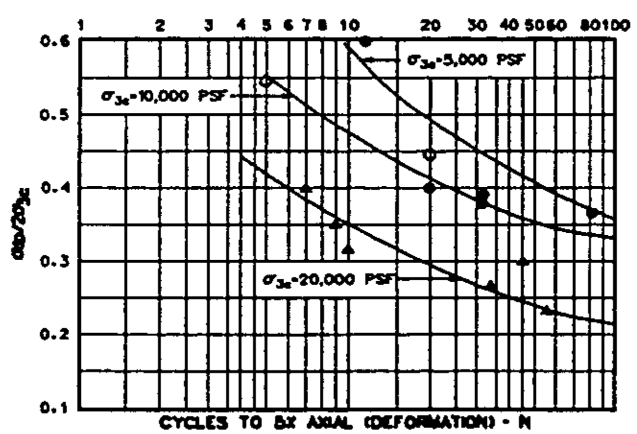
SEED/IDRISS, EERC 70-10, 1970
DYNAMIC PROPERTIES



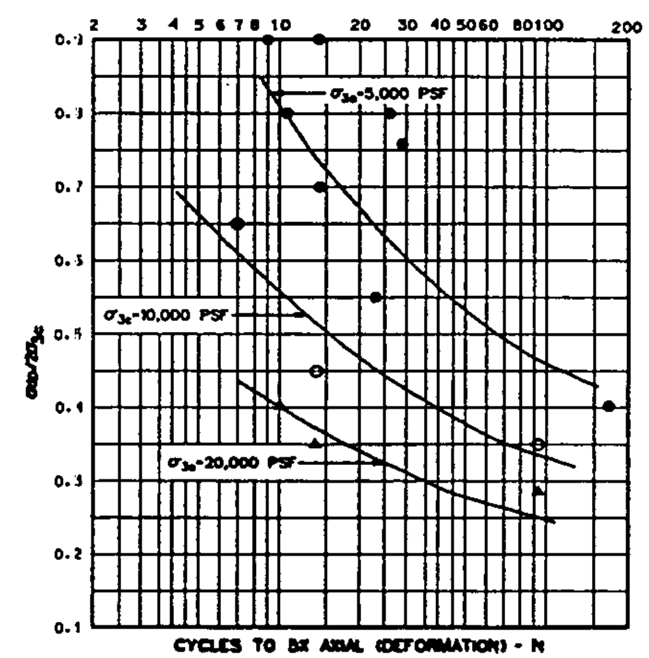




R_D = 80%
K_c = 1.0



R_D = 80%
K_c = 1.5



R_D = 100%
K_c = 1.5

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REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: D.S.P.
DRAWN BY: D.S.P.
CHECKED BY: R.R.

SANTA ANA RIVER MAINSTEM, CALIFORNIA
WATER CONSERVATION STUDY

SEVEN OAKS DAM
EMBANKMENT AND SPILLWAY

ROCK TRANSITION
DYNAMIC TESTS RESULTS

SUBMITTED BY: DATE APPROVED: SPEC. NO. DACW09- DISTRICT FILE NO. SHEET

PLATE S-17

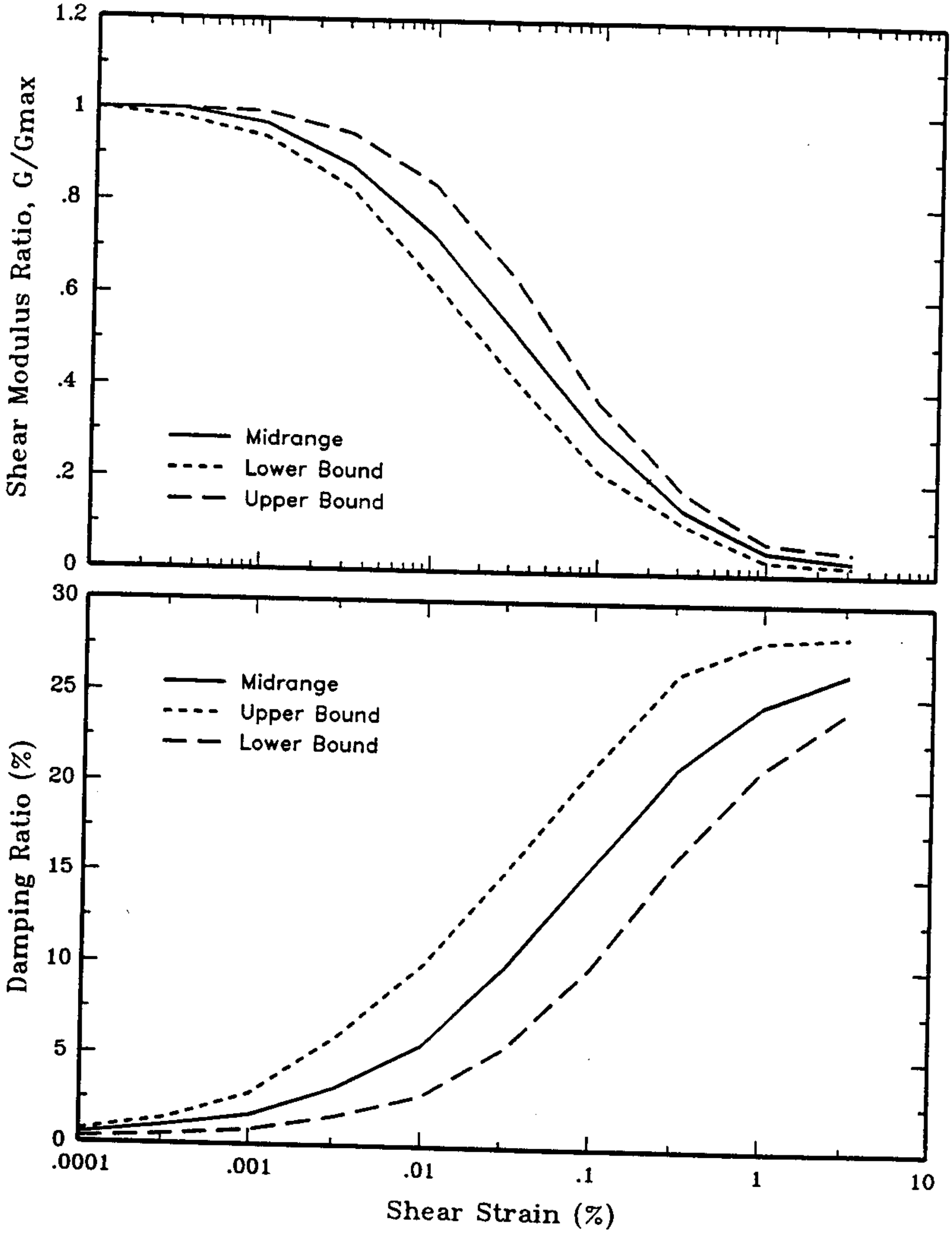
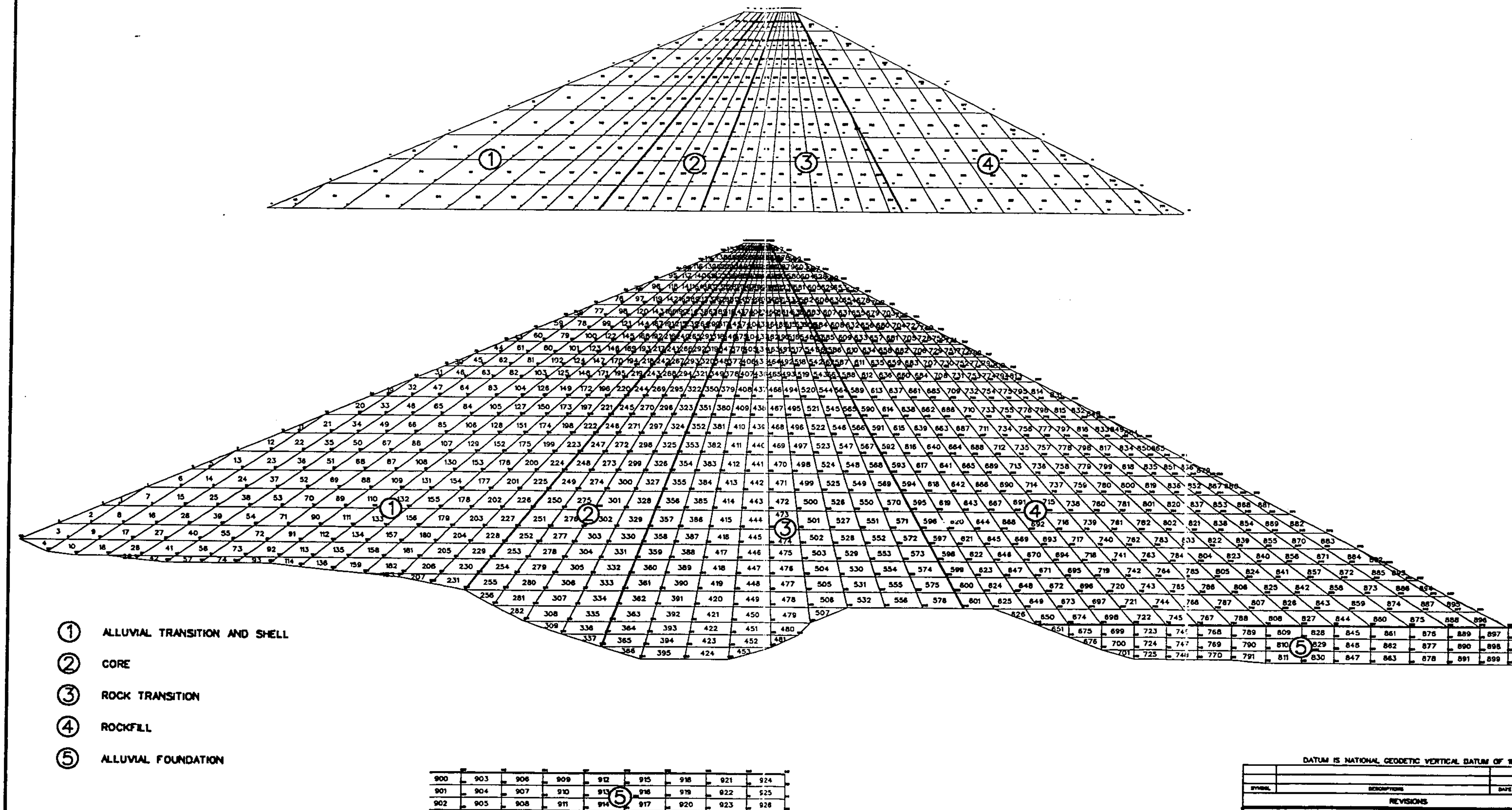


Plate S-18: **Variation of Shear Modulus and Damping Ratio for Sand (from Seed and Idriss, 1970)**



DATUM IS NATIONAL GEODETIC VERTICAL DATUM OF 1929

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

SANTA ANA RIVER MAINSTEM, CALIFORNIA
WATER CONSERVATION STUDY

SEVEN OAKS DAM
EMBANKMENT AND SPILLWAY
FINITE ELEMENT ANALYSIS
QUAD 4 MESH

DESIGNED BY: D.S.P.
DRAWN BY: D.S.P.
CHECKED BY: R.R.
SUBMITTED BY:
DATE APPROVED:
SPEC. NO. DACW09-
DISTRICT FILE NO.
SHEET

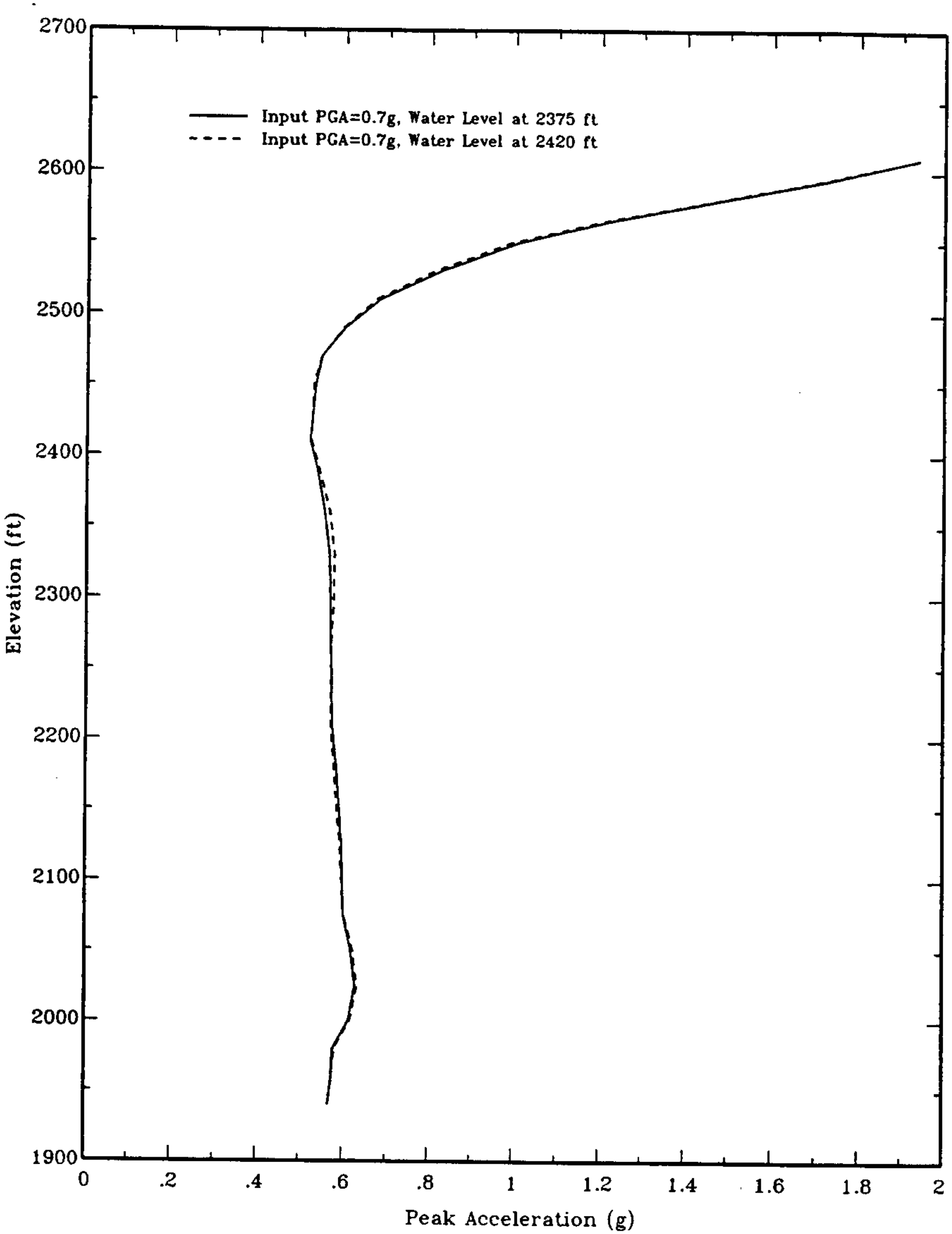


Plate S-20 Variation of Peak Horizontal Accelelation with Depth Below Crest - Seven Oaks Dam

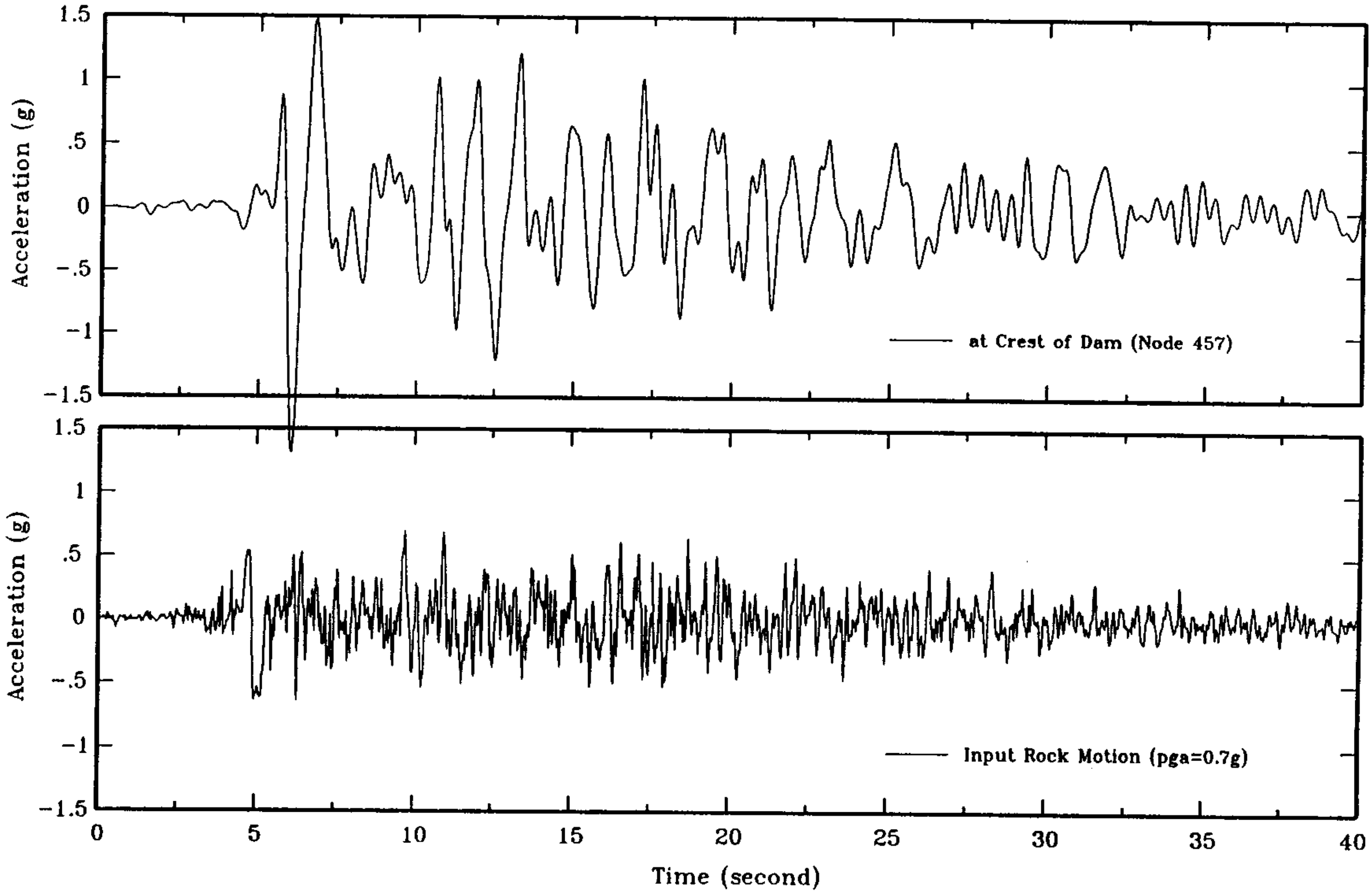


Plate S-21 Time Histories of Horizontal Acceleration, Maximum Credible Earthquake and Water Level at 2375 feet, Seven Oaks Dam

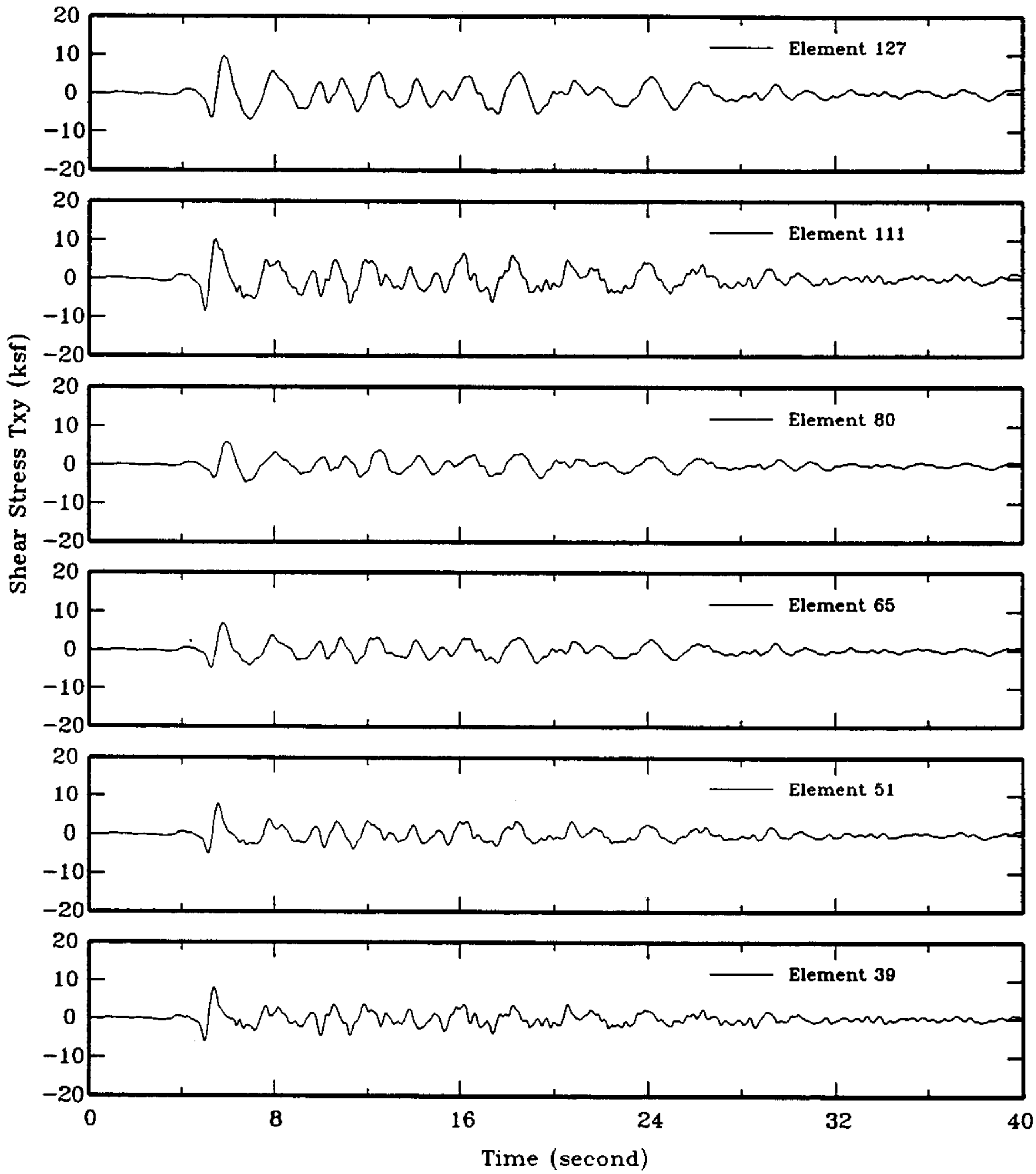


Plate S–22a Time Histories of Horizontal Shear Stress,
Water Level at 2375 ft, Seven Oaks Dam

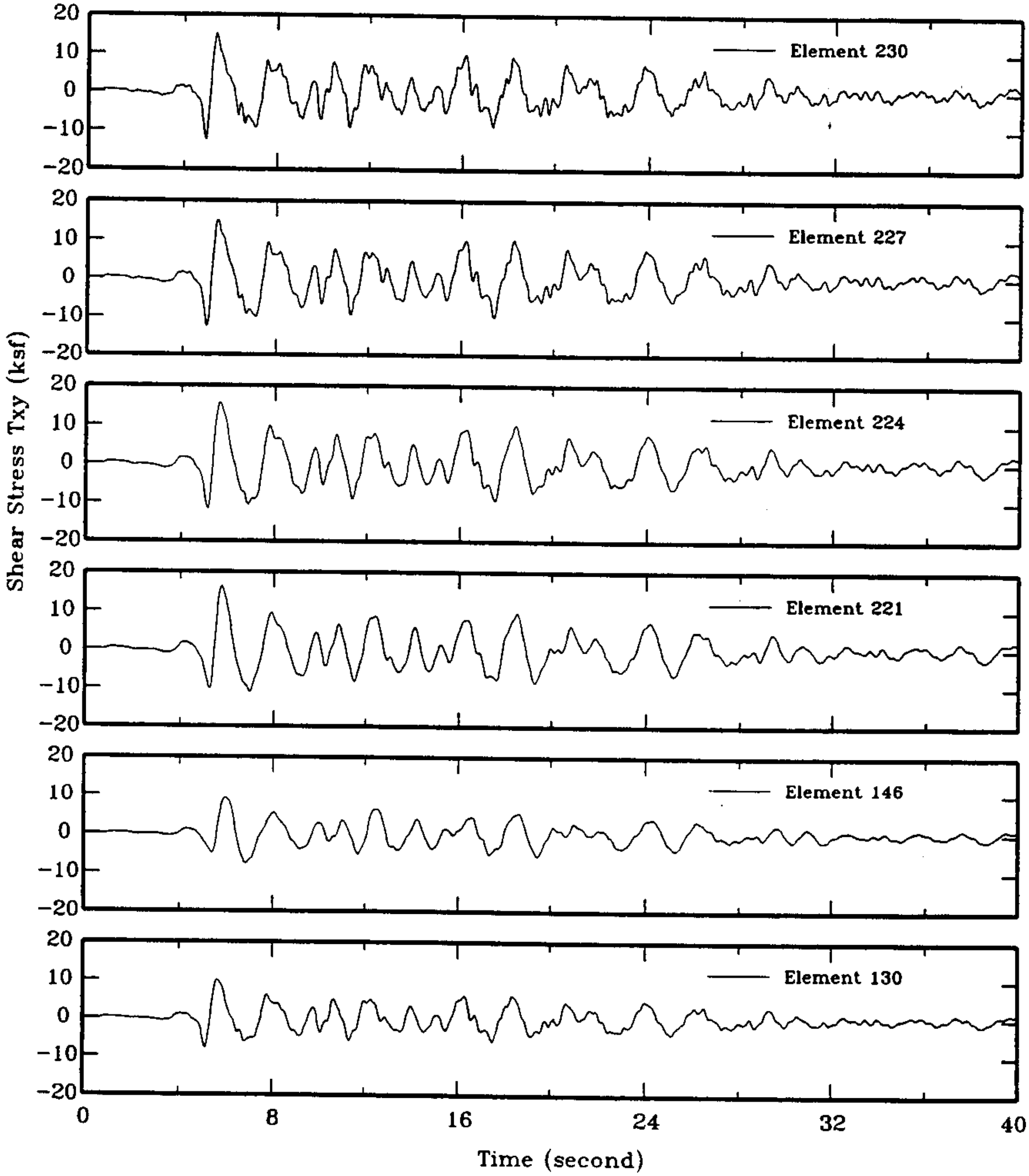


Plate S–22b Time Histories of Horizontal Shear Stress,
Water Level at 2375 ft, Seven Oaks Dam

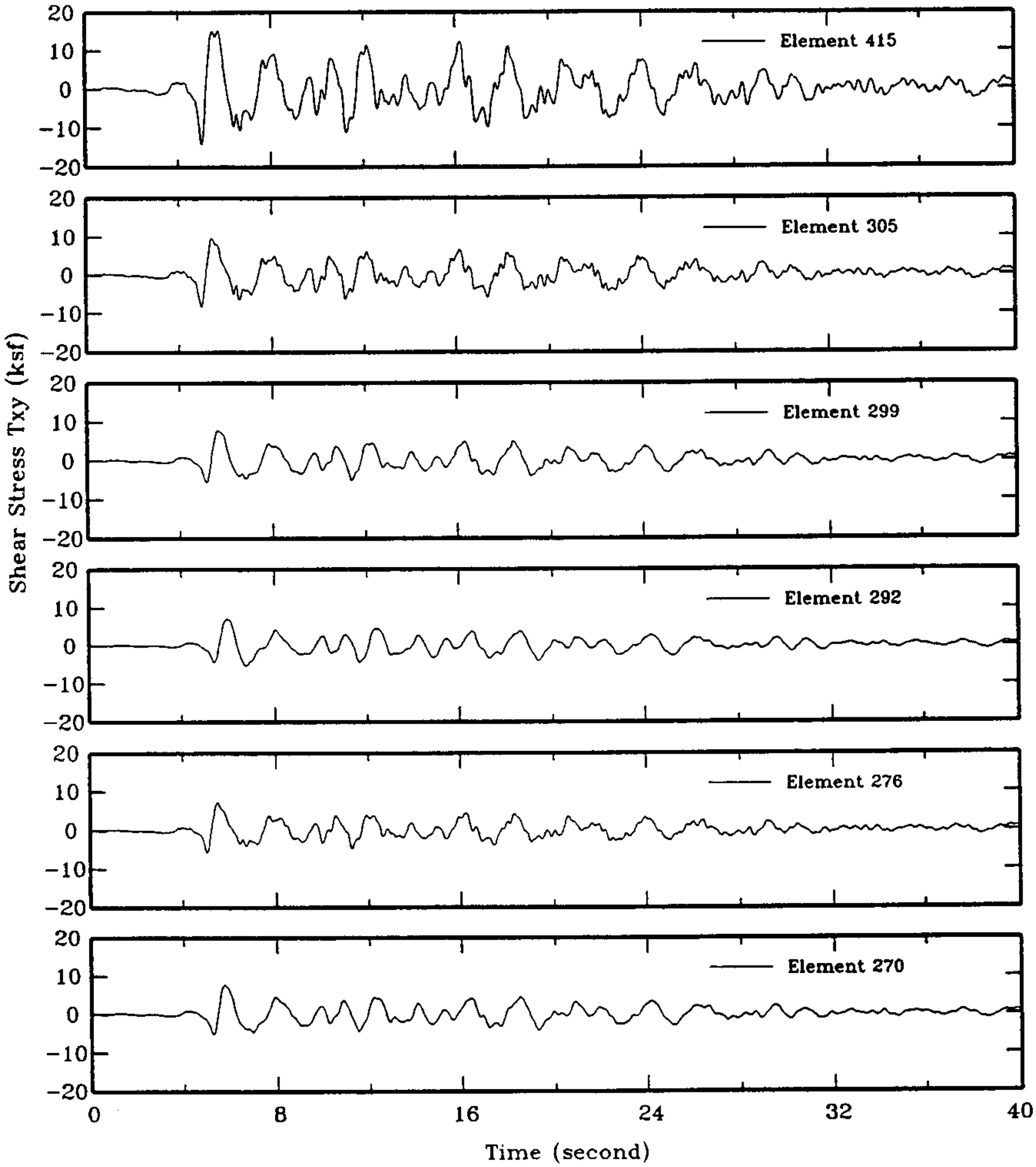


Plate S-22c Time Histories of Horizontal Shear Stress,
Water Level at 2375 ft, Seven Oaks Dam

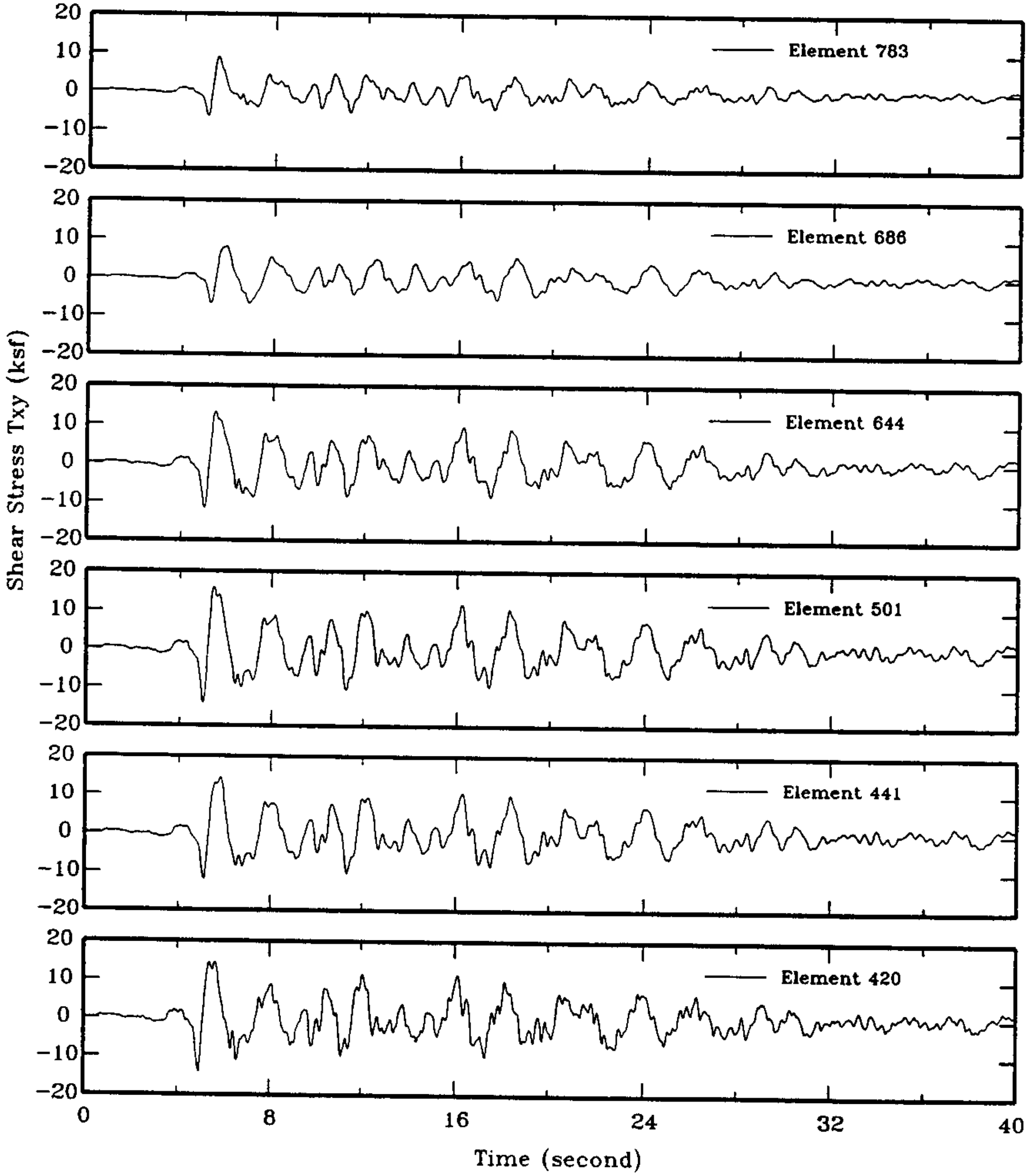


Plate S−22d Time Histories of Horizontal Shear Stress,
Water Level at 2375 ft, Seven Oaks Dam

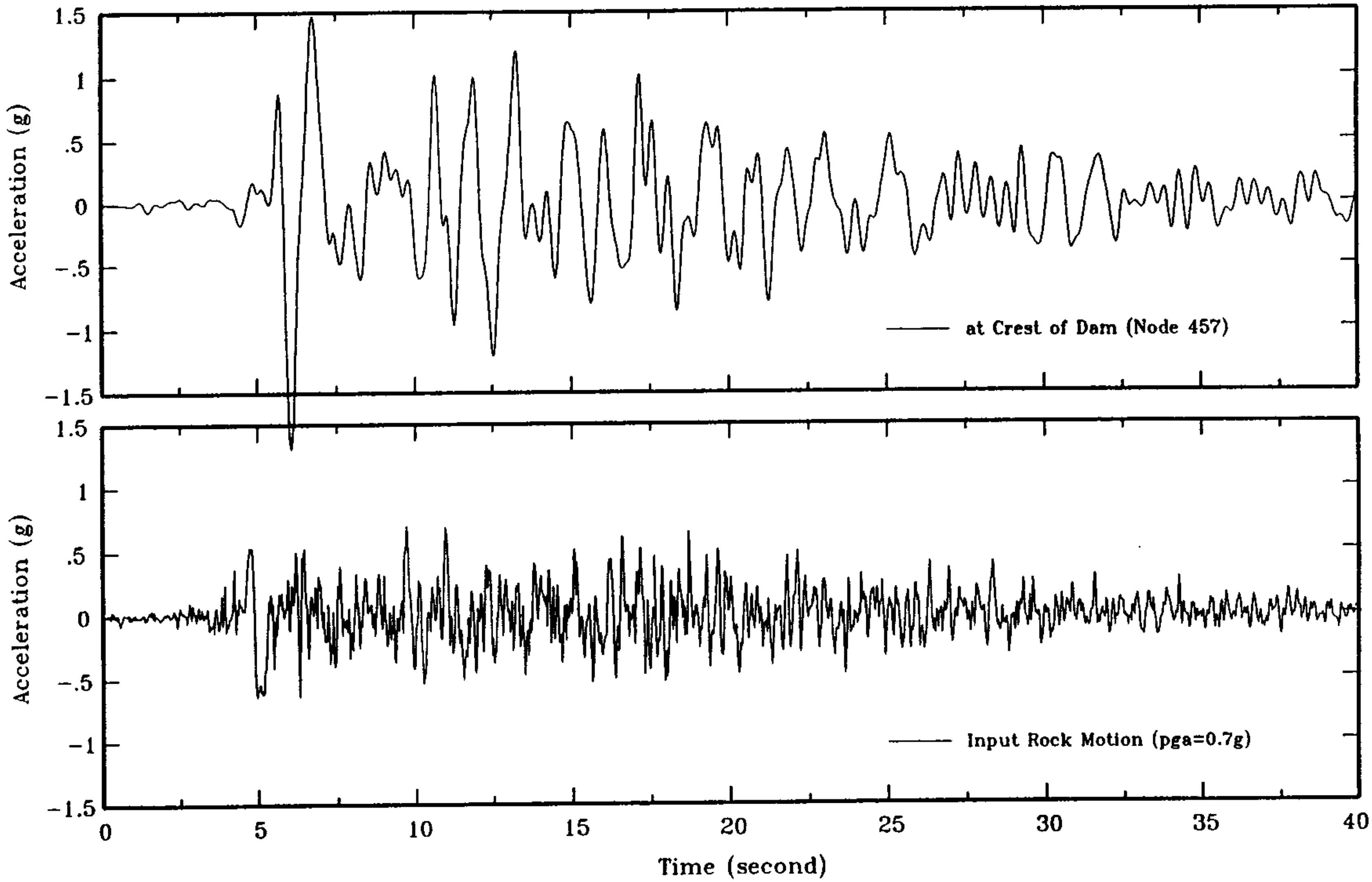


Plate S-23 Time Histories of Horizontal Acceleration, Maximum Credible Earthquake and Water Level at 2420 feet, Seven Oaks Dam

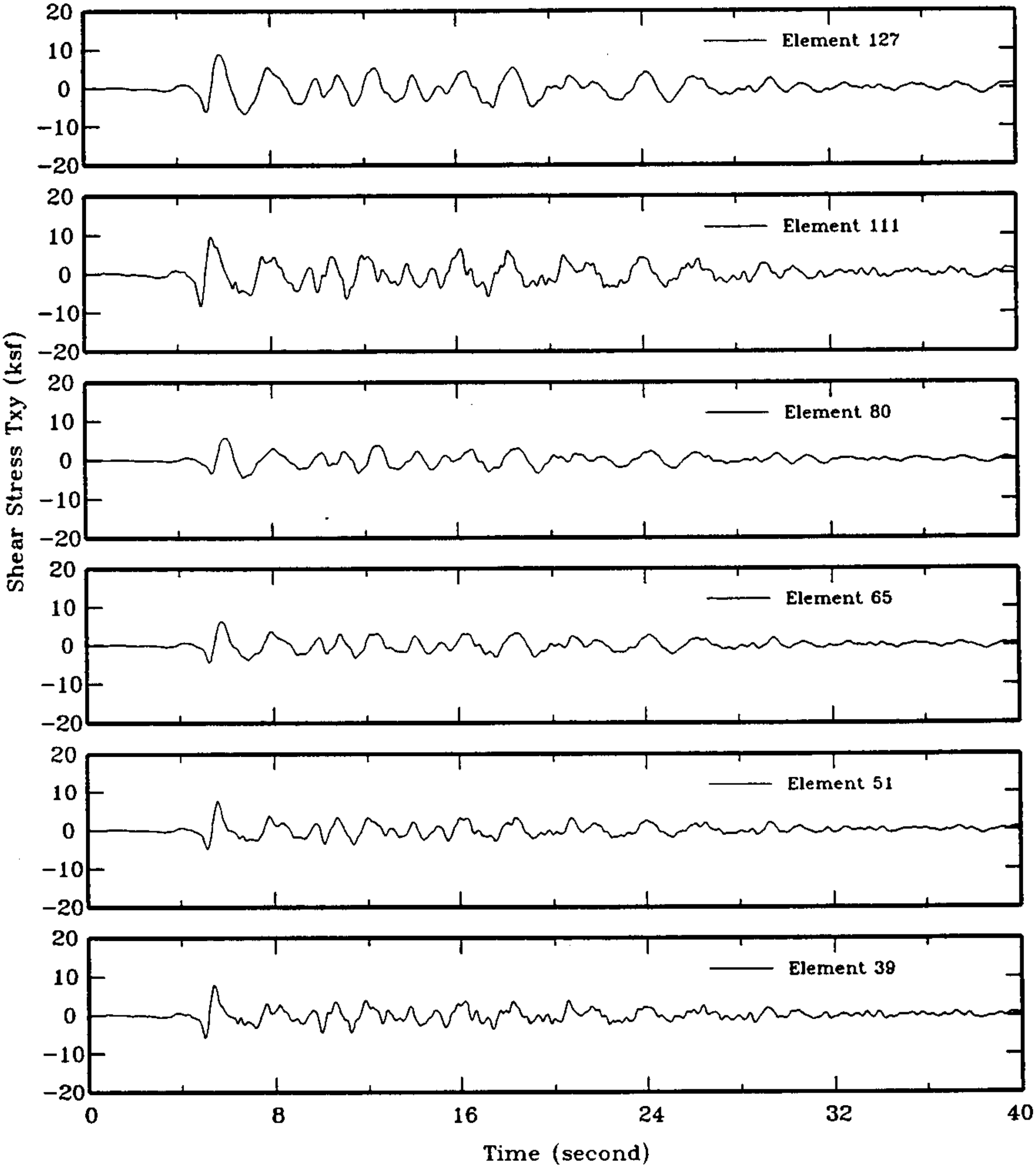


Plate S-24a Time Histories of Horizontal Shear Stress, Water Level at 2420 ft, Seven Oaks Dam

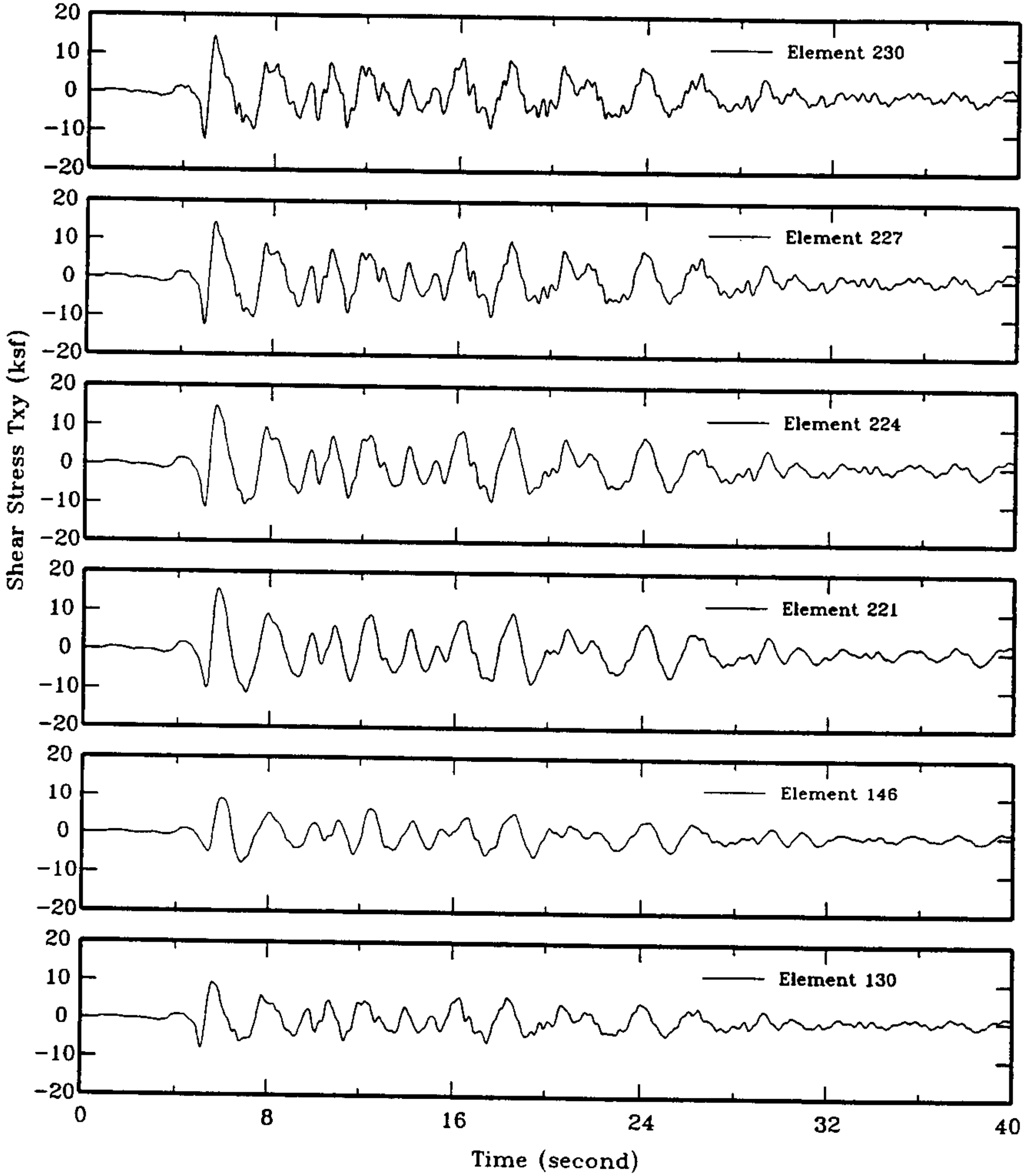


Plate S-24b Time Histories of Horizontal Shear Stress, Water Level at 2420 ft, Seven Oaks Dam

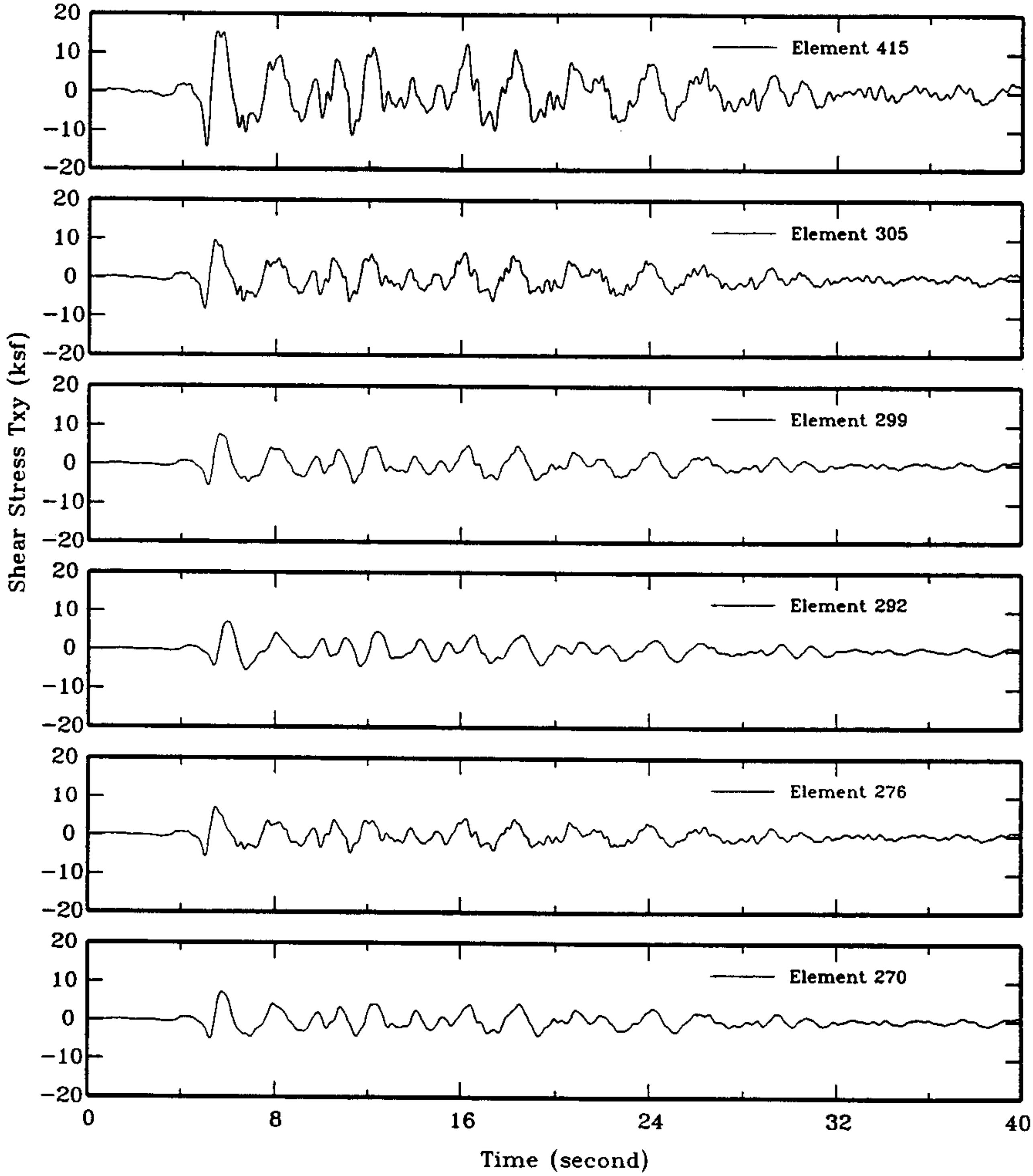


Plate S-24c Time Histories of Horizontal Shear Stress,
Water Level at 2420 ft, Seven Oaks Dam

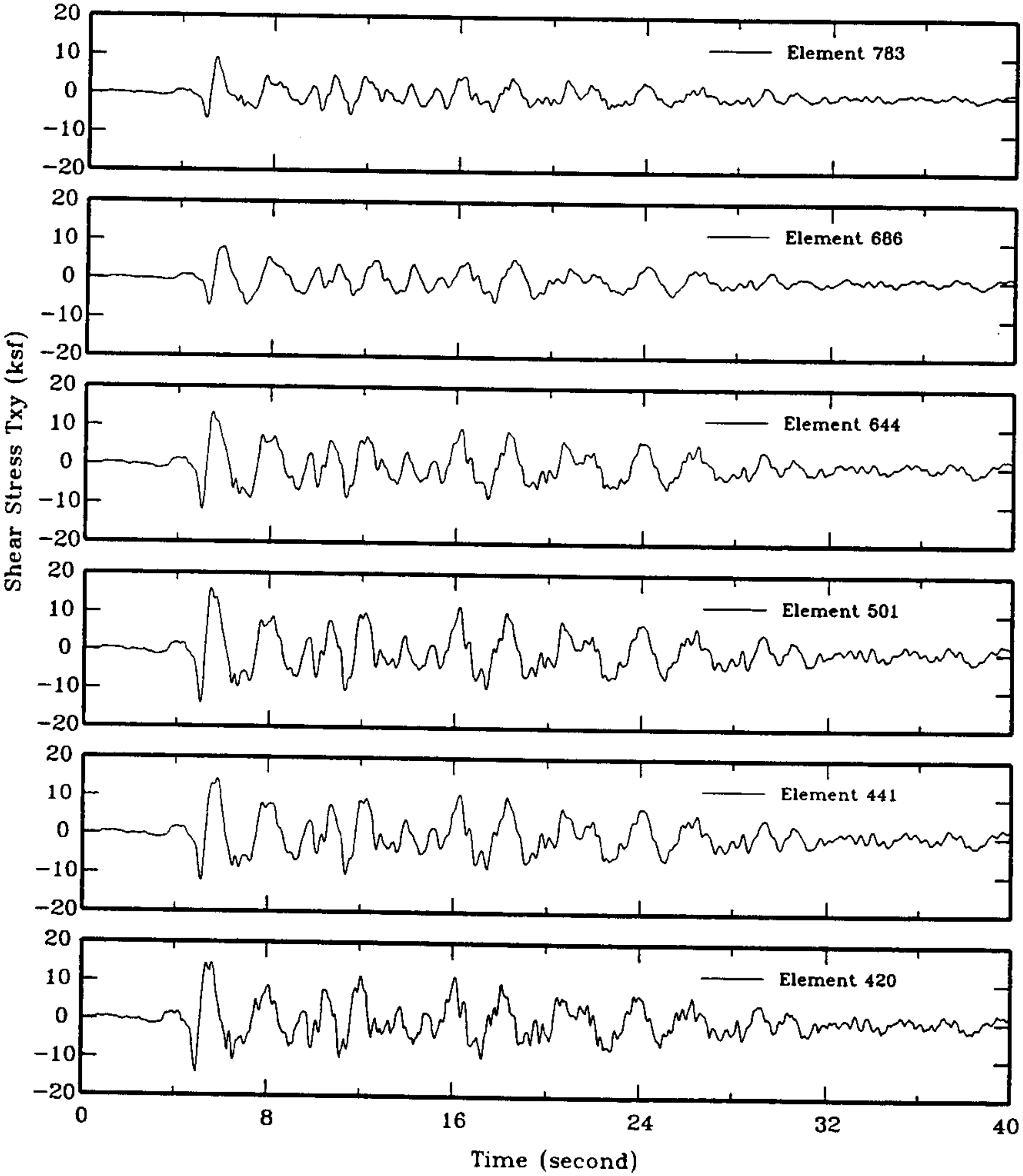
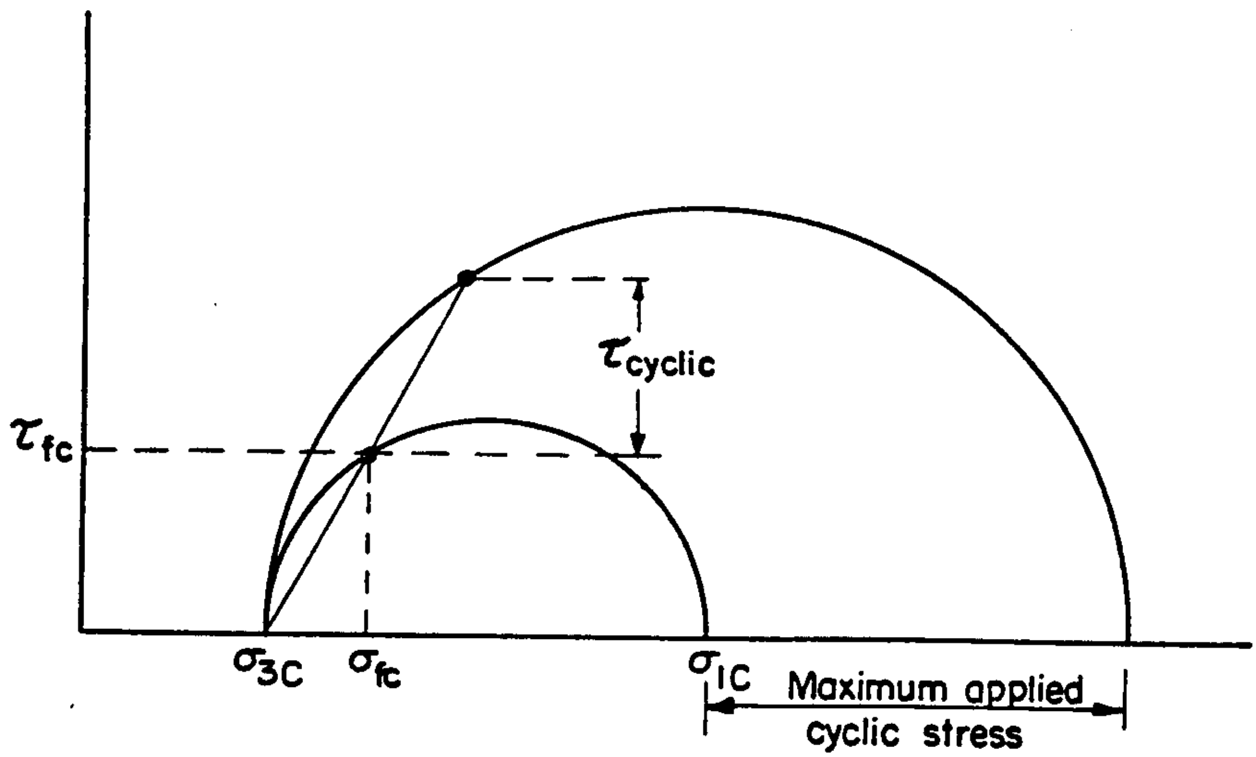


Plate S-24d Time Histories of Horizontal Shear Stress,
Water Level at 2420 ft, Seven Oaks Dam



τ_{fc} = Initial shear stress on potential failure surface

σ_{fc} = Initial normal stress on potential failure surface

a = τ_{fc}/σ_{fc}

τ_{cyclic} = Cyclic shear stress developed on potential failure surface

Plate S-25: **Procedure for Interpreting Cyclic Load Triaxial Test Data to Determine Cyclic Stress on Potential Failure Surface**

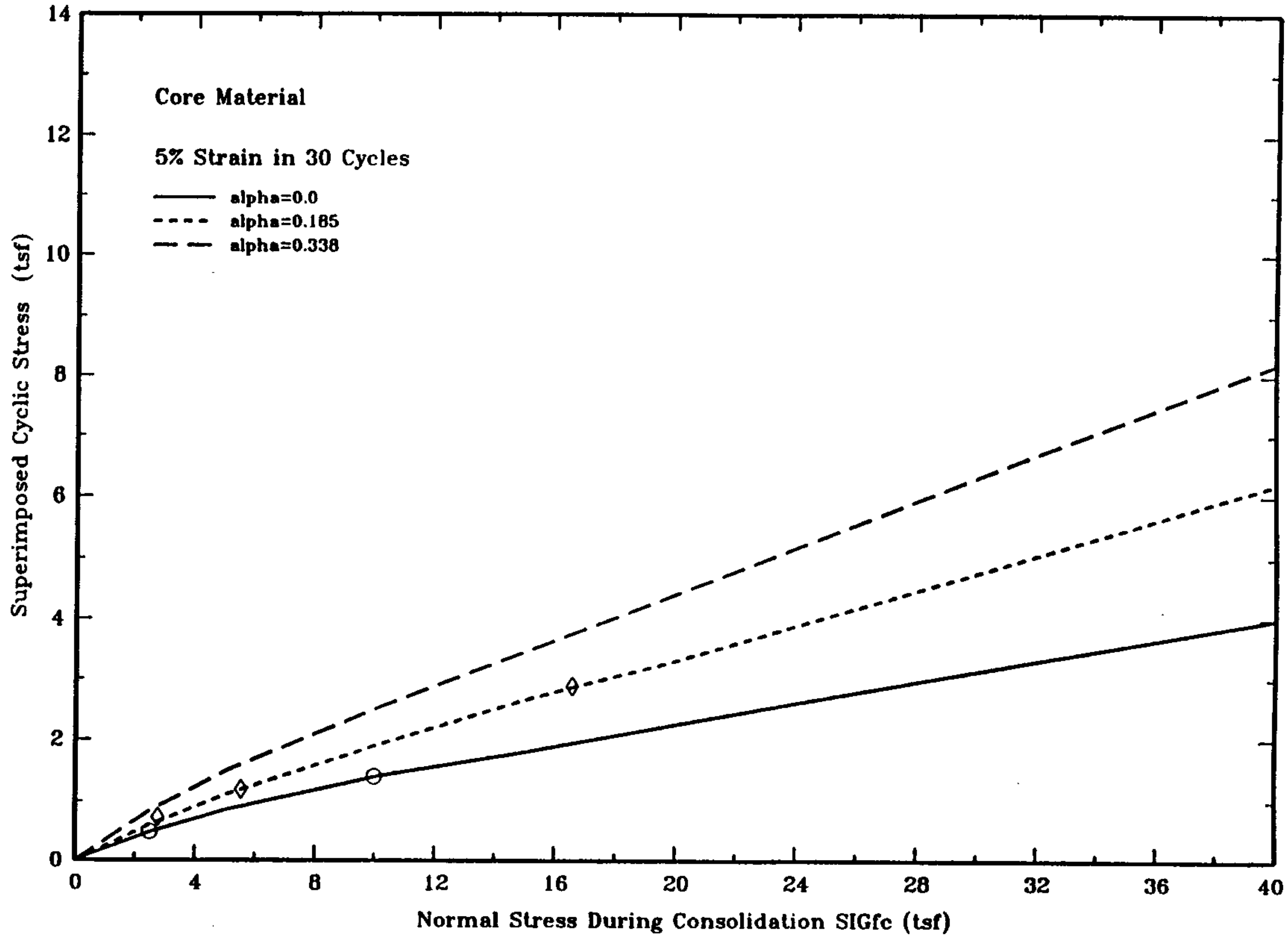


Plate S-26: **Superimposed Cyclic Shear Stress Causing 5% Strain in 30 Cycles, Core Material, Seven Oaks Dam**

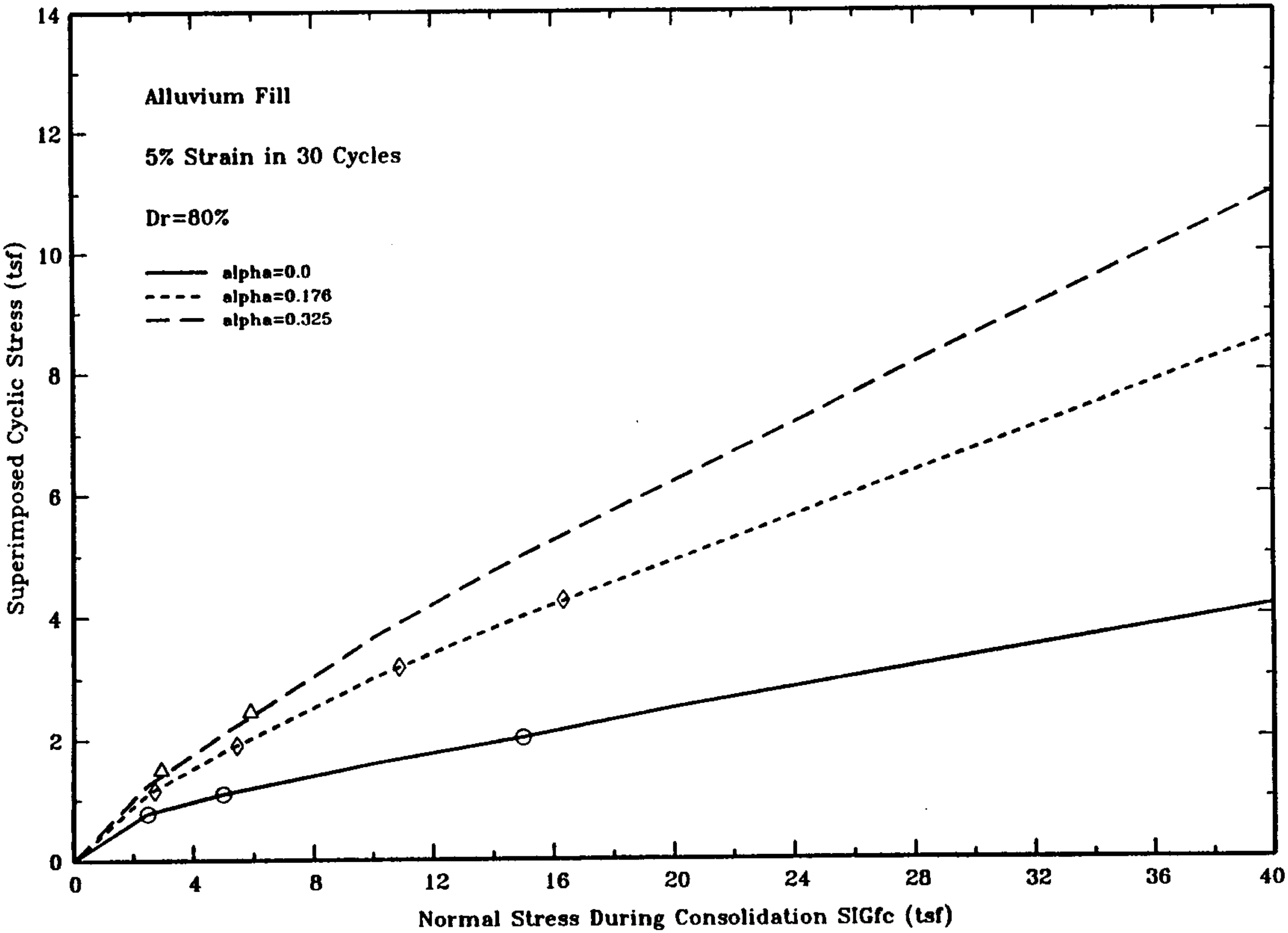


Plate S-27: **Superimposed Cyclic Shear Stress Causing 5% Strain in 30 Cycles, Alluvium Fill (Dr = 80%), Seven Oaks Dam**

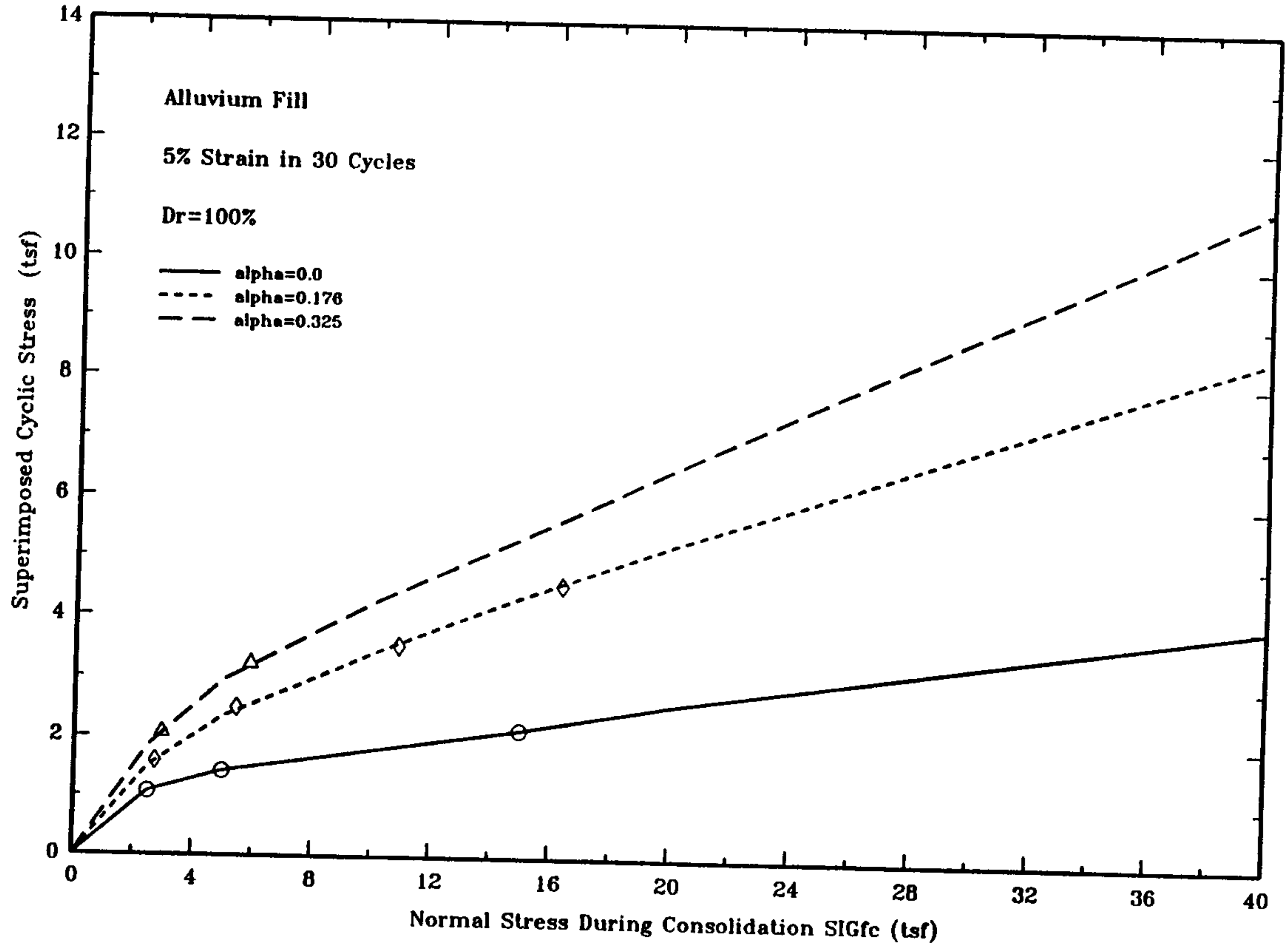


Plate S-28: **Superimposed Cyclic Shear Stress Causing 5% Strain in 30 Cycles, Alluvium Fill (Dr = 100%), Seven Oaks Dam**

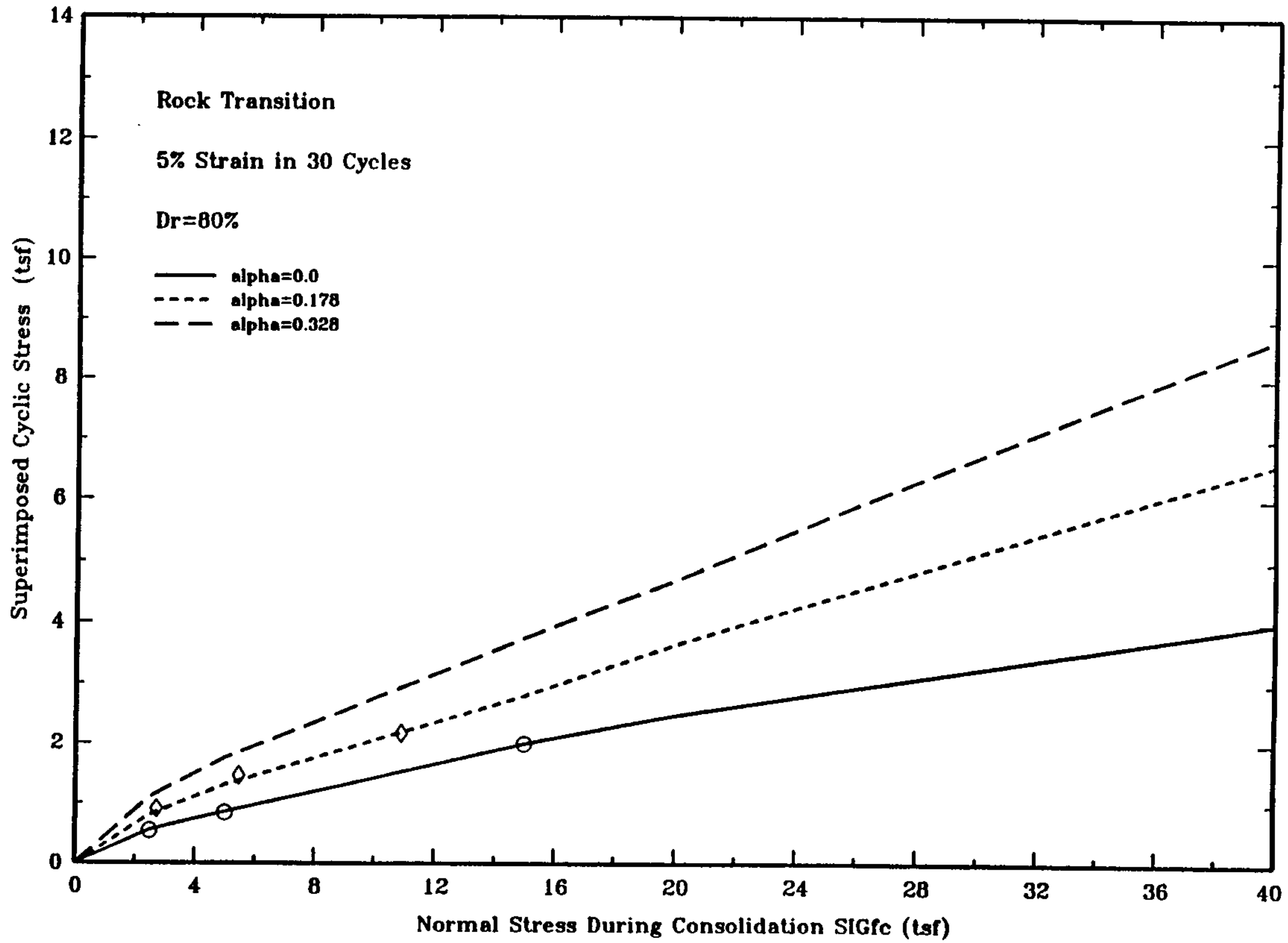


Plate S-29: **Superimposed Cyclic Shear Stress Causing 5% Strain in 30 Cycles, Rock Transition (Dr = 80%), Seven Oaks Dam**

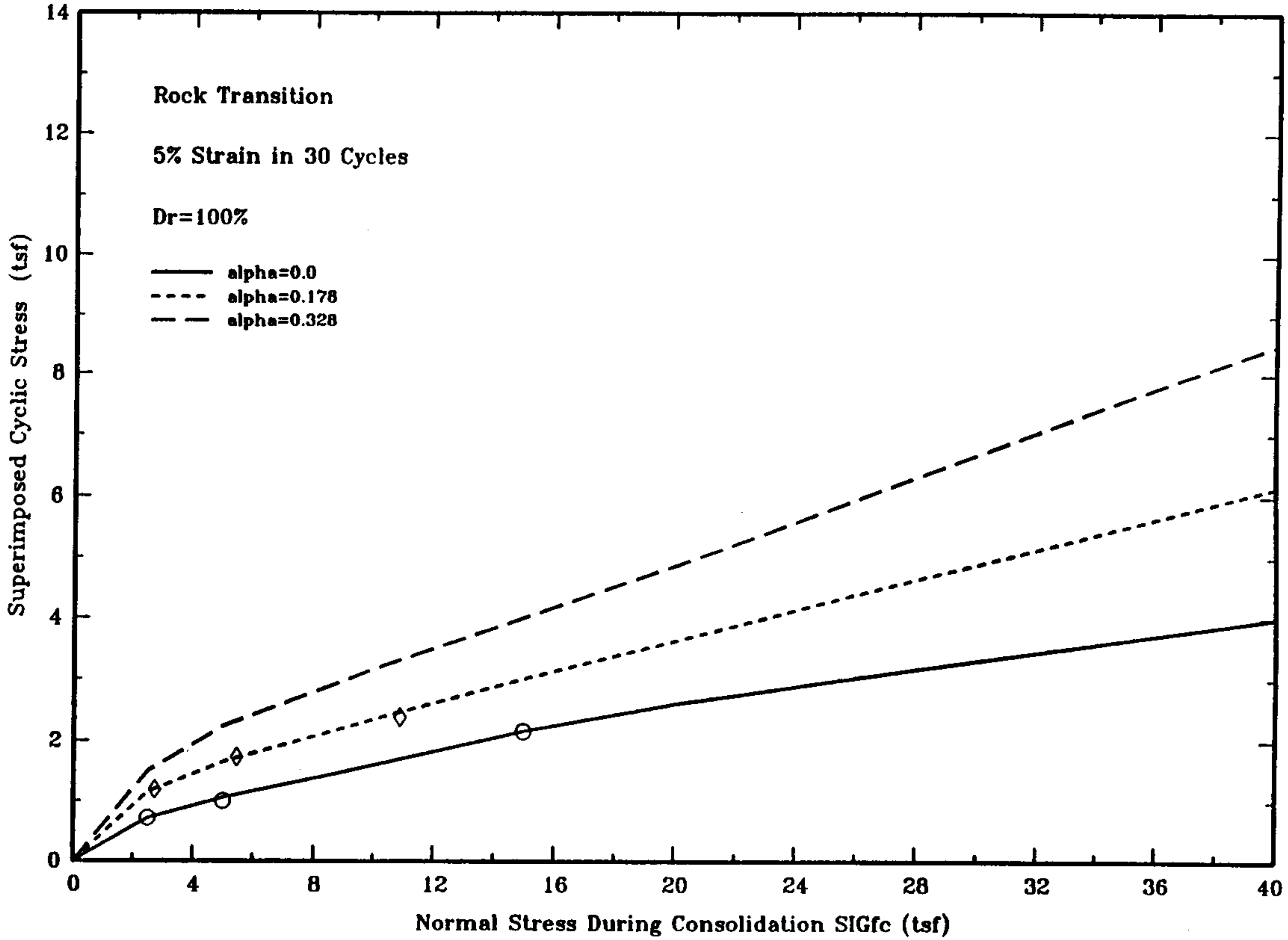
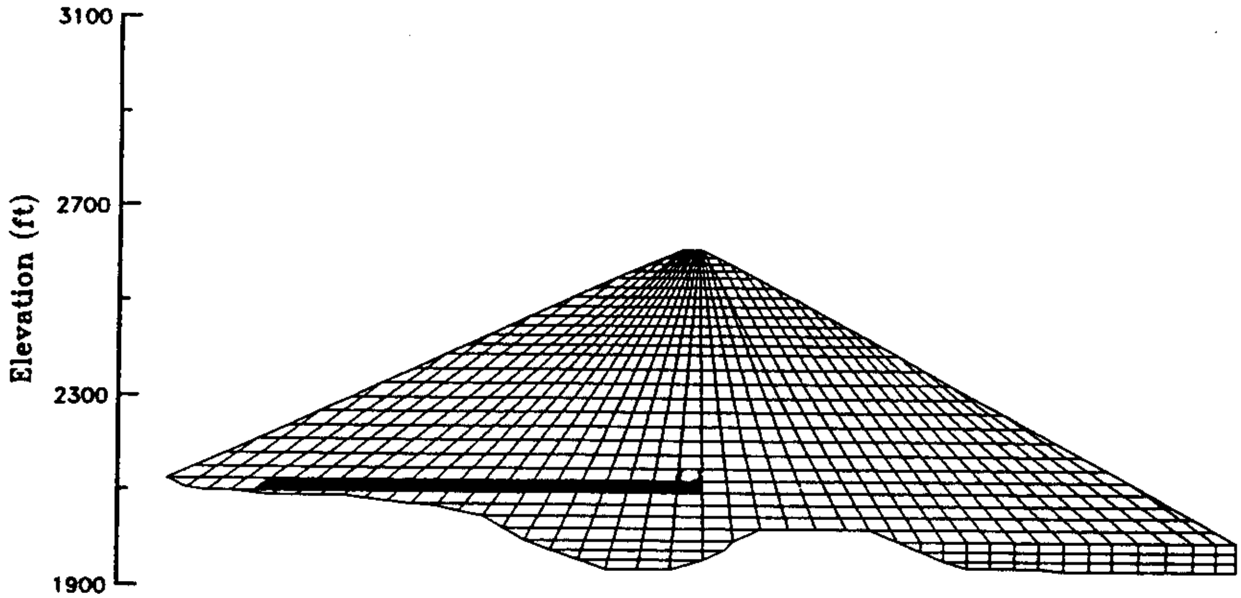


Plate S-30: Superimposed Cyclic Shear Stress Causing 5% Strain in 30 Cycles, Alluvium Fill (Dr = 100%), Seven Oaks Dam



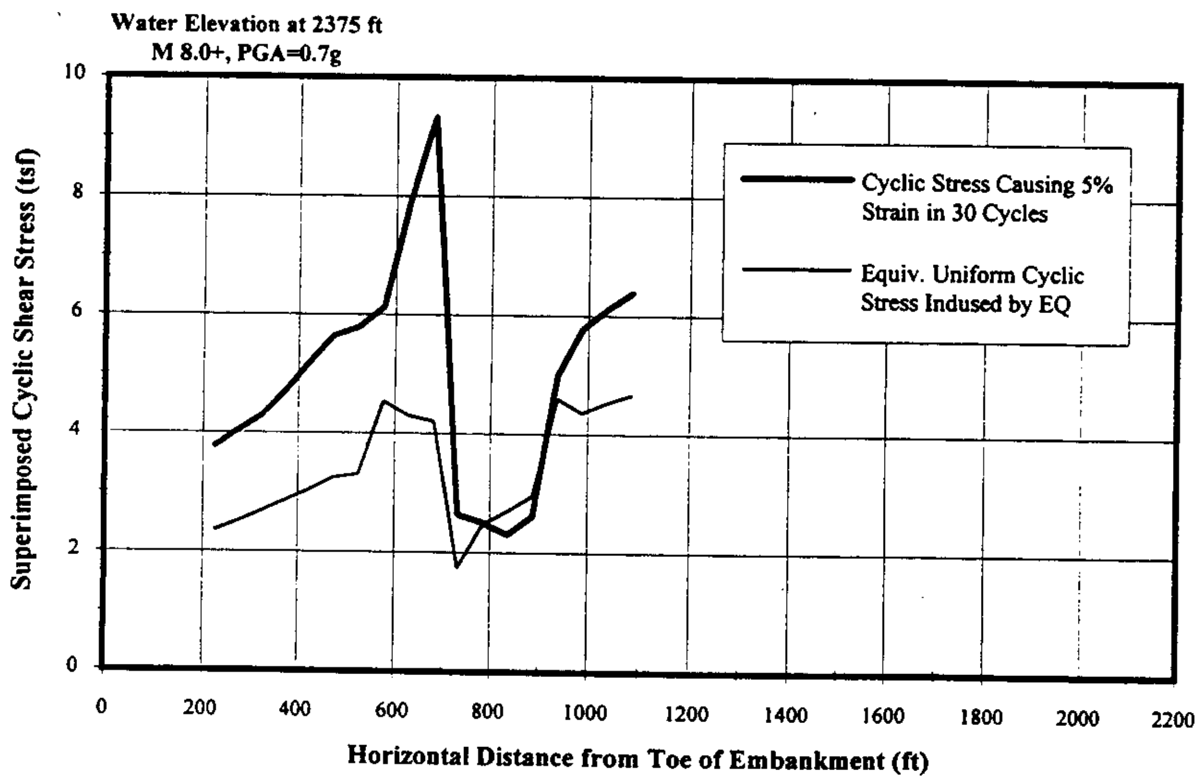
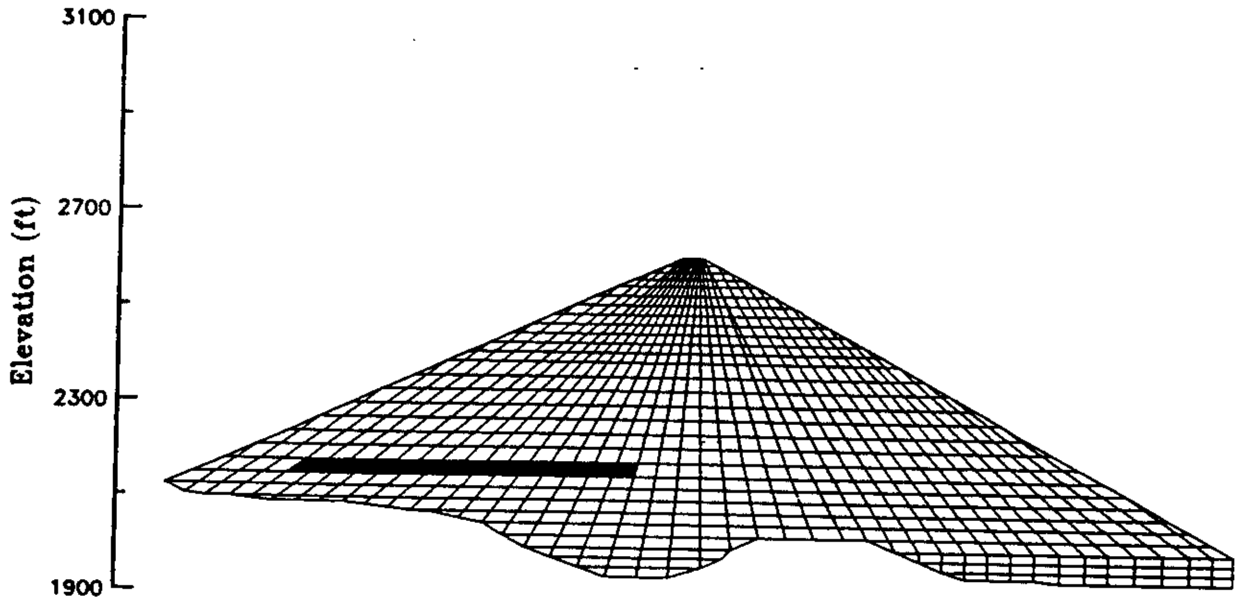


Plate S-31: Evaluation of Strain Potential During Maximum Credible Earthquake at Elevation 2112.5 Feet



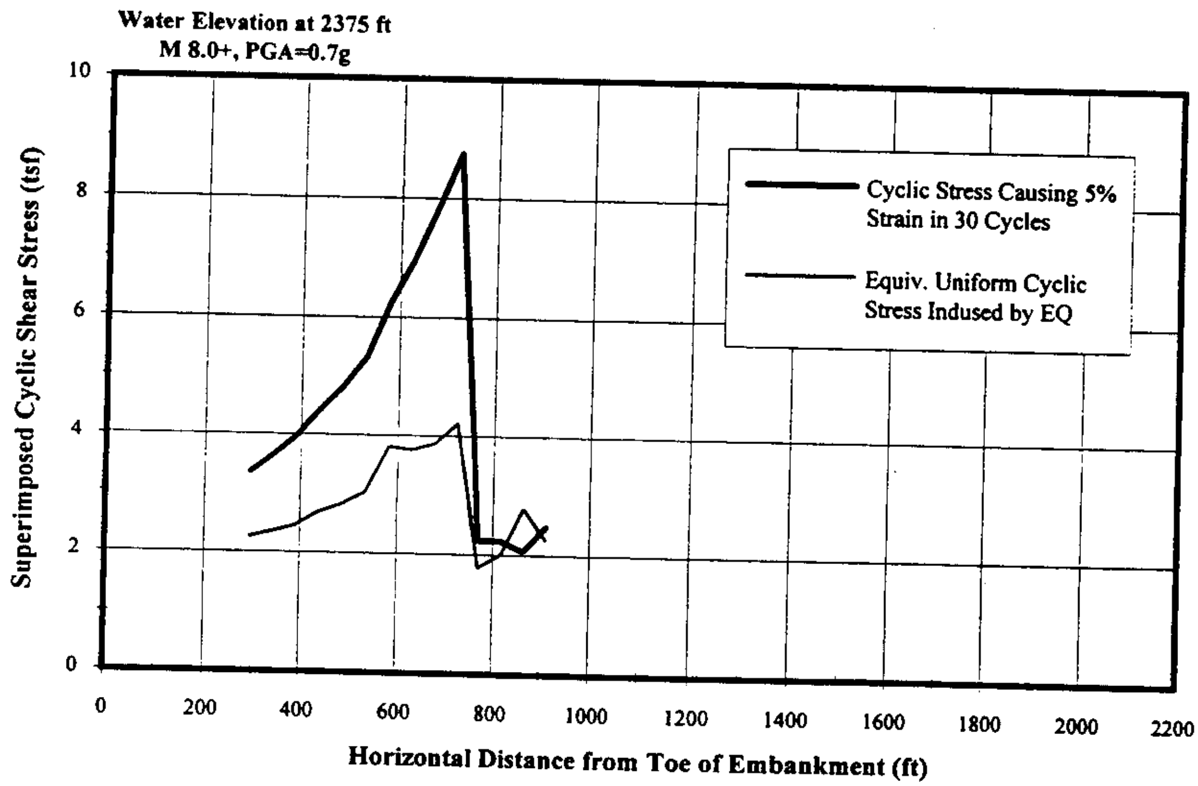
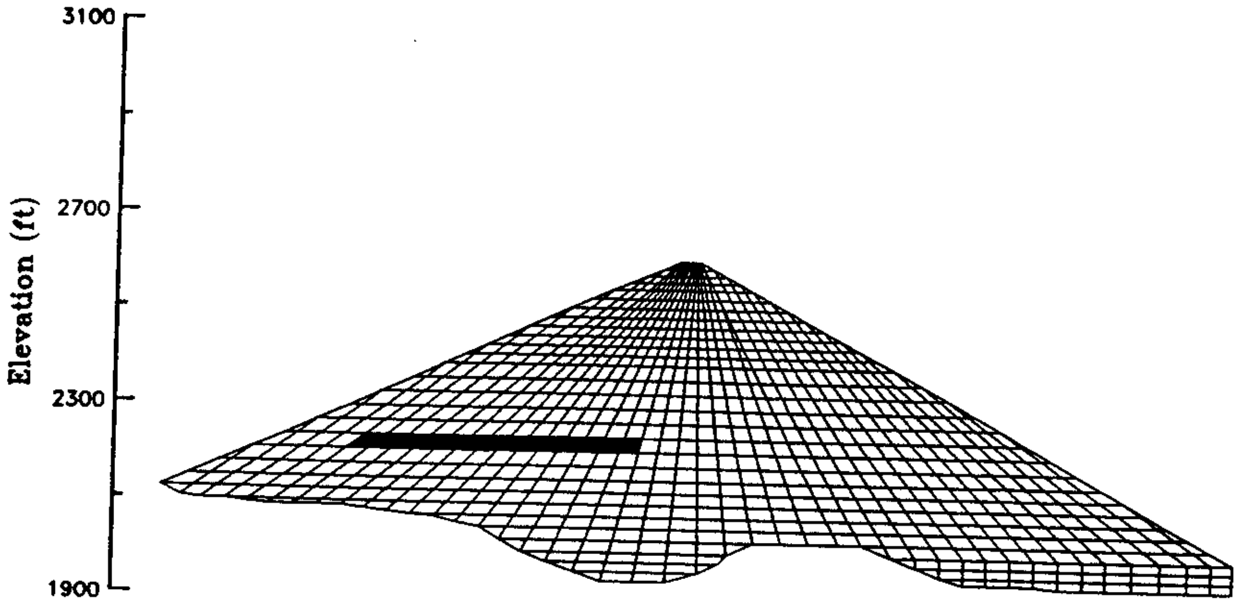


Plate S-32: Evaluation of Strain Potential During Maximum Credible Earthquake at Elevation 2165 Feet



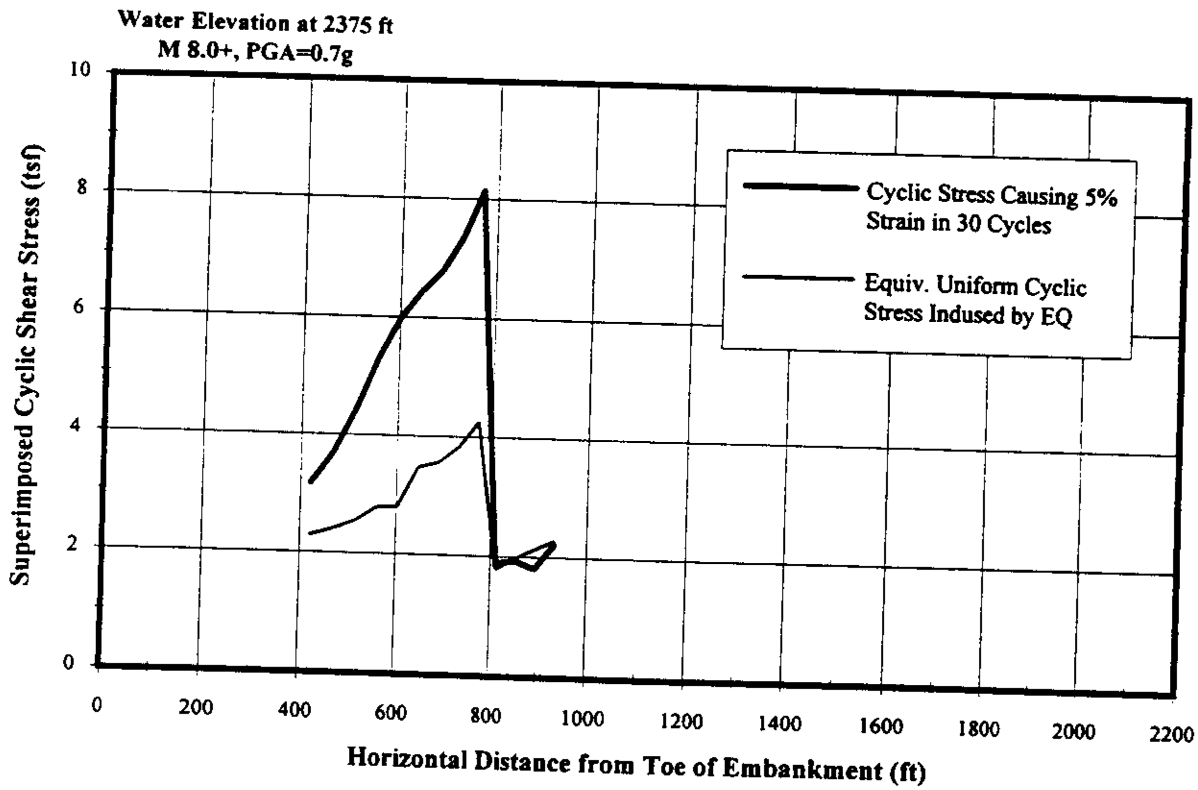
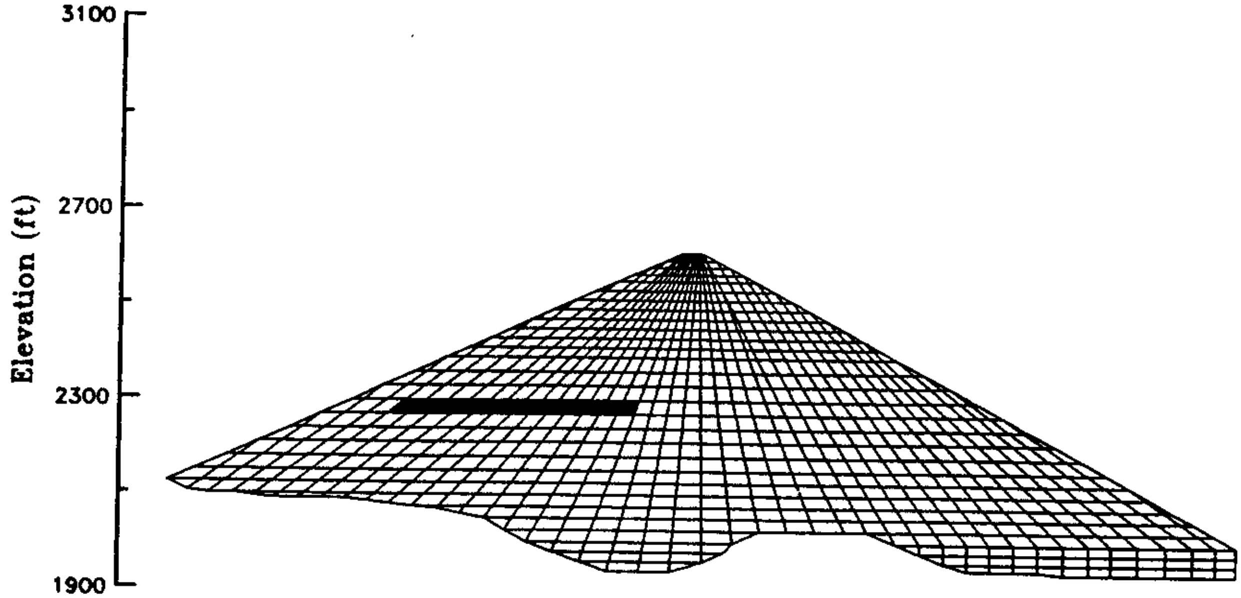


Plate S-33: Evaluation of Strain Potential During Maximum Credible Earthquake at Elevation 2225 Feet



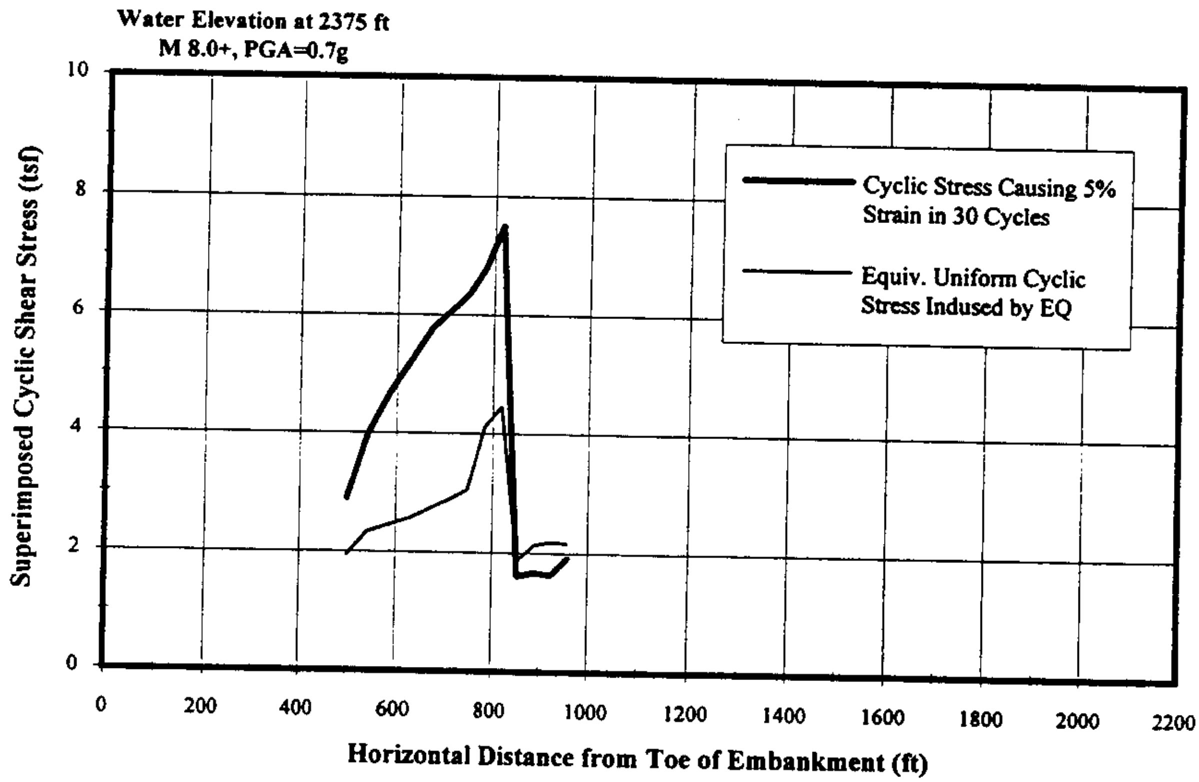


Plate S-34: Evaluation of Strain Potential During Maximum Credible Earthquake at Elevation 2285 Feet

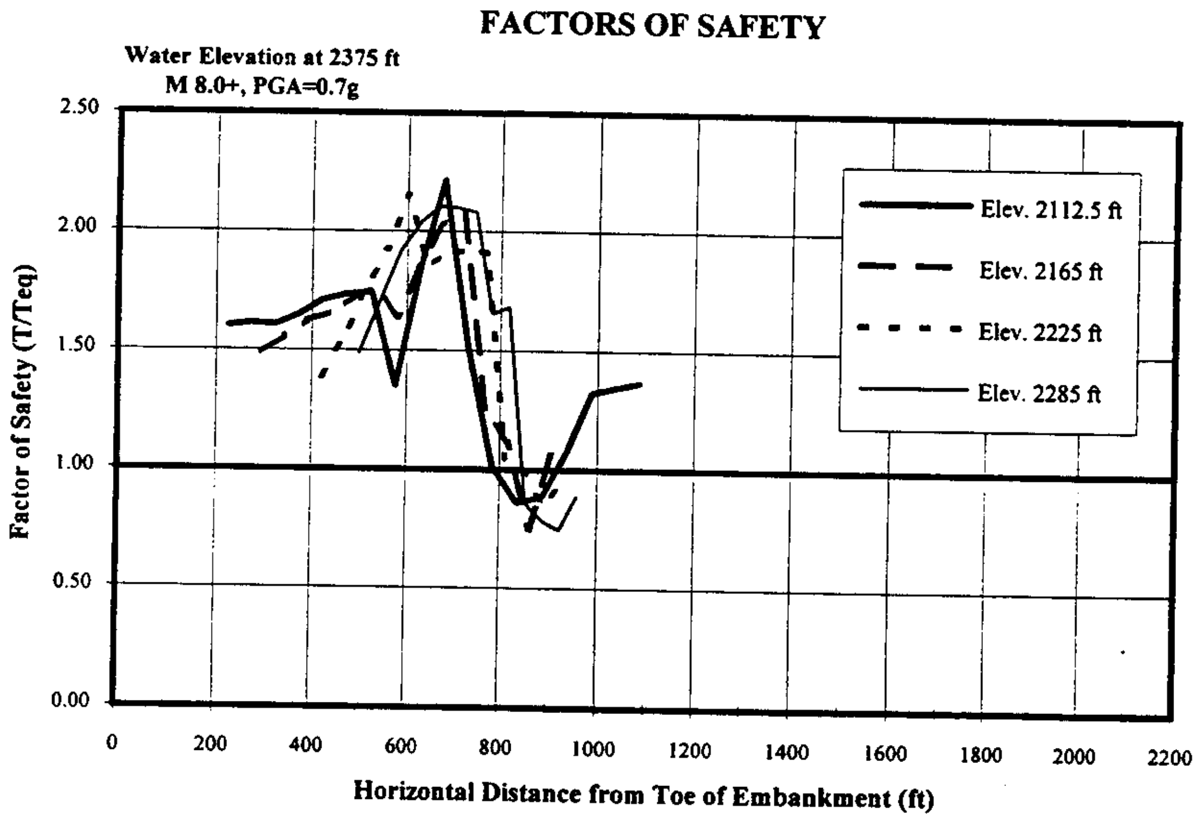


Plate S-35: Factors of Safety Using Cyclic Strength Based on 5% Axial Strain During Maximum Credible Earthquake

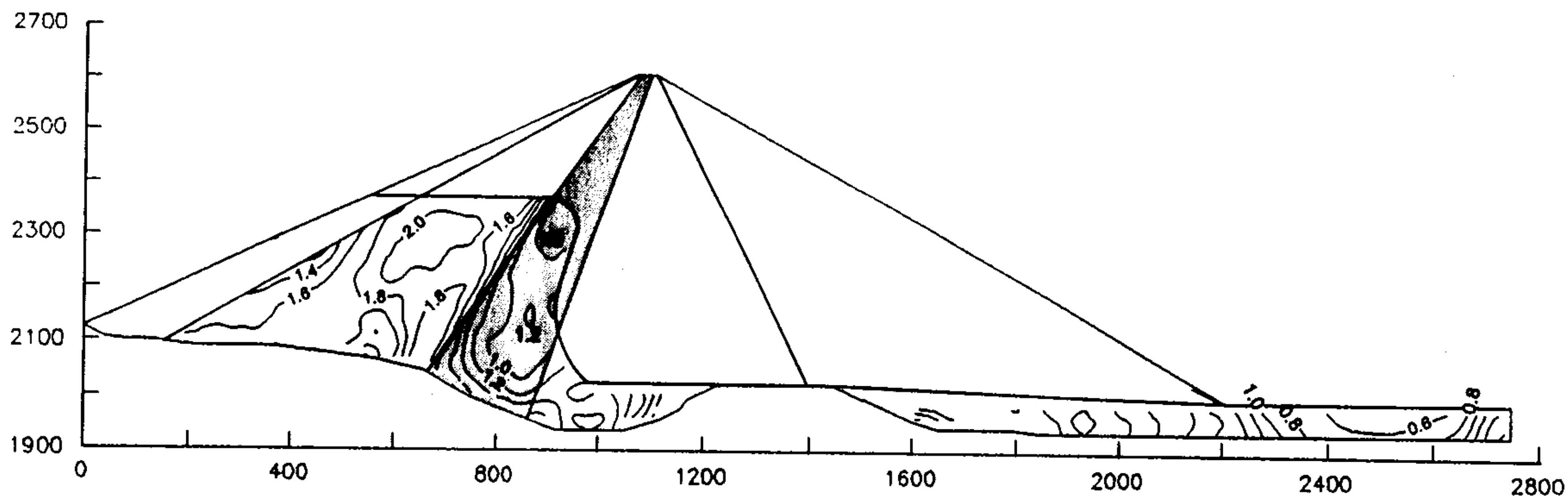
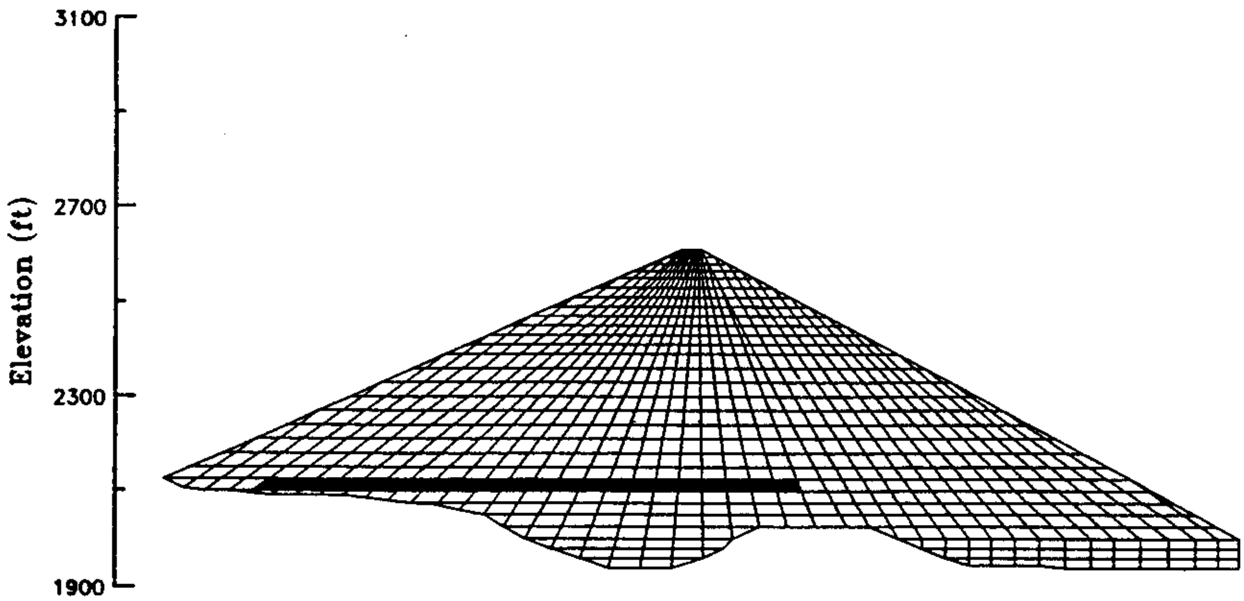


Plate S-36: Contours of Factors of Safety for Water Level at +2375 Feet



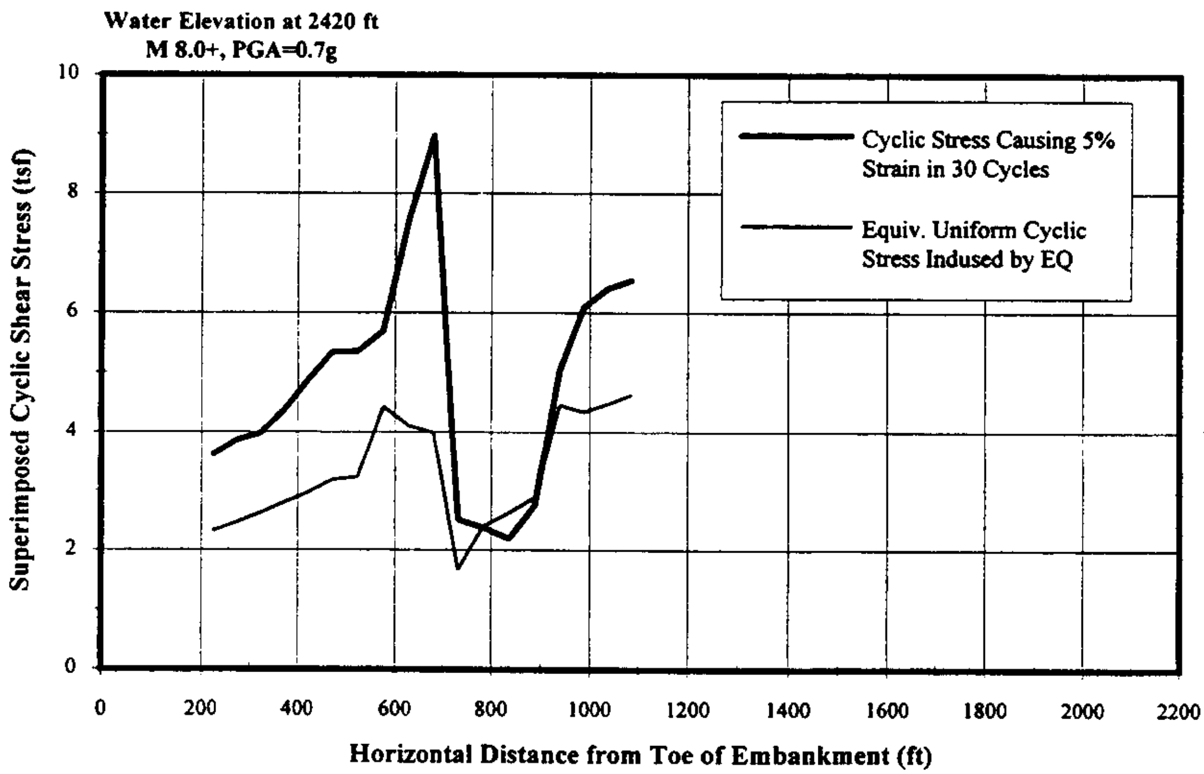
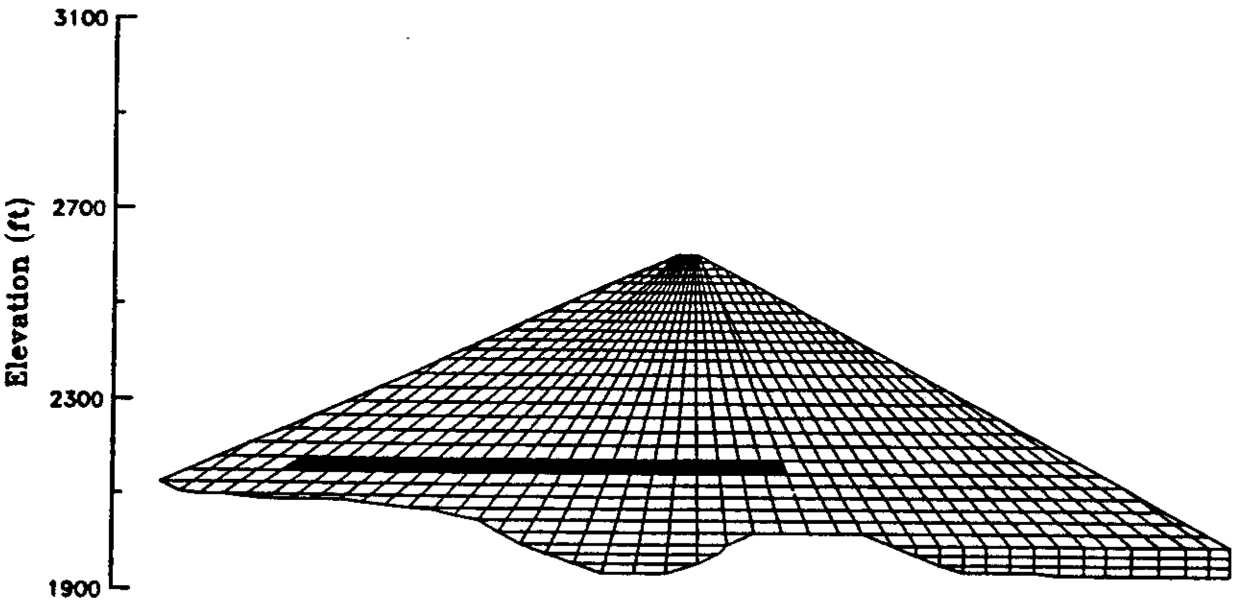


Plate S-37: Evaluation of Strain Potential During Maximum Probable Earthquake at Elevation 2112.5 Feet



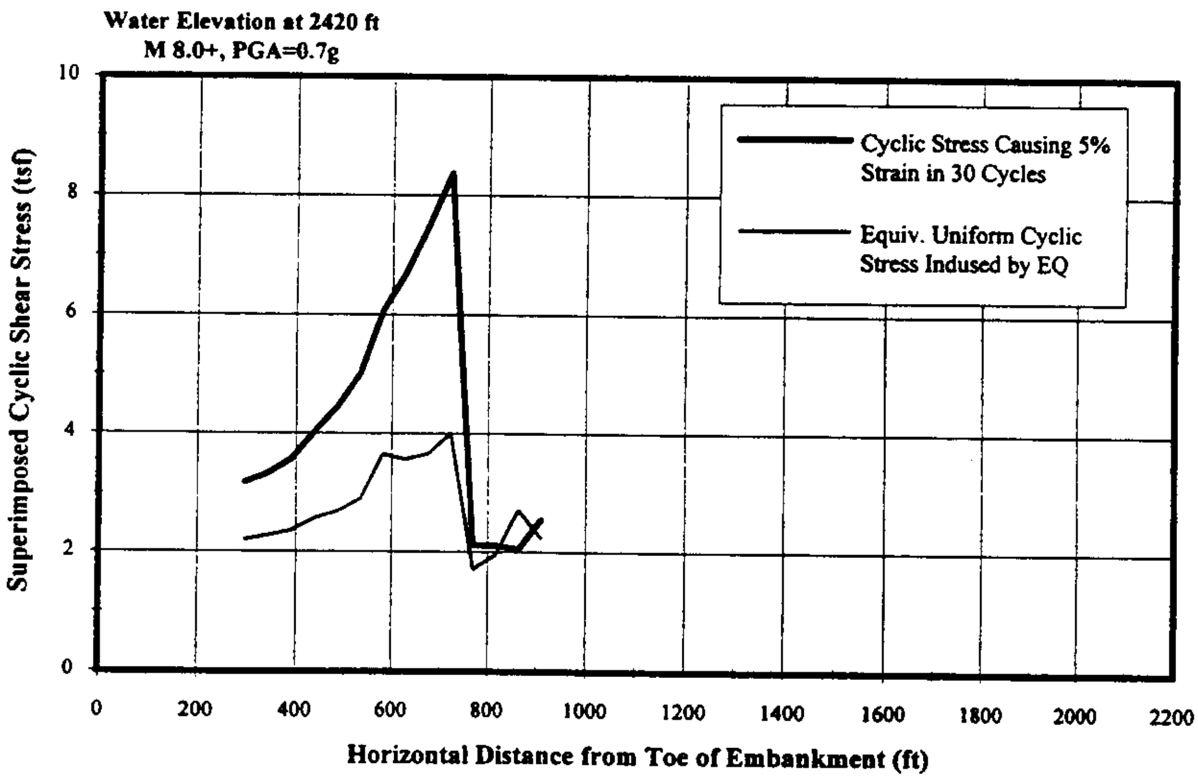
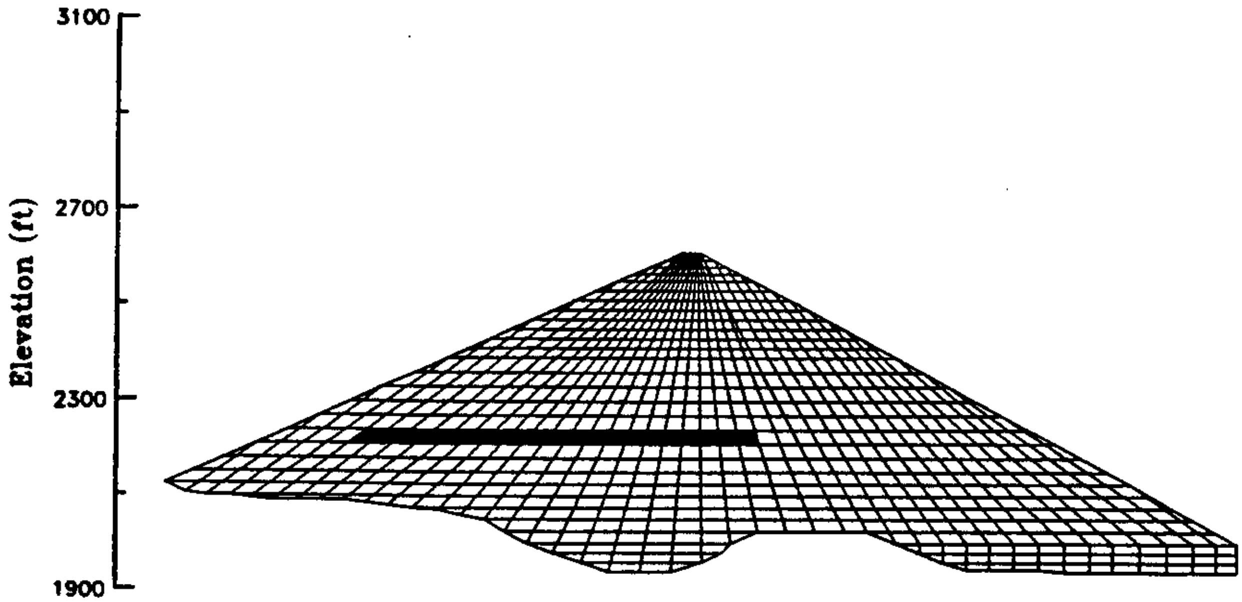


Plate S-38: Evaluation of Strain Potential During Maximum Probable Earthquake at Elevation 2165 Feet



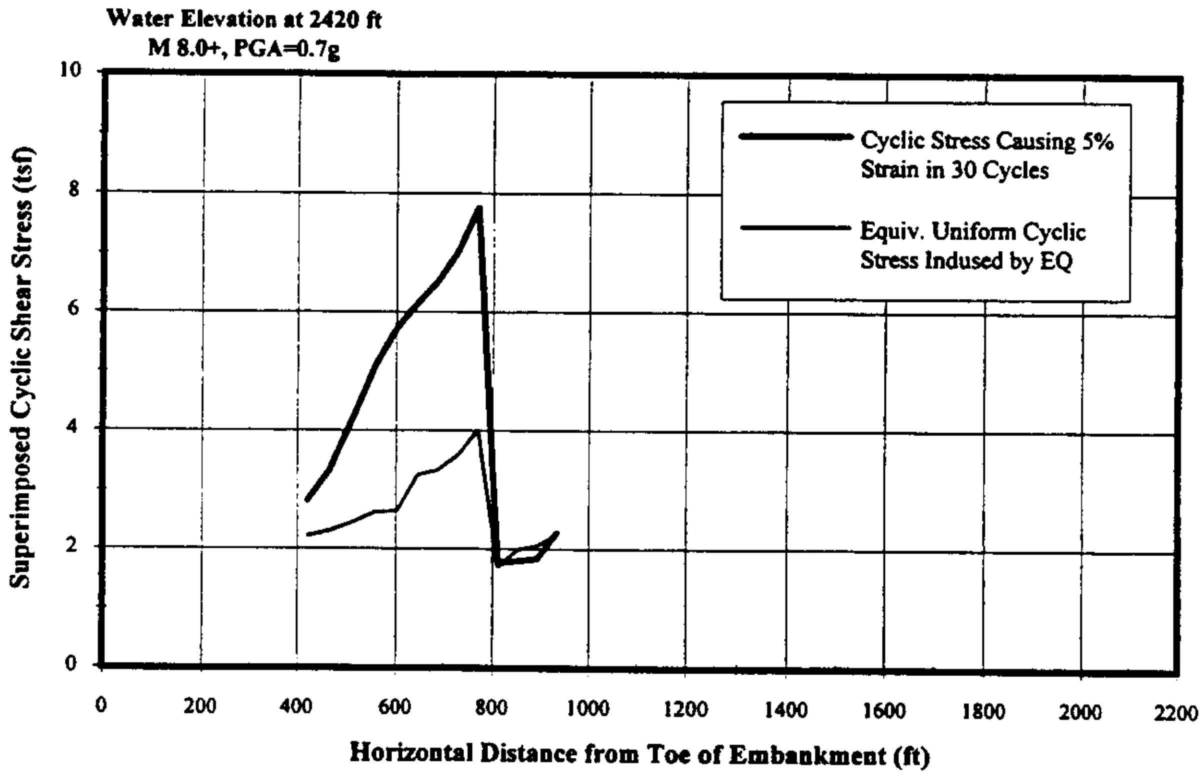


Plate S-39: Evaluation of Strain Potential During Maximum Probable Earthquake at Elevation 2225 Feet

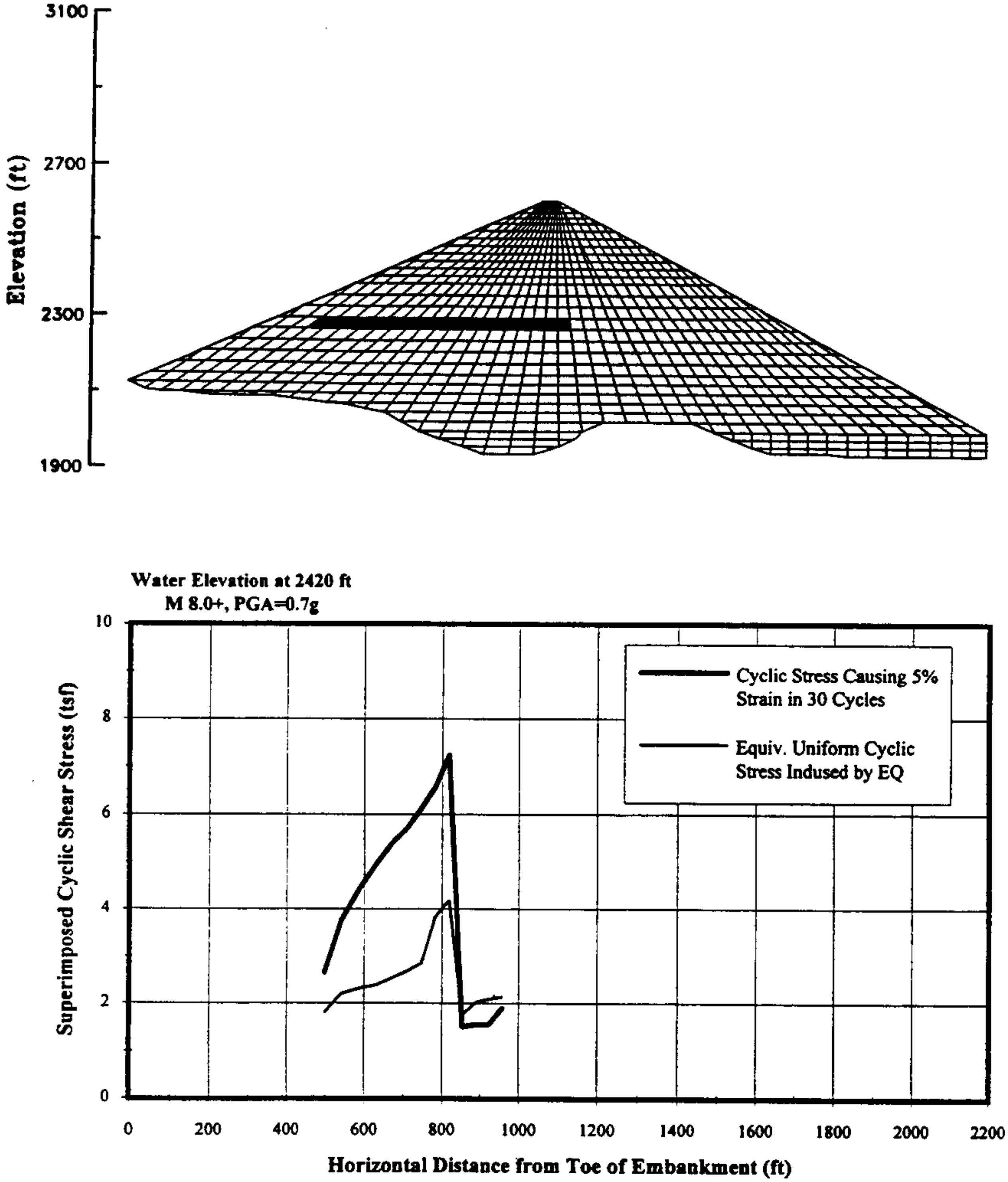


Plate S-40: Evaluation of Strain Potential During Maximum Probable Earthquake at Elevation 2285 Feet

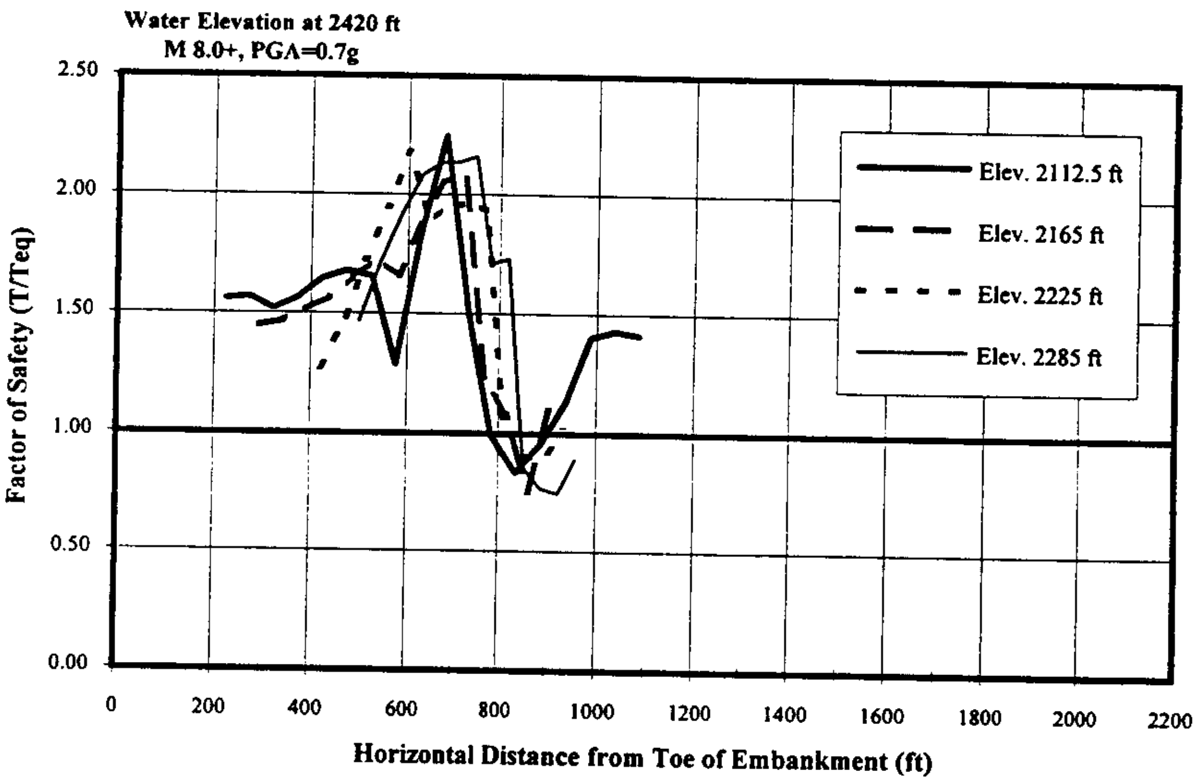


Plate S-41: Factors of Safety Using Cyclic Strength Based on 5% Axial Strain During Maximum Probable Earthquake

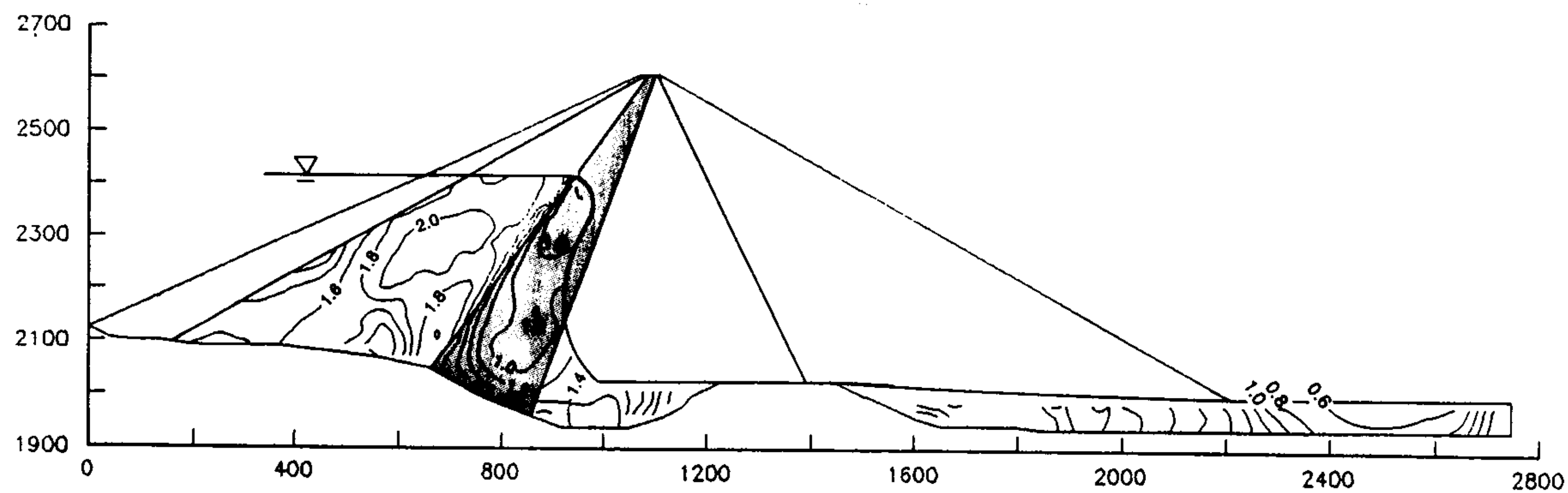


Plate S-42: Contours of Factors of Safety for Water Level at +2420 Feet

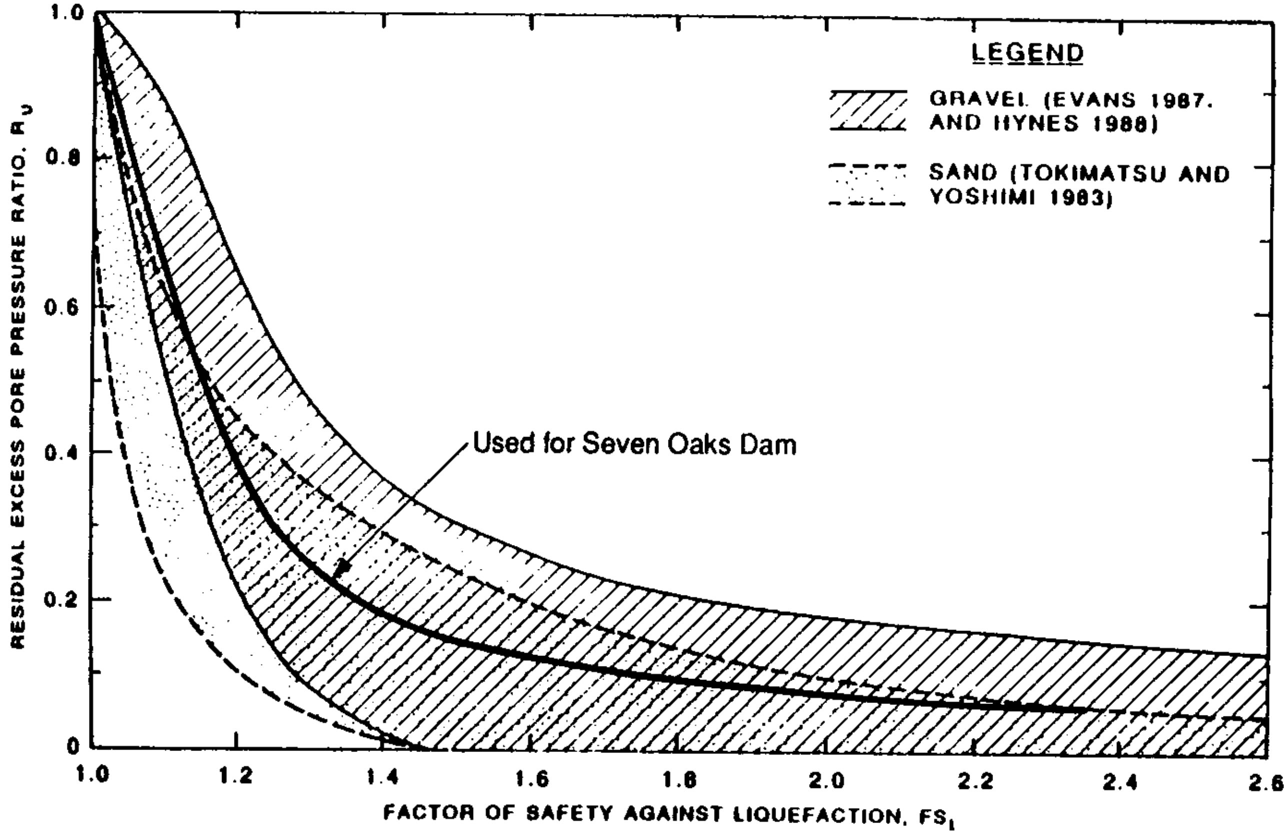


Plate S-43: Typical Relationships Between Residual Excess Pore Pressure Ratio and Factor of Safety Against Liquefaction; From Laboratory Data (Marcuson and Hynes, 1989)

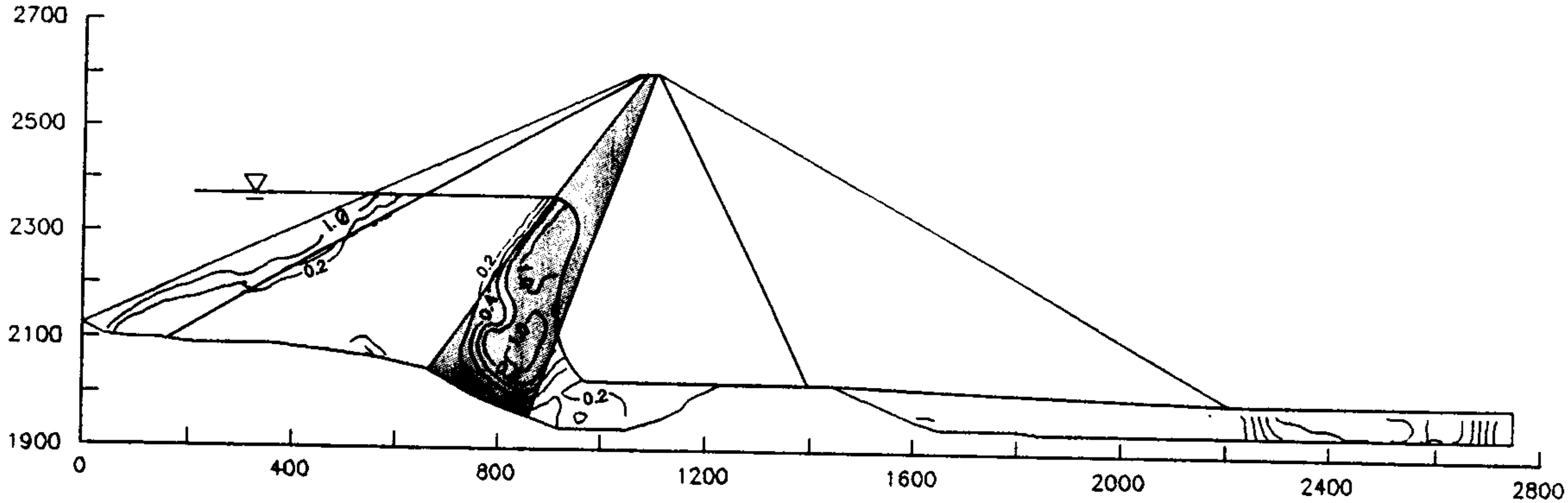


Plate S-44: Contours of Excess Pore Water Pressure Ratio for Water Level at 2375 Feet

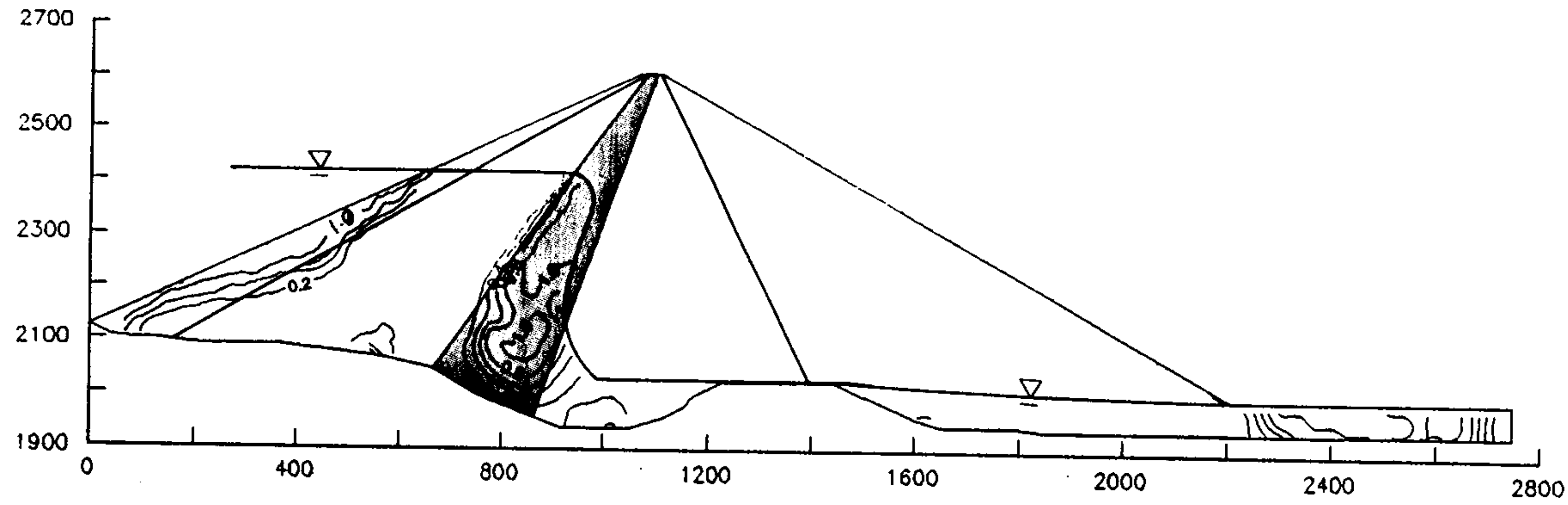
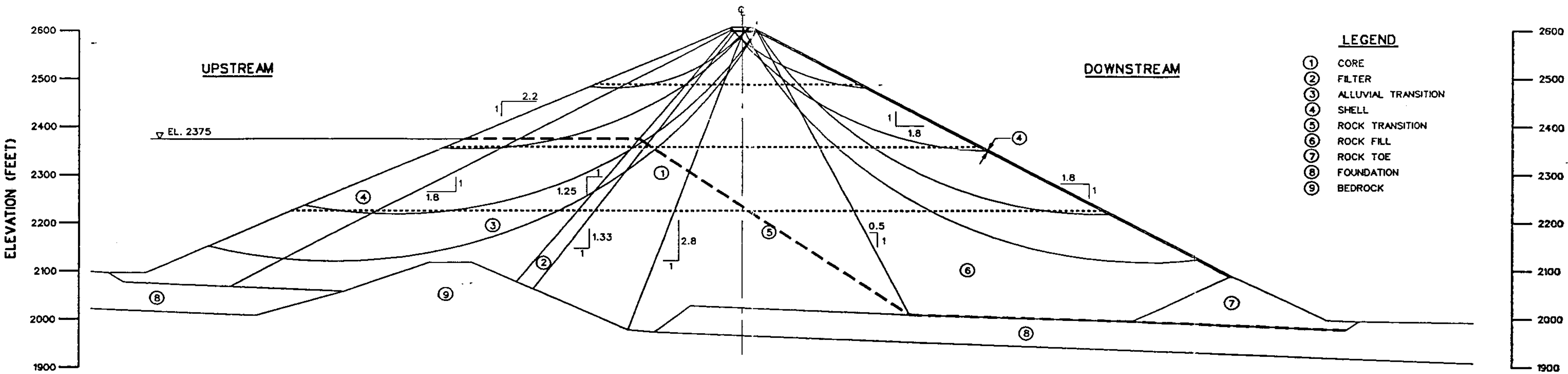


Plate S-45: Contours of Excess Pore Water Pressure Ratio for Water Level at 2420 Feet



EMBANKMENT SECTION

SCALE: FEET

100 50 0 100 200

YIELD ACCELERATION 2375 FT. WATER LEVEL		
	UPSTREAM	DOWNSTREAM
¼ HEIGHT	0.44	0.29
½ HEIGHT	0.32	0.30
¾ HEIGHT	0.23	0.30
FULL HEIGHT	0.22	0.34

NOTE:

1. UNDRAINED SHEAR STRENGTHS WERE REDUCED FOR COMPUTING YIELD ACCELERATIONS AS FOLLOWS:
   a. SHELL: NONE
   b. ALLUVIAL TRANSITION: 10 PERCENT
   c. ROCK TRANSITION: 15 PERCENT
   d. FILTER: 20 PERCENT
   e. CORE: 50 PERCENT

	UNIT WEIGHT (LB/C.F.)	PHI (DEG)	COHESION (LB/S.F.)
BEDROCK FOUNDATION	170	40	20000
ALLUVIAL FOUND.-SAT	148	31	0
SHELL-SATURATED	145	33.7	0
SHELL-MOIST	138	LOG EQ.	0
ALLUVIAL TRANS.-SAT.	148	31	0
ALLUVIAL TRANS.-MOIST	146	LOG EQ.	0
FILTER-SATURATED	140	28	0
FILTER-MOIST	127	37	0
CORE-SATURATED	138	DUNCAN 1	-
CORE-MOIST	136	DUNCAN 2	-
ROCK TRANSITION-SAT.	146	19	0
ROCK TRANSITION-MOIST	142	40	0
ROCKFILL	142	40	0
ROCKTOE	120	45	0

DUNCAN 1	
SIGMA	TAU
0	0
3380	1190
80000	19500

DUNCAN 2	
SIGMA	TAU
0	0
3380	2380
80000	39000

LOG EQUATION:

$\phi = \phi_0 - [\Delta\phi \times \log(\sigma_3/P_0)]$

$\phi_0 = 47°$ $\Delta\phi = 7°$

DATUM IS MEAN LOWER LOW WATER

SYMBOL	DESCRIPTION	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

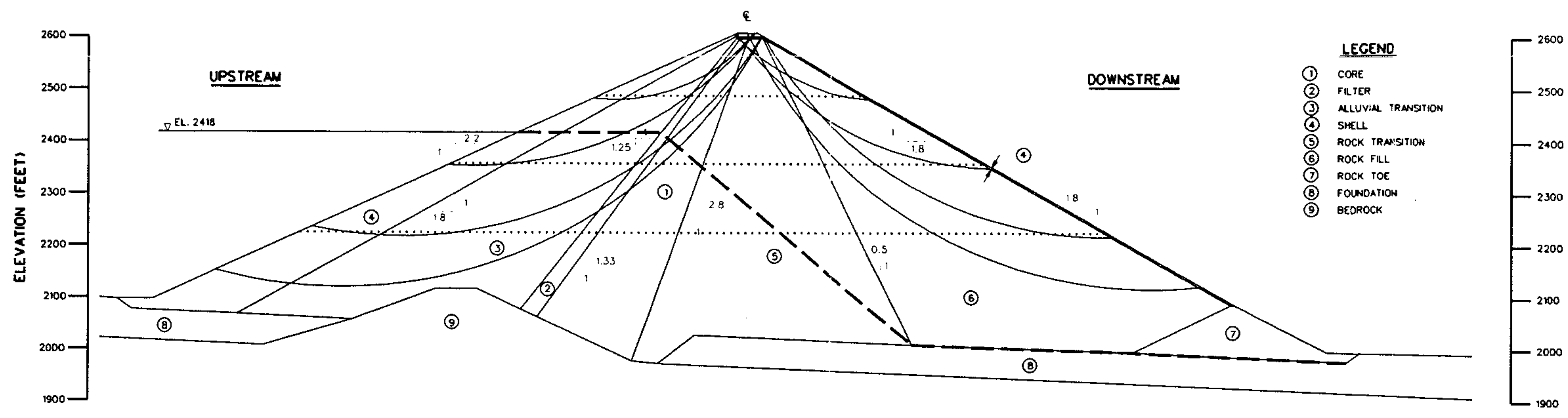
DESIGNED BY: D.S.P.
DRAWN BY: D.S.P.
CHECKED BY: A.T.R
SUBMITTED BY:

SANTA ANA RIVER MAINSTEM, CALIFORNIA
WATER CONSERVATION STUDY

SEVEN OAKS DAM
YIELD ACCELERATIONS
UPSTREAM AND DOWNSTREAM SLOPES
POOL AT 2375 FT.

DATE APPROVED:
SPEC. NO. DACW09-
DISTRICT FILE NO.
SHEET OF SHEETS

VALUE ENGINEERING PAYS



EMBANKMENT SECTION

SCALE: FEET

YIELD ACCELERATION 2418 FT. WATER LEVEL		
	UPSTREAM	DOWNSTREAM
1/4 HEIGHT	0.44	0.29
1/2 HEIGHT	.26	0.30
3/4 HEIGHT	0.21	0.30
FULL HEIGHT	0.21	0.34

NOTE:

1. UNDRAINED SHEAR STRENGTHS WERE REDUCED FOR COMPUTING YIELD ACCELERATIONS AS FOLLOWS:
   a. SHELL: NONE
   b. ALLUVIAL TRANSITION: 10 PERCENT
   c. ROCK TRANSITION: 15 PERCENT
   d. FILTER: 20 PERCENT
   e. CORE: 50 PERCENT

	UNIT WEIGHT (LB/C.F.)	PHI (DEG)	COHESION (LB/S.F.)
BEDROCK FOUNDATION	170	40	20000
ALLUVIAL FOUND.-SAT	148	31	0
SHELL-SATURATED	145	33.7	0
SHELL-MOIST	138	LOG EQ.	0
ALLUVIAL TRANS.-SAT.	148	31	0
ALLUVIAL TRANS.-MOIST	146	LOG EQ.	0
FILTER-SATURATED	140	28	0
FILTER-MOIST	127	37	0
CORE-SATURATED	138	DUNCAN 1	-
CORE-MOIST	136	DUNCAN 2	-
ROCK TRANSITION-SAT.	146	19	0
ROCK TRANSITION-MOIST	142	40	0
ROCKFILL	142	40	0
ROCKTOE	120	45	0

DUNCAN 1	
SIGMA	TAU
0	0
3380	1190
80000	19500

DUNCAN 2	
SIGMA	TAU
0	0
3380	2380
80000	39000

LOG EQUATION:

$\phi = \phi_0 - [\Delta\phi \times \log(\sigma_3/P_a)]$

$\phi_0 = 47°$ $\Delta\phi = 7°$

DATUM E MEAN LOWER LOW WATER

REVISIONS

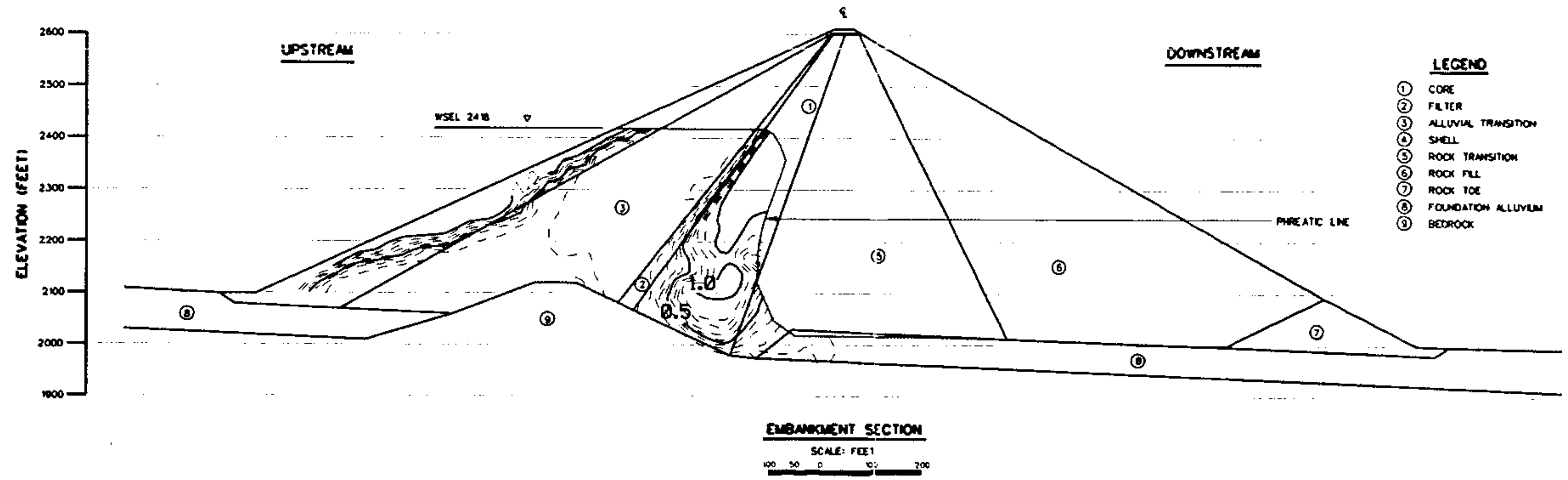
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

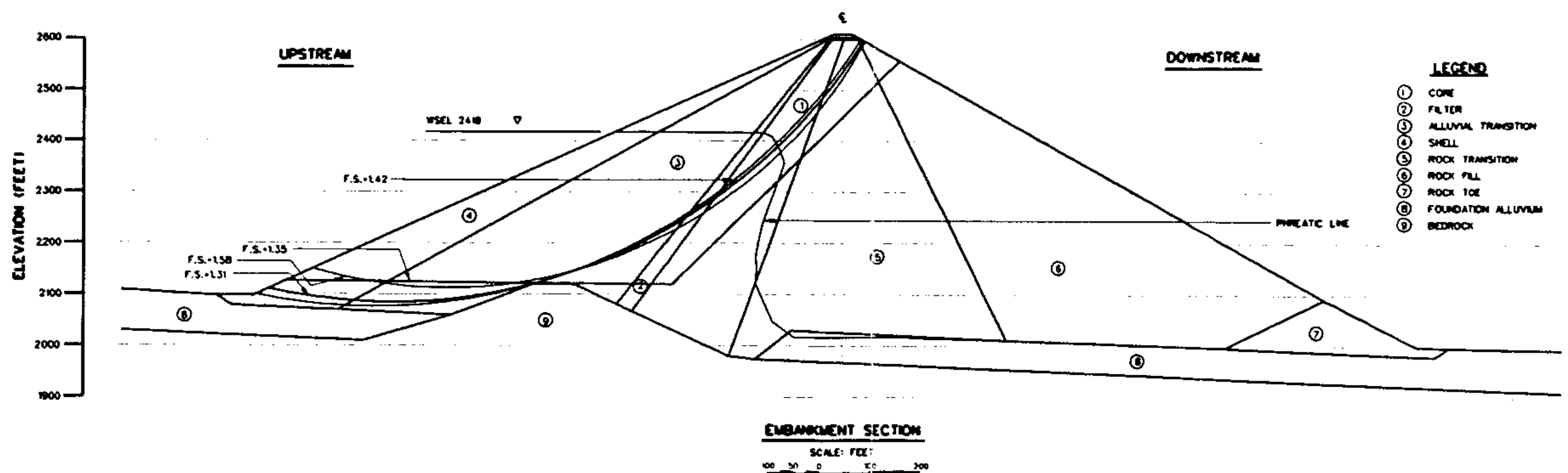
DESIGNED BY: D.S.P.
DRAWN BY: D.S.P.
CHECKED BY: A.T.R.

SANTA ANA RIVER MAINSTEM, CALIFORNIA
WATER CONSERVATION STUDY

SEVEN OAKS DAM
YIELD ACCELERATIONS
UPSTREAM AND DOWNSTREAM SLOPES
POOL AT 2418 FT.

SAFETY PAYS





NOTES:

1. CONTOURS REPRESENT CALCULATED EXCESS PORE PRESSURES INDUCED BY THE MAX. CREDIBLE EARTHQUAKE.
2. DRAINED STRENGTHS WERE RECOMMENDED BY DR. DUNCAN IN REPORT DATED 20 OCTOBER 92. CORE STRENGTHS ARE
3. COMPUTER PROGRAM UTEXAS3 WAS USED TO CALCULATE FACTORS OF SAFETY FOR BOTH CIRCULAR AND WEDGE FAILURE SURFACES USING SPENCER'S METHOD.

DATUM IS MEAN LOWER LOW WATER

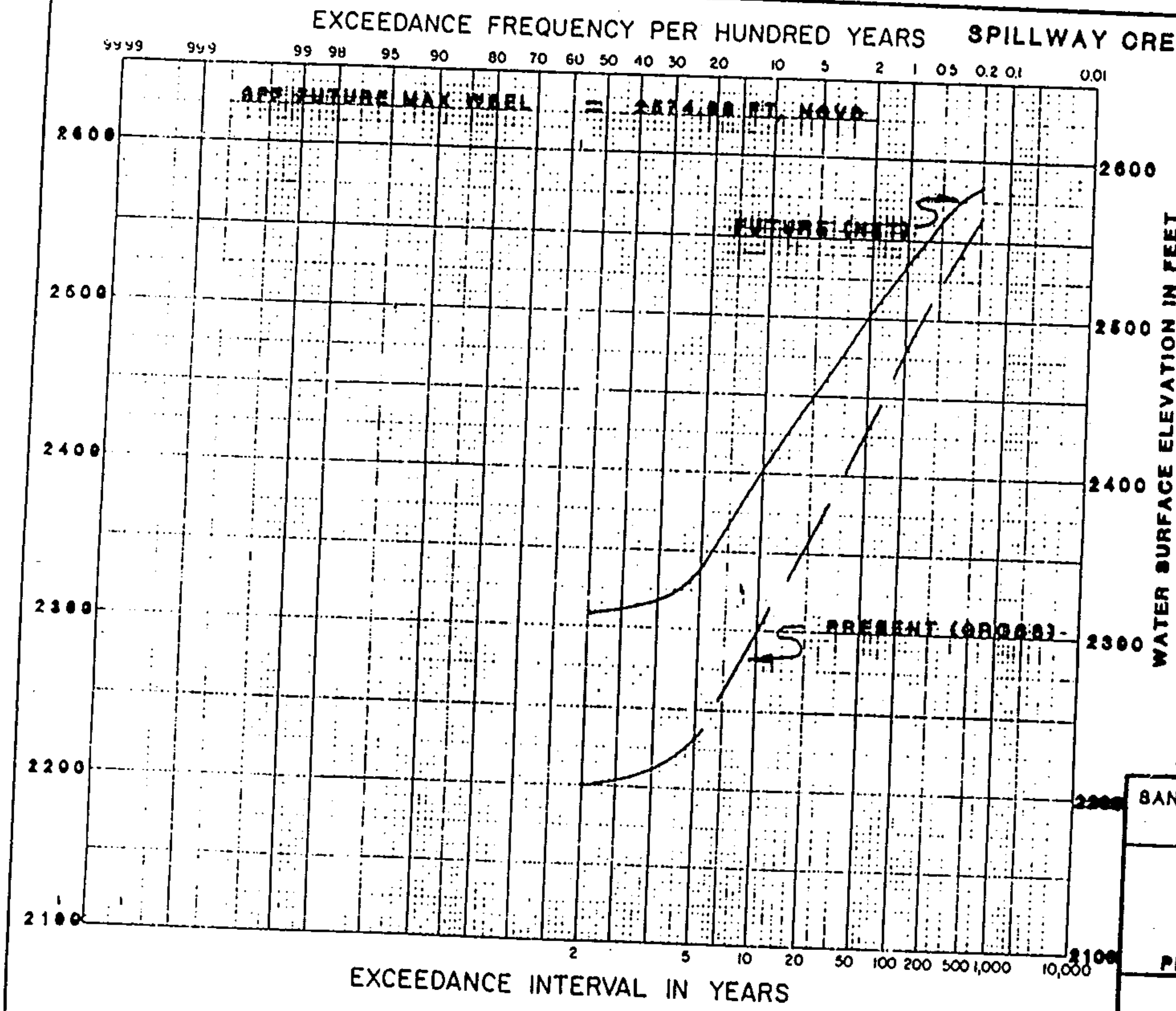
REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: D.S.P.
DRAWN BY: D.S.P.
CHECKED BY: A.A.

SANTA ANA RIVER MAINSTEM, CALIFORNIA
WATER CONSERVATION STUDY
SEVEN OAKS DAM
EMBANKMENT AND SPILLWAY
POST EARTHQUAKE SLOPE STABILITY
WSEL 2418

SUBMITTED BY:
DATE APPROVED
SPEC NO DACW09-
DISTRICT FILE NO
SHEET OF SHEETS



TOP OF DAM 2610 FEET

GROSS STORAGE AT SPILLWAY CREST = 146,000 A.F.

NET STORAGE AT SPILLWAY CREST = 118,000 A.F.

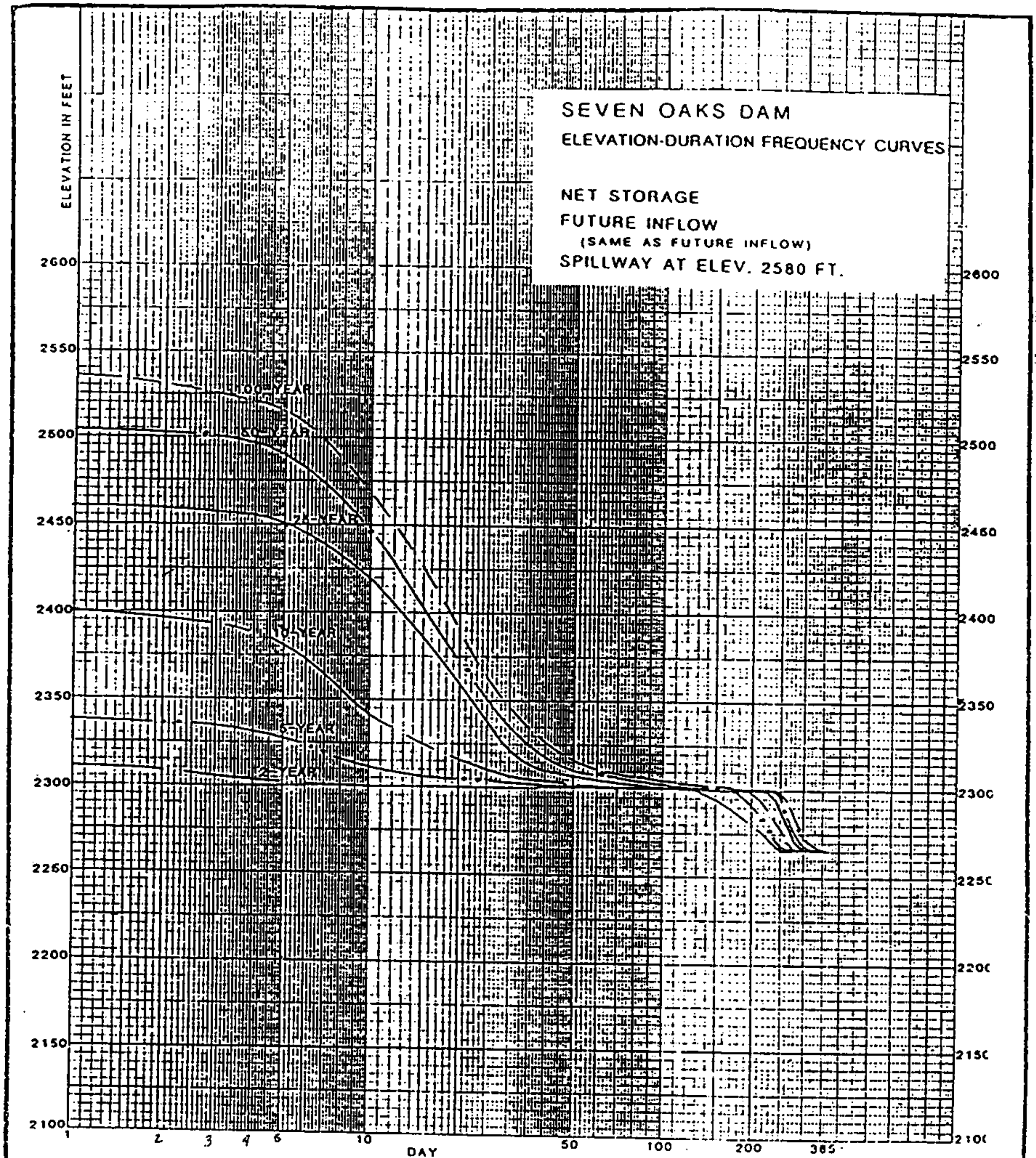
SANTA ANA RIVER MAINSTEM, CALIFORNIA
WATER CONSERVATION STUDY

SEVEN OAKS DAM

FILLING-FREQUENCY CURVE

PRESENT AND FUTURE CONDITIONS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



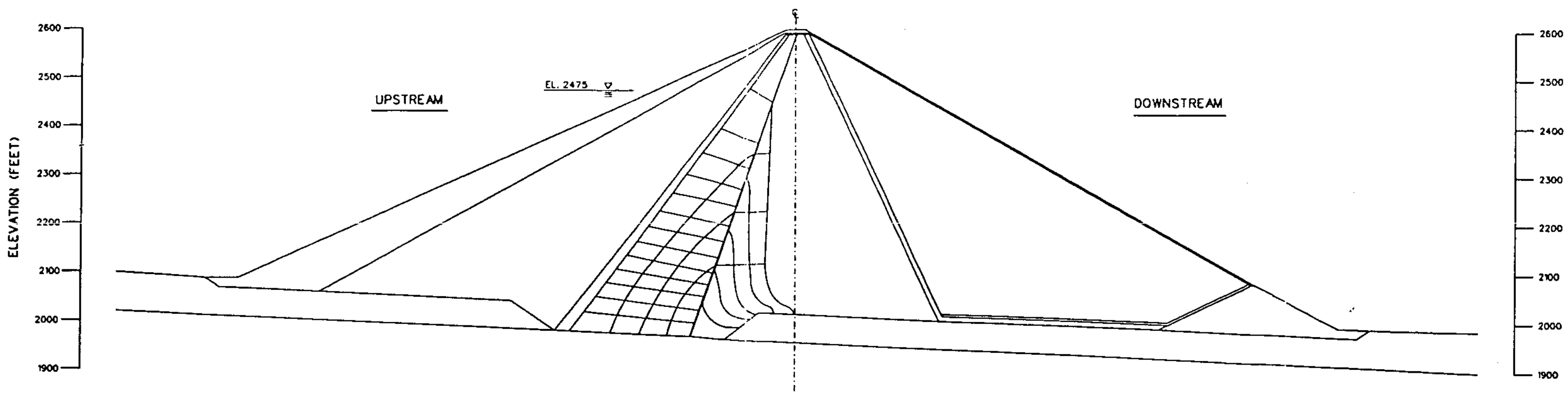
SANTA ANA RIVER MAINSTEM, CALIFORNIA
WATER CONSERVATION STUDY

ELEVATION-DURATION-FREQUENCY CURVES

SEVEN OAKS DAM

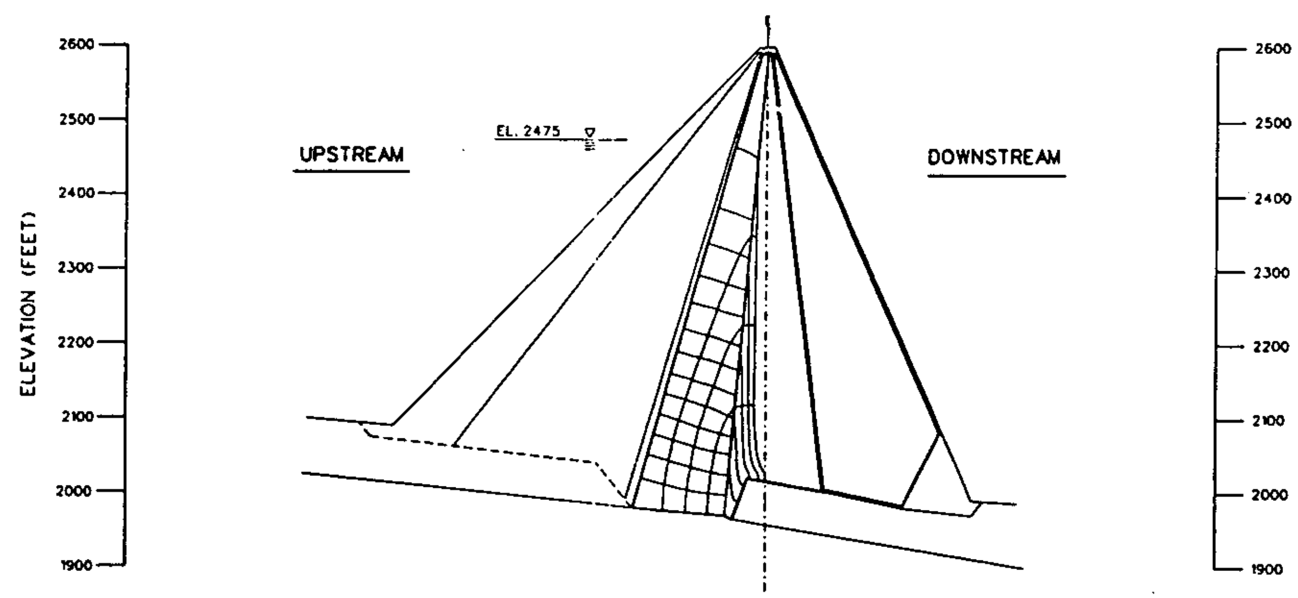
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

VALUE ENGINEERING PAYS



TRUE SECTION

SCALE: 1 IN = 100 FT



TRANSFORMED SECTION

TRANSFORMATION

CORE: $K_H = 4K_V$ TRANSFORMATION FACTOR $= \sqrt{\frac{K_V}{K_H}} = \sqrt{\frac{1}{4}} = 0.5$

TRANSFORMED CORE SECTION HORIZONTAL DIMENSION = 0.5 TRUE SECTION HORIZONTAL DIMENSION

$K_H = .01$

ROCK TRANSITION: $K_H = 16K_V$ TRANSFORMATION FACTOR $= \sqrt{\frac{K_V}{K_H}} = \sqrt{\frac{1}{16}} = 0.25$

TRANSFORMED ROCK TRANSITION HORIZONTAL DIMENSION = 0.25 TRUE SECTION HORIZONTAL DIMENSION

$K_H = .8$

EMBANKMENT SEEPAGE

FOR NON-ISOTROPIC SOIL THE EFFECTIVE COEFFICIENT OF PERMEABILITY

$K' = \sqrt{K_H K_V} = .005$ FEET/DAY.

SEEPAGE QUANTITY $= q/\text{FOOT} = \frac{N_f}{N_d} K' H = \frac{13}{4} \times .005 \times 475 = 8$ FT³/DAY

DATUM NATIONAL GEODETIC VERTICAL DATUM OF 1929

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: T.A.H.
DRAWN BY: A.C.
CHECKED BY: R.R.

SANTA ANA RIVER MAINSTEM, CALIFORNIA
FEATURE DESIGN MEMORANDUM

SEVEN OAKS DAM

EMBANKMENT AND SPILLWAY

EMBANKMENT SEEPAGE ANALYSIS
INTERMEDIATE POOL-INTACT CORE

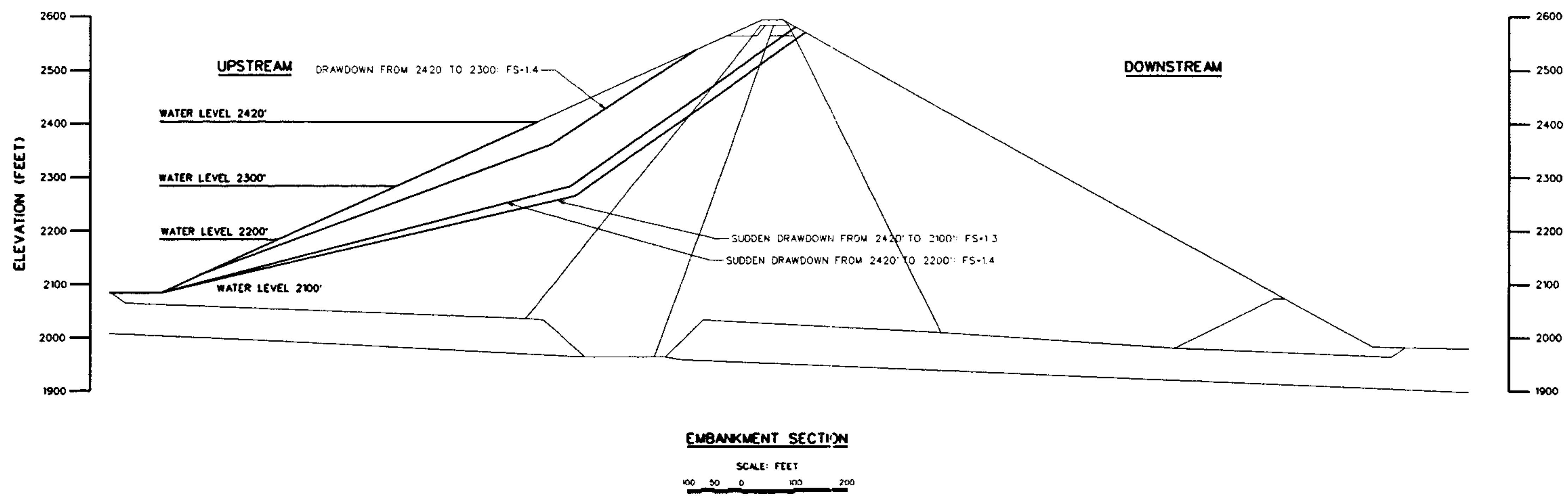
SUBMITTED BY: | DATE APPROVED: | SPEC NO. DACW09- | DISTRICT FILE NO. | SHEET OF SHEETS

COMPUTER AIDED DESIGN & DRAFTING CASE3.DGN

ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING

SAFETY PAYS

VALUE ENGINEERING PAYS



DATUM IS MEAN LOWER LOW WATER

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: D.S.P.
DRAWN BY: D.S.P.
CHECKED BY: A.T.R.

SANTA ANA RIVER MAINSTEM, CALIFORNIA
WATER CONSERVATION STUDY

SEVEN OAKS DAM
SUDDEN DRAWDOWN ANALYSIS
UPSTREAM SLOPE FROM 2420' TO 2300', 2200', 2100'

SUBMITTED BY:
DATE APPROVED:
SPEC. NO. DACW09-
DISTRICT FILE NO.
SHEET OF SHEETS

SAFETY PAYS

Seven Oaks Dam - Slope Stability Parameters - March 1995

FOR SUDDEN DRAWDOWN ANALYSIS

			Rapid Drawdown				EOC & Steady Seepage			
		γ	c	φ	c'	φ'	c	φ	c'	φ'
Bedrock Foundation	M								200 k	40
	S	170			200 k	40				
Alluvial Foundation	M	146							0	40
	S	148			0	40				
Alluvial Transtion	M	146			0	40			0	40
	S	148			0	40				
Filter	M	127			0	40			0	40
	S	140			0	40				
Core	M	136			0	35	Note 2			
	S	138	Note 1				Note 3			
Rock Transtion	M	142			0	39			0	39
	S	146			0	39				
Rock Fill	M	142							0	39
	S	146			0	39				
Rock Toe	M	120							0	39
	S	135			0	39				

M - Moist, S - Saturated, EOC - End of Construction.

Bilinear Envelopes

Note 1
Rapid Drawdown

σ	τ
0	0
3386	2370
80000	24340

Note 2
EOC

σ	τ
0	1200
9000	4200
80000	4200

Note 3
Steady Seepage

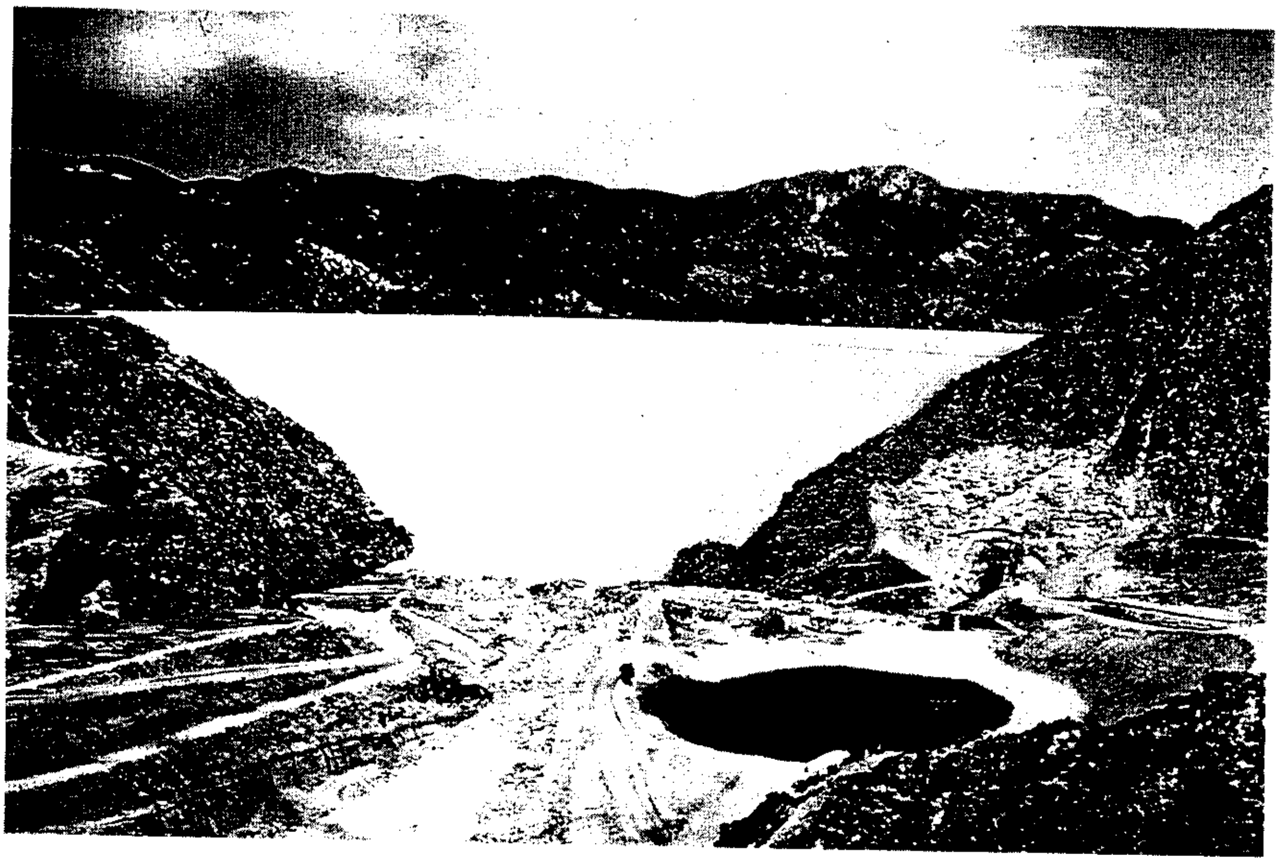
σ	τ
0	0
3386	2370
80000	38920

US Army Corps
of Engineers®
Los Angeles District

Feasibility Report

Seven Oaks Dam Water Conservation

Santa Ana River Basin, California



Appendix D. Design and Cost

June 1997

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Plates

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Structural Plates (Continuation)

DESIGN AND COST APPENDIX

SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

1 INTRODUCTION

1.1 General

A Feasibility Study, titled "Seven Oaks and Prado Dams Water Conservation Study, January 1995, F-3," investigated water conservation opportunities with the new Seven Oaks Dam on the Santa Ana River. That feasibility study developed three alternative pool elevations and several options to operate Seven Oaks Dam due to a conservation pool. In order to maintain and operate the dam, including the emergency bulkhead gate, the intake tower would need to be modified for any seasonal conservation pool that is higher than the existing high level intake invert. Alternate access to the intake tower as well as to the back of the reservoir would also be required. The purpose of this report is to present the preliminary designs and costs for the alternatives under consideration for the Draft Feasibility Study Report. A comparison of the alternatives and options is shown in Table 1.

1.1.1 F-4 Report

Subsequent to the F-3 report, the F-4 report was completed in December 1995. It included Alternative 4, water surface elevation at 2265 feet, as the baseline condition which would not require any modification to the intake tower. The report concluded that a National Economic Development (NED) Plan exists and that was Alternative 4 with a seasonal pool at El.2265. In addition, a Locally-Preferred Plan (LPP), Alternative 1, with a seasonal pool at El. 2300, was chosen by the local sponsor for implementation.

TABLE 1 - DESCRIPTION OF ALTERNATIVES

ALTERNATIVE	OPTION	INTAKE DESCRIPTION	WATER SURFACE	MAINTENANCE DECK
1		Modify existing intake structure with additional concrete and anchor tendons to the sides of the structure and strengthening of the trash structure for the high-level intake.	El. 2300	El. 2302
2	1	Modify existing intake structure with additional concrete and anchor tendons to the sides of the structure and strengthening of the trash structure for the high-level intake.	El. 2375	El. 2302
	2	Add 80-ft. steel frame, maintenance deck, and access bridge to top of existing intake structure	El. 2375	El. 2382
	3	Remove trash structure, maintenance deck, and access bridge and add 80-ft. concrete circular wetwell, trash structure, maintenance deck and access bridge at top of existing structure.	El. 2375	El. 2382
	4	Add bulkhead positioning frame to top of existing intake structure.	El. 2375	El. 2302
	5	Hydraulically operated slidegate in gateroom downstream of anchorage system	El. 2375	El. 2302
3	1	Modify existing intake structure with additional concrete and anchor tendons to the sides of the structure and strengthening of the trash structure of the high-level intake.	El. 2418	El. 2302
	2	Add 123-ft. steel frame, maintenance deck, and access bridge to top of existing intake structure	El. 2418	El. 2425
	3	Remove trash structure, maintenance deck, and access bridge and add 123-ft. concrete circular wetwell, trash structure, maintenance deck and access bridge at top of existing structure.	El. 2418	El. 2425
	4	Add bulkhead positioning frame to top of existing intake structure.	El. 2418	El. 2302
	5	Hydraulically operated slidegate in gateroom downstream of anchorage system.	El. 2418	El. 2302
4		Existing intake structure	El. 2265	El. 2302

1.2 Conservation Pool

The four alternatives for a conservation pool are outlined below.

1.2.1 Alternative 1

This operation involves normal flood operations in the winter months (debris pool to El. 2200 feet), then at the beginning of March, the seasonal conservation pool is expanded linearly over 30 days to a target conservation level of El. 2300 feet (16,293 acre-feet) at the beginning of April. From April through May, all inflow is released from the dam after the target elevation is reached. From June through September, all inflow plus a conservation pool release is made to insure the conservation pool is drained by the end of September.

1.2.2 Alternative 2

This operation involves normal flood operations in the winter months, then at the beginning of March, the seasonal conservation pool is expanded linearly over 30 days to a target conservation level of EL. 2375 feet (35,000 acre-feet) at the beginning of April. From April through May, all inflow is released from the dam after the target elevation is reached. From June through September, all inflow plus a conservation pool release is made to insure the conservation pool is drained by the end of September.

1.2.3 Alternative 3

This operation involves normal flood operations in the winter months, then at the beginning of March, the seasonal conservation pool is expanded linearly over 30 days to a target conservation level of El. 2418 feet (50,000 acre feet, present and 35,600 acre-feet future) at the beginning of April. From April through May, all inflow is released from the dam after the target elevation is reached. From June through September, all inflow plus a conservation pool release is made to insure the conservation pool is drained by the end of September.

1.2.4 Alternative 4

This operation involves normal flood operations in the winter months, then at the beginning of March, the seasonal conservation pool is expanded linearly over 30 days to a target conservation level of EL. 2265 (10,270 acre-feet) at the beginning of April. From April through May, all inflow is released from the dam after the target elevation is reached. From June through September, all inflow plus a conservation pool release is made to insure the conservation pool is drained by the end of September.

1.3 Existing Intake Structure

The existing design of the Seven Oaks Dam intake structure is based on eliminating a dead storage pool by providing a multilevel withdrawal wet well that will be stoplogged as the sediment deposition level increases to prevent passing sediment through the regulating outlet tunnel. At the top of the multilevel wet well structure is the high level intake to the large main wet well. The invert of the main wet well intake is El. 2265 which coincides with the maximum anticipated sediment level. At the top of the concrete trashrack structure are the El. 2302 service deck and bridge which allow mobile crane access for the purpose of lowering a maintenance bulkhead down the main wet well gate slot. The purpose of the maintenance bulkhead is to isolate and allow dewatering of the regulating outlet tunnel upstream of the control gates whenever the pool is between El. 2265 and El. 2302. Thus, the regulating outlet tunnel can be dewatered for inspection and repair any time except on the rare occasion when the dam is retaining a flood pool exceeding El. 2302.

1.4 Post - Feasibility Study Design Tasks

Detailed structural analysis of the intake structure using the Finite Element Method would be required to evaluate the structure in response to the seismic hydrodynamic forces for water conservation pools above El. 2265. The geometric and associated drainage design of the relocated reservoir road upstream of the dam and the geologic analysis of the rock excavation design would be required. In addition, analysis and remediation design of the rock slope above the intake structure would be necessary for water conservation storage above El. 2300.

2 DESIGN ASSUMPTIONS

2.1 Existing Conditions

The diversion tunnel has been completed. The base of the intake structure has already been completed. The third and final phase of the outlet works is to be completed during the current embankment/spillway construction contract. This phase 3 construction will complete the original flood control design of the intake tower. Project operation with a conservation pool will require renovation of the intake tower involving selective demolition and additional construction. Any modifications to the outlet tunnel would also require concrete removal and additional construction. References to "existing" structures refer to the Phase 3 flood control designed structures.

2.2 Existing Seismic Design

Under normal operating conditions a debris pool was to be maintained as the sediment level around the intake structure increased from El. 2100 to El. 2265. Thus, the load case for normal operation with earthquake was for a debris pool at El. 2265 with no sediment. This condition also covered the highly frequent storm events. Whenever the pool was to exceed El. 2265 for a debris pool and frequent flood events, sediment would surround the intake structure to a significant height and limit the response of the structure and the loads to the anchorage system. The probability of infrequent flood events and infrequent earthquake events is so low that a combination of these events was not considered.

2.3 Existing Trashrack, Maintenance Deck & Access Bridge

The trashrack is the weak link for Options 1 and 2. Portions of the trashrack would need to be removed and replaced. The location of the members requiring replacement may necessitate removal of portions of the maintenance deck. In Option 3, the trashrack, maintenance deck, and access bridge would be removed and relocated at the top of the structure. The existing maintenance deck and access bridge would remain at El 2302 for Options 1, 2, 4, and 5. A new maintenance deck and access bridge would be constructed in Options 2 and 3 at the elevations indicated in Table 1.

2.4 Existing Miscellaneous Elements

Several elements that exist at the current deck elevation would need to be moved or extended. The seismograph (accelerometer) would need to be moved to the new maintenance deck and be installed in a watertight compartment. The vent and gate control cable would both need to be extended to the new maintenance deck.

2.5 Existing Multi-level Withdrawal System

During a conservation period for pools above El. 2265, the Multi-level Withdrawal System (MWS) would remain closed with stoplogs. The sluicegate between the wet well and the MWS wet well would remain open to provide the required minimum discharge of 3 cfs through the minimum discharge line (MDL). If the conservation pool is seasonal, the MWS could be left open above the anticipated level of sediment during the season. There is some risk that sediment deposition would be more than anticipated. The MDL, MDL ball valve, and cone valves have been designed to operate at PMF.

2.6 Existing Tunnel

The existing design of the Seven Oaks Dam regulating outlet tunnel is based upon a normal pool at El. 2300 for external hydrostatic loading and El. 2575 for internal hydrostatic loading. The internal pressure only applies upstream of the regulating outlet gates. The external loading decreases linearly from the intake structure to El. 2151 at the downstream edge of the gate chamber; however, the entire portion of the tunnel between the intake structure and the gate chamber is designed for El. 2300 external hydrostatic loading. In the downstream tunnel the external hydrostatic loading varies linearly from El. 2117 to El. 2068 at the downstream portal, however the entire downstream tunnel is designed for El. 2109 external hydrostatic loading.

2.7 Existing Access to Tunnel

ER 1110-2-100 "Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures" outlines the requirements for inspection. The first inspection is to be made upon completion of the dam. The second inspection is at a reasonable stage of normal operating pool. Subsequent inspections are made at one-year intervals for four years, at two-year intervals for the next four years, and then extended to five-year intervals. Such inspections and access to the tunnel can be scheduled to avoid the conservation pool. Post-seismic inspections are discussed below.

2.8 Existing Post-Earthquake Action.

Post-earthquake action for the originally planned operations are developed and detailed in "Seven Oaks Dam Outlet Works Feature Design Memorandum Position Paper for Upstream Hydraulically-Operated Bulkhead Gate," by David Cozakos/Brian Tracy, 12 September 1989. These plans were based upon the joint probabilities of pool elevations and the design earthquake. The conservation pools listed will significantly alter the joint probabilities in this plan.

Since the conservation pool is seasonal, the joint probability of a flood event, a conservation pool, and a design earthquake is low. However, the joint probability of a conservation pool and design earthquake is not significantly less than that of a design earthquake. This feasibility design is based upon a design earthquake at conservation pool.

The discussion in the position paper concerning the crane-operated bulkhead will be applicable to Options 2 and Options 3. The discussion of hydraulically-operated bulkhead (both no flow design and full flow design) will be applicable to Option 5. Options 1 and 4 (Option 4 also has similar issues related to hydraulically-operated bulkhead) do not provide the required level of safety as outlined in the position paper.

3 Seismic Analysis

In the seismic analysis of intake structures, both water confined within the structure and water surrounding the structure are considered. Confined water is considered as additional mass and is a direct function of volume. Water surrounding the structure is also considered as additional structural mass, however, the added mass is a function of the reservoir-structure interaction rather than volume. For free-standing towers surrounded by water, design procedures are available for determining the added mass due to reservoir-structure interaction. For an inclined intake structure, added masses must be determined from a finite-element analysis which considers the reservoir-structure interaction.

The seismic design of the original tower was based on a water surface at El. 2265. The Westergaard method of determining the contribution of water surrounding the reservoir provided conservatism and required more reinforcement and a larger anchorage system than was considered reasonable. Dr. Yusof Ghanaat performed a finite-element analysis of the reservoir surrounding the Seven Oaks intake structure and determined the hydrodynamic contribution of the reservoir to the seismic response of the intake structure. Dr. Ghanaat's results were utilized in the WES analysis and the design.

As the depth of water surrounding the intake structure increases, the hydrodynamic contribution of the reservoir increases. For the Seven Oaks intake structure, the effects of additional submergence for the design case will need to be determined from a finite-element analysis of the reservoir-structure interaction. A rough approximation of the impact of additional submergence can be obtained by comparison with a free standing intake structure. This analogy is used only to show the effect of additional submergence.

For a free standing intake structure with a pool at El. 2300, the increase in added mass will be 91 percent at El. 2257, 23 percent at El. 2240, 13 percent at El. 2224, and 6 percent at El. 2207. With the pool at El. 2375 the increase in added mass will be 126 percent at El. 2257, 35 percent at El. 2240, 21 percent at El. 2224, and 12 percent at El. 2207.

When this analogy is applied to the Seven Oaks intake structure, the increase in added mass varies from 122 percent at El. 2265 to 12 percent at El. 2226. With the pool at El. 2375 the increase in added mass varies from 168 percent at El. 2265 to 20 percent at El. 2226. For the El. 2418 pool, the increase in added mass varies from 176 percent at El. 2265 to 22 percent at El. 2226

These additional added masses produce increases in the anchorage requirements. The increase in anchorage requirements vary from 38 percent at El. 2265 to 6 percent at El. 2226. With the pool at El. 2375 the increase in anchorage requirements varies from 52 percent at El. 2265 to 11 percent at El. 2226. For the El. 2418 pool, the increase in anchorage requirements varies from 54 percent at El. 2265 to 12 percent at El. 2226. Values are shown graphically in Fig. 1.

The design of the existing anchorage system was economized as much as judged prudent. This leaves little reserve capacity to resist increased forces from the greater seismic effects due to a conservation pool and additional structure. Once the intake structure has been constructed, additional anchors can not be installed and the existing anchors can not be changed. The size and length of anchors could only be modified prior to construction . When the anchorage requirements need to be increased greater than 20 percent, a larger diameter hole would be required.

4 ALTERNATIVE NO. 1 - Storage of 16,000 AF

Alternative 1 proposes a seasonal storage of 16,000 acre-feet to a reservoir elevation of 2300. Access and maintenance would be from the existing concrete deck at elevation 2302. Increased seismic loading from the conservation pool (see Paragraph 2.2 Existing Seismic Design and Paragraph 3. Seismic Analysis.) Requires structural modifications to the intake tower.

4.1 Anchorage System

Additional anchorage for the Intake Tower is required. Concrete and anchor tendons added to the sides of the structure would be required.

4.2 Trash Structure

Strengthening of the trash structure for the high-level intake may be required. Additional analysis is needed to determine if demolition and rebuilding of the trash structure is necessary.

4.3 Operations and Maintenance

Changes in operations and maintenance procedures would not be required.

5 ALTERNATIVE NO. 2 - Storage of 35,000 AF

Alternative 2 proposes a seasonal storage of 35,000 acre-feet to reservoir elevation 2,375 NGVD.

5.1 Option 1

This option considers using the existing bulkhead with the intake structure deck remaining at its existing elevation of 2302. The intake structure, access bridge and road would be inundated by the conservation pool. Access and maintenance would only be possible when the pool is below elevation 2302. Increased seismic loading from the conservation pool (see Paragraph 2.2 Existing Seismic Design and Paragraph 3. Seismic Analysis.) Requires structural modifications to the intake tower.

5.1.1 Operations and Maintenance

Changes in operations and maintenance procedures would be required. The pool would be lowered to El. 2300 when the upstream tunnel required maintenance or inspection. For maintenance or inspection of the intake structure interior, the pool would be lowered to El. 2265.

5.1.2 Anchorage System

Additional anchorage for the Intake Tower is required. Concrete and anchor tendons added to the sides of the structure would be required.

5.1.3 Intake Structure

The existing intake structure is not designed for the seismic forces from the conservation pool. Additional strength could be obtained in a concrete "jacket" placed around the existing structure and with additional concrete and anchor tendons to the sides of the structure.

5.2 Option 2 (Recommended)

An 80-foot high steel frame, concrete maintenance deck and access bridge would be constructed on top of the existing concrete maintenance deck. Access to the existing maintenance deck would be limited due to the steel framing members.

5.2.1 General Design

The steel frame extension design utilizes various steel sections as beams, columns and diagonal bracing. These members make up a three-story frame system oriented in a hexagonal fashion. The columns are designed with a fixed connection to the existing maintenance deck at El. 2302. They align with the existing columns of the trashrack structure [See Plate S-4]. The new deck at El. 2382, supported by the extended steel frame, is of similar design to the existing deck at El. 2302. This 80 foot extension would keep the access above the conservation pool. See paragraph 2.5 Multi-level Withdrawal System requirements.

5.2.2 Access

Access to the new maintenance deck would be provided by a 161 foot, two span steel girder bridge. The bridge would be of unequal spans, with the longer span from the support pier to the intake structure. This arrangement would preserve access to the existing bridge at El. 2302. Steel girders are more durable for delivery than prestressed girders, which require special handling/attention due to sharp turns in the access roads. To facilitate delivery, the steel girders could be spliced at the site.

5.2.3 Bulkheads and Guides

Due to the increased static head for this alternative, a new bulkhead design is required. A design similar to the existing bulkhead would provide adequate additional strength, provided that the design utilizes thicker web/flange plates and stiffening plates [see "Pertinent Data" of Plate S-15]. The bulkhead and pendants would be stored in the new slot below the deck. The existing storage slot is below the conservation pool and would be inaccessible.

The bulkhead guide slots would be extended to the new maintenance deck. The extended bulkhead guide slots would consist of steel plate and channels aligned with the existing slots. Adequate lateral support would be provided.

5.2.4 Tunnel

The outlet tunnel would be subjected to additional external hydrostatic loading due to the conservation pool. The existing tunnel liner can resist this additional loading.

5.2.5 Anchorage System

The mass of the steel frame extension is relatively insignificant when compared to the mass of the existing intake structure. The effects of the frame itself on the existing anchorage system are near or below 10%. The seismic loading from the conservation pool also increases the demands on the anchorage system. Additional anchorage for the Intake Tower is required. Concrete and anchor tendons added to the sides of the structure would be required.

5.2.6 Intake Structure

The existing intake structure is not designed for the seismic forces from the conservation pool. Additional strength could be obtained in a concrete "jacket" placed around the existing structure and with additional concrete and anchor tendons to the sides of the structure.

5.2.7 Constructibility

The design of the steel frame extension is adequate and meets zone 4, site-specific seismic design requirements. The existing concrete trashrack structure, however, does not meet seismic requirements with the added steel frame extension. Seismic analysis reveals that approximately 20% of the members in the existing trashrack structure would require modification to support the additional loads induced by the steel frame extension. Many of these members are the lower columns of the structure. Therefore, modification and/or replacement of these members would likely be very difficult. See Figure 2 for members which require replacement. Complete demolition and rebuilding of the trash structure is recommended to achieve the strengthened integral structure required. Temporary support of the existing bridge would also be required.

5.2.8 Existing Deck at El. 2302

Use of the existing deck at elevation 2302 would be restricted by the addition of the steel frame above, by the bulkhead guide extension and by a hoisting pendant slot. Since the upper portion of the intake structure would be vertical and the lower portion inclined, a slot from the bulkhead opening toward the center of the deck area would be required. The changing position of the bulkhead causes the position of the hoisting pendant at the existing deck to also move upstream. A slot of 10 feet long (toward the center of the deck) and about 12 inches wide would be required. This slot would restrict personnel access to the existing maintenance deck during bulkhead use. Along the pendants, the size (diameter) and flexibility of the sockets is different than the wire rope. If a roller is used to keep the pendants in the bulkhead slot, the sockets could jam against the roller.

During low water, removal of debris from the steel frame would be partially completed from the existing deck. Inspection of the frame would be possible from the El. 2302 deck. All crane work and inspection of the wet well, by skip, through the inspection slot, would be performed from the new maintenance deck at elevation 2382.

5.2.9 Operations and Maintenance

Operations and maintenance procedures would be similar to the existing intake structure. Bulkhead installation and removal would require additional hoisting time and the handling and storage of additional pendants. Since the maintenance deck is more than 80 feet above the trashrack, debris removal from the trashrack would require more time and be more difficult to accomplish. Crane operations from the El. 2302 maintenance deck would not be possible due to the steel frame. Additional maintenance of the steel bridge girders would be required in comparison to concrete girders.

5.2.10 Vent

The vent pipe which is required to dewater the tunnel will be relocated above the conservation pool.

5.3 **Option 3**

The existing structure (46-foot outside diameter wet-well only) would be extended 75 feet. The existing trashrack between El. 2265 and El. 2302, maintenance deck, and access bridge would be removed. A new trashrack would be built on top of the circular wet-well at El. 2340 and a new maintenance deck and access bridge would be constructed at El. 2382. The 80 foot extension would keep the bridge girders above the conservation pool. [See Plate S-6].

5.3.1 Access

Access to the new maintenance deck would be provided by a 159.7 foot, two span steel girder bridge. The bridge would be of unequal spans, with the longer span from the support pier to the intake structure. Steel girders are more durable for delivery than prestressed girders, which require special handling/attention due to sharp turns in the access roads. To facilitate delivery, the steel girders could be spliced at the site.

5.3.2 Bulkheads and Guides

Due to the increased static head for this alternative, a new bulkhead design is required. A design similar to the existing bulkhead would provide adequate additional strength, provided that the design utilizes thicker web/flange plates and stiffening plates [see "Pertinent Data" of Plate S-15]. The bulkhead guide slots would be extended with the wetwell to the new deck elevation.

5.3.3 Tunnel

The outlet tunnel would be subjected to additional external hydrostatic loading due to the conservation pool. The existing tunnel liner can resist this additional loading.

5.3.4 Anchorage System

The additional mass of the wet-well extension and confined water and the hydrodynamic added mass would significantly increase the strength requirements of the anchorage system. Additional study and complex analysis would be necessary to determine the anchorage system requirements. (A simplified analysis indicates that the anchorage requirements would be 3.62 times as large as the existing system). Additional anchorage for the Intake Tower is required. Concrete and anchor tendons added to the sides of the structure would be required.

5.3.5 Intake Structure

The existing intake structure is not designed for the seismic forces from the conservation pool. Additional strength could be obtained in a concrete "jacket" placed around the existing structure and with additional concrete and anchor tendons to the sides of the structure. The extent of strengthening needed is unknown and would required detailed analysis.

5.3.6 Constructibility

The increased mass of the segment of extended main wet well coupled with the increased mass of water confined within this segment, the raised mass of the trash rack structure, and the greatly increased hydrodynamic effects of raising the pool 110 feet above the current design pool significantly increases the structural response to the large design earthquake ground motions predicted for the Seven Oaks site. Preliminary dynamic analysis of the structure described above for this option indicate considerable changes from the current design are required as well as heavy reinforcing requirements for the extended segment of the structure. In addition to additional anchors for the anchorage system, redesign and rebuilding of the existing wet well would be required. Reinforcing of the wet well would approach the upper practical limit for conventional reinforced concrete design.

5.3.7 Operations and Maintenance

Operations and maintenance procedures would be similar to the existing intake structure. Bulkhead installation and removal would require additional hoisting time and the handling and storage of additional pendants. Since the maintenance deck is immediately above the trashrack (as it is in existing structure), debris removal from the trashrack would not require more time nor be more difficult to accomplish. Additional maintenance of the steel bridge girders would be required in comparison to concrete girders.

5.3.8 Vent

The vent pipe which is required to dewater the tunnel will be relocated above the conservation pool.

5.4 **Option 4**

A bulkhead positioning steel frame would be constructed on top of the existing concrete maintenance deck to store and position the bulkhead.

5.4.1 General Design

Bulkhead installation would be performed remotely by a winch located above the conservation pool. The bulkhead would be stored in the frame with remote controlled dogging devices. "Underwater" hoisting at the positioning frame is not possible.

5.4.2 Access Roads

Access roads must be provided to each sheave location and to the winch motor/drum location. The existing bridge and deck would remain in place for access to the positioning frame. Lowering of the pool is required for access to the entire system.

To allow access to the deck area, the bulkhead is temporarily dogged just below the maintenance deck. The bulkhead guides would be modified to include the dogging component. While temporarily dogged, the wire ropes would be removed to provide access to the maintenance deck.

5.4.3 Mechanical Equipment

5.4.3.1 Wire Rope

Wire rope would be chosen with a safety factor of 5 based on the weight of the bulkhead. Using a preliminary weight of 55,000 lbs., the wire rope would be near 1-1/4" diameter.

5.4.3.2 Sheaves and Wire Rope Drum

Sheaves would be nominally sized to 34 inches (27 times the rope diameter). The wire rope drum would be a nominally sized to 37-1/2 inches (30 times the rope diameter).

5.4.3.3 Hoisting Machinery

Assuming a lifting speed of 3 feet per minute, a 5 horsepower motor could be used with a gear reduction ratio of 5800:1 for a standard 1750 rpm motor. "Underwater" hoisting at the positioning frame is not practical. Additional information about underwater hoisting is not available due to National Security Classification. From this restriction, it can be inferred that design of underwater hoisting equipment would be a substantial undertaking beyond the scope of this project.

5.4.4 Bulkhead

Due to the increased static head for this alternative, a new bulkhead design is required. A design similar to the existing bulkhead would provide adequate additional strength, provided that the design utilizes thicker web/flange plates and stiffening plates [see "Pertinent Data" of Plate S-15].

For storage, the new bulkhead would be dogged in the positioning frame, rather than continuously hanging from the hoist cable. Storage of the bulkhead in its guides below the deck level is not practical due to the bulkhead catching debris and interference with water flow. The previous concept of the steel frame being portable, is not practical or suitable if the frame is used for storage.

The dogging system is remotely-controlled, electric motor operated. The bulkhead is dogged at the top portion. The frame would have a hinged arm on both sides which would support the bulkhead arm on each side. The bulkhead is secured by wedging at the bottom during storage.

5.4.5 Tunnel
The outlet tunnel would be subjected to additional external hydrostatic loading due to the conservation pool. The existing tunnel liner can resist this additional loading.

5.4.6 Existing Anchorage
Increased seismic loading from the conservation pool (see Paragraph 2.2 Existing Seismic Design and Paragraph 3. Seismic Analysis) requires structural modifications to the intake tower. Additional anchorage for the Intake Tower is required. Concrete and anchor tendons added to the sides of the structure would be required.

5.4.7 Intake Structure
The existing intake structure is not designed for the seismic forces from the conservation pool. Additional strength could be obtained in a concrete "jacket" placed around the existing structure and with additional concrete and anchor tendons to the sides of the structure. Strengthening of the trash structure for the high-level intake may also be required.

5.4.8 Constructibility
The delivery of the steel members for the positioning frame would be easily done by truck from the access road to the deck at El. 2302. Access to the sheave location would be difficult due to the steepness of the location. Rigging of the hoist line would require manual stringing of a lighter line to pull the main hoist line into place.

5.4.9 Operations and Maintenance
The intake structure, access bridge and road would be inundated by the conservation pool. This option would require extensive cabling and winch systems. Significant maintenance and potential hazards are likely with this option. The frame and mechanical equipment reduce deck accessibility and interfere with crane operation. Bulkhead in stored position blocks access to deck. Moving the bulkhead and wire cable for deck access would require involved procedures. This option also has elements that entrap debris. A more complicated design that would protect cabling and winches in addition to allowing deck access would still require significant maintenance. All equipment would be subject to inundation during flood events.

5.4.10 Vent
The vent pipe which is required to dewater the tunnel would be relocated above the conservation pool.

5.5 **Option 5**
A remotely operated hydraulic slidegate would be installed in a gateroom downstream of the intake structure anchorage system.

5.5.1 General Design
The gateroom would be excavated near the upstream end of the tunnel. The slidegate would be accessed through a vertical shaft with the entrance above the conservation pool at El. 2382 [See Plate S-8]. The gateroom and slidegate would be located downstream of the intake structure anchorage system. External hydrostatic loading due to the conservation pool would act on the outlet tunnel. The tunnel liner would resist this additional loading.

5.5.1.1 Slidegate

The rectangular slidegate would be approximately 8 feet high x 14 feet wide. The slidegate would be operated by a 30-inch diameter hydraulic cylinder. The hydraulic system would operate at a fluid pressure of 2,000 psig. The bonnet would withstand pressure from a PMF.

5.5.1.2 Sump Pump

A sump pump in the gateroom is required to pump out seepage water. The seepage would be discharged into the conservation pool. The pump would be capable of producing 480 feet of head to discharge seepage water from the PMF pool.

5.5.2 Anchorage System

Additional anchorage for the Intake Tower is required. Concrete and anchor tendons added to the sides of the structure would be required.

5.5.3 Intake Structure

The existing intake structure is not designed for the seismic forces from the conservation pool. Additional strength could be obtained in a concrete "jacket" placed around the existing structure and with additional concrete and anchor tendons to the sides of the structure. Strengthening of the trash structure for the high-level intake may also be required.

5.5.4 Limitations

The gateroom and its shaft must be located downstream of the intake structure anchorage system. A waterproof hatch would be provided for the vertical access shaft. The hatch would be above conservation pool, however, occasional flooding conditions would submerge the hatch. The upstream 285 feet of the tunnel would not be accessible during water conservation periods.

5.5.5 Constructibility

Most of the construction of the gate chamber would be similar to the construction of the existing regulating chamber further downstream. Installation of all the equipment would be from the vertical access shaft. The existing tunnel liner would have to be rebuilt from the intake tower to the gate chamber, to accommodate the gate. A transition section would be required downstream of the gate. Diversion or storage of the water would have to be coordinated with the construction season to construct the chamber. Modification of the minimum discharge line would be required.

The location of the new gate room needs to be assessed and verified. Excavation of the access shaft could interfere with or damage the existing intake structure anchorage system. The excavation method and required distance from existing features need to be determined. The effects of shaft excavation on the intake structure anchorage system and visa versa are unknown and would be difficult to quantify.

6 ALTERNATIVE NO. 3 - Storage of 50,000 AF

Alternative 3 proposes for a maximum 50,000 acre-feet seasonal storage to reservoir elevation 2,418 NGVD.

6.1 Option 1

This option considers using the existing bulkhead with the intake structure deck remaining at its existing elevation of 2302. The intake structure, access bridge and road would be inundated by the conservation pool.

6.1.1 Anchorage System

Additional anchorage for the Intake tower is required. Concrete and anchor tendons added to the sides of the structure would be required.

6.1.2 Intake Structure

The existing intake structure is not designed for the seismic forces from the conservation pool. Additional strength could be obtained in a concrete "jacket" placed around the existing structure and with additional concrete and anchor tendons to the sides of the structure. Strengthening of the trash structure for the high-level intake may also be required.

6.1.3 Operations and Maintenance

Changes in operations and maintenance procedures would be required. The pool would be lowered to El. 2300 when the upstream tunnel required maintenance or inspection. For maintenance or inspection of the intake structure interior, the pool would be lowered to El. 2265.

6.2 Option 2 (Recommended)

An 123-foot high steel frame, concrete maintenance deck and access bridge would be constructed on top of the existing concrete maintenance deck. Access to the existing maintenance deck would be limited due to the steel framing members.

6.2.1 General Design

The steel frame extension design in this option is similar to Option 2 of Alternative 2 (para. 5.2.1). The steel frame extension would be a four-story frame system [see Plate S-11]. The new deck at El. 2425 is of similar design to the existing deck at El. 2302. This 123-foot extension would keep the bridge girders above the conservation pool. See paragraph 2.5 Multi-level Withdrawal System requirements.

6.2.2 Access

Access to the new service deck would be provided by a 205.2-foot, two span steel girder bridge. This arrangement would preserve access to the existing bridge at El. 2302. Steel girders are more durable for delivery than prestressed girders, which require special handling/attention due to sharp turns in the access roads. To facility delivery, the steel girders could be spliced at the site.

6.2.3 Bulkheads and Guides

Due to the increased static head for this alternative, a new bulkhead design is required. A design similar to the existing bulkhead would provide adequate additional strength, provided that the design utilizes thicker web/flange plates and stiffening plates [see "Pertinent Data" of Plate S-15]. The bulkhead and pendants would be stored in the new slot below the deck. The existing storage slot is below the conservation pool and would be inaccessible.

The bulkhead guide slots would be extended to the new maintenance deck. The extended bulkhead guide slots would consist of steel plate and channels aligned with the existing slots. Adequate lateral support would be provided.

6.2.4 Tunnel

The outlet tunnel would be subjected to additional external hydrostatic loading due to the conservation pool. The existing tunnel liner can resist this additional loading.

6.2.5 Anchorage System

Additional anchorage for the Intake tower is required. Concrete and anchor tendons added to the sides of the structure would be required.

6.2.6 Intake Structure

The existing intake structure is not designed for the seismic forces from the conservation pool. Additional strength could be obtained in a concrete "jacket" placed around the existing structure and with additional concrete and anchor tendons to the sides of the structure.

6.2.7 Constructibility

As in Alternative 2, the design of the steel frame extension in this option also meets seismic design requirements. However, with the addition of the steel frame extension, the existing concrete trashrack structure does not meet seismic requirements. As in Alternative 2, option 2, several members would require modification to support the additional loads induced by the steel frame extension. Modification and/or replacement of these members would likely be very difficult. See Figure 2 for members which require replacement. Complete demolition and rebuilding of the trash structure is recommended to achieve the strengthened, integral structure required. Temporary support of the existing access bridge would also be required.

Access to the existing bridge is available for this option. However, deck access is still hindered. The design of the steel frame extension for this option required additional diagonal bracing. As a result of this design, vehicular access to the existing deck at El. 2302 is blocked.

6.2.8 Existing Deck at El. 2302

Use of the existing deck at elevation 2302 would be restricted by the addition of the steel frame above, by the bulkhead guide extension and by a hoisting pendant slot. Since the upper portion of the intake structure would be vertical and the lower portion inclined a slot from the bulkhead opening toward the center of the deck area would be required. The changing position of the bulkhead causes the position of the hoisting pendant at the existing deck to also move upstream. A slot of 14 feet long (toward the center of the deck) and about 12 inches wide would be required. This slot would restrict personnel access to the existing maintenance deck during bulkhead use. Along the pendants, the size (diameter) and flexibility of the sockets is different than the wire rope. If a roller is used to keep the pendants in the bulkhead slot, the sockets could jam against the roller. During low water, removal of debris from the steel frame would be partially completed from the existing deck. Inspection of the frame would be possible from the 2302 deck. All crane work and inspection of the wet well, by skip, through the inspection slot, would be performed from the new deck at elevation 2425.

6.2.9 Operations and Maintenance

Operations and maintenance procedures would be similar to the existing intake structure. Bulkhead installation and removal would require additional hoisting time and the handling and storage of additional pendants. Since the maintenance deck is more than 123 feet above the trashrack, debris removal from the trashrack would require more time and be more difficult to accomplish. Crane operations from the El. 2302 maintenance deck would not be possible due to the steel frame. Additional maintenance of the steel bridge girders would be required in comparison to concrete girders.

6.2.10 Vent

The vent pipe which is required to dewater the tunnel would be relocated above the conservation pool.

6.3 **Option 3**

Extend the trash rack portion of the intake structure 123 feet up with a vertical extension of the concrete wet well and construct a new concrete deck at El. 2425 NGVD.

This option is not structurally feasible since the design forces would exceed the maximum designable strength of the structure and anchorage system. This is consistent with early studies of Seven Oaks with a free standing tower.

6.4 **Option 4**

A bulkhead positioning steel frame would be constructed on top of the existing concrete maintenance deck to store and position the bulkhead. The construction of the steel frame would be the same as in Alternative 2 (para. 5.4). The general design is the same with the exception of the lengthened cabling and winch systems.

6.4.1 General Design

Bulkhead installation would be performed remotely by a winch located above the conservation pool. The bulkhead would be stored in the frame with remote controlled dogging devices. "Underwater" hoisting at the positioning frame is not possible.

6.4.2 Access Roads

Access roads must be provided to each sheave location and to the winch motor/drum location. The existing bridge and deck would remain in place for access to the positioning frame. Lowering of the pool is required for access to the entire system.

To allow access to the deck area, the bulkhead is temporarily dogged just below the maintenance deck. The bulkhead guides would be modified to include the dogging component. While temporarily dogged, the wire ropes would be removed to provide access to the maintenance deck.

6.4.3 Mechanical Equipment

6.4.3.1 Wire Rope

Wire rope would be chosen with a safety factor of 5 based on the weight of the bulkhead. Using a preliminary weight of 55,000 lbs., the wire rope would be near 1-1/4" diameter.

6.4.3.2 Sheaves and Wire Rope Drum

Sheaves would be nominally sized to 34 inches (27 times the rope diameter). The wire rope drum would be a nominally sized to 37-1/2 inches (30 times the rope diameter).

6.4.3.3 Hoisting Machinery

Assuming a lifting speed of 3 feet per minute, a 5 horsepower motor could be used with a gear reduction ratio of 5800:1 for a standard 1750 rpm motor. "Underwater" hoisting at the positioning frame is not practical. Additional information about underwater hoisting is not available due to National Security Classification. From this restriction, it can be inferred that design of underwater hoisting equipment would be a substantial undertaking beyond the scope of this project.

6.4.3.4 Bulkhead

Due to the increased static head for this alternative, a new bulkhead design is required. A design similar to the existing bulkhead would provide adequate additional strength, provided that the design utilizes thicker web/flange plates and stiffening plates [see "Pertinent Data" of Plate S-15].

For storage, the new bulkhead would be dogged in the positioning frame, rather than continuously hanging from the hoist cable. Storage of the bulkhead in its guide rails below the deck level is not practical due to the bulkhead catching debris and interference with water flow. The previous concept of the steel frame being portable, is not practical or suitable if the frame is used for storage support.

The dogging system is remotely-controlled, electric motor operated. The bulkhead is dogged at the top portion. The frame would have a hinged arm on both sides which would support the bulkhead arm on each side. The bulkhead is secured by wedging at the bottom during storage.

6.4.4 Tunnel

The outlet tunnel would be subjected to additional external hydrostatic loading due to the conservation pool. The existing tunnel liner can resist this additional loading.

6.4.5 Existing Anchorage

Increase seismic loading from the conservation pool (see Paragraph 2.2 Existing Seismic Design and Paragraph 3. Seismic Analysis). Requires structural modifications to the intake tower. Additional anchorage for the Intake tower is required. Concrete and anchor tendons added to the sides of the structure would be required.

6.4.6 Intake Structure

The existing intake structure is not designed for the seismic forces from the conservation pool. Additional strength could be obtained in a concrete "jacket" placed around the existing structure and with additional concrete and anchor tendons to the sides of the structure. Strengthening of the trash structure for the high-level intake may also be required.

6.4.7 Constructibility

The delivery of the steel members for the positioning frame would be easily done by truck from the access road to the deck at elevation 2302. Access to the sheave location would be difficult due to the steepness of the location. Rigging of the hoist line would require manual stringing of a lighter line to pull the main hoist line into place.

6.4.8 Operations and Maintenance

The limitations associated with this option are similar to those dictated in paragraph 5.4.9.

6.4.9 Vent

The vent which is required to dewater the tunnel would be relocated above the conservation pool.

6.5 **Option 5**

A remotely operated hydraulic slidegate would be installed in a gateroom downstream of the intake structure anchorage system.

6.5.1 General Design

The gateroom would be excavated near the upstream end of the tunnel. The slidegate would be accessed through a vertical shaft with the entrance above the conservation pool at El. 2382 [See Plate S-14]. The gateroom and slidegate would be located downstream of the intake structure anchorage system. External hydrostatic loading due to the conservation pool would act on the outlet tunnel. The tunnel liner would resist this additional loading.

6.5.1.1 Slidegate

The rectangular slidegate would be approximately 8 feet high x 14 feet wide. The slidegate would be operated by a 30-inch diameter hydraulic cylinder. The hydraulic system would operate at a fluid pressure of 2,000 psig. The bonnet would withstand pressure from a PMF.

6.5.1.2 Sump Pump

A sump pump in the gateroom is required to pump out seepage water. The seepage would be discharged into the conservation pool. The pump would be capable of producing 480 feet of head to discharge seepage water from the PMF pool.

6.5.2 Anchorage System

Additional anchorage for the Intake tower is required. Concrete and anchor tendons added to the sides of the structure would be required.

6.5.3 Intake Structure

The existing intake structure is not designed for the seismic forces from the consecration pool. Additional strength could be obtained in a concrete "jacket" placed around the existing structure and with additional concrete and anchor tendons to the sides of the structure.

6.5.4 Limitations

The gateroom and its shaft must be located downstream of the intake structure anchorage system. A waterproof hatch would be provided for the vertical access shaft.. The hatch would be above conservation pool, however, occasional flooding conditions would submerge the hatch. The upstream 300 feet of the tunnel would not be accessible during water conservation periods.

6.5.5 Constructibility

Most of the construction of the gate chamber would be similar to the construction of the existing regulating chamber further downstream. Installation of all the equipment would be from the vertical access shaft. The existing tunnel liner would have to be rebuilt from the intake tower to the gate chamber, to accommodate the gate. A transition section would be required downstream of the gate. Diversion or storage of the water would have to be coordinated with the construction season to construct the chamber. Modification of the minimum discharge line would be required.

The location of the new gate room needs to be assessed and verified. Excavation of the access shaft could interfere with or damage the existing intake structure anchorage system. The excavation method and required distance from existing features need to be determined. The effects of shaft excavation on the intake structure anchorage system and visa versa are unknown and would be difficult to quantify.

7. **ALTERNATIVE NO. 4 - storage of 10,270 AF**

Alternative 4 proposes a seasonal storage of 10,270 acre-feet to a reservoir elevation of 2265. As stated previously, the seismic design of the original tower was based on a water surface at El. 2265 (see Paragraph 3 Seismic Analysis). Therefore, structural modifications to the intake tower and outlet works are considered not necessary. Changes in operations and maintenance procedures would also not be required.

8. INTAKE STRUCTURE ACCESS ROAD

Vehicular access to the intake structure for Alternatives 1 and 4 is not impacted by water conservation. However, Alternatives 2 and 3 would required construction of a branch road to maintain vehicle and equipment access to the top of the intake tower for maintenance and monitoring.

Plates 3 to 11 illustrate the conceptual design of the branch road. The segment of the road requiring excavation of the rock ridge above the intake structure was designed based on topographic information that have since been superseded by the current flood control project construction. A redesign of the road would be necessary in future studies.

In order to maintain vehicular access to the intake structure for Alternative 2, Options 2, 3, 4 and 5, a new branch road, which would follow elevation 2380 NGVD along the upstream face of the dam would be required. It would branch across the upstream face of the dam from the existing intake structure access road commencing at station 36+50, and would be 1550 feet in length, of which 300 feet would be in rock excavation. The road would also require the construction of a approximately 160-foot long bridge, from the pad at the new access road terminus to the tower. The bridge would be at elevation 2382 NGVD. The present intake structure access road would remain intact.

In order to maintain vehicular access to the intake structure for Alternative 3, Options 2, 3, 4 and 5 a new branch road, which would follow elevation 2420 NGVD along the upstream face of the dam would be required. It would branch across the face of the dam from the present intake structure access road commencing at station 28+50 and would be 2269 feet in length, of which 300 feet would be in rock excavation. The road would also require the construction of an approximately 205-foot long bridge from the new access road terminus to the tower. The bridge would be at elevation 2425 NGVD. The present intake access road would remain intact.

The new branch of the intake access road, where required, would necessitate removal and replacement of a three-foot layer of armored stone from the upstream face of the dam.

9. RESERVOIR ROAD RELOCATION

The existing Warm Springs Canyon Access Road and connection to the streambed access road upstream to powerhouses #1 and #2 would be partially inundated by all four alternatives. Therefore, a section of the road would require relocation to above the water conservation pool. This relocated road extension would be unpaved, 22 feet wide, and cut into the mountain side. Alternative 1 requires approximately 3,720 linear feet of road; Alternative 2 requires approximately 9,100 linear feet of road; Alternative 3 requires approximately 10,075 linear feet of road; and Alternative 4 requires approximately 2,220 linear feet of road. Primary users would be the Southern California Edison Company, the U.S. Forest Service, local water districts and the Corps of Engineers. In addition, Alternative 3 would require approximately 550 feet of realigned road just south of the existing Warm Springs Canyon Access Road as it intersects the bottom of Warms Springs Canyon. (see plate 13).

Coordinations with the U.S. Forest Service for the right-of-way to construct the relocated road have identified their concerns on constructibility and environmental impacts. Based on their concerns, alternate existing access was investigated to allow Edison to reach their powerhouse no. 1 facility upstream of the dam. However, these existing access roads/trails would require substantial improvement and maintenance and would not provide Edison with timely access. The design and cost presented are for a new reservoir road relocation. Future studies and coordinations with the Forest Service and Edison may replace the design of the relocated road with other reasonable options.

10. COST ESTIMATES

10.1 Feasibility Cost Estimate

The cost estimate for all four alternatives for water conservation is shown in Table 3, "Feasibility Cost Estimate." The table is a summary of the M-CACES cost estimate document which is available in the Los Angeles District Office. Presented is the total cost of the recommended design option for each water conservation alternative. The total cost consist of the itemized cost of each construction feature, cost for planning, engineering, and design, cost for engineering during construction, cost for construction management, and cost values for lands and damages. The estimated construction costs are based on a 6-day work week and a 10-hour work day schedule.

The total cost, however, does not include any compensation to Southern California Edison for potential water conservation impacts to their pipeline relocation. Edison is currently designing the relocation of the existing hydropower flume to an underground pipeline for the flood control project. They have indicated that retrofit of their pipeline would be required to strengthen it for water conservation at an estimated cost of 3 to 4 million dollars.

10.1.1 Intake Structure Modification

The cost for the intake structure modification is based on a preliminary feasibility analysis. Additional detailed analysis is required for final design. The cost to modify the intake structure for seismic strengthening due to water conservation is separated from the cost to modify the tower for water conservation operations. The cost for the intake structure modifications includes a 25% contingency.

10.1.1.1 Seismic

The seismic strengthening cost for Alternative 1, El. 2300, includes the demolition of the existing trash structure and deck, reconstruction of a stronger trash structure and deck, construction of additional concrete on each side of the intake structure for installation of anchor tendons, installation of dowels to tie the additional fillet concrete to the existing intake structure. The seismic strengthening cost for Alternatives 2 and 3 are determined by extrapolation the quantities from the design for Alternative 1. Detailed analysis for Alternatives 2 or 3, if required, may not substantiate the design extrapolations. Therefore, their respective strengthening costs may increase due to a revised design.

10.1.1.2 Operations

The operation modification cost includes the relocation of the bulkhead storage slot, construction of a longer access bridge for water conservation pools above el. 2302, a stronger bulkhead gate, and miscellaneous structural steel associated with raising the service deck for Alternatives 2 and 3.

10.1.2 Intake Structure Access Road Modification

The cost reflects the construction of an access road branch from the existing access road on the upstream face of the dam to the new bridge abutment for the elevated service deck on top of the intake tower. It includes a 20% contingency.

10.1.3 Relocated Road in Reservoir

The cost shown is based on the design for a new relocated road above the water conservation pool. It would replace the existing streambed access road to enable Edison to continue maintenance access to their powerhouse no. 1 facility upstream of the reservoir. Also see paragraph 9. The cost includes a 20% contingency.

10.1.4 Intake Slope Treatment

Rock slope treatment above the intake structure is required to ensure slope stability due to water conservation pools above el. 2300. The cost includes application of shotcrete, pattern rock bolts, and wire mesh treatment to accommodate the longer inundation period from the pool due to Alternatives 2 and 3. The cost includes a 25% contingency.

10.1.5 Embankment Modification (Drain Fill)

Modification to the current construction of the flood control project dam is required to accommodate the potential for future water conservation above El. 2300. Specifically, the blanket drain zone along each abutment downstream of the core and inclined drain zones must be raised above the flood control project elevation 2300. The cost of this modification is included in this Feasibility Study for completeness, although the cost to implement the change would need to be expended during the current flood control project construction in order to accommodate the potential for future water conservation above El. 2300. The cost reflects a contract changeorder cost estimate.

10.1.6 Planning, Engineering, and Design

The 26.71 percent used is based on the estimated cost to prepare the final design for Alternative 1 and is derived from the Draft Project Management Plan (PMP). The cost applies to the preparation of a Design Documentation Report (DDR) and contract Plans and Specifications (P&S). This percentage is reasonably applied to the cost of the other alternatives.

10.1.7 Engineering During Construction

The 7.91 percent used is based on the estimated cost to provide engineering technical support during the construction of Alternative 1 and is derived from the Draft Project management Plan (PMP). This percentage is reasonably applied to the cost of other alternatives.

10.1.8 Construction Management (S&A)

The 8.0 percent used is determined from reasonable cost estimates of construction management of similar construction projects.

10.1.9 Lands and Damages

The real estate values shown are speculative because the required lands for water conservation is part of the flowage easement behind the dam for the flood control project. The values could range from zero to the fair market values shown, if insisted by the U.S. Forest Service. The values account for the land under the water conservation pool, damages to the land, temporary staging areas, a 5% administrative cost, and a 25% contingency. See further discussion in the Real Estate Appendix.

10.2 MCACES Cost Summary

The cost Summary for Alternative 1, El. 2300, is shown in Table 4 with the relevant cost account codes.

10.3 MCACES Detail Cost Estimate

The detail cost for Alternative 1, El. 2300, is shown in Table 5.

11. Additional Operation and Maintenance (O&M)

Increased operation and maintenance effort for the outlet works and access roads would result in additional annual operation and maintenance cost. The incremental cost is estimated by analyzing the increased O&M activities and comparing them to the activities and costs previously identified in Santa Ana River Mainstem Project Design Memorandum No. 4, Feature Design - Seven Oaks Dam Outlet Works, Volume 1 - Reports and Plates, dated

April 1991; and Design Memorandum No. 1, Phase 2 GDM, Volume 1 - Seven Oaks Dam, dated August 1988.

11.1 Alternative 1, El. 2300

Table 6 itemizes the estimated incremental annual O&M cost due to water conservation storage at El. 2300. The operation cost would be slightly higher to anticipate flood control operation during water conservation storage. Monitoring and evaluation costs are increased to fund the additional effort to monitor the reservoir, read and record instrumentations, and evaluate reservoir impacts. Maintenance repair frequency of the outlet tunnel is increased to account for the additional wear due to water conservation discharge in the main Regulated Outlet (RO). Increased used of the electrical and mechanical parts and motors and additional wear to the mechanical control gates and valves are expected. In addition, it would be necessary to maintain the relocated reservoir road to make it accessible for Southern California Edison to service their facilities upstream of the water conservation pool.

11.2 Alternative 2, El. 2375, and Alternative 3, El 2418

Table 7 and Table 8 itemize the estimated incremental annual O&M cost due to water conservation storage at El. 2375 and El. 2418, respectively. The operation cost would be slightly higher to anticipate flood control operation during water conservation storage. Monitoring and evaluation costs are increased to fund the additional effort to monitor the reservoir, read and record instrumentations, and evaluate reservoir impacts. Maintenance repair frequency of the outlet tunnel is increased to account for the additional wear due to water conservation discharge in the main Regulated Outlet (RO). Increased use of the electrical and mechanical parts and motors and additional wear to the mechanical control gates and valves are expected. In addition, it would be necessary to maintain the relocated reservoir road to make it accessible for Southern California Edison to service their facilities upstream of the water conservation pool. Additional effort would be necessary to remove debris around the intake structure trash racks, the elevated service deck, and new steel frame structure. Increased effort would also be needed to install the bulkhead gate, inspection of the new bridge, painting of the steel frame structure, and maintenance of relocated intake structure access road to the elevated service deck.

11.3 Alternative 4, El. 2265

Table 9 shows the estimated incremental annual O&M cost due to water conservation storage at El. 2265. The operation cost would be slightly higher to anticipate flood control operation during water conservation storage. Monitoring and evaluation costs are increased to fund the additional effort to monitor the reservoir, read and record instrumentations, and evaluate reservoir impacts. Increased use of the electrical and mechanical parts and motors and additional wear to the valves are expected. In addition, it would be necessary to maintain the relocated reservoir road to make it accessible for Southern California Edison to service their facilities upstream of the water conservation pool.

12. RECOMMENDATIONS

An evaluation matrix, Table 2, was developed to show the advantages and disadvantages of each option as well as other considerations taken in selecting the recommended option for each alternative. Each option was evaluated not only in terms of cost but also in terms of risk for the inability to operate the bulkhead gate. Although Option 1 has the lowest cost, not being able to lower the emergency bulkhead gate due to the water conservation pool is unacceptable. The next lowest cost option is Option 4, the bulkhead positioning steel frame. However, this option is not very reliable. Therefore, Options 1 and 4 were dropped from further consideration. Options 3 and 5 were determined to be too costly. This leaves Option 2, which consists of a steel frame and concrete deck on top of the existing concrete deck to be at El. 2302. Option is 2 recommended for Alternatives 2 and 3 due to its least cost and acceptable risk and reliability. This design option was carried forward from the F-4 report to the development of the cost estimate in the current Draft Feasibility Study Report.

ALTERNATIVE 1 - CONSERVATION POOL AT EL. 2300.

	OPTION 1 Maintenance Deck at El. 2302	No other options for this Alternative			
Advantages	-				
Disadvantages	- Modify existing intake structure and trashrack. - Additional anchor tendons required.				
Construction Considerations	-Demolish and modify portion of intake structure and add concrete to sides of tower to accommodate additional anchors. - Limited construction season (risk of flood during construction).				
Operation Considerations	- Same as existing.				
Use of Existing Deck at El. 2302	- Same as existing.				
Maintenance Deck	- Same as existing.				
Operation Costs	- Same as existing.				
Considerations	- Seismic analysis required. - Redesign of tower required.				

ALTERNATIVE 2 - CONSERVATION POOL AT EL. 2375.

	OPTION 1	OPTION 2 Steel Frame Extension	OPTION 3 Concrete Extension	OPTION 4 Bulkhead Frame	OPTION 5 New Gate Chamber
Advantages	-	- Maintenance capability at new deck level. - Conventional construction. - Conventional delivery of construction materials.	- Capabilities preserved at new deck level. - Conventional construction. - Construction matches existing structure. - Aesthetics good.	- Low cost adaptation to preserve some maintenance capabilities.	- Remote operation. - Simplifies bulkhead installation.
Disadvantages	- Must lower pool below El. 2300 for all maintenance. -.Modify existing intake structure and trashrack. - Additional anchor tendons required. - New bulkhead required.	-Steel frame debris removal and maintenance (painting) required. - New access bridge and road required. -.Modify existing intake structure and trashrack. - Additional anchor tendons required. - New bulkhead required.	-.Modify existing intake structure and trashrack. - Additional anchor tendons required. - New bulkhead required. - Demolition of bridge and access deck. - New access bridge and road required. - High initial cost.	- Modify existing intake structure and trashrack. - Additional anchor tendons required. - New bulkhead required. - High maintenance of equipment required. - Low reliability of equipment to operate properly. - Some sheaves continuously submerged. - Hoisting equipment submerged during flood events. - Equipment exposed and subject to damage. - New access required.	- Modify existing intake structure and trashrack. - Additional anchor tendons required. - New bulkhead required. - Rock excavation required. - No access to upstream portion of tunnel when pool is above El. 2265. - New access road required.
Construction Considerations	- Demolish and modify portion of intake structure and add concrete to sides of tower to accommodate additional anchors. - Limited construction season (risk of flood during construction).	-Demolish and modify portion of intake structure and add concrete to sides of tower to accommodate additional anchors. - Limited construction season (risk of flood during construction). - Delivery of bridge girders and bulkhead will be difficult.	- Demolish and modify portion of intake structure and add concrete to sides of tower to accommodate additional anchors. - Limited construction season (risk of flood during construction). - Delivery of concrete same as for the lower portion of the structure. - Seasonal construction of concrete required. - Demolition of existing trash structure and bridge required. - Delivery of bridge girders and bulkhead will be difficult.	- Demolish and modify portion of intake structure and add concrete to sides of tower to accommodate additional anchors. - Limited construction season (risk of flood during construction). - Minimum effort required. - Additional access roads or extreme terrain required for wire rope sheaves. - Delivery of bulkhead will be difficult. - Additional power supply from tunnel outlet will be required.	- Demolish and modify portion of intake structure and add concrete to sides of tower to accommodate additional anchors. - Limited construction season (risk of flood during construction). - Excavation of shaft and chamber a substantial undertaking. Protection of existing tunnel, and anchorage systems require attention and will present some risk. - Construction season limited to dry season. - Delivery of bulkhead will be difficult. - Additional power supply from tunnel outlet will be required.
Operation Considerations	- Maintenance and inspection limited to an annual cycle. - Coordination of interested parties required to lower pool during conservation pool periods.	- Periodic debris removal from frame required. - Maintenance painting required. - Limited use of El. 2302 deck.	- Same as existing.	- Remote sensing required. - Equipment inaccessible for timely repairs and inspection. - Open slot for bulkhead may become plugged with debris, preventing operation.	- Maintenance and inspection of tower and upstream tunnel limited to annual cycles. - Coordination of interested parties required to lower pool during conservation pool periods.
Use of Deck at El. 2302 (must be scheduled to pool elevation.)	- Lowering of pool required to access deck for inspection and maintenance.	- Use of El. 2302 deck restricted to personnel access only. - Additional slot for bulkhead pendants reduces deck area, accessibility, and structural integrity.	- Deck eliminated	- Frame and mechanical equipment reduce deck accessibility. - Bulkhead must be stored for deck access.	- Lowering of pool required to access deck for inspection and maintenance of upstream tunnel and intake structure.
Maintenance Deck	- Same as existing. - Accessible when pool is lowered.	- Located at El. 2382.	- Located at El. 2382.	- Accessible when pool is lowered. - Uses existing deck at El 2302. - Use restricted by bulkhead positioning frame.	- Accessible when pool is lowered. - Uses existing deck at El 2302.
Operation Costs		- Removal of debris around steel structure. - Periodic painting of steel frame. - 40% more time to install/remove bulkhead - Increased effort to remove trash from trashrack and steel frame.	Similar cost as existing.	- Exposed mechanical equipment will require additional maintenance	- Additional equipment, gates, and chamber require additional operation costs.
Considerations	- Risk of lack of timely access. - Seismic analysis required. - Redesign of intake structure and anchorage required.	- Economics and aesthetics. - Seismic analysis required. - Redesign of intake structure and anchorage required.	- Economics and aesthetics - Seismic analysis required. - Redesign of intake structure and anchorage required.	- Reliability risk - Seismic analysis required. - Redesign of intake structure and anchorage required.	- Convenient but at a price. Not all of tunnel is accessible for inspection. - Seismic analysis required. - Redesign of intake structure and anchorage required.

Table 2. EVALUATION MATRIX Seven Oaks Dam, Water Conservation Feasibility Study, DRAFT REPORT

ALTERNATIVE 3 - CONSERVATION POOL AT El. 2418.

	OPTION 1 **Maintenance Deck at El. 2302**	**OPTION 2** **Steel Frame Extension**	**OPTION 3** **Concrete Extension**	**OPTION 4** **Bulkhead Frame**	**OPTION 5** **New Gate Chamber**
Advantages	-	- Maintenance capability at new deck level. - Conventional construction. - Conventional delivery of construction materials.	N/A	- Low cost adaptation to preserve some maintenance capabilities.	- Remote operation. - Simplifies bulkhead installation.
Disadvantages	- Must lower pool below El. 2300 for all maintenance. - Modify existing intake structure and trashrack. - Additional anchor tendons required. - New bulkhead required.	-Steel frame debris removal and maintenance (painting) required. - New access bridge and road required. - Modify existing intake structure and trashrack. - Additional anchor tendons required. - New bulkhead required.	- Not structurally feasible.	- Modify existing intake structure and trashrack. - Additional anchor tendons required. - New bulkhead required. - High maintenance of equipment required. - Low reliability of equipment to operate properly. - Some sheaves continuously submerged. - Hoisting equipment submerged during flood events. - Equipment exposed and subject to damage. - New access required.	- Modify existing intake structure and trashrack. - Additional anchor tendons required. - Rock excavation required. - No access to upstream portion of tunnel when pool is above El. 2300. - New access road required. - New bulkhead required.
Construction Considerations	- Demolish and modify portion of intake structure and add concrete to sides of tower to accommodate additional anchors. - Limited construction season (risk of flood during construction).	- Demolish and modify portion of intake structure and add concrete to sides of tower to accommodate additional anchors. - Limited construction season (risk of flood during construction). - Delivery of bridge girders and bulkhead will be difficult.	N/A	- Demolish and modify portion of intake structure and add concrete to sides of tower to accommodate additional anchors. - Limited construction season (risk of flood during construction). - Minimum effort required. - Additional access roads on extreme terrain required for wire rope sheaves. - Delivery of bulkhead will be difficult. - Additional power supply from tunnel outlet will be required.	- Demolish and modify portion of intake structure and add concrete to sides of tower to accommodate additional anchors. - Limited construction season (risk of flood during construction). - Excavation of shaft and chamber a substantial undertaking. Protection of existing tunnel, and anchorage systems require attention and will present some risk. - Construction season limited to dry season. - Delivery of bulkhead will be difficult. - Additional power supply from tunnel outlet will be required.
Operation Considerations	- Maintenance and inspection limited to an annual cycle. - Coordination of interested parties required to lower pool during conservation pool periods.	- Periodic debris removal from frame required. - Maintenance painting required. - Limited use of El. 2302 deck.	N/A	- Remote sensing required. - Equipment inaccessible for timely repairs and inspection. - Open slot for bulkhead may become plugged with debris, preventing operation.	- Maintenance and inspection of tower and upstream tunnel limited to annual cycles. - Coordination of interested parties required to lower pool during conservation pool periods.
Use of Deck at El. 2302 (must be scheduled to pool elevation.)	- Lowering of pool required to access deck for inspection and maintenance.	- Use of El. 2302 deck restricted to personnel access only. - Additional slot for bulkhead pendants reduces deck area, accessibility, and structural integrity.	N/A	- Frame and mechanical equipment reduce deck accessibility. - Bulkhead must be stored for deck access.	- Lowering of pool required to access deck for inspection and maintenance of upstream tunnel and intake structure.
Maintenance Deck	- Same as existing. - Accessible when pool is lowered.	- Located at El. 2425.	N/A	- Accessible when pool is lowered. - Uses existing deck at El 2302. - Use restricted by bulkhead positioning frame.	- Accessible when pool is lowered. - Uses existing deck at El 2302.
Operation Costs		- Removal of debris around steel structure. - Periodic painting of steel frame. - 60% more time to install/remove bulkhead - Increased effort to remove trash from trashrack and steel frame.	- Not structurally feasible.	- Exposed mechanical equipment will require additional maintenance	- Additional equipment, gates, and chamber require additional operation costs.
Considerations	- Risk of lack of timely access. - Seismic analysis required. - Redesign of intake structure and anchorage required.	- Economics and aesthetics. - Seismic analysis required. - Redesign of intake structure and anchorage required.	- Not structurally feasible.	- Reliability risk - Seismic analysis required. - Redesign of intake structure and anchorage required.	- Convenient but at a price. Not all of tunnel is accessible for inspection. - Seismic analysis required. - Redesign of intake structure and anchorage required.

ALTERNATIVE 4 - CONSERVATION POOL AT EL. 2265.

	OPTION 1 **Maintenance Deck at El. 2302**	**No other options for this Alternative**			
Advantages	-				
Disadvantages	- Minium conservation storage. - Storage totally depleted by estimated sediment deposition in year 100 of flood control project.	.			
Construction Considerations	-Requires no intake tower modification.				
Operation Considerations	- Same as existing.				
Use of Existing Deck at El. 2302	- Same as existing.				
Maintenance Deck	- Same as existing.				
Operation Costs	- Same as existing.				
Considerations	- Seismic analysis not required.				

Table 3:

FEASIBILITY COST ESTIMATE

SEVEN OAKS DAM, WATER CONSERVATION FEASIBILITY STUDY

Draft Feasibility Study Report

COST ESTIMATE 1997 PRICE LEVEL

Water Con. Alts.	Opt.	Intake Structure Modification		Intake Road Modification	Relocated Road in Reservoir	Intake Slope Treatment	Dam Modification (Drain Fill)	Total Const. Cost	PED	EDC	Const. Mngmt (S.& A)	Lands and Damages	Total Cost
		Raise Height	Seismic										
ALT. I WSEL. 2300	1	NO ACTION	$3,261,852	NO ACTION	$1,965,194	NO ACTION	NO ACTION	$5,227,046	$1,395,000	$413,000	$418,000	$657,000	$8,110,046
ALT. II WSEL. 2375	2	$1,741,742	$4,684,765	$371,137	$4,204,256	$1,871,928	$822,500	$13,696,328	$3,658,289	$1,083,380	$1,095,706	$1,519,000	$21,052,703
ALT. III WSEL. 2418	2	$2,493,237	$6,334,553	$919,198	$4,591,748	$2,591,639	$1,289,500	$18,219,875	$4,866,529	$1,441,192	$1,457,590	$2,038,000	$28,023,186
ALT. IV WSEL. 2265	2	NO ACTION	NO ACTION	NO ACTION	$1,075,800	NO ACTION	NO ACTION	$1,075,800	$287,346	$85,096	$86,064	$627,000	$2,161,306

FOOTNOTES:

1. PED denotes planning, engineering, and design costs.
2. EDC denotes engineering technical support during construction.
3. Constr. Mngmt. (S & A) denotes construction contract management, supervision, and administration.
4. Lands and Damages costs presented are based on current fair market values. The costs could range from zero to the fair market value shown. See further discussion in the text and in the Real Estate Appendix.

Table 4:

MCACES COST ESTIMATE SUMMARY, ALTERNATIVE 1 - WSEL 2300

SEVEN OAKS DAM, WATER CONSERVATION FEASIBILITY STUDY

Draft Feasibility Study Report

OCTOBER 1, 1996 BASELINE ESTIMATE

CODE OF ACCOUNT	DESCRIPTION	COST WITHOUT CONTINGENCIES	CONTG.	COST WITH CONTINGENCIES
04.	DAMS			
04.03.	OUTLET WORKS			
04.03.56	Intake Structure Modification	$2,609,482	25%	$3,262,000
	Strengthen Intake Structure (Seismic)			
04.03.56.03	Seismic Improvements	$1,689,526	25%	$2,112,000
04.03.56.05	Structural / Micell. Steel	$9,987	25%	$12,000
04.03.56.13	Addtnl Tower Strengthening (20')	$524,366	25%	$655,000
04.03.56.99	Concrete Belts @ 20'	$385,604	25%	$482,000
08.	ROADS			
08.01.	Relocated Road in Reservoir	$1,637,662	20%	$1,965,000
08.01.19.	Construct Roadbed to Subgrade			
08.01.19.02	Site Work (Earthwork)	$1,571,232	20%	$1,885,000
08.01.99.	Associated General Items			
08.01.99.02	Site work (Barrier Fence)	$66,430	20%	$80,000
	TOTAL CONSTRUCTION COST:	$4,247,144		$5,227,000
01.	LANDS & DAMAGES	$525,998	25%	$657,000
30.	PLANNING, ENGRG, & DESIGN (PED)	$1,395,000	N/A	$1,395,000
30.10.	Engineering During Construction	$413,000	N/A	$413,000
31.	CONSTRUCTION MANAGEMENT (S&A)	$418,000	N/A	$418,000
	TOTAL COST:	$6,999,142		$8,110,000

Table 5:

MCACES COST ESTIMATE DETAILS, ALTERNATIVE 1 - WSEL 2300

SEVEN OAKS DAM, WATER CONSERVATION FEASIBILITY STUDY

Draft Feasibility Study Report

CON STUDY/INTK TWR '97 (Alt I)
7-OAKS DAM, WATER CONSERVATION
FEASIBILITY STUDY
(Alt I, Opt 1.)
El. 2300

Designed By: Portland District/LA District
Estimated By: JUAN DOMINGUEZ

Prepared By: U.S. ARMY CORPS OF ENGINEERS.

Preparation Date: 03/13/97
Effective Date of Pricing: 03/13/97

Sales Tax: 7.75%

Currency in DOLLARS

LABOR ID: 7OAK94 EQUIP ID: 7OAK95

CREW ID: 94COST UPB ID: RG793A

The object of the Water Conservation Study is to conserve water up to elevation 2300. The work includes the strengthening of the intake tower and the relocation of a road in the reservoir.

The strengthening of the intake tower involves the construction of anchorage blocks and recontruction of the trash structure, deck and bulkhead storage slot. Futhermore, the upper 20' will be strenghten and concrete belts will be added.

Presplitting was considered under the construction of the road in the reservoir. The road construction will be a cut and fill operation.

1) 20% Contingency covers all unknowns uncertainties and unanticipated conditions not possible to evaluate from data at hand.
The contingency factor was based on the ER 1110-2-1302, for construction projects under $10,000,000.

2) 25% Contingency was based on the design engineer's percentage of conficence on his quantity take-off.

3) The escalation factors were furnished by PPMD.

SUMMARY REPORTS — SUMMARY PAGE

No Detailed Estimate...

No Backup Reports...

* * * END TABLE OF CONTENTS * * *

** CONTRACTOR SETTINGS **

		AMOUNT	PCT	PCT S	RISK	DIFF	SIZE	PERIOD	INVEST	ASSIST	SUBCON
AA General Contractor-Relocated Rd.											
Prime Contractor's Field Overhead	S		10.00	8.00							
Prime's Home Office Expence	P		4.00								
Prime Contractor's Profit	S		9.00	5.00							
Prime Contractor's Bond	C			(Class: B)							
BB Fencing Subcontractor											
Prime Contractor's Field Overhead	P		10.00								
Prime's Home Office Expence	P		4.00								
Prime Contractor's Profit	P		8.00								
Prime Contractor's Bond	C			(Class: B)							
CC Blasting Subcontractor											
Prime Contractor's Field Overhead	P		10.00								
Prime's Home Office Expence	P		4.00								
Prime Contractor's Profit	P		8.00								
Prime Contractor's Bond	C			(Class: B)							
1A Intake Struct. Seismic Mod.											
Prime Contractor's Field Overhead	S		10.00	8.00							
Prime's Home Office Expence	P		4.00								
Prime Contractor's Profit	S		9.00	5.00							
Prime Contractor's Bond	C			(Class: B)							
S2 Structural Steel Subcontractor											
Prime Contractor's Field Overhead	P		10.00								
Prime's Home Office Expence	P		4.00								
Prime Contractor's Profit	C		9.20		0.075	0.075	0.109	0.064	0.075	0.120	0.120
Prime Contractor's Bond	C			(Class: B)							

U.S. Army Corps of Engineers
PROJECT I1121G: CON STUDY/INTK TWR '97 (Alt I) - 7-OAKS DAM, WATER CONSERVATION
7-OAKS DAM, INTAKE STRUCTURE FEASIBILITY
** PROJECT OWNER SUMMARY - Contract **

	QUANTITY UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT COST	NOTES
01 Lands & Damages		525,998	131,500	0	657,498		
04 Dams		2,609,482	652,370	427,303	3,689,155		2
08 Roads		1,637,662	327,532	257,441	2,222,635		1
30 Planning, Engineering and Design		1,813,000	0	76,146	1,889,146		
31 Construction Management (S&I)		418,000	0	54,758	472,758		
TOTAL CON STUDY/INTK TWR '97 (Alt I)	1.00 EA	7,004,142	1,111,402	815,647	8,931,192	8931192	

	QUANTITY UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT COST	NOTES
01 Lands & Damages		525,998	131,500	0	657,498		
04 Dams							
04. 03 Outlet Works		2,609,482	652,370	427,303	3,689,155		
TOTAL Dams		2,609,482	652,370	427,303	3,689,155		2
08 Roads							
08. 01 Relocated Rd.-Earthwork Cut/Fill		1,637,662	327,532	257,441	2,222,635		
TOTAL Roads		1,637,662	327,532	257,441	2,222,635		1
30 Planning, Engineering and Design							
30. 10 Engineering During Construction		413,000	0	17,346	430,346		
30. 26 Micllaneous Acitivities		1,400,000	0	58,800	1,458,800		
TOTAL Planning, Engineering and Design		1,813,000	0	76,146	1,889,146		
31 Construction Management (S&I)		418,000	0	54,758	472,758		

	QUANTITY UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT COST	NOTES
01 Lands & Damages		525,998	131,500	0	657,498		
04 Dams							
04. 03 Outlet Works							
04. 03.56 Strengthen Intake Structure		2,609,482	652,370	427,303	3,689,155		
TOTAL Outlet Works		2,609,482	652,370	427,303	3,689,155		
TOTAL Dams		2,609,482	652,370	427,303	3,689,155		2
08 Roads							
08. 01 Relocated Rd.-Earthwork Cut/Fill							
08. 01.19 Construct Roadbed to Subgrade		1,571,232	314,246	246,998	2,132,476		
08. 01.99 Associated General Items		66,430	13,286	10,443	90,159		
TOTAL Relocated Rd.-Earthwork Cut/Fill		1,637,662	327,532	257,441	2,222,635		
TOTAL Roads		1,637,662	327,532	257,441	2,222,635		1
30 Planning, Engineering and Design							
30. 10 Engineering During Construction		413,000	0	17,346	430,346		
30. 26 Micllaneous Acitivities		1,400,000	0	58,800	1,458,800		
TOTAL Planning, Engineering and Design		1,813,000	0	76,146	1,889,146		
31 Construction Management (S&I)		418,000	0	54,758	472,758		

	QUANTITY UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT COST	NOTES
01 Lands & Damages		525,998	131,500	0	657,498		
04 Dams							
04. 03 Outlet Works							
04. 03.56 Strengthen Intake Structure							
04. 03.56.03 Seismic Improvements		1,689,526	422,381	276,660	2,388,567		1
04. 03.56.05 Structural/Miscll. Steel	5600.00 LBS	9,987	2,497	1,635	14,119	2.52	
04. 03.56.13 Addtnl Twr Strengthening, (20')		524,366	131,091	85,865	741,322		1
04. 03.56.99 Concrete Belts @ 20' spcng.		385,604	96,401	63,143	545,147		1
TOTAL Strengthen Intake Structure		2,609,482	652,370	427,303	3,689,155		
TOTAL Outlet Works		2,609,482	652,370	427,303	3,689,155		
TOTAL Dams		2,609,482	652,370	427,303	3,689,155		2
08 Roads							
08. 01 Relocated Rd.-Earthwork Cut/Fill							
08. 01.19 Construct Roadbed to Subgrade							
08. 01.19.02 Site Work	247540.00 CY	1,571,232	314,246	246,998	2,132,476	8.61	
TOTAL Construct Roadbed to Subgrade		1,571,232	314,246	246,998	2,132,476		
08. 01.99 Associated General Items							
08. 01.99.02 Site Work		66,430	13,286	10,443	90,159		
TOTAL Associated General Items		66,430	13,286	10,443	90,159		
TOTAL Relocated Rd.-Earthwork Cut/Fill		1,637,662	327,532	257,441	2,222,635		
TOTAL Roads		1,637,662	327,532	257,441	2,222,635		1
30 Planning, Engineering and Design							
30. 10 Engineering During Construction		413,000	0	17,346	430,346		
30. 26 Micllaneous Acitivities		1,400,000	0	58,800	1,458,800		
TOTAL Planning, Engineering and Design		1,813,000	0	76,146	1,889,146		
31 Construction Management (S&I)		418,000	0	54,758	472,758		

	QUANTITY UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT COST	NOTES
01 Lands & Damages		525,998	131,500	0	657,498		
04 Dams							
04. 03 Outlet Works							
04. 03.56 Strengthen Intake Structure							
04. 03.56.03 Seismic Improvements							
04. 03.56.03.10 DEMO. CONCRETE	675.00 CY	22,868	5,717	3,745	32,330	47.90	1
04. 03.56.03.20 TIEBACK ANCHORS, 100' in length	3000.00 LF	489,231	122,308	80,112	691,651	230.55	
04. 03.56.03.30 INT TWR, CONCRETE	1375.00 CY	537,342	134,335	87,990	759,667	552.49	
04. 03.56.03.40 INT TWR, REINFORCEMENT	393000.00 LBS	380,604	95,151	62,324	538,078	1.37	
04. 03.56.03.50 CEMENT	9700.00 CWT	45,611	11,403	7,469	64,482	6.65	
04. 03.56.03.60 POZZOLAN	2900.00 CF	9,834	2,459	1,610	13,903	4.79	
04. 03.56.03.70 WATER REDUCING ADMIXTURE	680.00 GAL	3,960	990	649	5,599	8.23	
04. 03.56.03.80 STRUCTURAL/MISCLL. STEEL	30000.00 LBS	53,500	13,375	8,761	75,636	2.52	
04. 03.56.03.90 DRILL & GROUT REINFORCING STEEL	1310.00 EA	146,575	36,644	24,002	207,221	158.18	
TOTAL Seismic Improvements		1,689,526	422,381	276,660	2,388,567		1
04. 03.56.05 Structural/Miscll. Steel	5600.00 LBS	9,987	2,497	1,635	14,119	2.52	
04. 03.56.13 Addtnl Twr Strengthening, (20')							
04. 03.56.13.10 DEMO. CONCRETE	560.00 CY	18,972	4,743	3,107	26,822	47.90	1
04. 03.56.13.30 INT TWR, CONCRETE	560.00 CY	218,845	54,711	35,836	309,392	552.49	
04. 03.56.13.40 INT TWR, REINFORCEMENT	280000.00 LBS	271,168	67,792	44,404	383,364	1.37	
04. 03.56.13.50 CEMENT	2500.00 CWT	11,755	2,939	1,925	16,619	6.65	
04. 03.56.13.60 POZZOLAN	760.00 CF	2,577	644	422	3,644	4.79	
04. 03.56.13.70 WATER REDUCING ADMIXTURE	180.00 GAL	1,048	262	172	1,482	8.23	
TOTAL Addtnl Twr Strengthening, (20')		524,366	131,091	85,865	741,322		1
04. 03.56.99 Concrete Belts @ 20' spcng.							
04. 03.56.99.30 INT TWR, CONCRETE	630.00 CY	246,200	61,550	40,315	348,066	552.49	
04. 03.56.99.40 INT TWR, REINFORCEMENT	126000.00 LBS	122,026	30,506	19,982	172,514	1.37	
04. 03.56.99.50 CEMENT	2835.00 CWT	13,331	3,333	2,183	18,846	6.65	
04. 03.56.99.60 POZZOLAN	850.00 CF	2,882	721	472	4,075	4.79	
04. 03.56.99.70 WATER REDUCING ADMIXTURE	200.00 GAL	1,165	291	191	1,647	8.23	
TOTAL Concrete Belts @ 20' spcng.		385,604	96,401	63,143	545,147		1
TOTAL Strengthen Intake Structure		2,609,482	652,370	427,303	3,689,155		
TOTAL Outlet Works		2,609,482	652,370	427,303	3,689,155		
TOTAL Dams		2,609,482	652,370	427,303	3,689,155		2

	QUANTITY UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT COST	NOTES
08 Roads							
08. 01 Relocated Rd.-Earthwork Cut/Fill							
08. 01.19 Construct Roadbed to Subgrade							
08. 01.19.02 Site Work							
08. 01.19.02.01 Presplit Cut Material	36968.00 LF	441,913	88,383	69,469	599,764	16.22	
08. 01.19.02.02 Cut/Fill w/ Scraper & Push Dozer	247540.00 BCY	575,764	115,153	90,510	781,426	3.16	
08. 01.19.02.03 Compct Fill/Smooth-Wheel Rollers	210830.00 BCY	525,272	105,054	82,573	712,899	3.38	
08. 01.19.02.04 Rock Barrier Fence	1850.00 LF	28,284	5,657	4,446	38,387	20.75	
TOTAL Site Work	247540.00 CY	1,571,232	314,246	246,998	2,132,476	8.61	
TOTAL Construct Roadbed to Subgrade		1,571,232	314,246	246,998	2,132,476		
08. 01.99 Associated General Items							
08. 01.99.02 Site Work							
08. 01.99.02.03 Relocated Rd. Guard Rail	3580.00 LF	66,430	13,286	10,443	90,159	25.18	
TOTAL Site Work		66,430	13,286	10,443	90,159		
TOTAL Associated General Items		66,430	13,286	10,443	90,159		
TOTAL Relocated Rd.-Earthwork Cut/Fill		1,637,662	327,532	257,441	2,222,635		
TOTAL Roads		1,637,662	327,532	257,441	2,222,635		1
30 Planning, Engineering and Design							
30. 10 Engineering During Construction		413,000	0	17,346	430,346		
30. 26 Micllaneous Acitivities		1,400,000	0	58,800	1,458,800		
TOTAL Planning, Engineering and Design		1,813,000	0	76,146	1,889,146		
31 Construction Management (S&I)		418,000	0	54,758	472,758		

	QUANTITY	UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
01 Lands & Damages			525,998	0	0	0	0	525,998	
04 Dams			2,129,614	190,724	92,813	167,228	29,103	2,609,482	
08 Roads			1,318,885	124,014	57,716	117,367	19,680	1,637,662	
30 Planning, Engineering and Design			1,813,000	0	0	0	0	1,813,000	
31 Construction Management (S&I)			418,000	0	0	0	0	418,000	
TOTAL CON STUDY/INTK TWR '97 (Alt I)	1.00	EA	6,205,497	314,738	150,529	284,595	48,783	7,004,142	7004142
Contingency	15.87	%						1,111,402	
SUBTOTAL								8,115,544	
Escalation to Mid-pto of Construction	10.05	%						815,647	
TOTAL INCL OWNER COSTS								8,931,192	

	QUANTITY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
01 Lands & Damages		525,998	0	0	0	0	525,998	
Contingency	25.00 %						131,500	
TOTAL INCL OWNER COSTS							657,498	
04 Dams								
04. 03 Outlet Works		2,129,614	190,724	92,813	167,228	29,103	2,609,482	
TOTAL Dams		2,129,614	190,724	92,813	167,228	29,103	2,609,482	
Contingency	25.00 %						652,370	
SUBTOTAL							3,261,852	
Escalation to Mid-pto of Construction	13.10 %						427,303	
TOTAL INCL OWNER COSTS							3,689,155	
08 Roads								
08. 01 Relocated Rd.-Earthwork Cut/Fill		1,318,885	124,014	57,716	117,367	19,680	1,637,662	
TOTAL Roads		1,318,885	124,014	57,716	117,367	19,680	1,637,662	
Contingency	20.00 %						327,532	
SUBTOTAL							1,965,195	
Escalation to Mid-pto of Construction	13.10 %						257,441	
TOTAL INCL OWNER COSTS							2,222,635	
30 Planning, Engineering and Design								
30. 10 Engineering During Construction		413,000	0	0	0	0	413,000	
30. 26 Micllaneous Acitivities		1,400,000	0	0	0	0	1,400,000	
TOTAL Planning, Engineering and Design		1,813,000	0	0	0	0	1,813,000	
Escalation to Mid-pto of Construction	4.20 %						76,146	
TOTAL INCL OWNER COSTS							1,889,146	
31 Construction Management (S&I)		418,000	0	0	0	0	418,000	
Escalation to Mid-pto of Construction	13.10 %						54,758	
TOTAL INCL OWNER COSTS							472,758	

	QUANTITY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
01 Lands & Damages		525,998	0	0	0	0	525,998	
Contingency	25.00 %						131,500	
TOTAL INCL OWNER COSTS							657,498	
04 Dams								
04. 03 Outlet Works								
04. 03.56 Strengthen Intake Structure		2,129,614	190,724	92,813	167,228	29,103	2,609,482	
TOTAL Outlet Works		2,129,614	190,724	92,813	167,228	29,103	2,609,482	
TOTAL Dams		2,129,614	190,724	92,813	167,228	29,103	2,609,482	
Contingency	25.00 %						652,370	
SUBTOTAL							3,261,852	
Escalation to Mid-pto of Construction	13.10 %						427,303	
TOTAL INCL OWNER COSTS							3,689,155	
08 Roads								
08. 01 Relocated Rd.-Earthwork Cut/Fill								
08. 01.19 Construct Roadbed to Subgrade		1,266,242	118,750	55,400	111,947	18,894	1,571,232	
08. 01.99 Associated General Items		52,644	5,264	2,316	5,420	786	66,430	
TOTAL Relocated Rd.-Earthwork Cut/Fill		1,318,885	124,014	57,716	117,367	19,680	1,637,662	
TOTAL Roads		1,318,885	124,014	57,716	117,367	19,680	1,637,662	
Contingency	20.00 %						327,532	
SUBTOTAL							1,965,195	
Escalation to Mid-pto of Construction	13.10 %						257,441	
TOTAL INCL OWNER COSTS							2,222,635	
30 Planning, Engineering and Design								
30. 10 Engineering During Construction		413,000	0	0	0	0	413,000	
30. 26 Micllaneous Acitivities		1,400,000	0	0	0	0	1,400,000	
TOTAL Planning, Engineering and Design		1,813,000	0	0	0	0	1,813,000	
Escalation to Mid-pto of Construction	4.20 %						76,146	

		QUANTITY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST

	TOTAL INCL OWNER COSTS							1,889,146	
31	Construction Management (S&I)		418,000	0	0	0	0	418,000	
	Escalation to Mid-pto of Construction	13.10 %						54,758	

	TOTAL INCL OWNER COSTS							472,758	

	QUANTITY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
01 Lands & Damages		525,998	0	0	0	0	525,998	
Contingency	25.00 %						131,500	
TOTAL INCL OWNER COSTS							657,498	
04 Dams								
04. 03 Outlet Works								
04. 03.56 Strengthen Intake Structure								
04. 03.56.03 Seismic Improvements		1,381,730	122,694	60,177	106,042	18,882	1,689,526	
04. 03.56.05 Structural/Miscll. Steel	5600.00 LBS	8,371	670	362	470	114	9,987	1.78
04. 03.56.13 Addtnl Twr Strengthening, (20')		428,145	38,269	18,657	33,444	5,851	524,366	
04. 03.56.99 Concrete Belts @ 20' spcng.		311,367	29,091	13,618	27,272	4,255	385,604	
TOTAL Strengthen Intake Structure		2,129,614	190,724	92,813	167,228	29,103	2,609,482	
TOTAL Outlet Works		2,129,614	190,724	92,813	167,228	29,103	2,609,482	
TOTAL Dams		2,129,614	190,724	92,813	167,228	29,103	2,609,482	
Contingency	25.00 %						652,370	
SUBTOTAL							3,261,852	
Escalation to Mid-pto of Construction	13.10 %						427,303	
TOTAL INCL OWNER COSTS							3,689,155	
08 Roads								
08. 01 Relocated Rd.-Earthwork Cut/Fill								
08. 01.19 Construct Roadbed to Subgrade								
08. 01.19.02 Site Work	247540.00 CY	1,266,242	118,750	55,400	111,947	18,894	1,571,232	6.35
TOTAL Construct Roadbed to Subgrade		1,266,242	118,750	55,400	111,947	18,894	1,571,232	
08. 01.99 Associated General Items								
08. 01.99.02 Site Work		52,644	5,264	2,316	5,420	786	66,430	
TOTAL Associated General Items		52,644	5,264	2,316	5,420	786	66,430	
TOTAL Relocated Rd.-Earthwork Cut/Fill		1,318,885	124,014	57,716	117,367	19,680	1,637,662	
TOTAL Roads		1,318,885	124,014	57,716	117,367	19,680	1,637,662	

U.S. Army Corps of Engineers
7-OAKS DAM, INTAKE STRUCTURE FEASIBILITY
** PROJECT INDIRECT SUMMARY - Element **

	QUANTITY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
Contingency	20.00 %						327,532	
SUBTOTAL							1,965,195	
Escalation to Mid-pto of Construction	13.10 %						257,441	
TOTAL INCL OWNER COSTS							2,222,635	
30 Planning, Engineering and Design								
30. 10 Engineering During Construction		413,000	0	0	0	0	413,000	
30. 26 Micllaneous Acitivities		1,400,000	0	0	0	0	1,400,000	
TOTAL Planning, Engineering and Design		1,813,000	0	0	0	0	1,813,000	
Escalation to Mid-pto of Construction	4.20 %						76,146	
TOTAL INCL OWNER COSTS							1,889,146	
31 Construction Management (S&I)		418,000	0	0	0	0	418,000	
Escalation to Mid-pto of Construction	13.10 %						54,758	
TOTAL INCL OWNER COSTS							472,758	

	QUANTITY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
01 Lands & Damages		525,998	0	0	0	0	525,998	
Contingency	25.00 %						131,500	
TOTAL INCL OWNER COSTS							657,498	
04 Dams								
04. 03 Outlet Works								
04. 03.56 Strengthen Intake Structure								
04. 03.56.03 Seismic Improvements								
04. 03.56.03.10 DEMO. CONCRETE	675.00 CY	18,140	1,814	798	1,868	248	22,868	33.88
04. 03.56.03.20 TIEBACK ANCHORS, 100' in length	3000.00 LF	410,076	32,806	17,715	23,030	5,604	489,231	163.08
04. 03.56.03.30 INT TWR, CONCRETE	1375.00 CY	426,250	42,625	18,755	43,887	5,825	537,342	390.79
04. 03.56.03.40 INT TWR, REINFORCEMENT	393000.00 LBS	319,024	25,522	13,782	17,916	4,360	380,604	0.97
04. 03.56.03.50 CEMENT	9700.00 CWT	36,181	3,618	1,592	3,725	494	45,611	4.70
04. 03.56.03.60 POZZOLAN	2900.00 CF	7,801	780	343	803	107	9,834	3.39
04. 03.56.03.70 WATER REDUCING ADMIXTURE	680.00 GAL	3,142	314	138	323	43	3,960	5.82
04. 03.56.03.80 STRUCTURAL/MISCLL. STEEL	30000.00 LBS	44,844	3,588	1,937	2,518	613	53,500	1.78
04. 03.56.03.90 DRILL & GROUT REINFORCING STEEL	1310.00 EA	116,272	11,627	5,116	11,971	1,589	146,575	111.89
TOTAL Seismic Improvements		1,381,730	122,694	60,177	106,042	18,882	1,689,526	
04. 03.56.05 Structural/Miscll. Steel	5600.00 LBS	8,371	670	362	470	114	9,987	1.78
04. 03.56.13 Addtnl Twr Strengthening, (20')								
04. 03.56.13.10 DEMO. CONCRETE	560.00 CY	15,050	1,505	662	1,550	206	18,972	33.88
04. 03.56.13.30 INT TWR, CONCRETE	560.00 CY	173,600	17,360	7,638	17,874	2,372	218,845	390.79
04. 03.56.13.40 INT TWR, REINFORCEMENT	280000.00 LBS	227,294	18,184	9,819	12,765	3,106	271,168	0.97
04. 03.56.13.50 CEMENT	2500.00 CWT	9,325	933	410	960	127	11,755	4.70
04. 03.56.13.60 POZZOLAN	760.00 CF	2,044	204	90	210	28	2,577	3.39
04. 03.56.13.70 WATER REDUCING ADMIXTURE	180.00 GAL	832	83	37	86	11	1,048	5.82
TOTAL Addtnl Twr Strengthening, (20')		428,145	38,269	18,657	33,444	5,851	524,366	
04. 03.56.99 Concrete Belts @ 20' spcng.								
04. 03.56.99.30 INT TWR, CONCRETE	630.00 CY	195,300	19,530	8,593	20,108	2,669	246,200	390.79
04. 03.56.99.40 INT TWR, REINFORCEMENT	126000.00 LBS	102,282	8,183	4,419	5,744	1,398	122,026	0.97
04. 03.56.99.50 CEMENT	2835.00 CWT	10,575	1,057	465	1,089	145	13,331	4.70
04. 03.56.99.60 POZZOLAN	850.00 CF	2,287	229	101	235	31	2,882	3.39
04. 03.56.99.70 WATER REDUCING ADMIXTURE	200.00 GAL	924	92	41	95	13	1,165	5.82
TOTAL Concrete Belts @ 20' spcng.		311,367	29,091	13,618	27,272	4,255	385,604	

	QUANTITY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
TOTAL Strengthen Intake Structure		2,129,614	190,724	92,813	167,228	29,103	2,609,482	
TOTAL Outlet Works		2,129,614	190,724	92,813	167,228	29,103	2,609,482	
TOTAL Dams		2,129,614	190,724	92,813	167,228	29,103	2,609,482	
Contingency	25.00 %						652,370	
SUBTOTAL							3,261,852	
Escalation to Mid-pto of Construction	13.10 %						427,303	
TOTAL INCL OWNER COSTS							3,689,155	
08 Roads								
08. 01 Relocated Rd.-Earthwork Cut/Fill								
08. 01.19 Construct Roadbed to Subgrade								
08. 01.19.02 Site Work								
08. 01.19.02.01 Presplit Cut Material	36968.00 LF	370,024	29,602	15,985	20,781	5,521	441,913	11.95
08. 01.19.02.02 Cut/Fill w/ Scraper & Push Dozer	247540.00 BCY	456,274	45,627	20,076	46,978	6,808	575,764	2.33
08. 01.19.02.03 Compct Fill/Smooth-Wheel Rollers	210830.00 BCY	416,261	41,626	18,315	42,858	6,211	525,272	2.49
08. 01.19.02.04 Rock Barrier Fence	1850.00 LF	23,683	1,895	1,023	1,330	353	28,284	15.29
TOTAL Site Work	247540.00 CY	1,266,242	118,750	55,400	111,947	18,894	1,571,232	6.35
TOTAL Construct Roadbed to Subgrade		1,266,242	118,750	55,400	111,947	18,894	1,571,232	
08. 01.99 Associated General Items								
08. 01.99.02 Site Work								
08. 01.99.02.03 Relocated Rd. Guard Rail	3580.00 LF	52,644	5,264	2,316	5,420	786	66,430	18.56
TOTAL Site Work		52,644	5,264	2,316	5,420	786	66,430	
TOTAL Associated General Items		52,644	5,264	2,316	5,420	786	66,430	
TOTAL Relocated Rd.-Earthwork Cut/Fill		1,318,885	124,014	57,716	117,367	19,680	1,637,662	
TOTAL Roads		1,318,885	124,014	57,716	117,367	19,680	1,637,662	
Contingency	20.00 %						327,532	
SUBTOTAL							1,965,195	
Escalation to Mid-pto of Construction	13.10 %						257,441	

	QUANTITY	UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
TOTAL INCL OWNER COSTS								2,222,635	
30 Planning, Engineering and Design									
30. 10 Engineering During Construction			413,000	0	0	0	0	413,000	
30. 26 Micllaneous Acitivities			1,400,000	0	0	0	0	1,400,000	
TOTAL Planning, Engineering and Design			1,813,000	0	0	0	0	1,813,000	
Escalation to Mid-pto of Construction	4.20	%						76,146	
TOTAL INCL OWNER COSTS								1,889,146	
31 Construction Management (S&I)			418,000	0	0	0	0	418,000	
Escalation to Mid-pto of Construction	13.10	%						54,758	
TOTAL INCL OWNER COSTS								472,758	

	QUANTITY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
01 Lands & Damages		0	0	0	0	525,998	525,998	
04 Dams		8,310	1,091,281	294,364	743,968	0	2,129,614	
08 Roads		8,472	655,728	453,326	209,831	0	1,318,885	
30 Planning, Engineering and Design		0	0	0	0	1,813,000	1,813,000	
31 Construction Management (S&I)		0	0	0	0	418,000	418,000	
TOTAL CON STUDY/INTK TWR '97 (Alt I)	1.00 EA	16,781	1,747,009	747,691	953,799	2,756,998	6,205,497	6205497
Prime Contractor's Field Overhead	5.07 %						314,738	
SUBTOTAL							6,520,235	
Prime's Home Office Expence	2.31 %						150,529	
SUBTOTAL							6,670,764	
Prime Contractor's Profit	4.27 %						284,595	
SUBTOTAL							6,955,359	
Prime Contractor's Bond	0.70 %						48,783	
TOTAL INCL INDIRECTS							7,004,142	
Contingency	15.87 %						1,111,402	
SUBTOTAL							8,115,544	
Escalation to Mid-pto of Construction	10.05 %						815,647	
TOTAL INCL OWNER COSTS							8,931,192	

	QUANTITY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
01 Lands & Damages		0	0	0	0	525,998	525,998	
Contingency	25.00 %						131,500	
TOTAL INCL OWNER COSTS							657,498	
04 Dams								
04.03 Outlet Works		8,310	1,091,281	294,364	743,968	0	2,129,614	
TOTAL Dams		8,310	1,091,281	294,364	743,968	0	2,129,614	
Prime Contractor's Field Overhead	8.96 %						190,724	
SUBTOTAL							2,320,337	
Prime's Home Office Expence	4.00 %						92,813	
SUBTOTAL							2,413,151	
Prime Contractor's Profit	6.93 %						167,228	
SUBTOTAL							2,580,379	
Prime Contractor's Bond	1.13 %						29,103	
TOTAL INCL INDIRECTS							2,609,482	
Contingency	25.00 %						652,370	
SUBTOTAL							3,261,852	
Escalation to Mid-pto of Construction	13.10 %						427,303	
TOTAL INCL OWNER COSTS							3,689,155	
08 Roads								
08.01 Relocated Rd.-Earthwork Cut/Fill		8,472	655,728	453,326	209,831	0	1,318,885	
TOTAL Roads		8,472	655,728	453,326	209,831	0	1,318,885	
Prime Contractor's Field Overhead	9.40 %						124,014	
SUBTOTAL							1,442,900	
Prime's Home Office Expence	4.00 %						57,716	
SUBTOTAL							1,500,615	
Prime Contractor's Profit	7.82 %						117,367	
SUBTOTAL							1,617,982	
Prime Contractor's Bond	1.22 %						19,680	
TOTAL INCL INDIRECTS							1,637,662	
Contingency	20.00 %						327,532	

	QUANTITY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
SUBTOTAL							1,965,195	
Escalation to Mid-pto of Construction	13.10 %						257,441	
TOTAL INCL OWNER COSTS							2,222,635	
30 Planning, Engineering and Design								
30. 10 Engineering During Construction		0	0	0	0	413,000	413,000	
30. 26 Micllaneous Acitivities		0	0	0	0	1,400,000	1,400,000	
TOTAL Planning, Engineering and Design		0	0	0	0	1,813,000	1,813,000	
Escalation to Mid-pto of Construction	4.20 %						76,146	
TOTAL INCL OWNER COSTS							1,889,146	
31 Construction Management (S&I)		0	0	0	0	418,000	418,000	
Escalation to Mid-pto of Construction	13.10 %						54,758	
TOTAL INCL OWNER COSTS							472,758	

	QUANTITY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
01 Lands & Damages			0	0	0	0	525,998	525,998	
Contingency	25.00	%						131,500	
TOTAL INCL OWNER COSTS								657,498	
04 Dams									
04. 03 Outlet Works									
04. 03.56 Strengthen Intake Structure			8,310	1,091,281	294,364	743,968	0	2,129,614	
TOTAL Outlet Works			8,310	1,091,281	294,364	743,968	0	2,129,614	
TOTAL Dams			8,310	1,091,281	294,364	743,968	0	2,129,614	
Prime Contractor's Field Overhead	8.96	%						190,724	
SUBTOTAL								2,320,337	
Prime's Home Office Expence	4.00	%						92,813	
SUBTOTAL								2,413,151	
Prime Contractor's Profit	6.93	%						167,228	
SUBTOTAL								2,580,379	
Prime Contractor's Bond	1.13	%						29,103	
TOTAL INCL INDIRECTS								2,609,482	
Contingency	25.00	%						652,370	
SUBTOTAL								3,261,852	
Escalation to Mid-pto of Construction	13.10	%						427,303	
TOTAL INCL OWNER COSTS								3,689,155	
08 Roads									
08. 01 Relocated Rd.-Earthwork Cut/Fill									
08. 01.19 Construct Roadbed to Subgrade			7,370	618,746	453,095	194,401	0	1,266,242	
08. 01.99 Associated General Items			1,102	36,982	232	15,430	0	52,644	
TOTAL Relocated Rd.-Earthwork Cut/Fill			8,472	655,728	453,326	209,831	0	1,318,885	
TOTAL Roads			8,472	655,728	453,326	209,831	0	1,318,885	
Prime Contractor's Field Overhead	9.40	%						124,014	
SUBTOTAL								1,442,900	
Prime's Home Office Expence	4.00	%						57,716	

	QUANTITY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
SUBTOTAL							1,500,615	
Prime Contractor's Profit	7.82 %						117,367	
SUBTOTAL							1,617,982	
Prime Contractor's Bond	1.22 %						19,680	
TOTAL INCL INDIRECTS							1,637,662	
Contingency	20.00 %						327,532	
SUBTOTAL							1,965,195	
Escalation to Mid-pto of Construction	13.10 %						257,441	
TOTAL INCL OWNER COSTS							2,222,635	
30 Planning, Engineering and Design								
30. 10 Engineering During Construction		0	0	0	0	413,000	413,000	
30. 26 Micllaneous Acitivities		0	0	0	0	1,400,000	1,400,000	
TOTAL Planning, Engineering and Design		0	0	0	0	1,813,000	1,813,000	
Escalation to Mid-pto of Construction	4.20 %						76,146	
TOTAL INCL OWNER COSTS							1,889,146	
31 Construction Management (S&I)		0	0	0	0	418,000	418,000	
Escalation to Mid-pto of Construction	13.10 %						54,758	
TOTAL INCL OWNER COSTS							472,758	

	QUANTITY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
01 Lands & Damages		0	0	0	0	525,998	525,998	
Contingency	25.00 %						131,500	
TOTAL INCL OWNER COSTS							657,498	
04 Dams								
04. 03 Outlet Works								
04. 03.56 Strengthen Intake Structure								
04. 03.56.03 Seismic Improvements		5,457	723,806	196,194	461,730	0	1,381,730	
04. 03.56.05 Structural/Miscll. Steel	5600.00 LBS	37	2,243	18	6,110	0	8,371	1.49
04. 03.56.13 Addtnl Twr Strengthening, (20')		2,009	208,836	49,938	169,371	0	428,145	
04. 03.56.99 Concrete Belts @ 20' spcng.		806	156,396	48,215	106,757	0	311,367	
TOTAL Strengthen Intake Structure		8,310	1,091,281	294,364	743,968	0	2,129,614	
TOTAL Outlet Works		8,310	1,091,281	294,364	743,968	0	2,129,614	
TOTAL Dams		8,310	1,091,281	294,364	743,968	0	2,129,614	
Prime Contractor's Field Overhead	8.96 %						190,724	
SUBTOTAL							2,320,337	
Prime's Home Office Expence	4.00 %						92,813	
SUBTOTAL							2,413,151	
Prime Contractor's Profit	6.93 %						167,228	
SUBTOTAL							2,580,379	
Prime Contractor's Bond	1.13 %						29,103	
TOTAL INCL INDIRECTS							2,609,482	
Contingency	25.00 %						652,370	
SUBTOTAL							3,261,852	
Escalation to Mid-pto of Construction	13.10 %						427,303	
TOTAL INCL OWNER COSTS							3,689,155	
08 Roads								
08. 01 Relocated Rd.-Earthwork Cut/Fill								
08. 01.19 Construct Roadbed to Subgrade								
08. 01.19.02 Site Work	247540.00 CY	7,370	618,746	453,095	194,401	0	1,266,242	5.12

U.S. Army Corps of Engineers
7-OAKS DAM, INTAKE STRUCTURE FEASIBILITY
** PROJECT DIRECT SUMMARY - Element **

	QUANTITY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
TOTAL Construct Roadbed to Subgrade		7,370	618,746	453,095	194,401	0	1,266,242	
08. 01.99 Associated General Items								
08. 01.99.02 Site Work		1,102	36,982	232	15,430	0	52,644	
TOTAL Associated General Items		1,102	36,982	232	15,430	0	52,644	
TOTAL Relocated Rd.-Earthwork Cut/Fill		8,472	655,728	453,326	209,831	0	1,318,885	
TOTAL Roads		8,472	655,728	453,326	209,831	0	1,318,885	
Prime Contractor's Field Overhead	9.40 %						124,014	
SUBTOTAL							1,442,900	
Prime's Home Office Expence	4.00 %						57,716	
SUBTOTAL							1,500,615	
Prime Contractor's Profit	7.82 %						117,367	
SUBTOTAL							1,617,982	
Prime Contractor's Bond	1.22 %						19,680	
TOTAL INCL INDIRECTS							1,637,662	
Contingency	20.00 %						327,532	
SUBTOTAL							1,965,195	
Escalation to Mid-pto of Construction	13.10 %						257,441	
TOTAL INCL OWNER COSTS							2,222,635	
30 Planning, Engineering and Design								
30. 10 Engineering During Construction		0	0	0	0	413,000	413,000	
30. 26 Micllaneous Acitivities		0	0	0	0	1,400,000	1,400,000	
TOTAL Planning, Engineering and Design		0	0	0	0	1,813,000	1,813,000	
Escalation to Mid-pto of Construction	4.20 %						76,146	
TOTAL INCL OWNER COSTS							1,889,146	
31 Construction Management (S&I)		0	0	0	0	418,000	418,000	
Escalation to Mid-pto of Construction	13.10 %						54,758	
TOTAL INCL OWNER COSTS							472,758	

	QUANTITY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
01 Lands & Damages		0	0	0	0	525,998	525,998	
Contingency	25.00 %						131,500	
TOTAL INCL OWNER COSTS							657,498	
04 Dams								
04. 03 Outlet Works								
04. 03.56 Strengthen Intake Structure								
04. 03.56.03 Seismic Improvements								
04. 03.56.03.10 DEMO. CONCRETE	675.00 CY	262	9,992	8,148	0	0	18,140	26.87
04. 03.56.03.20 TIEBACK ANCHORS, 100' in length	3000.00 LF	0	220,226	75,940	113,910	0	410,076	136.69
04. 03.56.03.30 INT TWR, CONCRETE	1375.00 CY	0	240,625	104,706	80,919	0	426,250	310.00
04. 03.56.03.40 INT TWR, REINFORCEMENT	393000.00 LBS	2,515	143,931	749	174,344	0	319,024	0.81
04. 03.56.03.50 CEMENT	9700.00 CWT	0	0	0	36,181	0	36,181	3.73
04. 03.56.03.60 POZZOLAN	2900.00 CF	0	0	0	7,801	0	7,801	2.69
04. 03.56.03.70 WATER REDUCING ADMIXTURE	680.00 GAL	0	0	0	3,142	0	3,142	4.62
04. 03.56.03.80 STRUCTURAL/MISCLL. STEEL	30000.00 LBS	199	12,018	96	32,730	0	44,844	1.49
04. 03.56.03.90 DRILL & GROUT REINFORCING STEEL	1310.00 EA	2,481	97,014	6,555	12,704	0	116,272	88.76
TOTAL Seismic Improvements		5,457	723,806	196,194	461,730	0	1,381,730	
04. 03.56.05 Structural/Miscll. Steel	5600.00 LBS	37	2,243	18	6,110	0	8,371	1.49
04. 03.56.13 Addtnl Twr Strengthening, (20')								
04. 03.56.13.10 DEMO. CONCRETE	560.00 CY	217	8,290	6,760	0	0	15,050	26.87
04. 03.56.13.30 INT TWR, CONCRETE	560.00 CY	0	98,000	42,644	32,956	0	173,600	310.00
04. 03.56.13.40 INT TWR, REINFORCEMENT	280000.00 LBS	1,792	102,547	533	124,214	0	227,294	0.81
04. 03.56.13.50 CEMENT	2500.00 CWT	0	0	0	9,325	0	9,325	3.73
04. 03.56.13.60 POZZOLAN	760.00 CF	0	0	0	2,044	0	2,044	2.69
04. 03.56.13.70 WATER REDUCING ADMIXTURE	180.00 GAL	0	0	0	832	0	832	4.62
TOTAL Addtnl Twr Strengthening, (20')		2,009	208,836	49,938	169,371	0	428,145	
04. 03.56.99 Concrete Belts @ 20' spcng.								
04. 03.56.99.30 INT TWR, CONCRETE	630.00 CY	0	110,250	47,975	37,076	0	195,300	310.00
04. 03.56.99.40 INT TWR, REINFORCEMENT	126000.00 LBS	806	46,146	240	55,896	0	102,282	0.81
04. 03.56.99.50 CEMENT	2835.00 CWT	0	0	0	10,575	0	10,575	3.73
04. 03.56.99.60 POZZOLAN	850.00 CF	0	0	0	2,287	0	2,287	2.69
04. 03.56.99.70 WATER REDUCING ADMIXTURE	200.00 GAL	0	0	0	924	0	924	4.62
TOTAL Concrete Belts @ 20' spcng.		806	156,396	48,215	106,757	0	311,367	

	QUANTITY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
TOTAL Strengthen Intake Structure		8,310	1,091,281	294,364	743,968	0	2,129,614	
TOTAL Outlet Works		8,310	1,091,281	294,364	743,968	0	2,129,614	
TOTAL Dams		8,310	1,091,281	294,364	743,968	0	2,129,614	
Prime Contractor's Field Overhead	8.96 %						190,724	
SUBTOTAL							2,320,337	
Prime's Home Office Expence	4.00 %						92,813	
SUBTOTAL							2,413,151	
Prime Contractor's Profit	6.93 %						167,228	
SUBTOTAL							2,580,379	
Prime Contractor's Bond	1.13 %						29,103	
TOTAL INCL INDIRECTS							2,609,482	
Contingency	25.00 %						652,370	
SUBTOTAL							3,261,852	
Escalation to Mid-pto of Construction	13.10 %						427,303	
TOTAL INCL OWNER COSTS							3,689,155	
08 Roads								
08. 01 Relocated Rd.-Earthwork Cut/Fill								
08. 01.19 Construct Roadbed to Subgrade								
08. 01.19.02 Site Work								
08. 01.19.02.01 Presplit Cut Material	36968.00 LF	0	277,053	0	92,971	0	370,024	10.01
08. 01.19.02.02 Cut/Fill w/ Scraper & Push Dozer	247540.00 BCY	2,718	126,523	329,751	0	0	456,274	1.84
08. 01.19.02.03 Compct Fill/Smooth-Wheel Rollers	210830.00 BCY	4,388	203,090	122,303	90,868	0	416,261	1.97
08. 01.19.02.04 Rock Barrier Fence	1850.00 LF	264	12,079	1,041	10,562	0	23,683	12.80
TOTAL Site Work	247540.00 CY	7,370	618,746	453,095	194,401	0	1,266,242	5.12
TOTAL Construct Roadbed to Subgrade		7,370	618,746	453,095	194,401	0	1,266,242	
08. 01.99 Associated General Items								
08. 01.99.02 Site Work								
08. 01.99.02.03 Relocated Rd. Guard Rail	3580.00 LF	1,102	36,982	232	15,430	0	52,644	14.70

	QUANTITY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
TOTAL Site Work			1,102	36,982	232	15,430	0	52,644	
TOTAL Associated General Items			1,102	36,982	232	15,430	0	52,644	
TOTAL Relocated Rd.-Earthwork Cut/Fill			8,472	655,728	453,326	209,831	0	1,318,885	
TOTAL Roads			8,472	655,728	453,326	209,831	0	1,318,885	
Prime Contractor's Field Overhead	9.40	%						124,014	
SUBTOTAL								1,442,900	
Prime's Home Office Expence	4.00	%						57,716	
SUBTOTAL								1,500,615	
Prime Contractor's Profit	7.82	%						117,367	
SUBTOTAL								1,617,982	
Prime Contractor's Bond	1.22	%						19,680	
TOTAL INCL INDIRECTS								1,637,662	
Contingency	20.00	%						327,532	
SUBTOTAL								1,965,195	
Escalation to Mid-pto of Construction	13.10	%						257,441	
TOTAL INCL OWNER COSTS								2,222,635	
30 Planning, Engineering and Design									
30. 10 Engineering During Construction			0	0	0	0	413,000	413,000	
30. 26 Micllaneous Acitivities			0	0	0	0	1,400,000	1,400,000	
TOTAL Planning, Engineering and Design			0	0	0	0	1,813,000	1,813,000	
Escalation to Mid-pto of Construction	4.20	%						76,146	
TOTAL INCL OWNER COSTS								1,889,146	
31 Construction Management (S&I)			0	0	0	0	418,000	418,000	
Escalation to Mid-pto of Construction	13.10	%						54,758	
TOTAL INCL OWNER COSTS								472,758	

No errors detected...

* * * END OF ERROR REPORT * * *

Table 6:
ADDITIONAL OPERATION AND MAINTENANCE (O & M) COST ALTERNATIVE 1 - EL.2300

SEVEN OAKS DAM, WATER CONSERVATION FEASIBILITY STUDY

Draft Feasibility Study Report

ITEM	DESCRIPTION	ADDITIONAL ANNUAL COST
1	Operations:	
	Potential flood control operations	$2,000
	Facilities maintenance	
	Relocated reservoir road	$2,700
	Relocated intake structure access road	N/A
	Painting new steel frame	N/A
	Install new bulkhead gate	N/A
2	Inspection and Monitoring:	
	Evaluations	$1,000
	Bridge Inspections	N/I
	Reservoir monitoring	$1,000
	Instrumentation	$500
3	DEBRIS REMOVAL:	N/I
4	STEEL/CONCRETE REPAIR:	
	Tunnel invert	$5,000
5	ELECTRICAL:	
	Motors and parts	$400
6	MECHANICAL:	
	Motors and parts	$13,900
	Control gates and valves	$15,000
	TOTAL COST:	**$41,500**

NOTES:
N / A denotes not applicable.
N / I denotes no increase.

Table 7:
ADDITIONAL OPERATION AND MAINTENANCE (O & M) COST ALTERNATIVE 2 - EL.2375

SEVEN OAKS DAM, WATER CONSERVATION FEASIBILITY STUDY

Draft Feasibility Study Report

ITEM	DESCRIPTION	ADDITIONAL ANNUAL COST
1	Operations:	
	Potential flood control operations	$2,000
	Facilities maintenance	
	Relocated reservoir road	$9,000
	Relocated intake structure access road	N/I
	Painting new steel frame	$11,000
	Install new bulkhead gate	$12,000
2	Inspection and Monitoring:	
	Evaluations	$1,000
	Bridge Inspections	$750
	Reservoir monitoring	$1,000
	Instrumentation	$1,500
3	DEBRIS REMOVAL:	$35,000
4	STEEL/CONCRETE REPAIR:	
	Tunnel invert	$7,800
5	ELECTRICAL:	
	Motors and parts	$400
6	MECHANICAL:	
	Motors and parts	$13,900
	Control gates and valves	$15,000
	TOTAL COST:	$110,350

NOTES:
N / A denotes not applicable.
N / I denotes no increase.

Table 8:
ADDITIONAL OPERATION AND MAINTENANCE (O & M) COST
ALTERNATIVE 3 - EL.2418

SEVEN OAKS DAM, WATER CONSERVATION FEASIBILITY STUDY

Draft Feasibility Study Report

ITEM	DESCRIPTION	ADDITIONAL ANNUAL COST
1	Operations:	
	Potential flood control operations	$2,000
	Facilities maintenance	
	Relocated reservoir road	$11,000
	Relocated intake structure access road	N/I
	Painting new steel frame	$16,000
	Install new bulkhead gate	$13,500
2	Inspection and Monitoring:	
	Evaluations	$1,000
	Bridge Inspections	$1,000
	Reservoir monitoring	$1,000
	Instrumentation	$1,500
3	DEBRIS REMOVAL:	$50,000
4	STEEL/CONCRETE REPAIR:	
	Tunnel invert	$13,300
5	ELECTRICAL:	
	Motors and parts	$400
6	MECHANICAL:	
	Motors and parts	$13,900
	Control gates and valves	$15,000
	TOTAL COST:	$139,600

NOTES:
N / A denotes not applicable.
N / I denotes no increase.

Table 9:
ADDITIONAL OPERATION AND MAINTENANCE (O & M) COST ALTERNATIVE 4 - EL.2265

SEVEN OAKS DAM, WATER CONSERVATION FEASIBILITY STUDY

Draft Feasibility Study Report

ITEM	DESCRIPTION	ADDITIONAL ANNUAL COST
1	Operations:	
	Potential flood control operations	$2,000
	Facilities maintenance	
	Relocated reservoir road	$2,700
	Relocated intake structure access road	N/A
	Painting new steel frame	N/A
	Install new bulkhead gate	N/A
2	Inspection and Monitoring:	
	Evaluations	$1,000
	Bridge Inspections	N/I
	Reservoir monitoring	$1,000
	Instrumentation	$500
3	DEBRIS REMOVAL:	N/I
4	STEEL/CONCRETE REPAIR:	
	Tunnel invert	N/I
5	ELECTRICAL:	
	Motors and parts	$400
6	MECHANICAL:	
	Motors and parts	$13,900
	Control gates and valves	$15,000
	TOTAL COST:	$36,500

NOTES:
N / A denotes not applicable.
N / I denotes no increase.

SEVEN OAKS DAM

WATER CONSERVATION FEASIBILITY STUDY

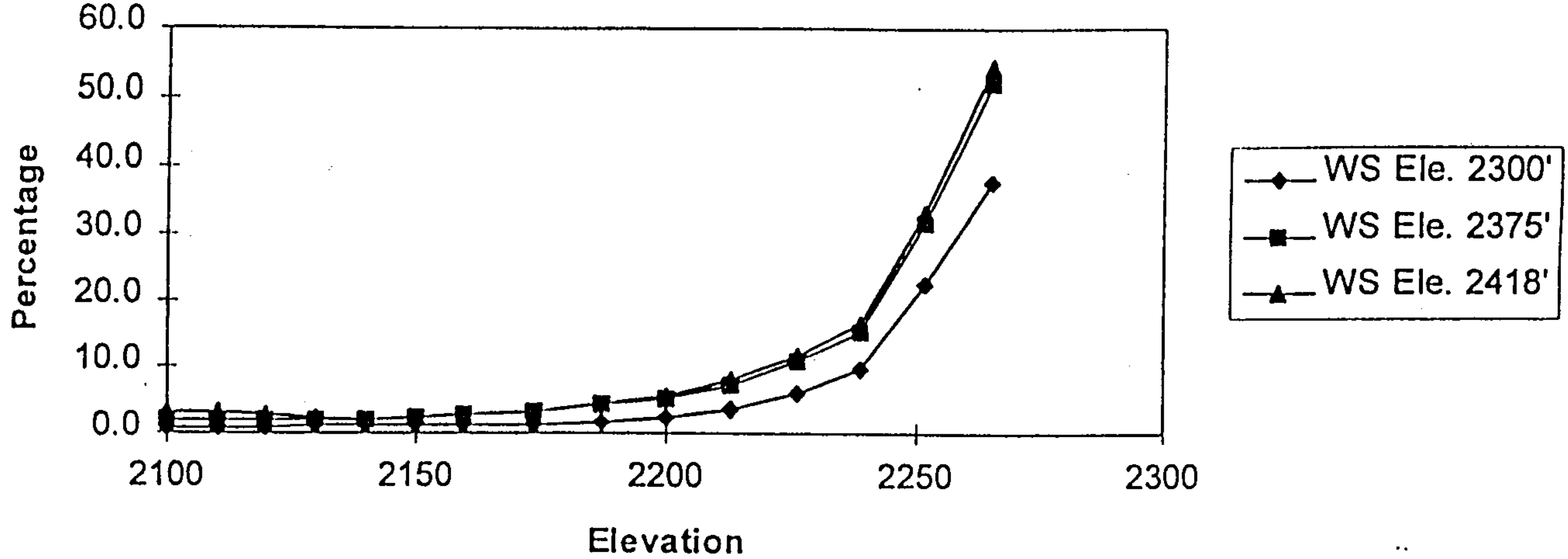
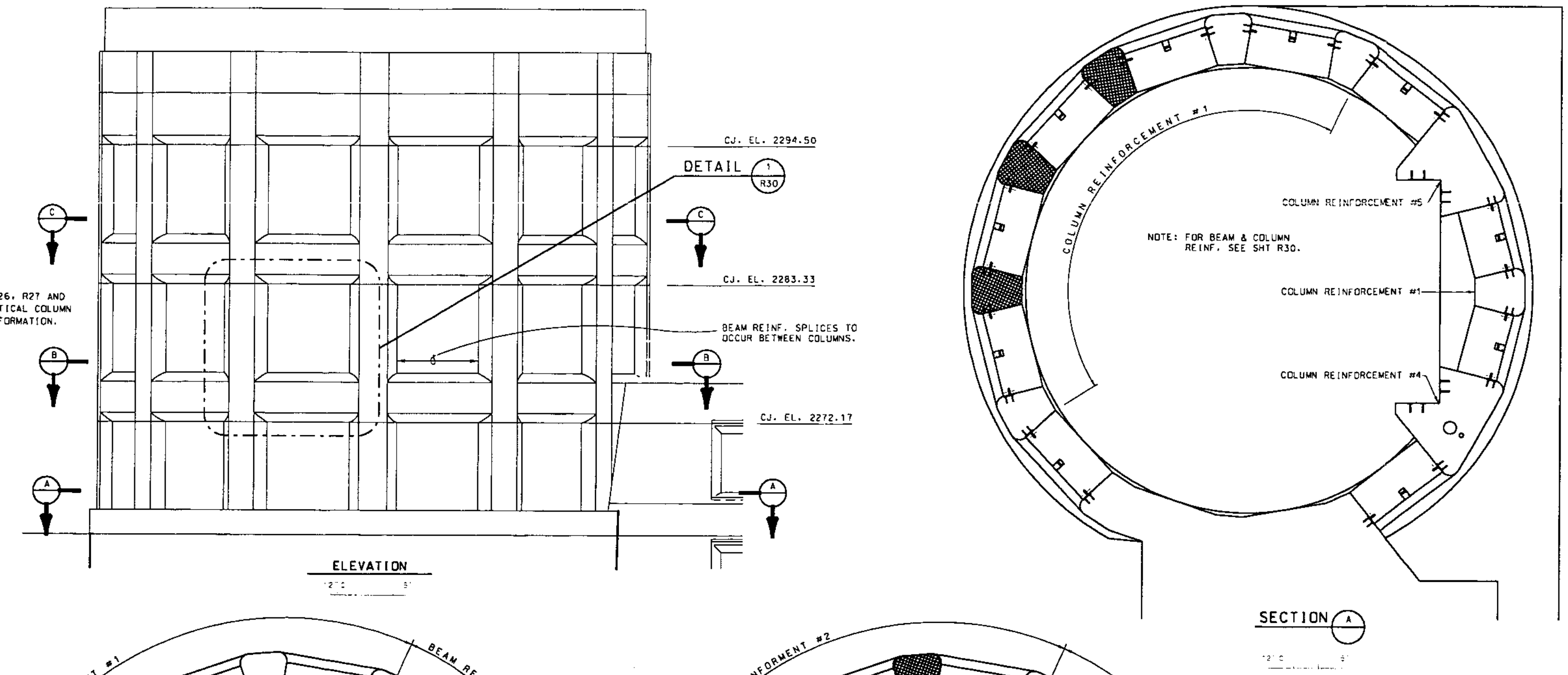
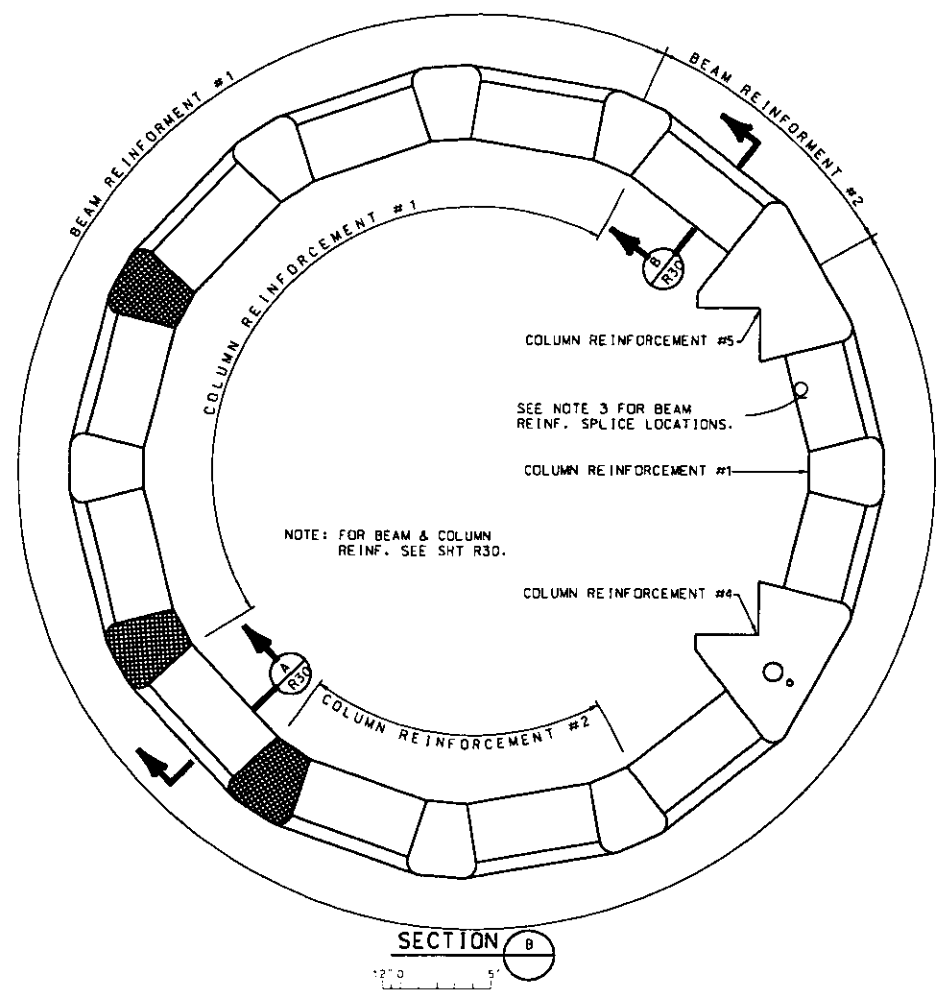
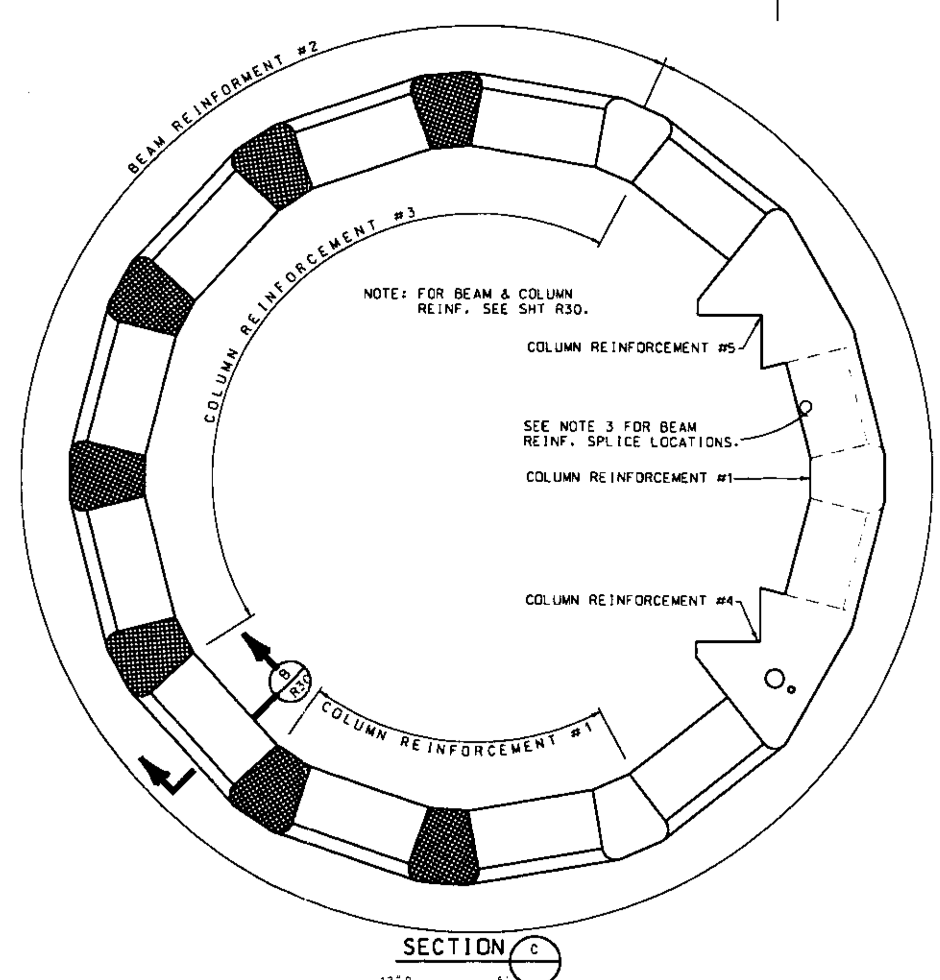


Fig. 1 - Percentage Increase in Anchorage Requirements







NOTES:

1. ALL STATIONS ARE 'R.O.' STATIONS.
2. SEE GENERAL CONCRETE AND REINFORCEMENT NOTES, SHT. R1.
3. SPLICE BEAM REINFORCEMENT BETWEEN COLUMNS ONLY. NO MORE THAN 33% OF HORIZONTAL BEAM REINFORCEMENT CAN BE SPLICED BETWEEN ANY 2 COLUMNS.
4. THIS DRAWING WAS MODELED FROM DISTRICT FILE NO. 243/351, SHEET R29. DESIGN FILE "mdhrb1.cok" FOR THE FEASIBILITY STUDY, 100% SUBMITTAL.

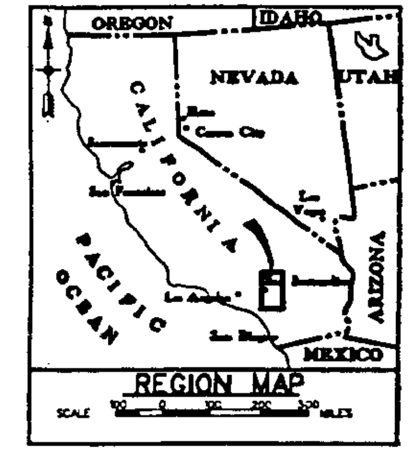
KEY:

OVERSTRESSED COLUMNS

CADD GENERATED DESIGN FILE: /DCN/OAKS/PHASE4/FIG4-100.DAK

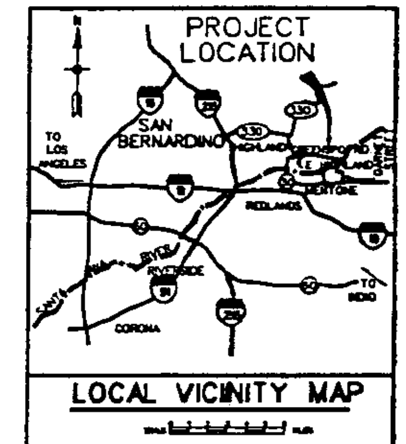
U.S. ARMY ENGINEER DISTRICT PORTLAND CORPS OF ENGINEERS	U.S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS
DESIGNED BY: M. HANSON	SANTA ANA RIVER MAINSTEM SAN BERNARDINO COUNTY, CALIFORNIA SEVEN OAKS DAM DAM AND APPURTENANCES OUTLET WORKS
DRAWN BY: W. DEMO	INTAKE STRUCTURE REINFORCEMENT
CHECKED BY: R. DEWEY	TRASHRACK ELEVATION, PLAN AND DETAILS FIGURE 2 - FEASIBILITY STUDY, 100% SUBMITTAL
SUBMITTED BY: DAVID J. ILLIAS, P.E. ACTING CHIEF, DESIGN BRANCH DATE APPROVED: N/A	SPEC. NO. DACW09-93-B-0010 DISTRICT FILE NO. SEE NOTE 4 SHEET

SANTA ANA RIVER MAINSTEM
SAN BERNARDINO COUNTY, CALIFORNIA
SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY



INDEX TO DRAWINGS

STRUCTURES



INTERSTATE HIGHWAY
STATE HIGHWAY

SYMBOL	DESCRIPTION	DATE	APPROVAL
REVISIONS			

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: R.D.
DRAWN BY: R.J.
CHECKED BY: A.J.

SANTA ANA RIVER MAINSTEM
WATER CONSERVATION FEASIBILITY STUDY

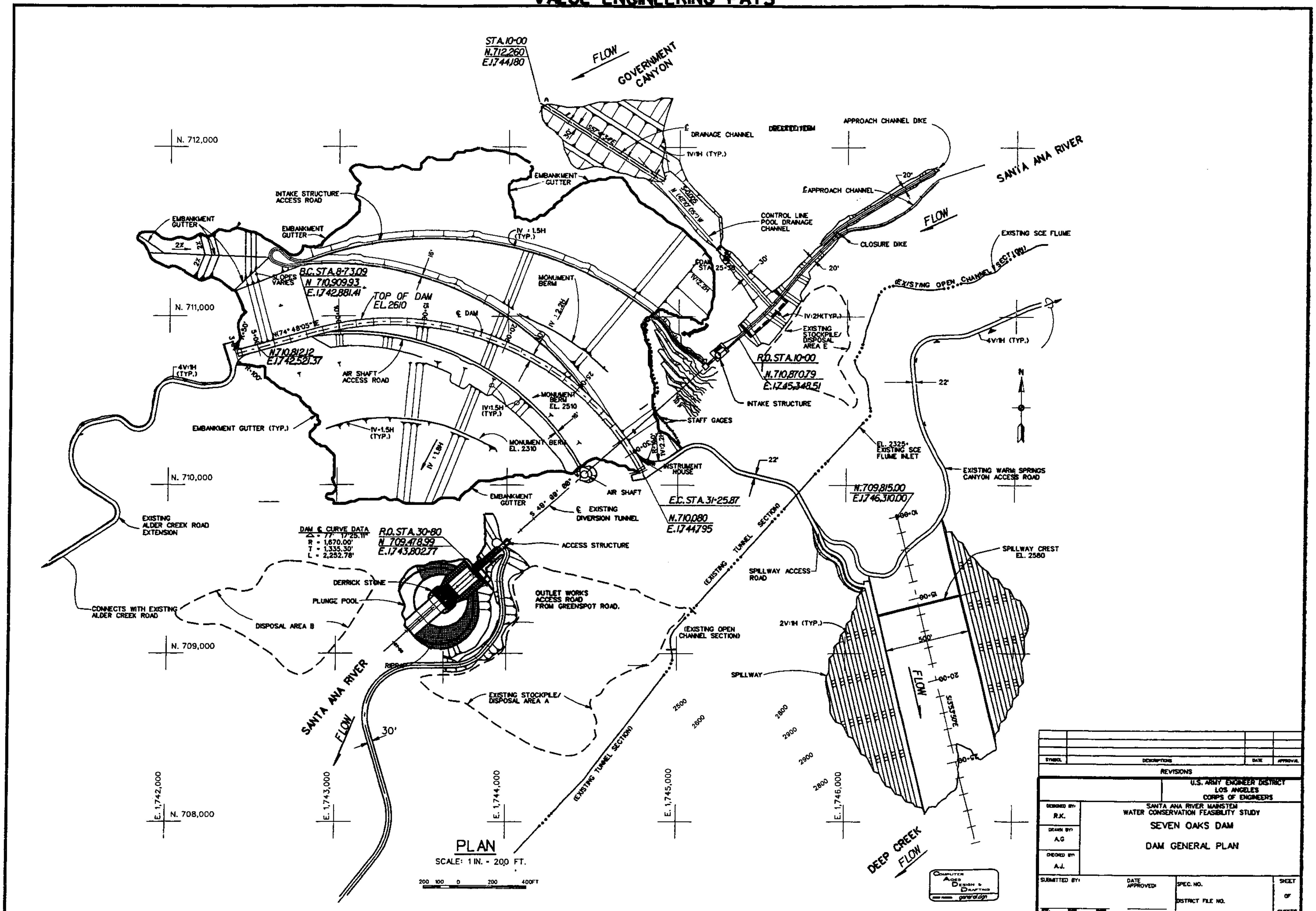
SEVEN OAKS DAM

PROJECT LOCATION, VICINITY MAPS AND SHEET INDEX

SUBMITTED BY: | DATE APPROVED: | SPEC. NO. | DISTRICT FILE NO. | SHEET OF SHEETS

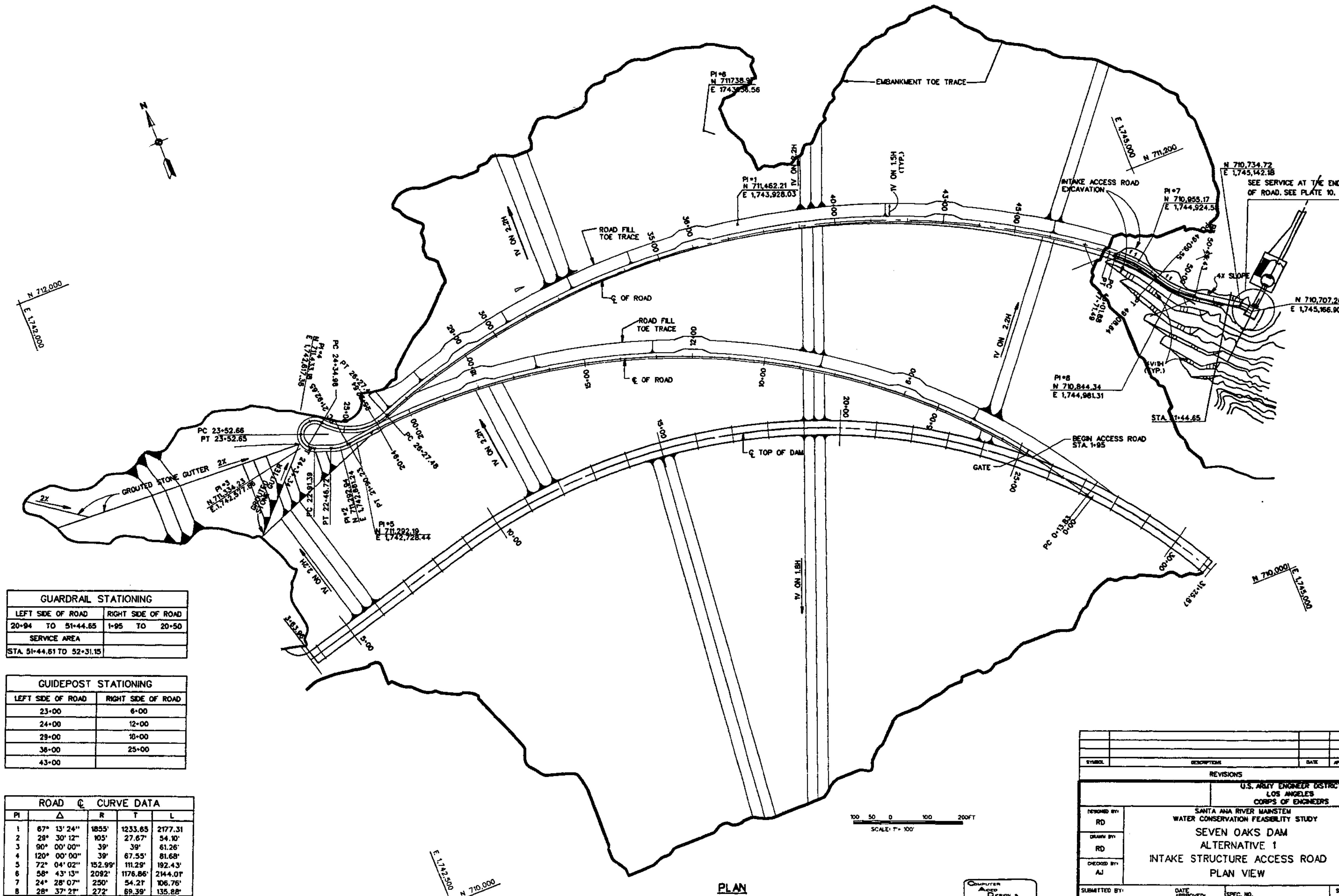
PLATE 1

ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING


STA.10-00
N.712,260
E.1,744,180
FLOW
GOVERNMENT CANYON
DRAINAGE CHANNEL
APPROACH CHANNEL DIKE
SANTA ANA RIVER
N. 712,000
N. 711,000
N. 710,000
N. 709,000
N. 708,000
E. 1,742,000
E. 1,743,000
E. 1,744,000
E. 1,745,000
E. 1,746,000
EMBANKMENT GUTTER
INTAKE STRUCTURE ACCESS ROAD
APPROACH CHANNEL
CONTROL LINE POOL DRAINAGE CHANNEL
CLOSURE DIKE
EXISTING SCE FLUME
EXISTING OPEN CHANNEL SECTION
B.C. STA. 8+73.09
N. 710,909.93
E. 1,742,881.41
TOP OF DAM EL. 2610
SLOPES VARIES
MONUMENT BERM
EXISTING STOCKPILE/ DISPOSAL AREA E
R.O. STA. 10-00
N. 710,870.79
E. 1,745,348.51
N.710,812.12
E.1,742,521.37
AIR SHAFT ACCESS ROAD
INTAKE STRUCTURE
MONUMENT BERM EL. 2510
STAFF GAGES
EMBANKMENT GUTTER (TYP.)
MONUMENT BERM EL. 2310
INSTRUMENT HOUSE
AIR SHAFT
EXISTING WARM SPRINGS CANYON ACCESS ROAD
EL. 2325± EXISTING SCE FLUME INLET
N.709,815.00
E.1,746,310.00
E.C. STA. 31+25.87
N.710,080
E.1,744,795
EXISTING DIVERSION TUNNEL
EXISTING ALDER CREEK ROAD EXTENSION
DAM CURVE DATA
R = 1,670.00'
T = 1,335.30'
L = 2,252.78'
R.O. STA. 30-80
N. 709,478.99
E. 1,743,802.77
ACCESS STRUCTURE
DERRICK STONE
PLUNGE POOL
OUTLET WORKS ACCESS ROAD FROM GREENSPOT ROAD.
CONNECTS WITH EXISTING ALDER CREEK ROAD
DISPOSAL AREA B
SPILLWAY ACCESS ROAD
SPILLWAY CREST EL. 2580
(EXISTING TUNNEL SECTION)
(EXISTING OPEN CHANNEL SECTION)
2V:1H (TYP.)
SPILLWAY
EXISTING STOCKPILE/ DISPOSAL AREA A
DEEP CREEK
FLOW
PLAN
SCALE: 1 IN. = 200 FT.
REVISIONS
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS
SANTA ANA RIVER MAINSTEM
WATER CONSERVATION FEASIBILITY STUDY
SEVEN OAKS DAM
DAM GENERAL PLAN
DESIGNED BY: R.K.
DRAWN BY: A.G
CHECKED BY: A.J.
SUBMITTED BY:
DATE APPROVED:
SPEC. NO.
DISTRICT FILE NO.
SHEET OF SHEETS
PLATE 2

VALUE ENGINEERING PAYS

ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING



GUARDRAIL STATIONING	
LEFT SIDE OF ROAD	RIGHT SIDE OF ROAD
20+94 TO 51+44.65	1+95 TO 20+50
SERVICE AREA	
STA. 51+44.61 TO 52+31.15	

GUIDEPOST STATIONING	
LEFT SIDE OF ROAD	RIGHT SIDE OF ROAD
23+00	6+00
24+00	12+00
29+00	18+00
38+00	25+00
43+00	

ROAD ℄ CURVE DATA

PI	Δ	R	T	L
1	67° 13' 24"	1855'	1233.65	2177.31
2	29° 30' 12"	105'	27.67'	54.10'
3	90° 00' 00"	39'	39'	61.26'
4	120° 00' 00"	39'	67.55'	81.68'
5	72° 04' 02"	152.99'	111.29'	192.43'
6	58° 43' 13"	2092'	1176.86'	2144.01'
7	24° 28' 07"	250'	54.21'	106.76'
8	28° 37' 21"	272'	69.39'	135.88'

PLAN
SCALE: 1 IN. = 100 FT.

100 50 0 100 200FT
SCALE: 1"= 100'

COMPUTER AIDED DESIGN & DRAFTING

SYMBOL	DESCRIPTION	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: RD
DRAWN BY: RD
CHECKED BY: AJ

SANTA ANA RIVER MAINSTEM
WATER CONSERVATION FEASIBILITY STUDY
SEVEN OAKS DAM
ALTERNATIVE 1
INTAKE STRUCTURE ACCESS ROAD
PLAN VIEW

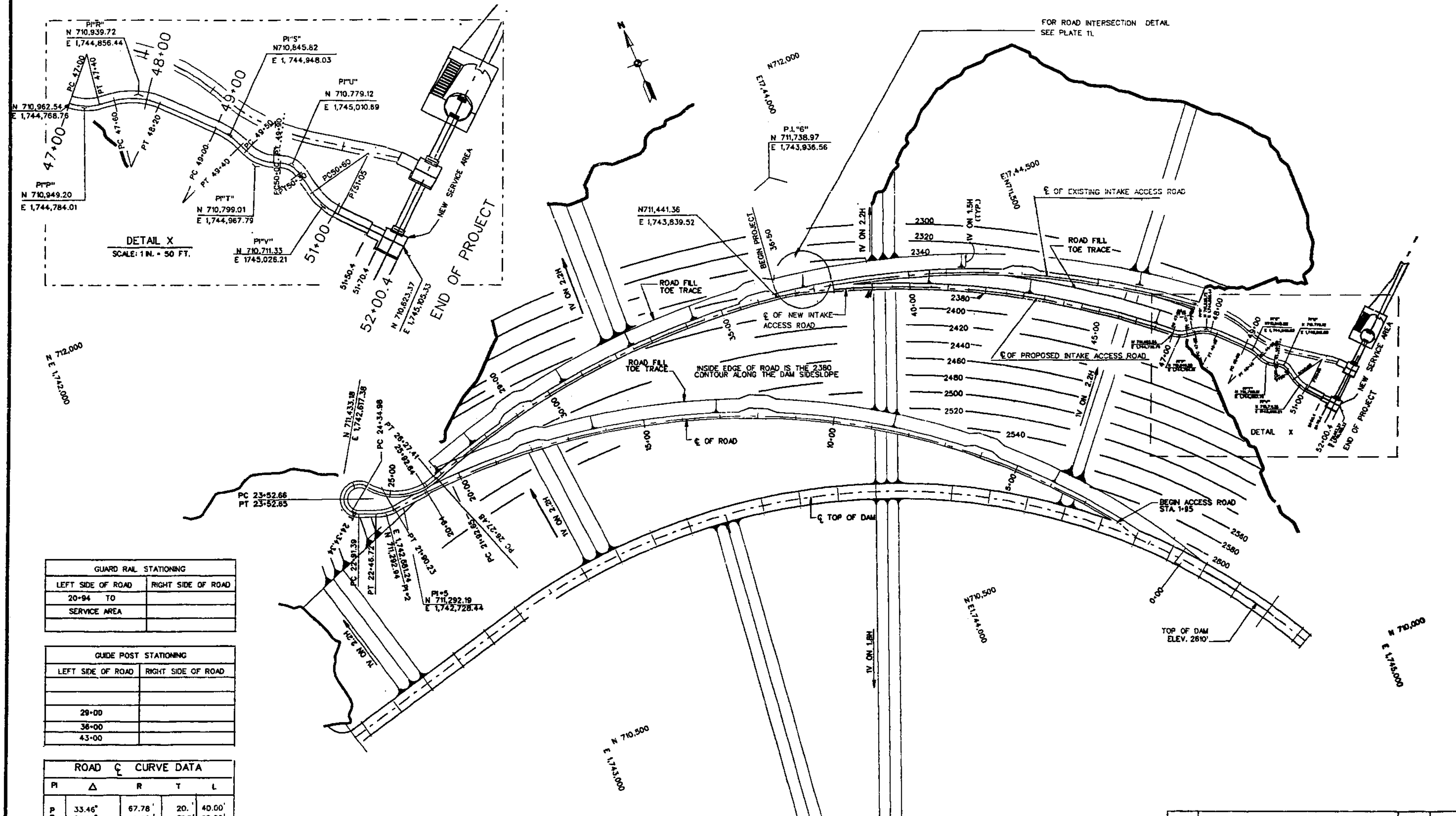
SUBMITTED BY: DATE APPROVED: SPEC. NO. DISTRICT FILE NO. SHEET OF SHEETS

SAFETY PAYS

PLATE 3

VALUE ENGINEERING PAYS

ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING



GUARD RAIL STATIONING	
LEFT SIDE OF ROAD	RIGHT SIDE OF ROAD
20+94 TO	
SERVICE AREA	

GUIDE POST STATIONING	
LEFT SIDE OF ROAD	RIGHT SIDE OF ROAD
29+00	
36+00	
43+00	

ROAD ℄ CURVE DATA

PI	Δ	R	T	L
P	33.46°	67.78'	20.'	40.00'
R	38.28°	90.23'	31.5'	60.00'
S	21.58°	106.45'	20.11'	40.00'
T	42.41°	54.12'	21.12'	40.00'
U	51.95°	33.0'	16.3'	30.00'
V	89.95°	28.62'	23.01'	45.00'
PI	**Δ**	**R**	**T**	**L**
2	29° 30' 12"	105'	27.67'	54.10'
3	90° 00' 00"	39'	39'	61.26'
4	90° 00' 00"	39'	67.55'	81.68'
5	120° 00' 00"	152.99'	111.29'	192.43'
6	58° 43' 13"	2092'	1176.86'	2144.01'

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: RD
DRAWN BY: RD
CHECKED BY: AJ

SANTA ANA RIVER MAINSTEM
WATER CONSERVATION FEASIBILITY STUDY

SEVEN OAKS DAM
ALTERNATIVE 2
INTAKE STRUCTURE ACCESS ROAD
PLAN VIEW

SUBMITTED BY:
DATE APPROVED:
SPEC. NO.
DISTRICT FILE NO.
SHEET OF SHEETS

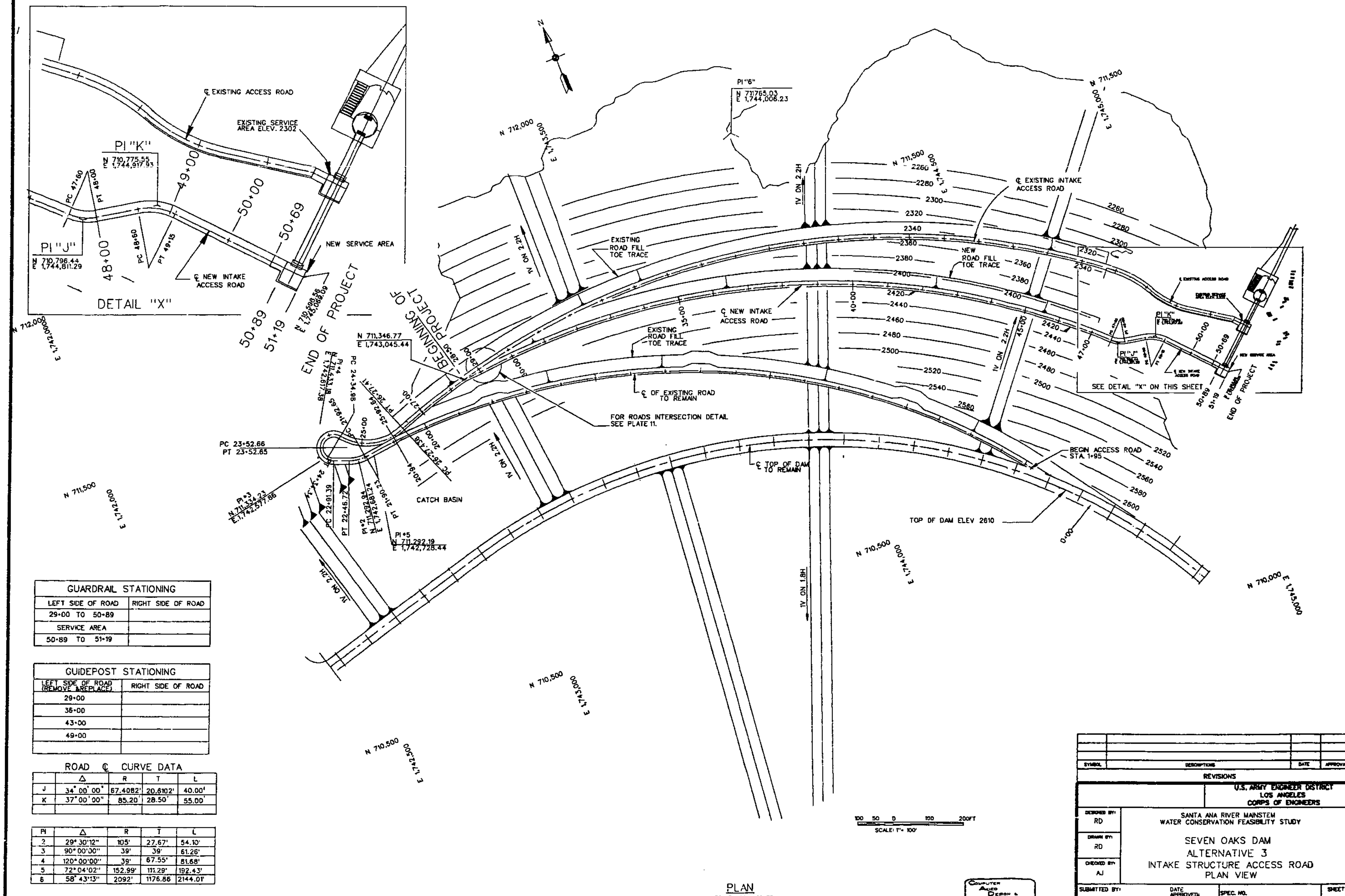
COMPUTER AIDED DESIGN & DRAFTING

SAFETY PAYS

PLATE 4

VALUE ENGINEERING PAYS

ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING



GUARDRAIL STATIONING	
LEFT SIDE OF ROAD	RIGHT SIDE OF ROAD
29+00 TO 50+89	
SERVICE AREA	
50+89 TO 51+19	

GUIDEPOST STATIONING	
LEFT SIDE OF ROAD (REMOVE & REPLACE)	RIGHT SIDE OF ROAD
29+00	
36+00	
43+00	
49+00	

ROAD ℄ CURVE DATA

	Δ	R	T	L
J	34° 00' 00"	67.4082'	20.6102'	40.00'
K	37° 00' 00"	85.20'	28.50'	55.00'

PI	Δ	R	T	L
2	29° 30'12"	105'	27.67'	54.10'
3	90° 00'30"	39'	39'	61.26'
4	120° 00'00"	39'	67.55'	81.68'
5	72° 04'02"	152.99'	111.29'	192.43'
6	58° 43'13"	2092'	1176.86	2144.01'

PLAN
SCALE: 1 IN. = 100 FT.

COMPUTER AIDED DESIGN & DRAFTING

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: RD
DRAWN BY: RD
CHECKED BY: AJ

SANTA ANA RIVER MAINSTEM
WATER CONSERVATION FEASIBILITY STUDY

SEVEN OAKS DAM
ALTERNATIVE 3
INTAKE STRUCTURE ACCESS ROAD
PLAN VIEW

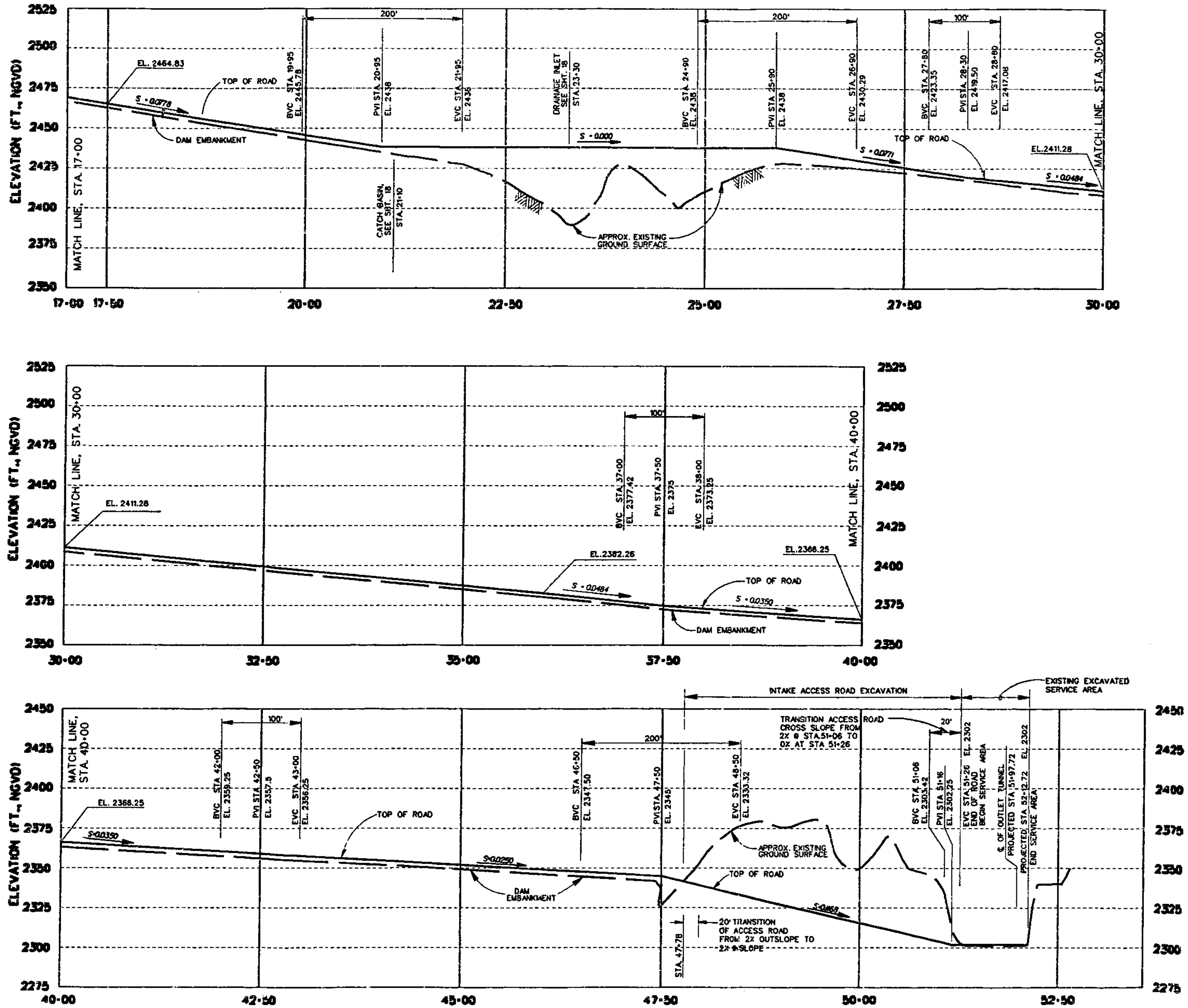
SUBMITTED BY: | DATE APPROVED: | SPEC. NO. | DISTRICT FILE NO. | SHEET OF SHEETS

PLATE 5

SAFETY PAYS

ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING

VALUE ENGINEERING PAYS



PROFILE
HORIZ. SCALE: 1 IN. = 50 FT.
VERT. SCALE: 1 IN. = 25 FT.

SCALE: 1" = 25'
SCALE: 1" = 50'

COMPUTER AIDED DESIGN & DRAFTING

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: RD
DRAWN BY: TC
CHECKED BY: AJ

SANTA ANA RIVER MAINSTEM
WATER CONSERVATION FEASIBILITY STUDY
SEVEN OAKS DAM

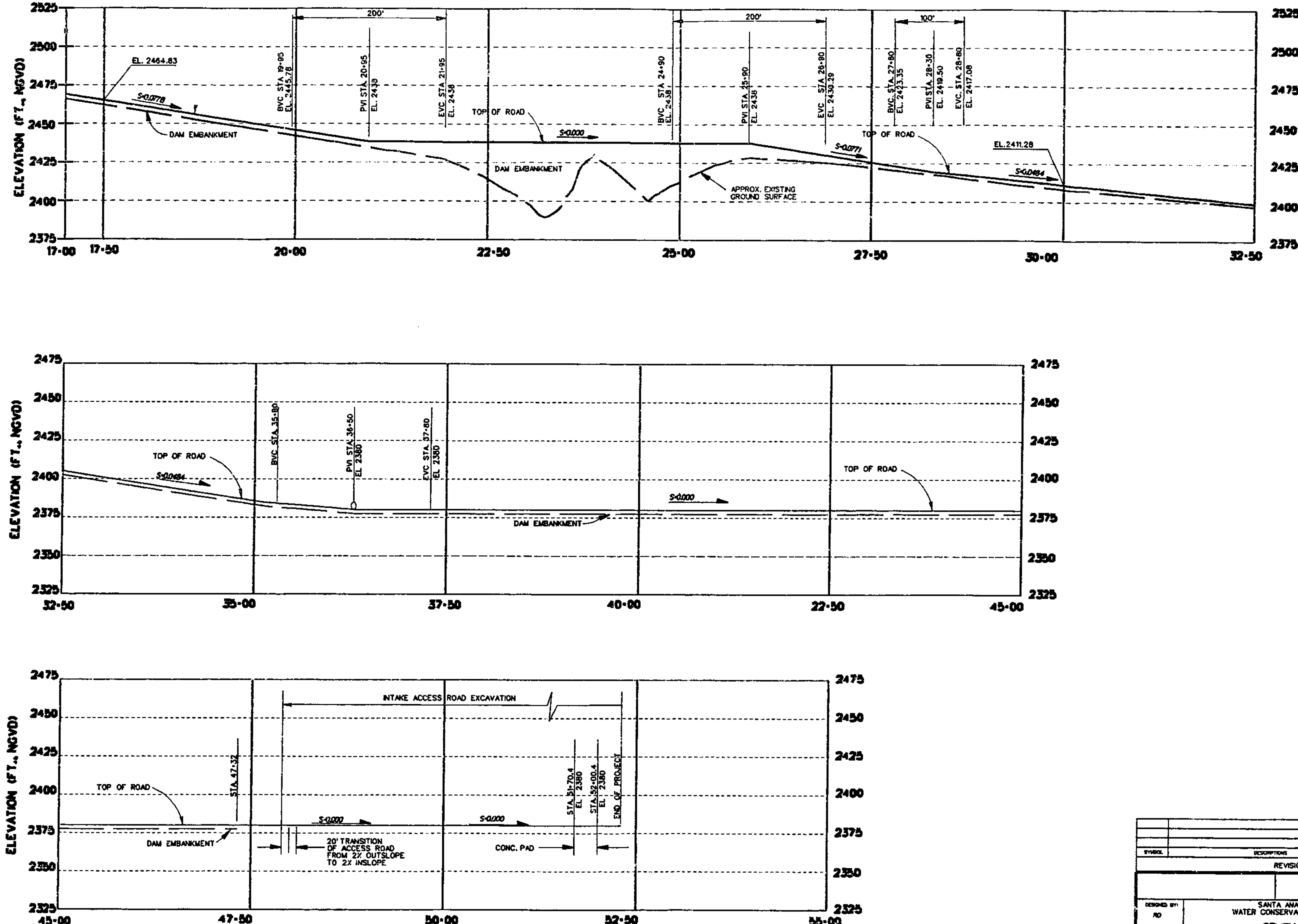
ALTERNATIVE 1
INTAKE STRUCTURE ACCESS ROAD PROFILE

SUBMITTED BY:
DATE APPROVED:
SPEC. NO.
DISTRICT FILE NO.
SHEET
OF
SHEETS

SAFETY PAYS

PLATE 6

ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING



PROFILE
VERT. SCALE: 1 IN. = 25 FT.
HORIZ. SCALE: 1 IN. = 50 FT.

Computer Aided Design & Drafting

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

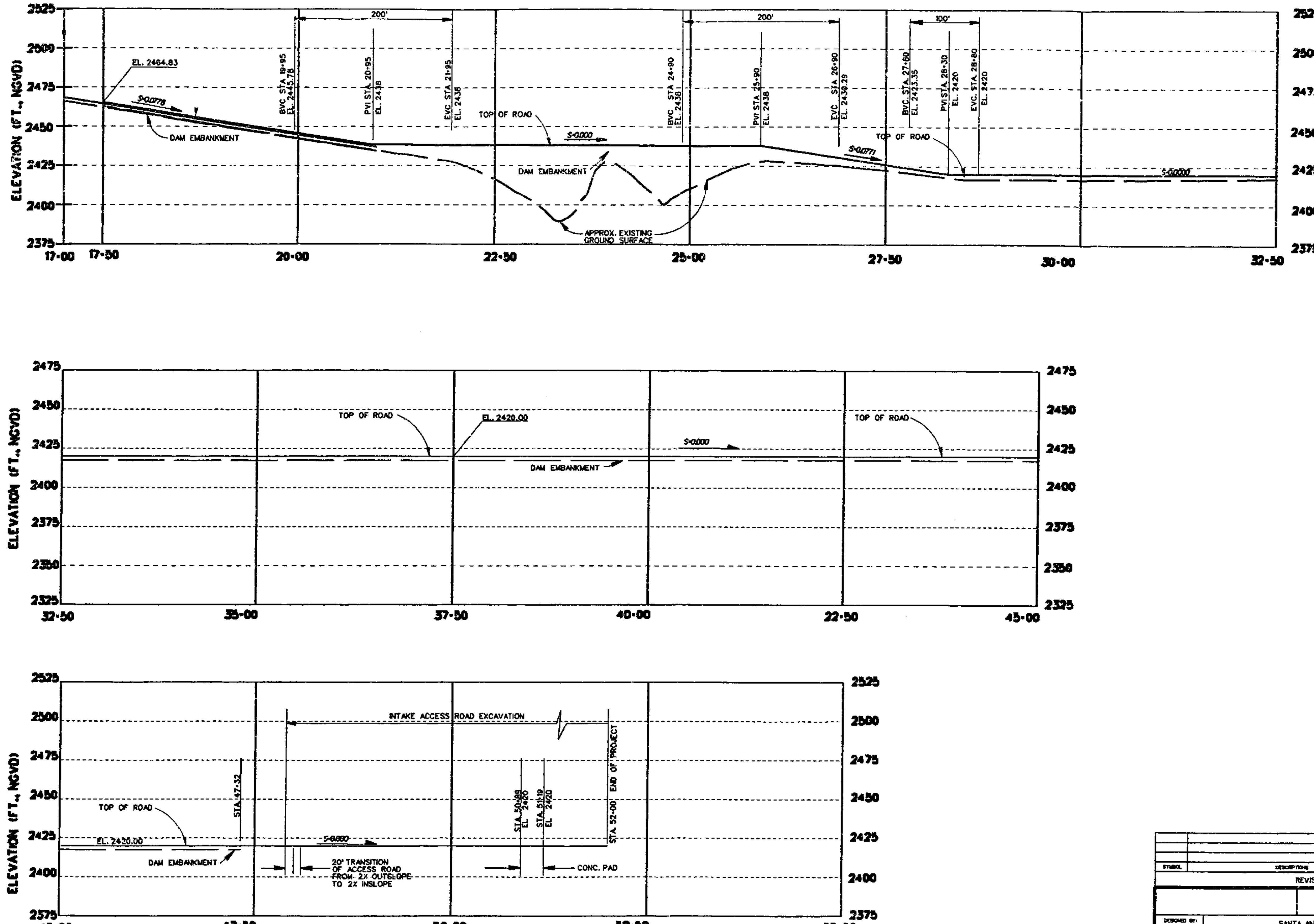
DESIGNED BY: RD
DRAWN BY: TC
CHECKED BY: AJ

SANTA ANA RIVER MAINSTEM
WATER CONSERVATION FEASIBILITY STUDY
SEVEN OAKS DAM

ALTERNATIVE 2
INTAKE STRUCTURE ACCESS ROAD PROFILE

SUBMITTED BY:
DATE APPROVED:
SPEC. NO.
DISTRICT FILE NO.
SHEET OF SHEETS

VALUE ENGINEERING PAYS



PROFILE
VERT. SCALE: 1 IN. = 25 FT.
HORIZ. SCALE: 1 IN. = 50 FT.

ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: RD
DRAWN BY: TC
CHECKED BY: AJ

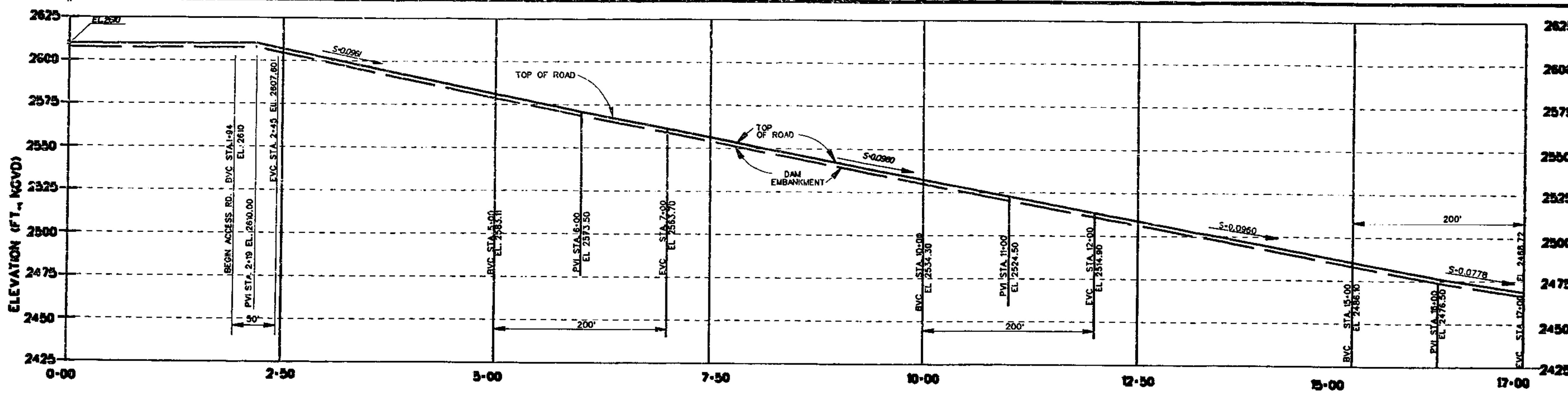
SANTA ANA RIVER MAINSTEM
WATER CONSERVATION FEASIBILITY STUDY
SEVEN OAKS DAM
ALTERNATIVE 3
INTAKE STRUCTURE ACCESS ROAD PROFILE

SUBMITTED BY:
DATE APPROVED:
SPEC. NO
DISTRICT FILE NO.
SHEET OF SHEETS

SAFETY PAYS

PLATE 8

VALUE ENGINEERING PAYS



ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: RD
DRAWN BY: TC
CHECKED BY: AJ

SANTA ANA RIVER MAINSTEM
WATER CONSERVATION FEASIBILITY STUDY

SEVEN OAKS DAM

ALL ALTERNATIVES

INTAKE STRUCTURE ACCESS ROAD PROFILE

SUBMITTED BY: | DATE APPROVED: | SPEC. NO. | DISTRICT FILE NO. | SHEET OF SHEETS

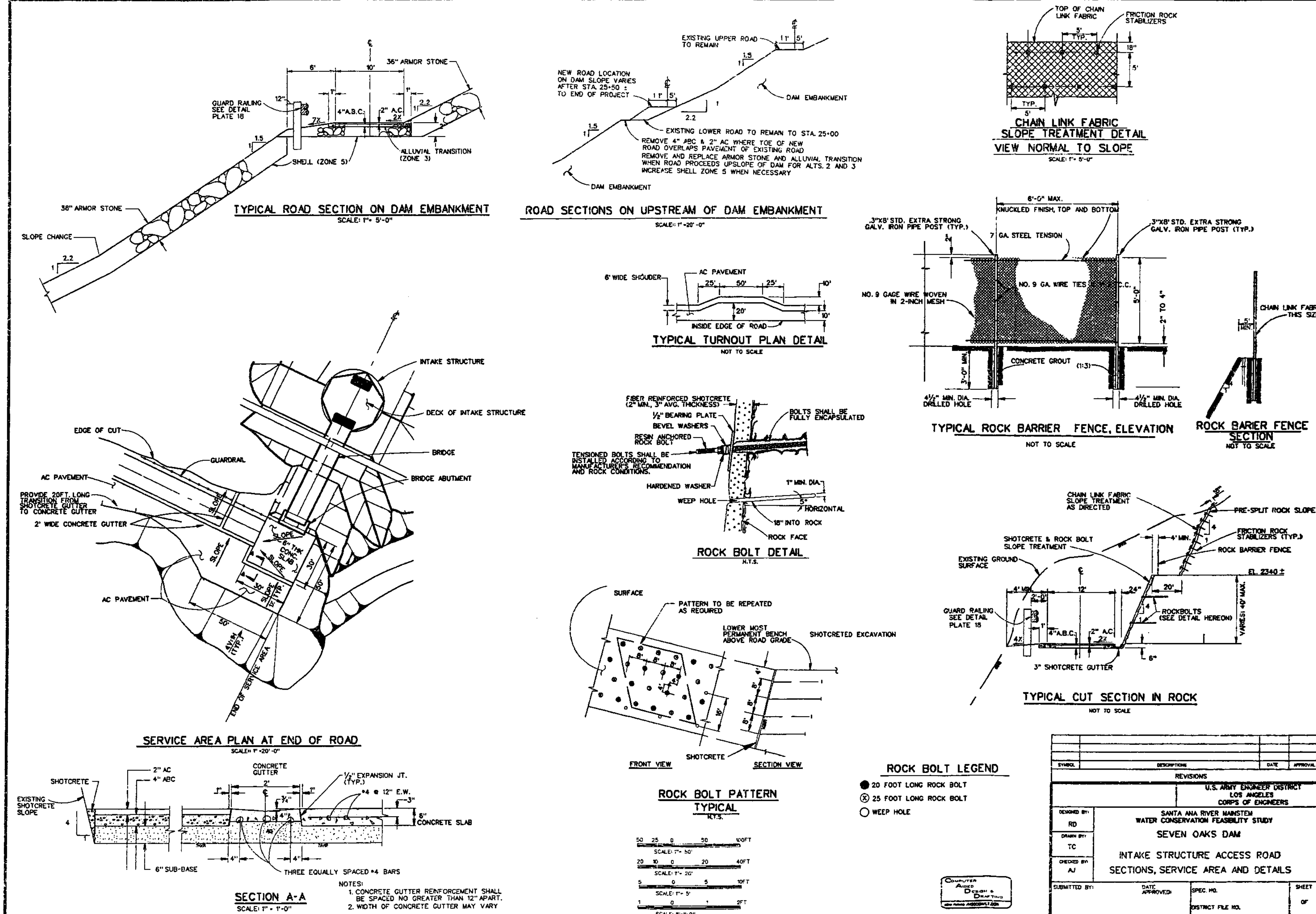
Computer Aided Design & Drafting

PLATE 9

SAFETY PAYS

VALUE ENGINEERING PAYS

ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING



SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

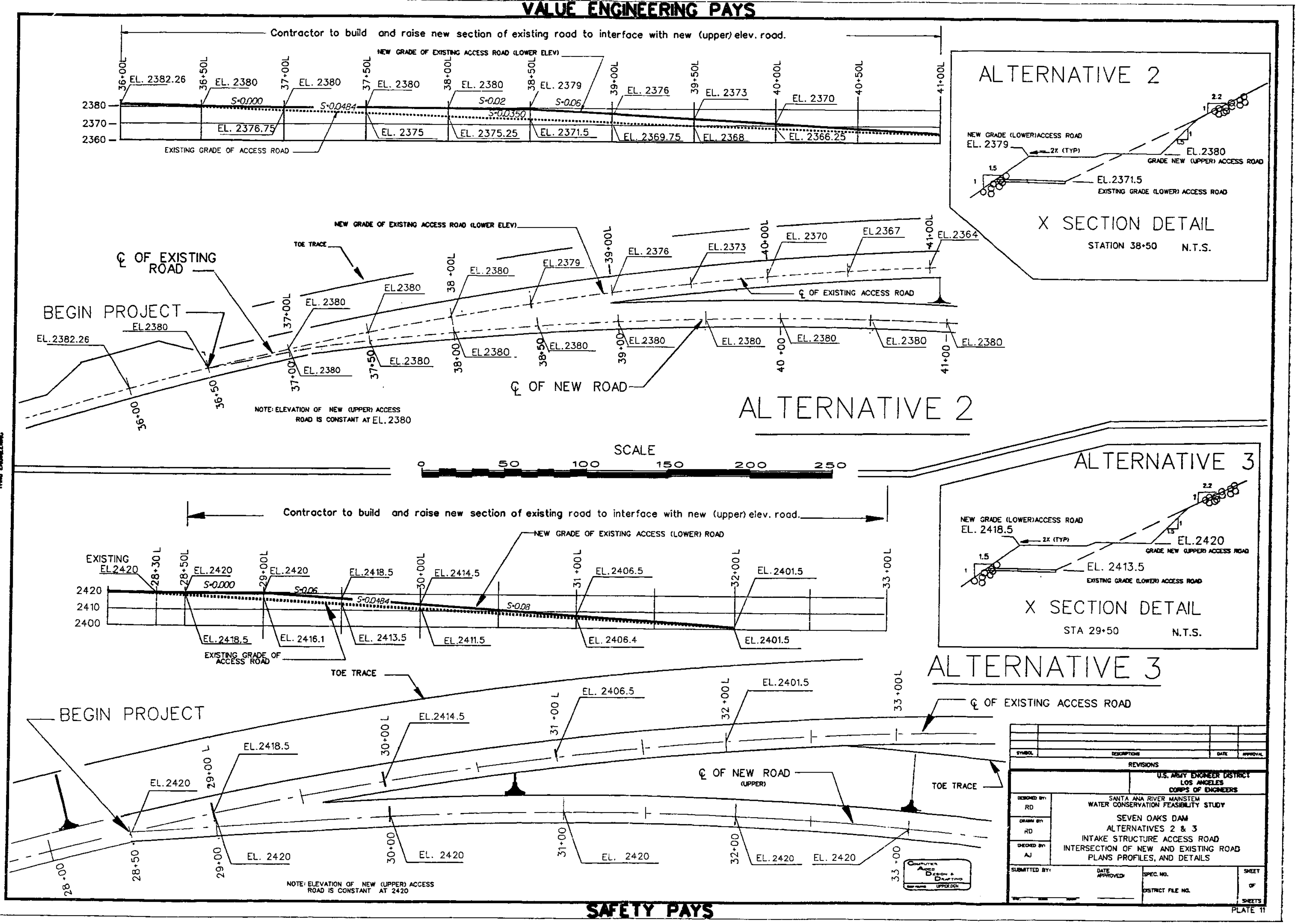
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: RD	SANTA ANA RIVER MAINSTEM WATER CONSERVATION FEASIBILITY STUDY
DRAWN BY: TC	SEVEN OAKS DAM
CHECKED BY: AJ	INTAKE STRUCTURE ACCESS ROAD SECTIONS, SERVICE AREA AND DETAILS

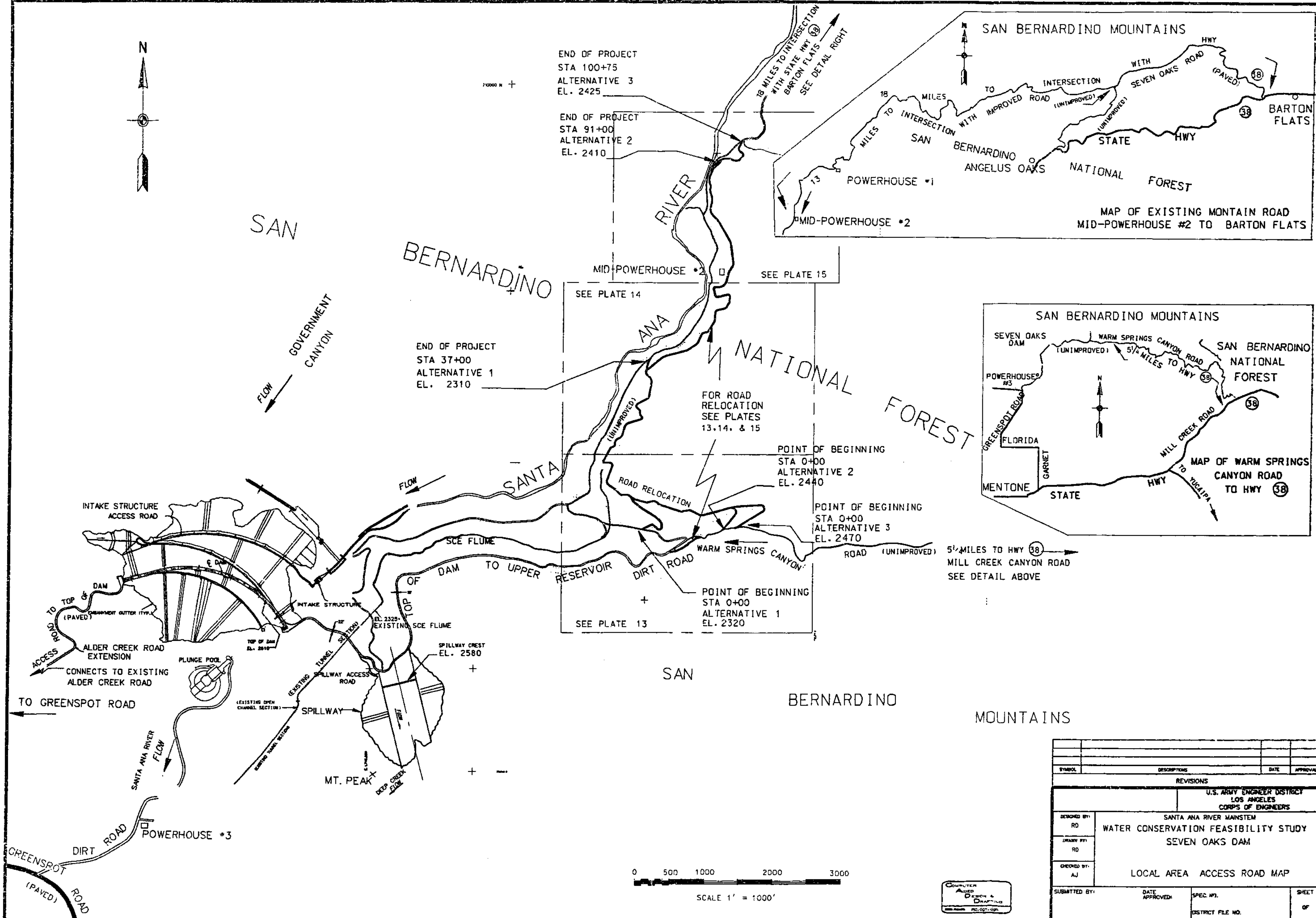
SUBMITTED BY: | DATE APPROVED: | SPEC. NO. | DISTRICT FILE NO. | SHEET OF SHEETS

PLATE 10

SAFETY PAYS



VALUE ENGINEERING PAYS
Contractor to build and raise new section of existing road to interface with new (upper) elev. road.
NEW GRADE OF EXISTING ACCESS ROAD (LOWER ELEV)
EXISTING GRADE OF ACCESS ROAD
ALTERNATIVE 2
X SECTION DETAIL
STATION 38+50
N.T.S.
NEW GRADE (LOWER)ACCESS ROAD EL. 2379
GRADE NEW (UPPER) ACCESS ROAD EL.2380
EXISTING GRADE (LOWER) ACCESS ROAD EL.2371.5
TOE TRACE
℄ OF EXISTING ROAD
BEGIN PROJECT
℄ OF EXISTING ACCESS ROAD
℄ OF NEW ROAD
NOTE: ELEVATION OF NEW (UPPER) ACCESS ROAD IS CONSTANT AT EL.2380
ALTERNATIVE 2
SCALE
0 50 100 150 200 250
ALTERNATIVE 3
X SECTION DETAIL
STA 29+50
N.T.S.
NEW GRADE (LOWER)ACCESS ROAD EL. 2418.5
GRADE NEW (UPPER) ACCESS ROAD EL.2420
EXISTING GRADE (LOWER) ACCESS ROAD EL. 2413.5
Contractor to build and raise new section of existing road to interface with new (upper) elev. road.
NEW GRADE OF EXISTING ACCESS (LOWER) ROAD
EXISTING EL.2420
EXISTING GRADE OF ACCESS ROAD
ALTERNATIVE 3
BEGIN PROJECT
℄ OF EXISTING ACCESS ROAD
℄ OF NEW ROAD (UPPER)
TOE TRACE
NOTE: ELEVATION OF NEW (UPPER) ACCESS ROAD IS CONSTANT AT 2420
REVISIONS
U.S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS
SANTA ANA RIVER MAINSTEM WATER CONSERVATION FEASIBILITY STUDY
SEVEN OAKS DAM
ALTERNATIVES 2 & 3
INTAKE STRUCTURE ACCESS ROAD
INTERSECTION OF NEW AND EXISTING ROAD
PLANS PROFILES, AND DETAILS
DESIGNED BY: RD
DRAWN BY: RD
CHECKED BY: AJ
SAFETY PAYS
PLATE 11



SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

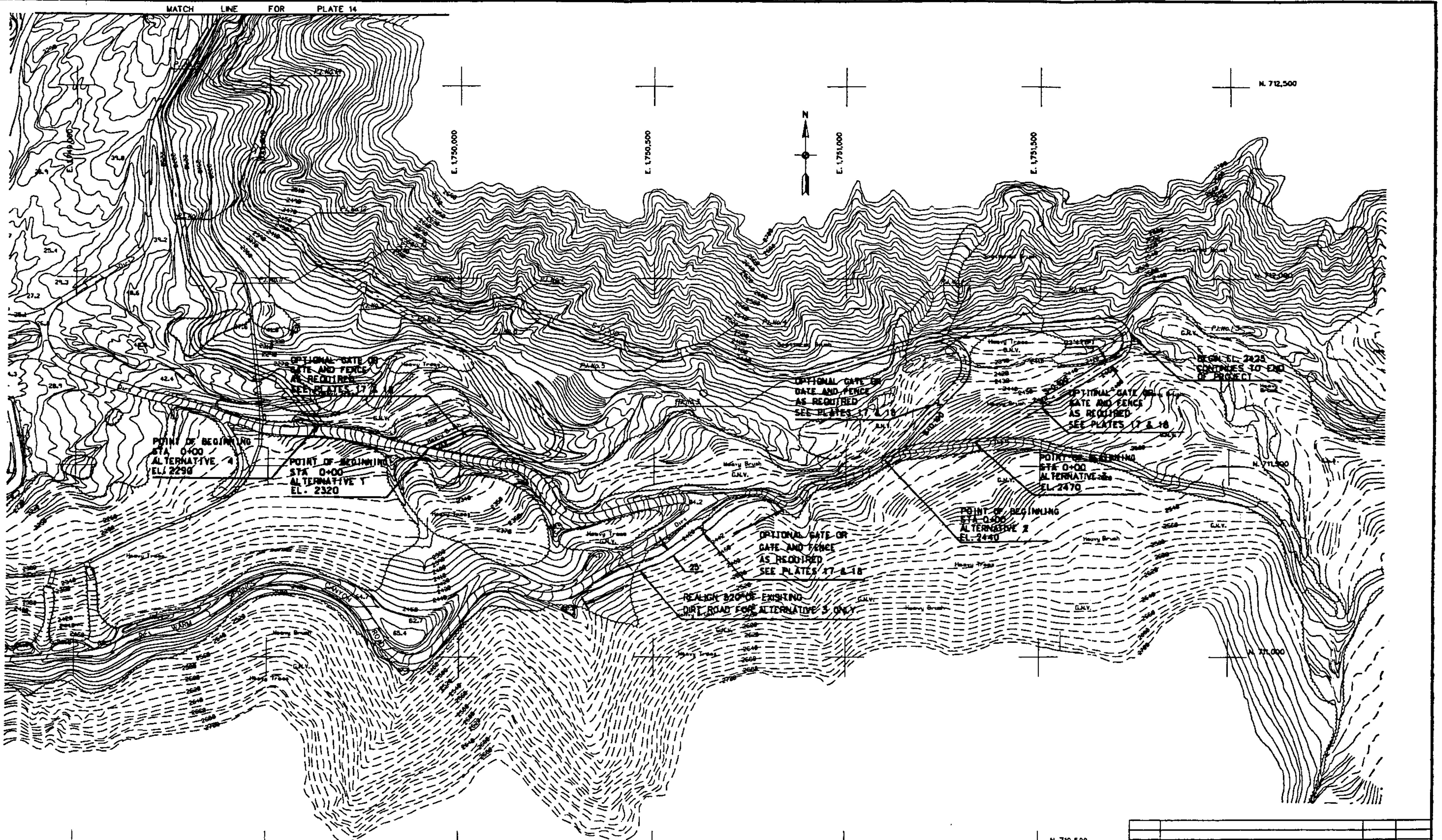
DESIGNED BY: RD
DRAWN BY: RD
CHECKED BY: AJ

SANTA ANA RIVER MAINSTEM
WATER CONSERVATION FEASIBILITY STUDY
SEVEN OAKS DAM

LOCAL AREA ACCESS ROAD MAP

SUBMITTED BY: DATE APPROVED: SPEC. NO. DISTRICT FILE NO. SHEET OF SHEETS

PLATE 12



SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

SANTA ANA RIVER MAINSTEM
WATER CONSERVATION FEASIBILITY STUDY

DESIGNED BY: R.D
DRAWN BY: R.D.
CHECKED BY: A.J.

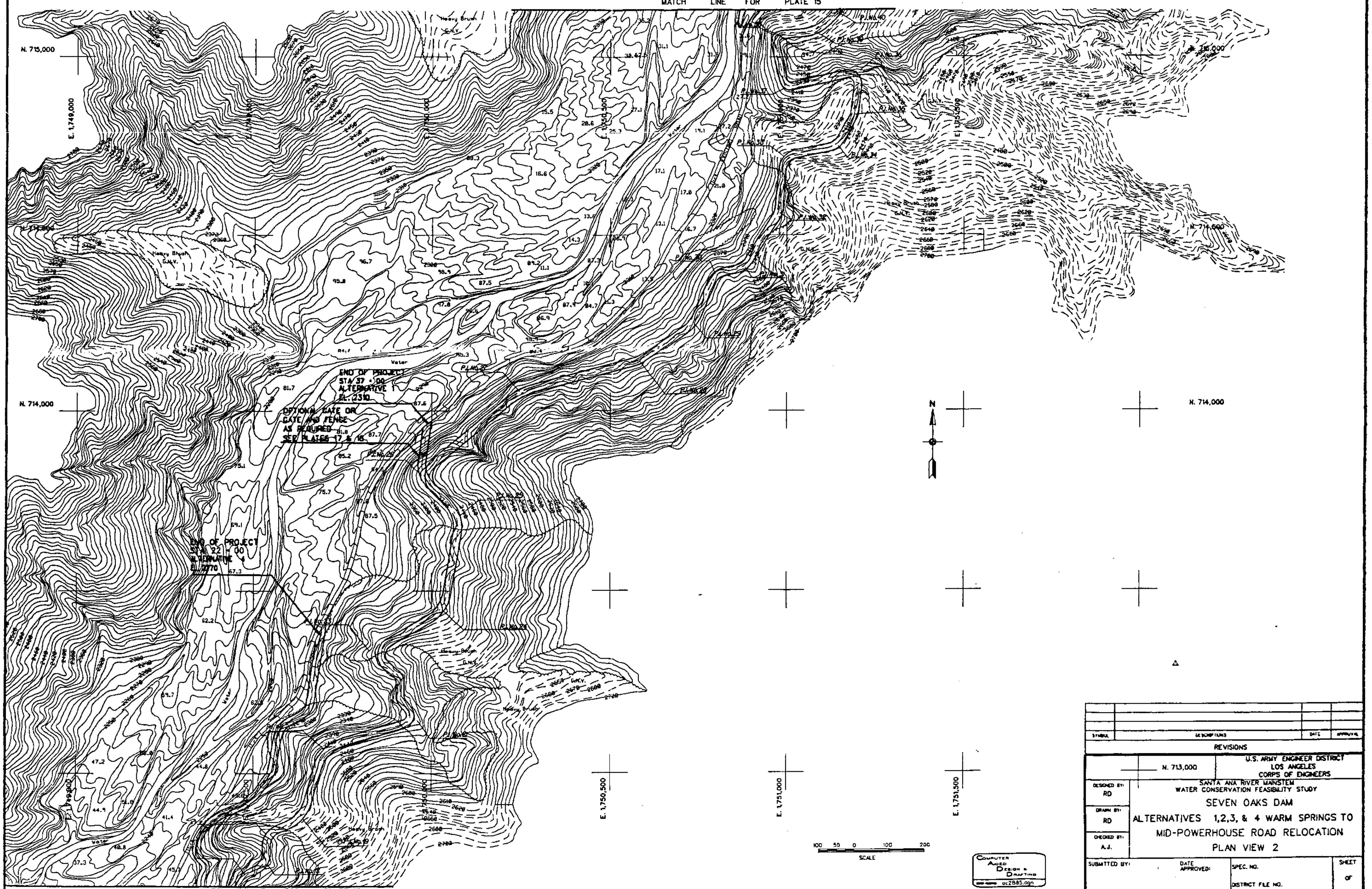
SEVEN OAKS DAM
ALTERNATIVES 1,2,3, & 4 WARM SPRINGS
TO MID-POWERHOUSE ROAD RELOCATION
PLAN VIEW 1

SUBMITTED BY: DATE APPROVED: SPEC. NO. SHEET OF SHEETS
DISTRICT FILE NO.

PLATE 13

VALUE ENGINEERING PAYS

ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING



Computer Aided Design & Drafting oc2885.dgn

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

N. 713,000

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

SANTA ANA RIVER MAINSTEM
WATER CONSERVATION FEASIBILITY STUDY

SEVEN OAKS DAM

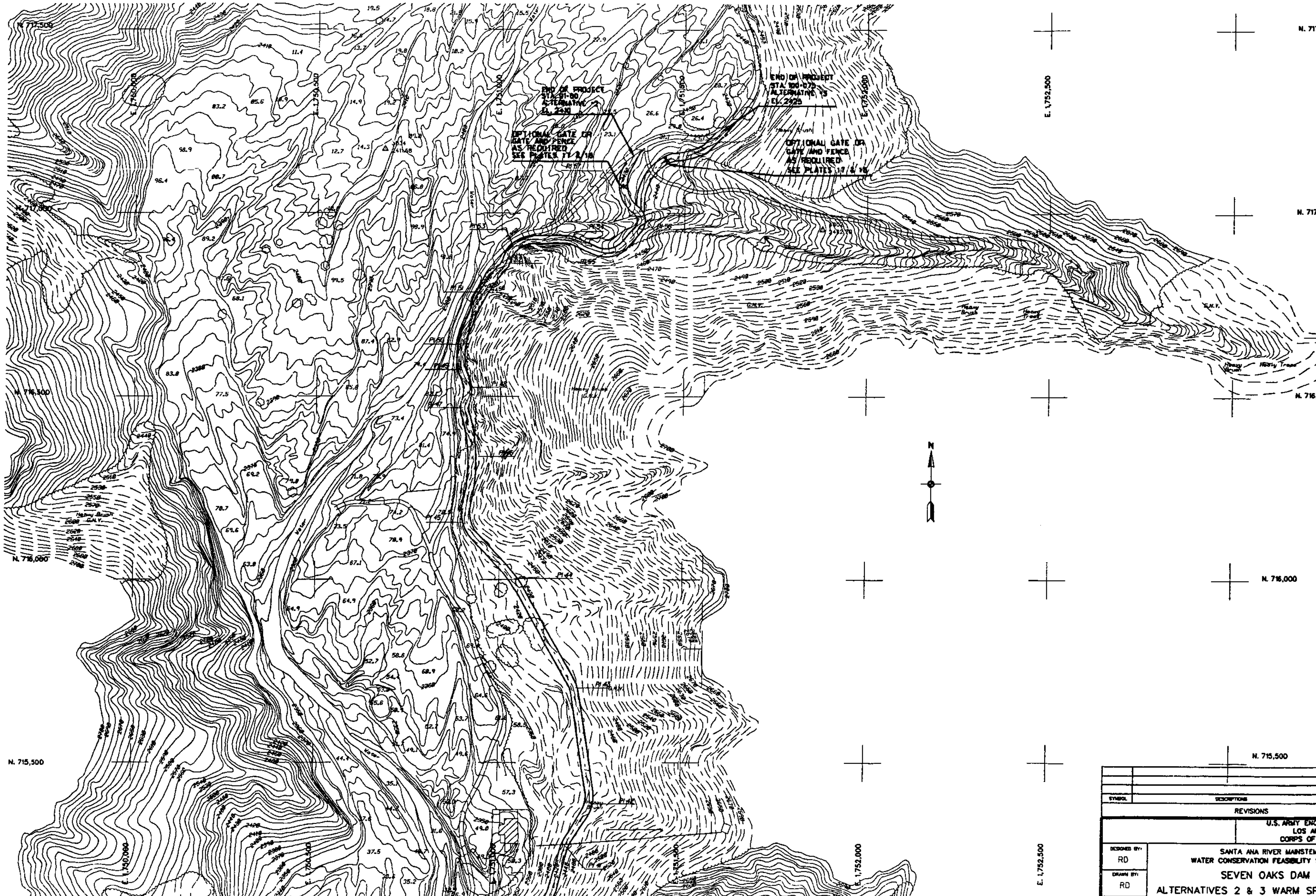
ALTERNATIVES 1,2,3, & 4 WARM SPRINGS TO MID-POWERHOUSE ROAD RELOCATION

PLAN VIEW 2

DESIGNED BY: RD
DRAWN BY: RD
CHECKED BY: A.J.
SUBMITTED BY:
DATE APPROVED:
SPEC. NO.
DISTRICT FILE NO.
SHEET OF SHEETS

PLATE 14

SAFFTY PAYS



100 50 0 100 200FT.
SCALE: 1"= 100'

COMPUTER AIDED DESIGN & DRAFTING
go1885.dgn

ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

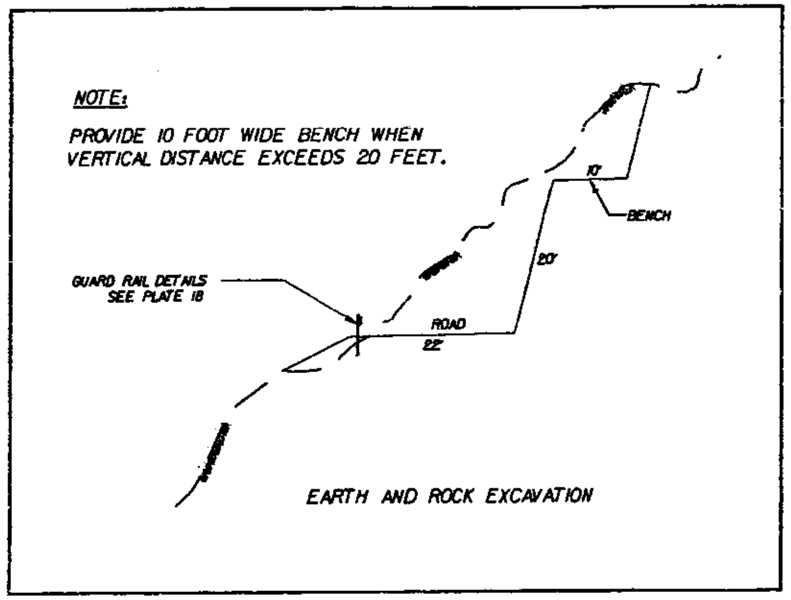
DESIGNED BY: RD
DRAWN BY: RD
CHECKED BY: AJ
SUBMITTED BY:
DATE APPROVED:

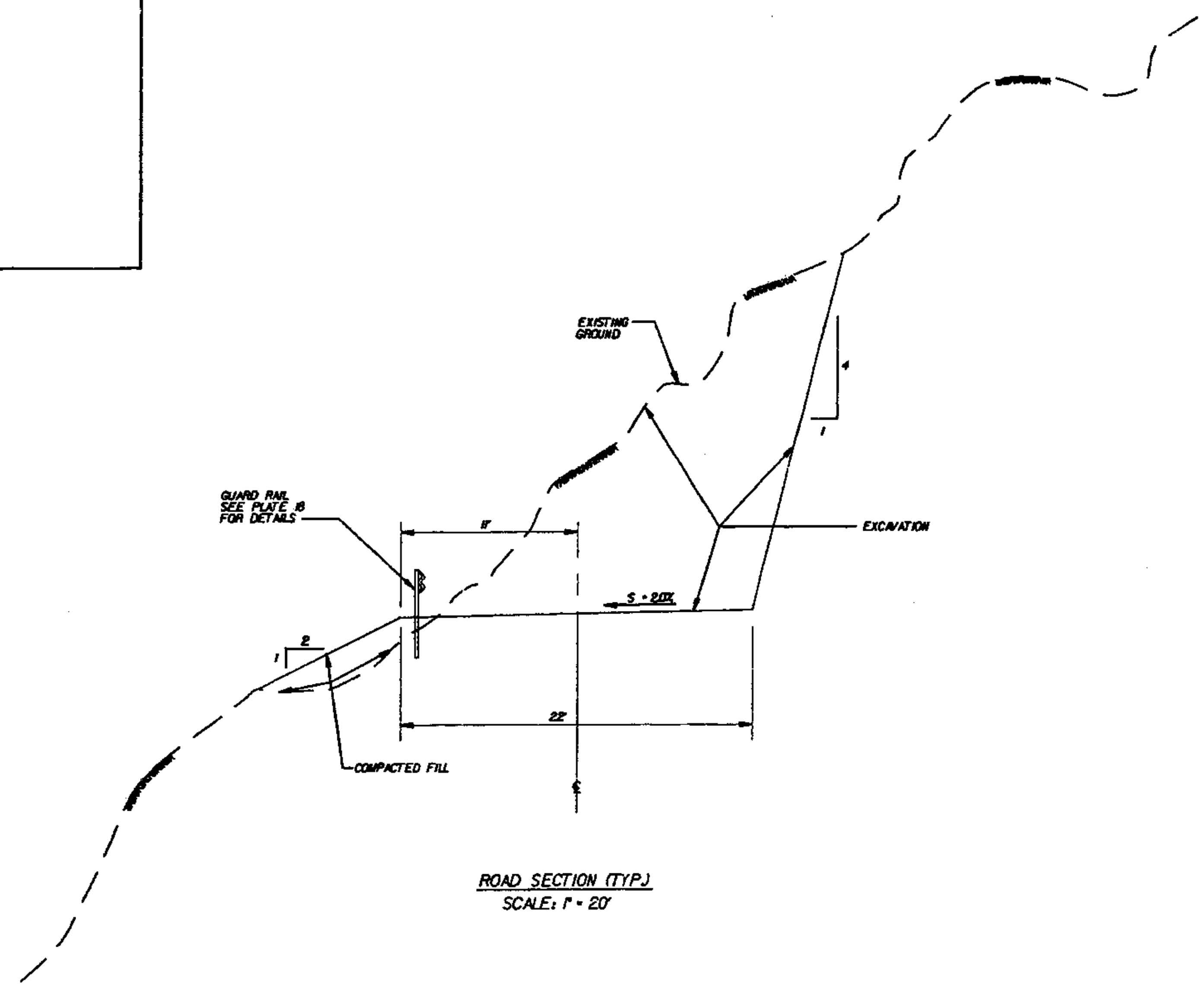
SANTA ANA RIVER MAINSTEM
WATER CONSERVATION FEASIBILITY STUDY
SEVEN OAKS DAM
ALTERNATIVES 2 & 3 WARM SPRINGS TO
MID-POWERHOUSE ROAD RELOCATION
PLAN VIEW 3

SPEC. NO.
DISTRICT FILE NO.
SHEET OF SHEETS

VALUE ENGINEERING PAYS

ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING





ROAD SECTION (TYP.)
SCALE: 1" = 20'

40 20 0 40 80FT
SCALE: 1" = 40'

20 10 0 20 40FT
SCALE: 1" = 20'

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: R.D.
DRAWN BY: J.M.
CHECKED BY: A.J.

SANTA ANA RIVER MAINSTEM
WATER CONSERVATION FEASIBILITY STUDY

SEVEN OAKS DAM

WARM SPRING TO MID-POWERHOUSE ROAD
RELOCATION SECTIONS AND DETAILS

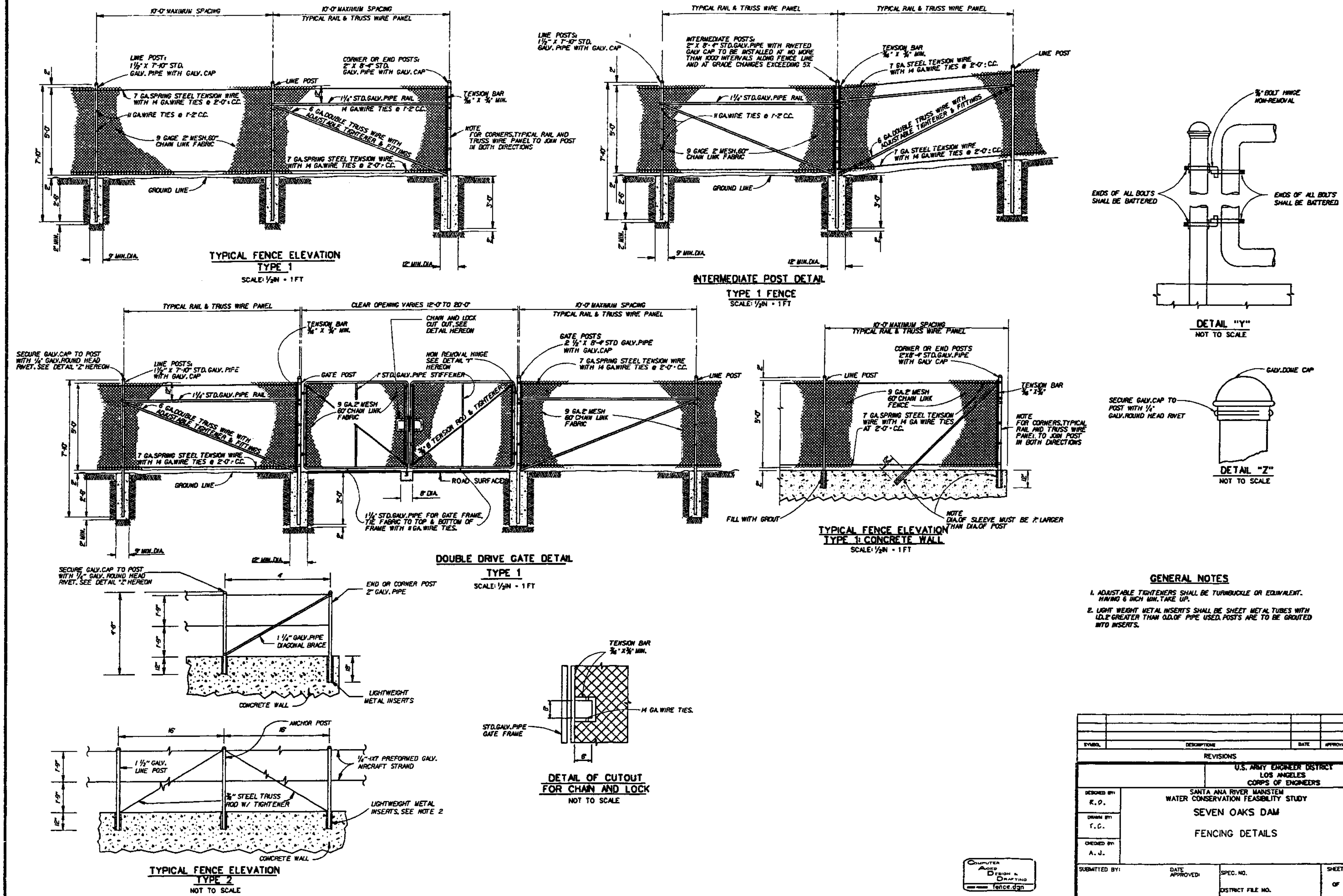
SUBMITTED BY:
DATE APPROVED:
SPEC. NO.
DISTRICT FILE NO.
SHEET OF SHEETS

PLATE 16

SAFETY PAYS

VALUE ENGINEERING PAYS

ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING



GENERAL NOTES

1. ADJUSTABLE TIGHTENERS SHALL BE TURNBUCKLE OR EQUIVALENT. HAVING 6 INCH MIN. TAKE UP.
2. LIGHT WEIGHT METAL INSERTS SHALL BE SHEET METAL TUBES WITH I.D. 2" GREATER THAN O.D. OF PIPE USED. POSTS ARE TO BE GROUTED INTO INSERTS.

Computer Aided Design & Drafting fence.dgn

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

SANTA ANA RIVER MAINSTEM
WATER CONSERVATION FEASIBILITY STUDY

SEVEN OAKS DAM

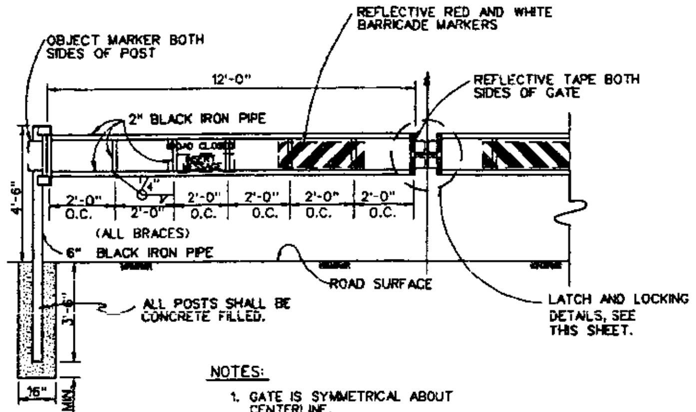
FENCING DETAILS

DESIGNED BY: K.O.
DRAWN BY: T.C.
CHECKED BY: A.J.
SUBMITTED BY:
DATE APPROVED:
SPEC. NO.
DISTRICT FILE NO.
SHEET OF SHEETS

PLATE 17

SAFETY PAYS

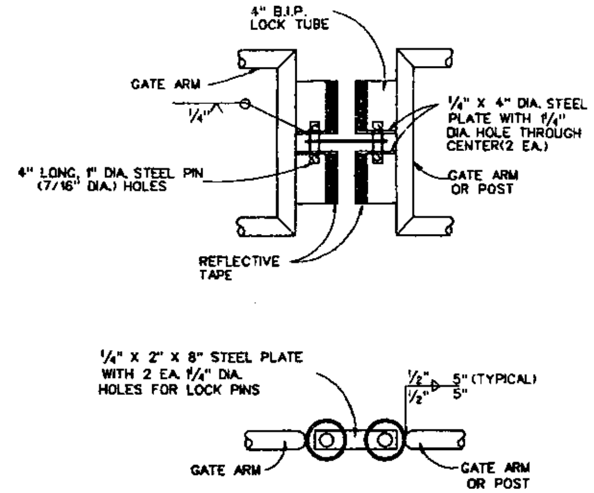
VALUE ENGINEERING PAYS



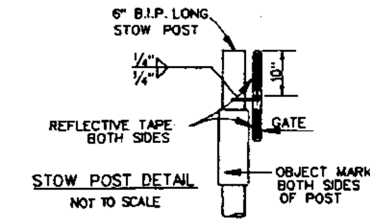
NOTES:

1. GATE IS SYMMETRICAL ABOUT CENTERLINE.
2. SEE HINGE AND STOW POST DETAILS ON THIS SHEET
3. CONCRETE SHALL CONFORM TO ASTM C94 USING 3/4-INCH AGGREGATES, AND HAVING MINIUM COMPRESSIVE STRENGTH OF 2000 PSI AT 28 DAYS.

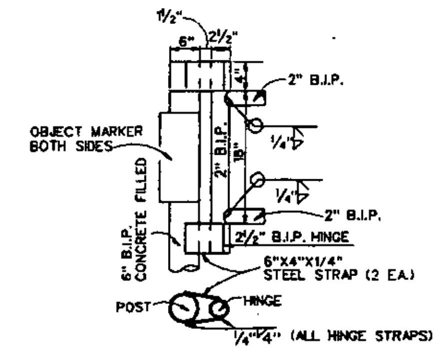
TWO LANE -DOUBLE GATE DETAIL
NOT TO SCALE



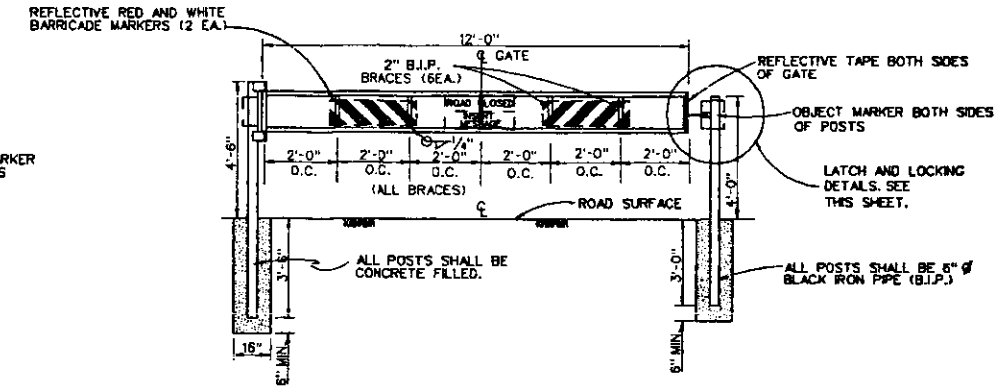
LATCH AND LOCKING DETAIL
NOT TO SCALE



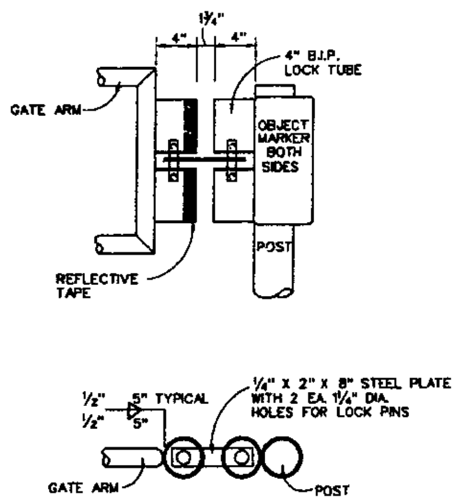
STOW POST DETAIL
NOT TO SCALE



HINGE DETAIL
NOT TO SCALE



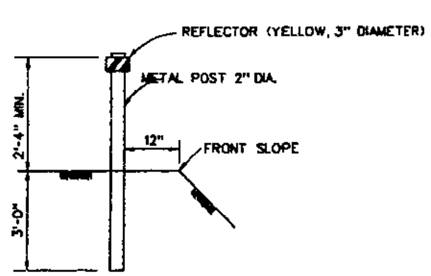
SINGLE LANE GATE DETAIL
NOT TO SCALE



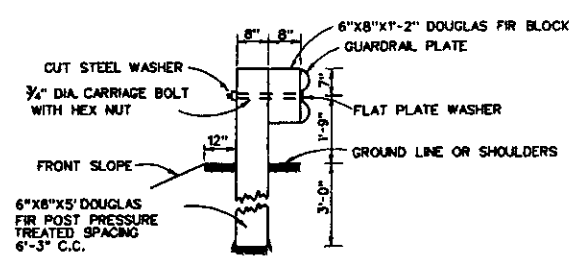
LATCH AND LOCKING DETAIL
NOT TO SCALE

NOTES:

1. "NO TRESPASSING" WARNING SIGNS WILL BE FURNISHED BY THE CONTRACTING OFFICER.
2. SLIT C3X1¼"X1/4" CHANNEL POST TO 6" DEEP AS SHOWN AND BOLT WITH ⅜"Ø BOLT.



GUIDEPOST DETAIL
NOT TO SCALE



GUARDRAIL DETAIL
NOT TO SCALE

COMPUTER AIDED DESIGN & DRAFTING GATECULV.DGN

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

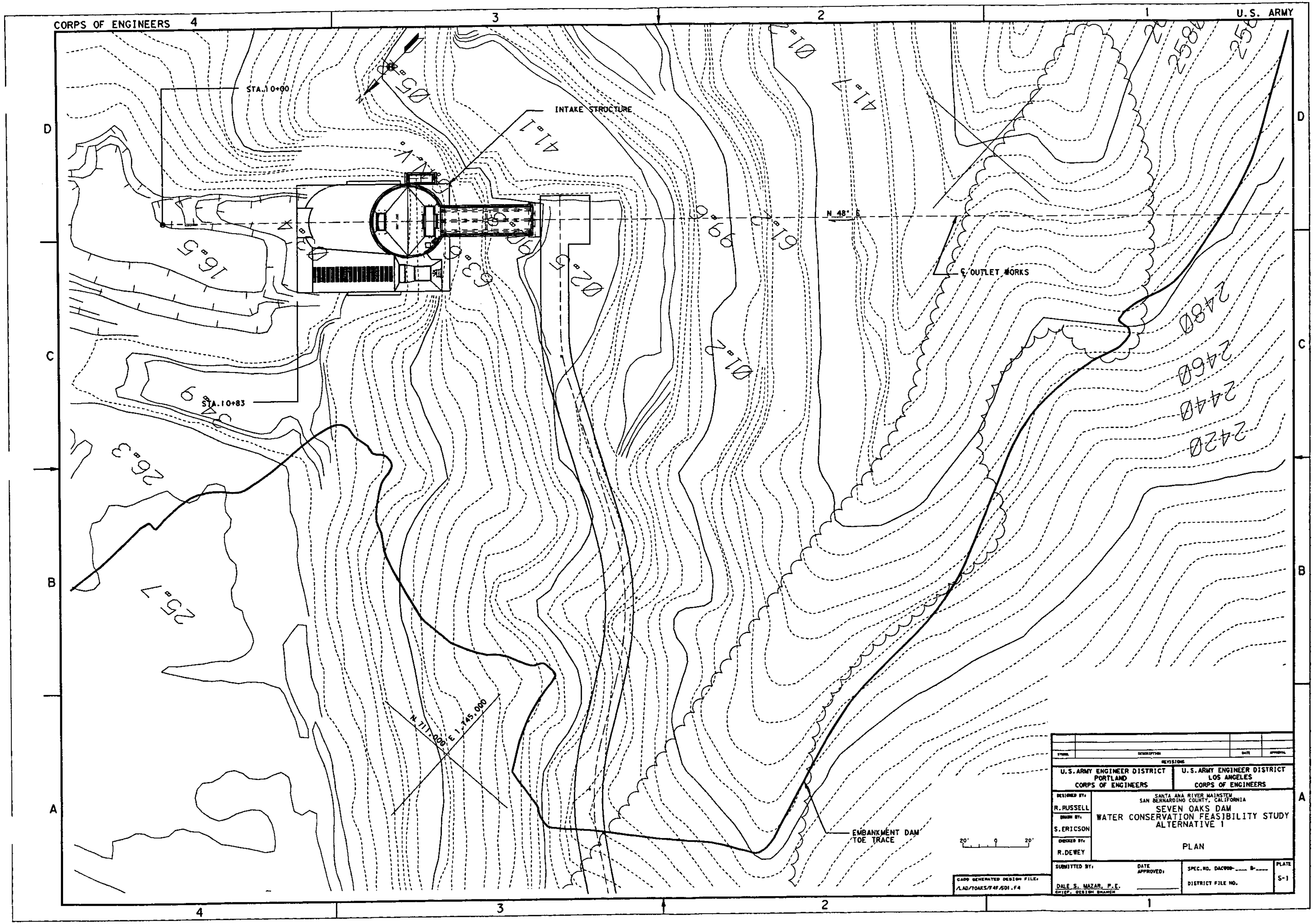
REVISIONS

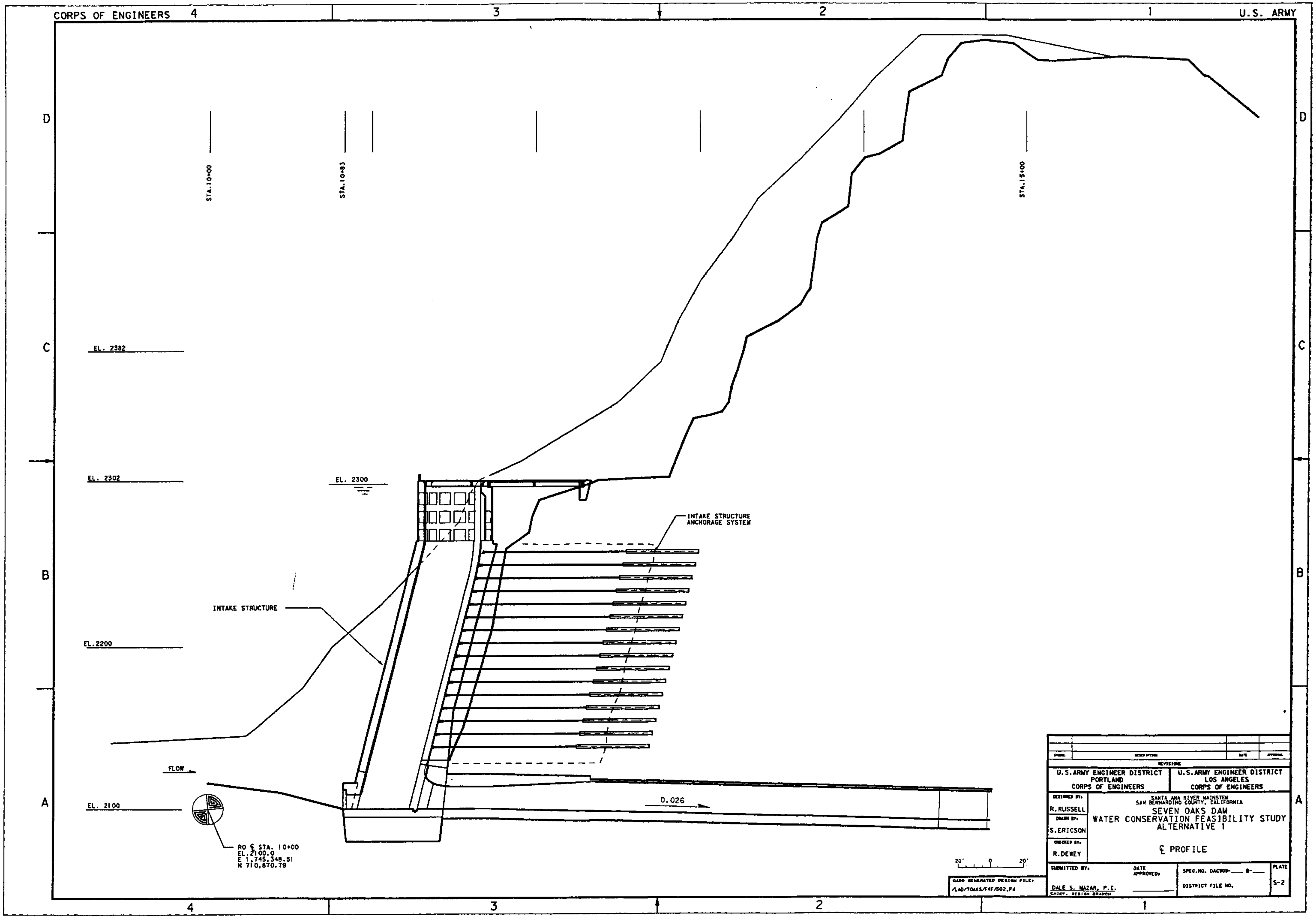
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

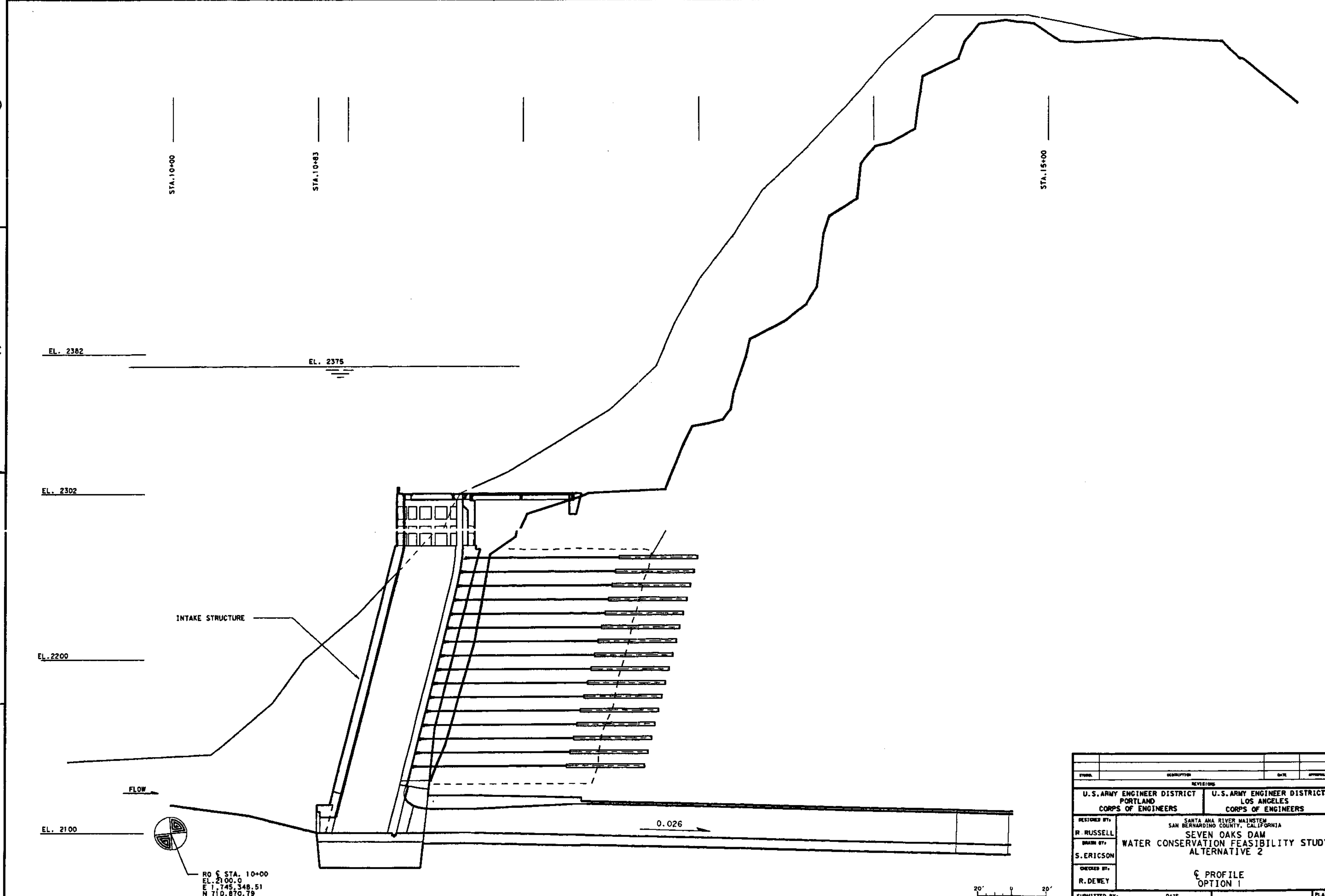
DESIGNED BY: RD	SANTA ANA RIVER MAINSTEM WATER CONSERVATION FEASIBILITY STUDY
DRAWN BY: RD	SEVEN OAKS DAM
CHECKED BY: AJ	STEEL GATES, GUIDEPOST AND GUARDRAIL DETAILS
SUBMITTED BY:	DATE APPROVED: · SPEC. NO. · DISTRICT FILE NO. · SHEET OF SHEETS

PLATE 18

SAFETY PAYS


CORPS OF ENGINEERS
U.S. ARMY
STA.10+00
INTAKE STRUCTURE
STA.10+83
N 48° E
℄ OUTLET WORKS
N 711,000
E 1,745,000
EMBANKMENT DAM
TOE TRACE
2480
2460
2440
2420
20' 0 20'
CADD GENERATED DESIGN FILE:
/LAD/7OAKS/F4F/S01.F4
REVISIONS
U.S. ARMY ENGINEER DISTRICT
PORTLAND
CORPS OF ENGINEERS
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS
DESIGNED BY: R.RUSSELL
DRAWN BY: S.ERICSON
CHECKED BY: R.DEWEY
SANTA ANA RIVER MAINSTEM
SAN BERNARDINO COUNTY, CALIFORNIA
SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY
ALTERNATIVE 1
PLAN
SUBMITTED BY:
DATE APPROVED:
DALE S. MAZAR, P.E.
CHIEF, DESIGN BRANCH
SPEC.NO. DACW09-
DISTRICT FILE NO.
PLATE
S-1


CORPS OF ENGINEERS
U.S. ARMY
STA.10+00
STA.10+83
STA.15+00
EL. 2382
EL. 2302
EL. 2300
EL.2200
EL. 2100
INTAKE STRUCTURE
INTAKE STRUCTURE ANCHORAGE SYSTEM
FLOW
0.026
RO ℄ STA. 10+00
EL.2100.0
E 1,745,348.51
N 710,870.79
20' 0 20'
CADD GENERATED DESIGN FILE:
/LAD/7OAKS/F4F/S02.F4
REVISIONS
U.S.ARMY ENGINEER DISTRICT
PORTLAND
CORPS OF ENGINEERS
U.S.ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS
SANTA ANA RIVER MAINSTEM
SAN BERNARDINO COUNTY, CALIFORNIA
SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY
ALTERNATIVE 1
℄ PROFILE
DESIGNED BY: R.RUSSELL
DRAWN BY: S.ERICSON
CHECKED BY: R.DEWEY
SUBMITTED BY:
DALE S. MAZAR, P.E.
CHIEF, DESIGN BRANCH
DATE APPROVED:
SPEC.NO. DACW09-___ B-___
DISTRICT FILE NO.
PLATE
S-2



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DRAWN BY: S. ERICSON
CHECKED BY: R. DEWEY

SANTA ANA RIVER MAINSTEM
SAN BERNARDINO COUNTY, CALIFORNIA
SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY
ALTERNATIVE 2

℄ PROFILE
OPTION 1

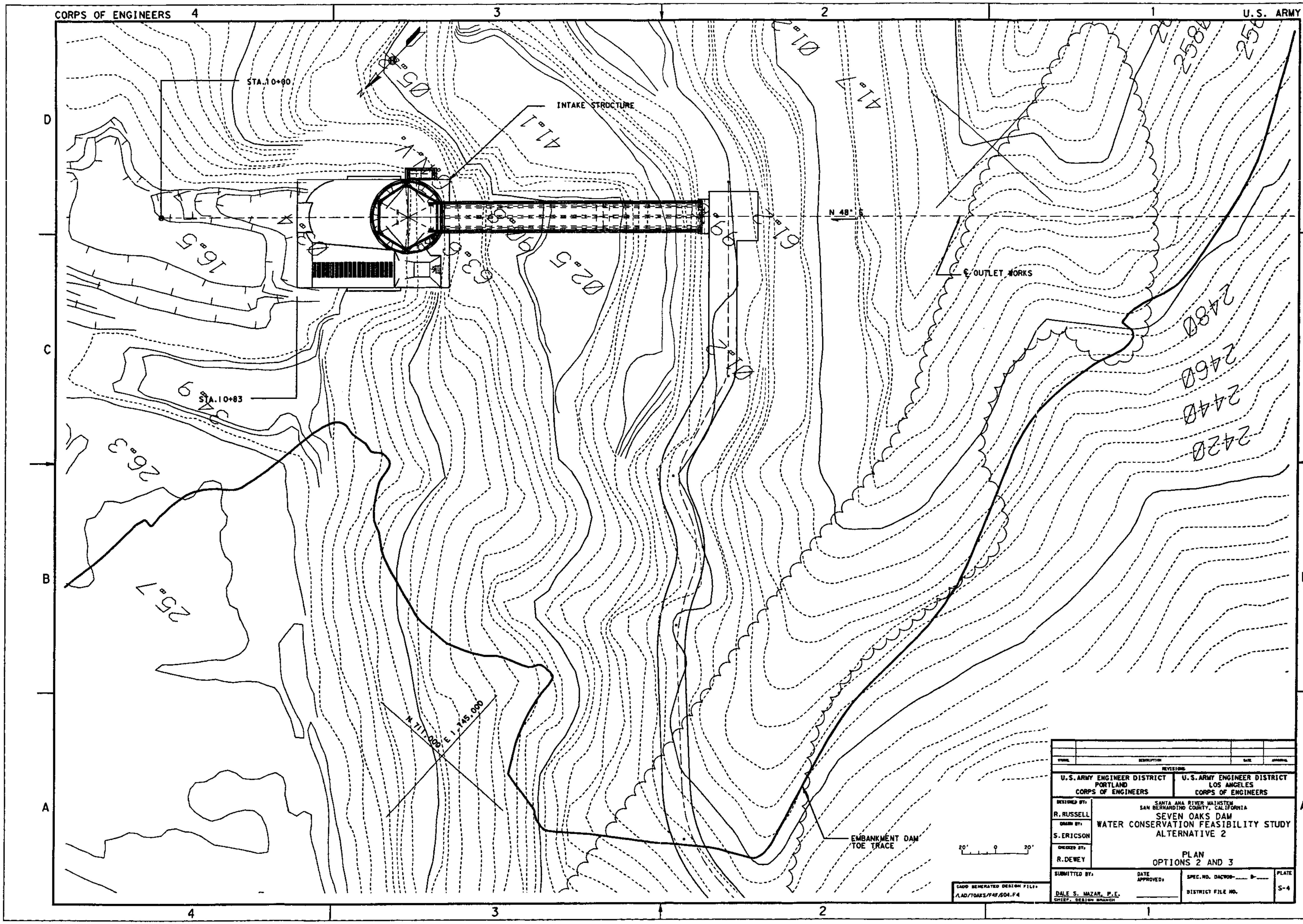
SUBMITTED BY: DALE S. MAZAR, P.E.
CHIEF, DESIGN BRANCH

DATE APPROVED: ______

SPEC. NO. DACW09-___ B-___

DISTRICT FILE NO.

PLATE S-3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N 717,000
E 1,745,000
EMBANKMENT DAM TOE TRACE
2420
2440
2460
2480
U.S. ARMY ENGINEER DISTRICT PORTLAND CORPS OF ENGINEERS
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SANTA ANA RIVER MAINSTEM
SAN BERNARDINO COUNTY, CALIFORNIA
SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY
ALTERNATIVE 2
PLAN
OPTIONS 2 AND 3
DESIGNED BY: R.RUSSELL
DRAWN BY: S.ERICSON
CHECKED BY: R.DEWEY
SUBMITTED BY: DALE S. MAZAR, P.E.
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PLATE S-4
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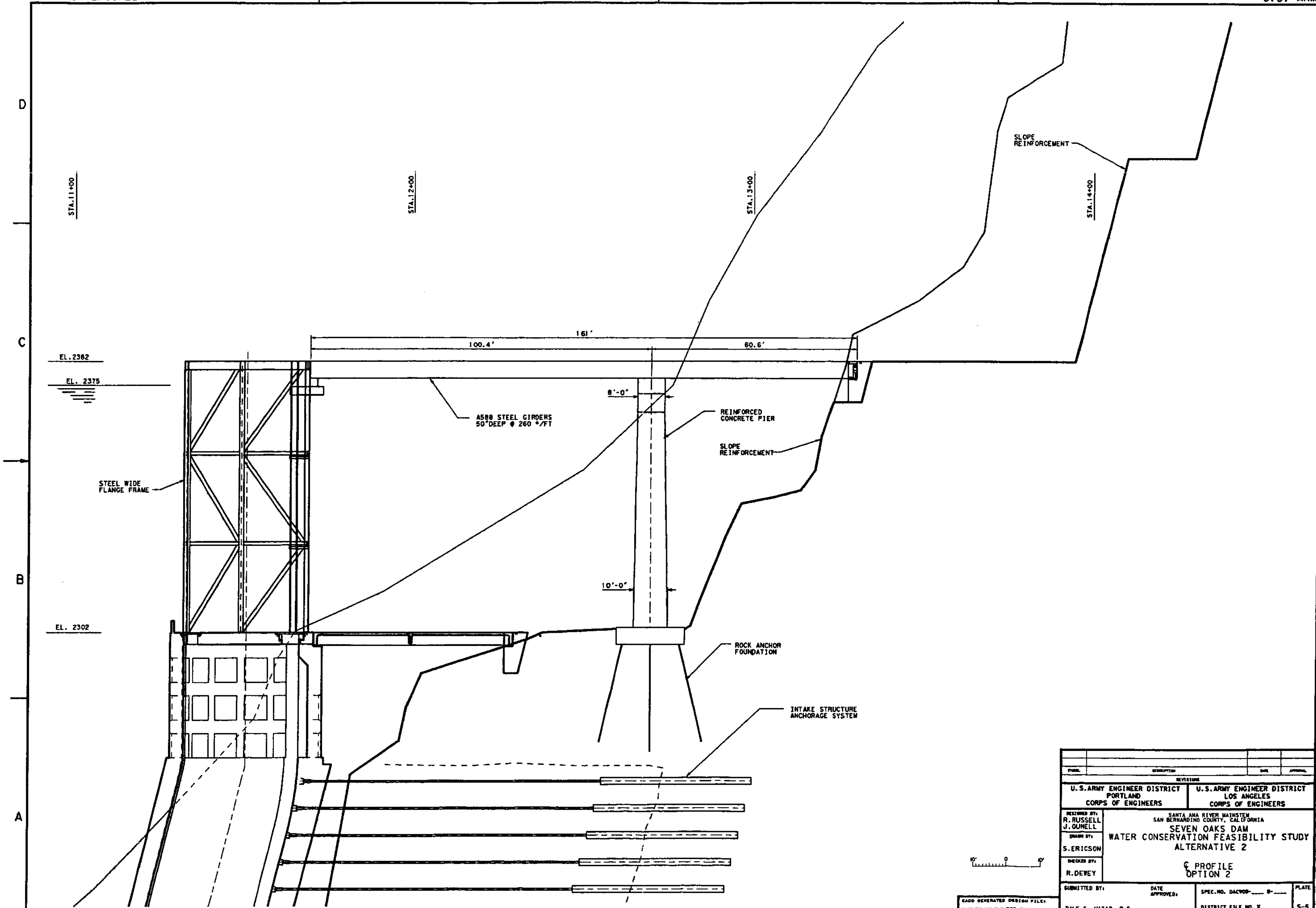

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LOS ANGELES
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DRAWN BY: S.ERICSON

CHECKED BY: R.DEWEY

SANTA ANA RIVER MAINSTEM
SAN BERNARDINO COUNTY, CALIFORNIA

SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY
ALTERNATIVE 2

℄ PROFILE
OPTION 2

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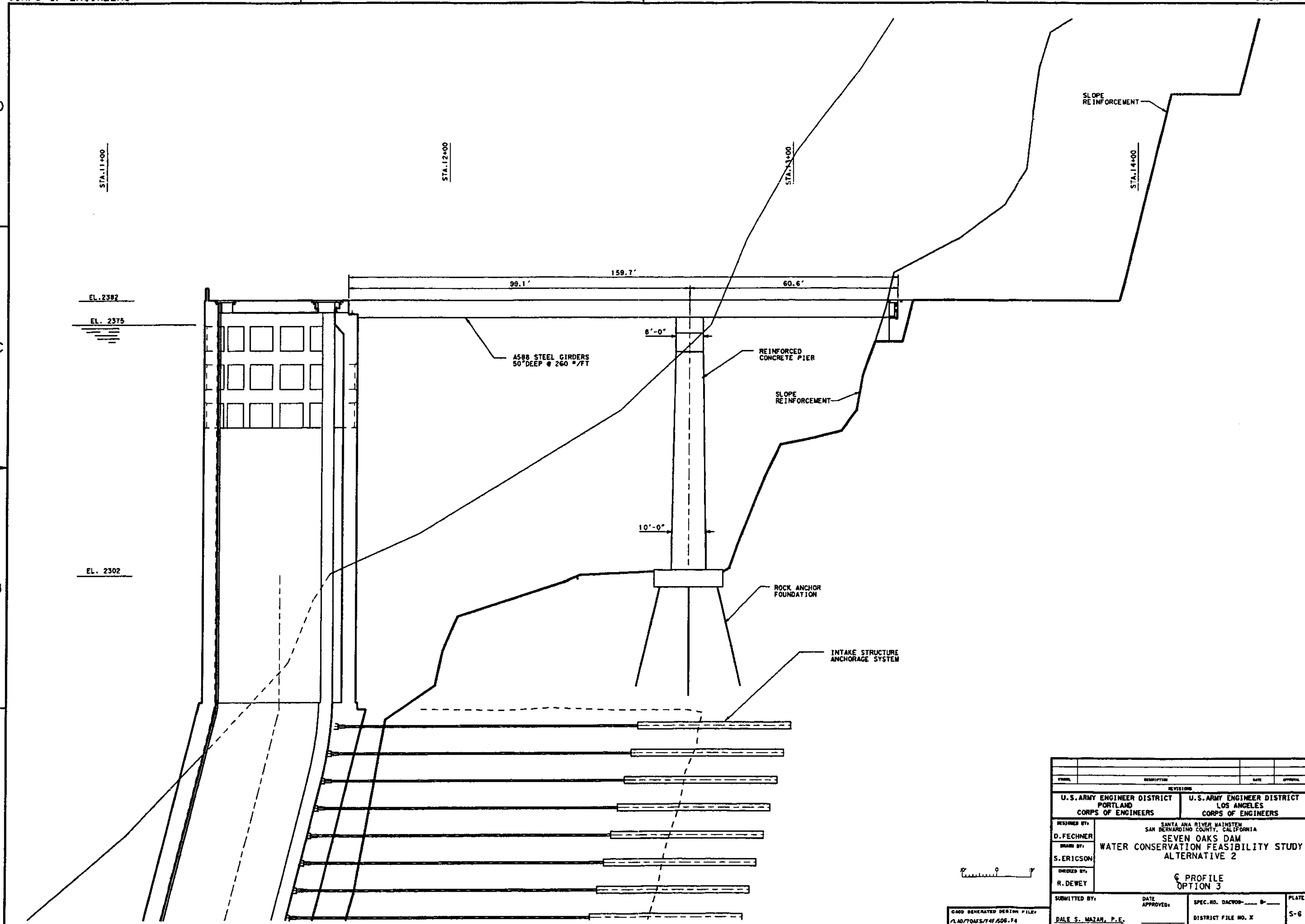
PLATE S-5



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SANTA ANA RIVER MAINSTEM
SAN BERNARDINO COUNTY, CALIFORNIA

SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY
ALTERNATIVE 2

℄ PROFILE
OPTION 3

DESIGNED BY: D.FECHNER
DRAWN BY: S.ERICSON
CHECKED BY: R.DEWEY
SUBMITTED BY: DALE S. MAZAR, P.E. CHIEF, DESIGN BRANCH
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DISTRICT FILE NO. X
PLATE S-6

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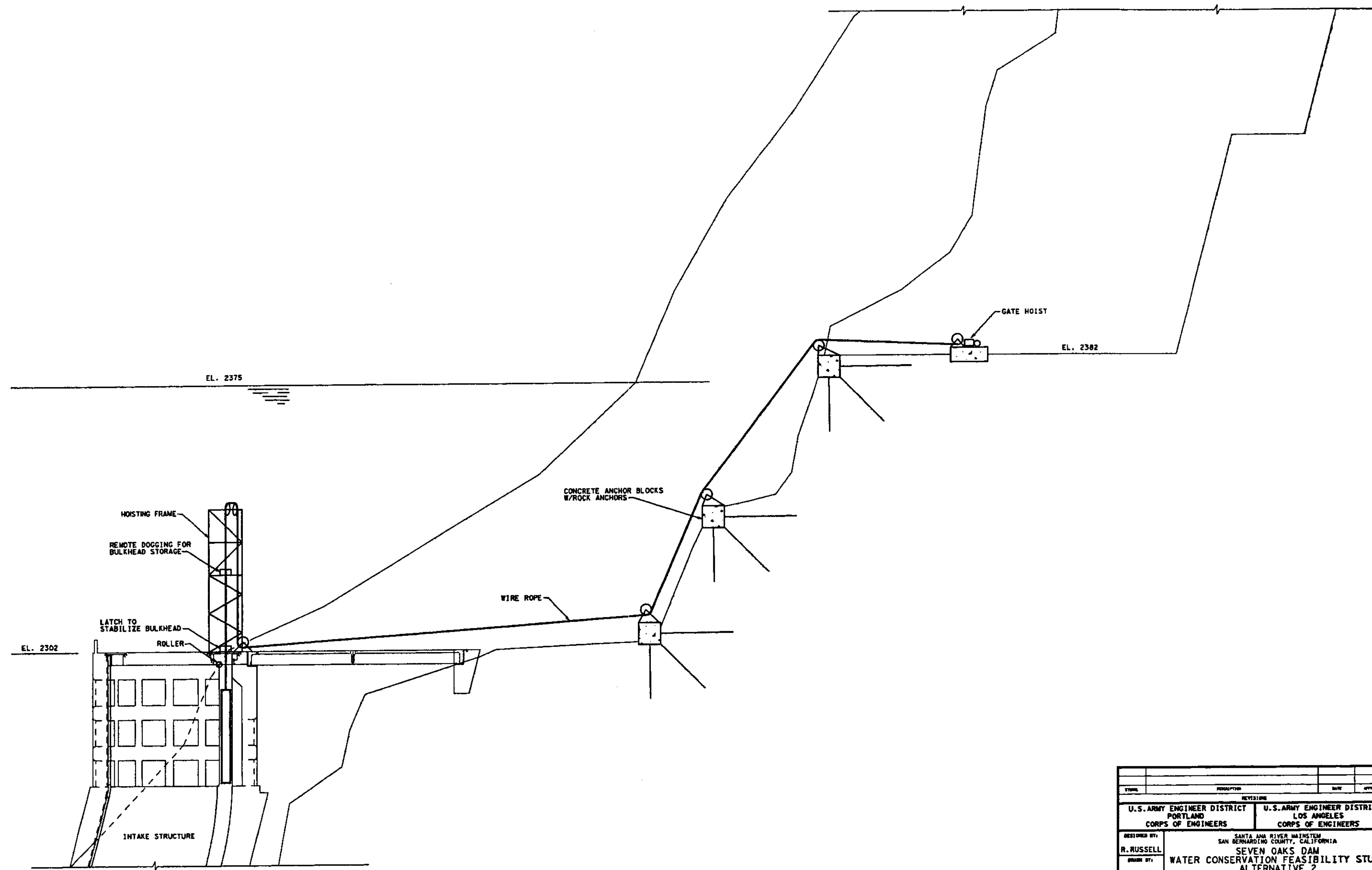

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CORPS OF ENGINEERS

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CORPS OF ENGINEERS

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DRAWN BY: D. WESTON
CHECKED BY: R. DEWEY

SANTA ANA RIVER MAINSTEM
SAN BERNARDINO COUNTY, CALIFORNIA

SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY
ALTERNATIVE 2

OPTION 4

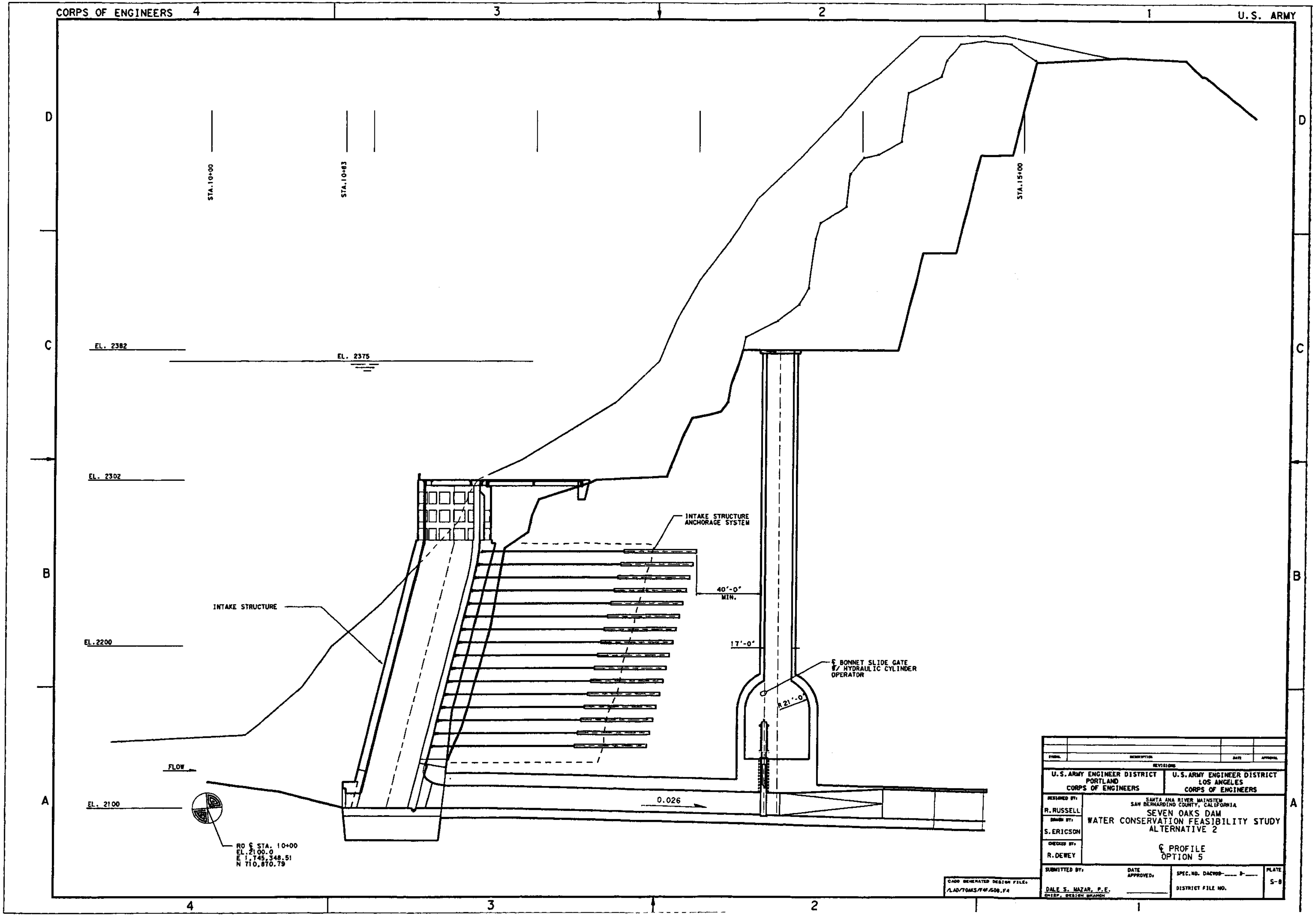
SUBMITTED BY: DALE S. MAZAR, P.E., CHIEF, DESIGN BRANCH

DATE APPROVED: ______

SPEC. NO. DACW09-___ B-___

DISTRICT FILE NO.

PLATE S-7



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STA.15+00
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EL. 2375
EL. 2302
EL.2200
EL. 2100
INTAKE STRUCTURE
INTAKE STRUCTURE ANCHORAGE SYSTEM
40'-0" MIN.
17'-0"
℄ BONNET SLIDE GATE W/ HYDRAULIC CYLINDER OPERATOR
R 21'-0"
FLOW
0.026
RO ℄ STA. 10+00
EL.2100.0
E 1,745,348.51
N 710,870.79
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DRAWN BY: S.ERICSON
CHECKED BY: R.DEWEY
SANTA ANA RIVER MAINSTEM
SAN BERNARDINO COUNTY, CALIFORNIA
SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY
ALTERNATIVE 2
℄ PROFILE
OPTION 5
SUBMITTED BY:
DALE S. MAZAR, P.E.
CHIEF, DESIGN BRANCH
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SPEC.NO. DACW09-
DISTRICT FILE NO.
PLATE S-8
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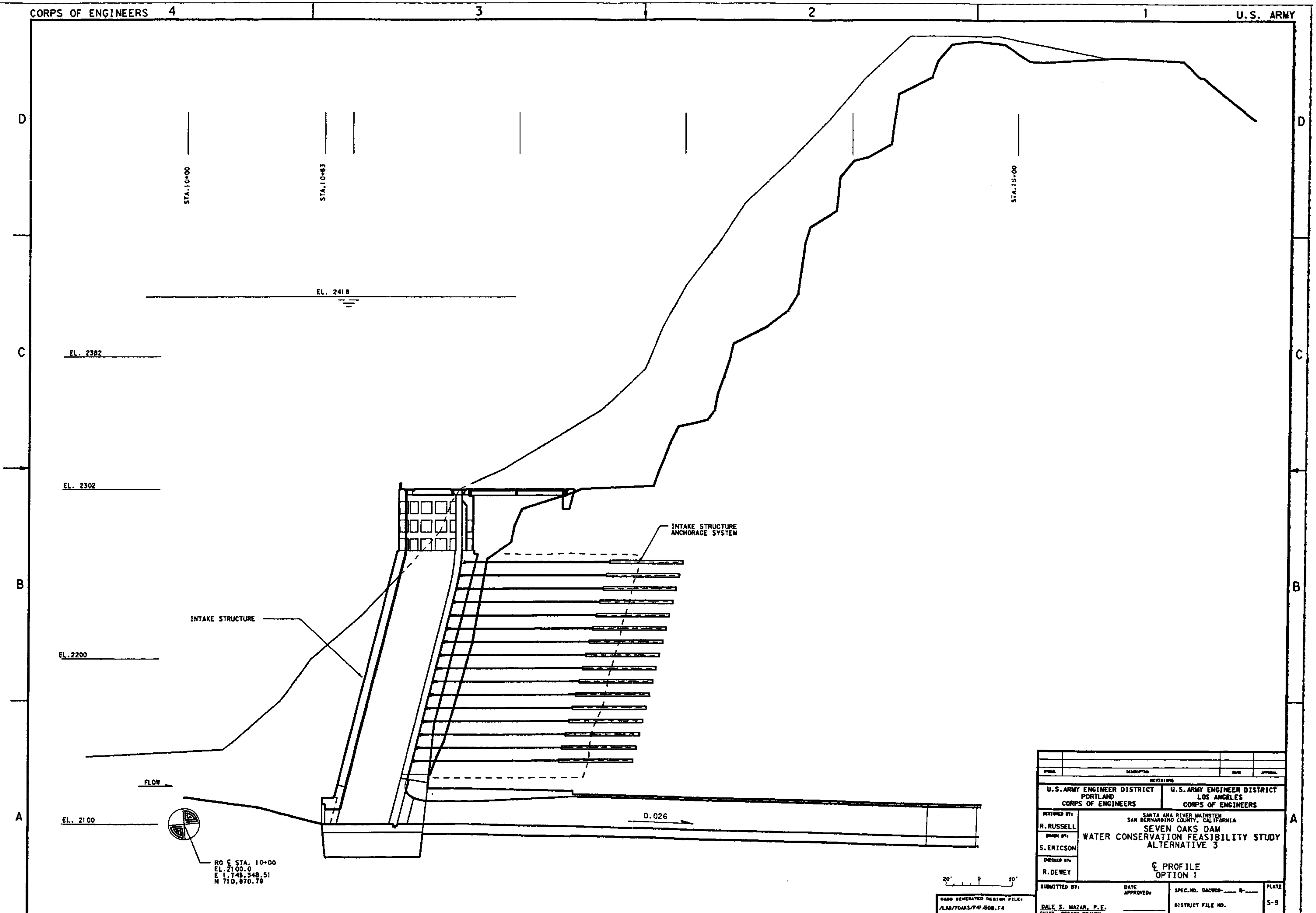

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SANTA ANA RIVER MAINSTEM
SAN BERNARDINO COUNTY, CALIFORNIA
SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY
ALTERNATIVE 3

℄ PROFILE
OPTION 1

SUBMITTED BY: DALE S. MAZAR, P.E., CHIEF, DESIGN BRANCH
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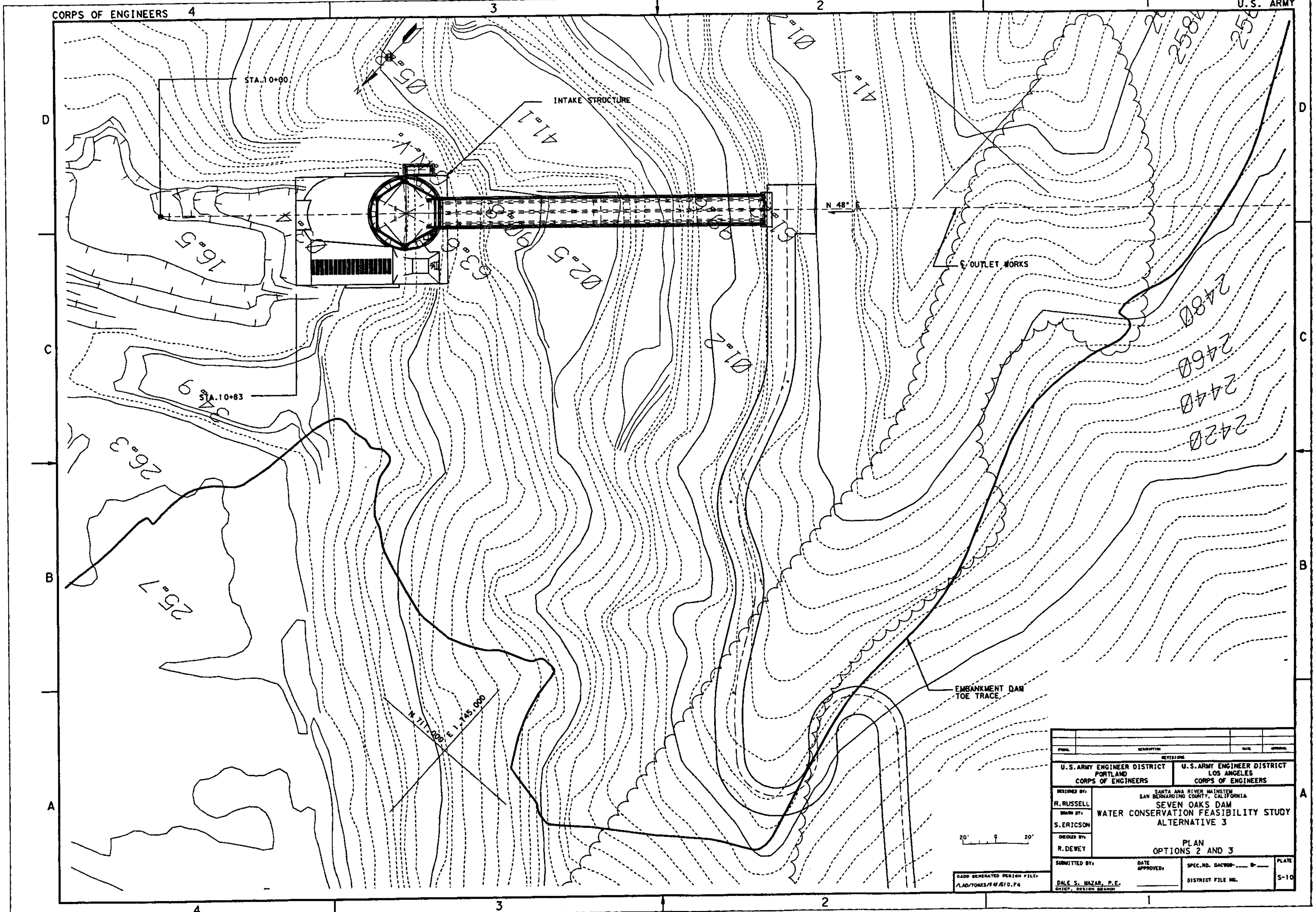
DISTRICT FILE NO.
PLATE S-9



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SANTA ANA RIVER MAINSTEM
SAN BERNARDINO COUNTY, CALIFORNIA
SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY
ALTERNATIVE 3

PLAN
OPTIONS 2 AND 3

DESIGNED BY: R. RUSSELL
DRAWN BY: S. ERICSON
CHECKED BY: R. DEWEY
SUBMITTED BY: DALE S. MAZAR, P.E. CHIEF, DESIGN BRANCH
DATE APPROVED:
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DISTRICT FILE NO.
PLATE S-10

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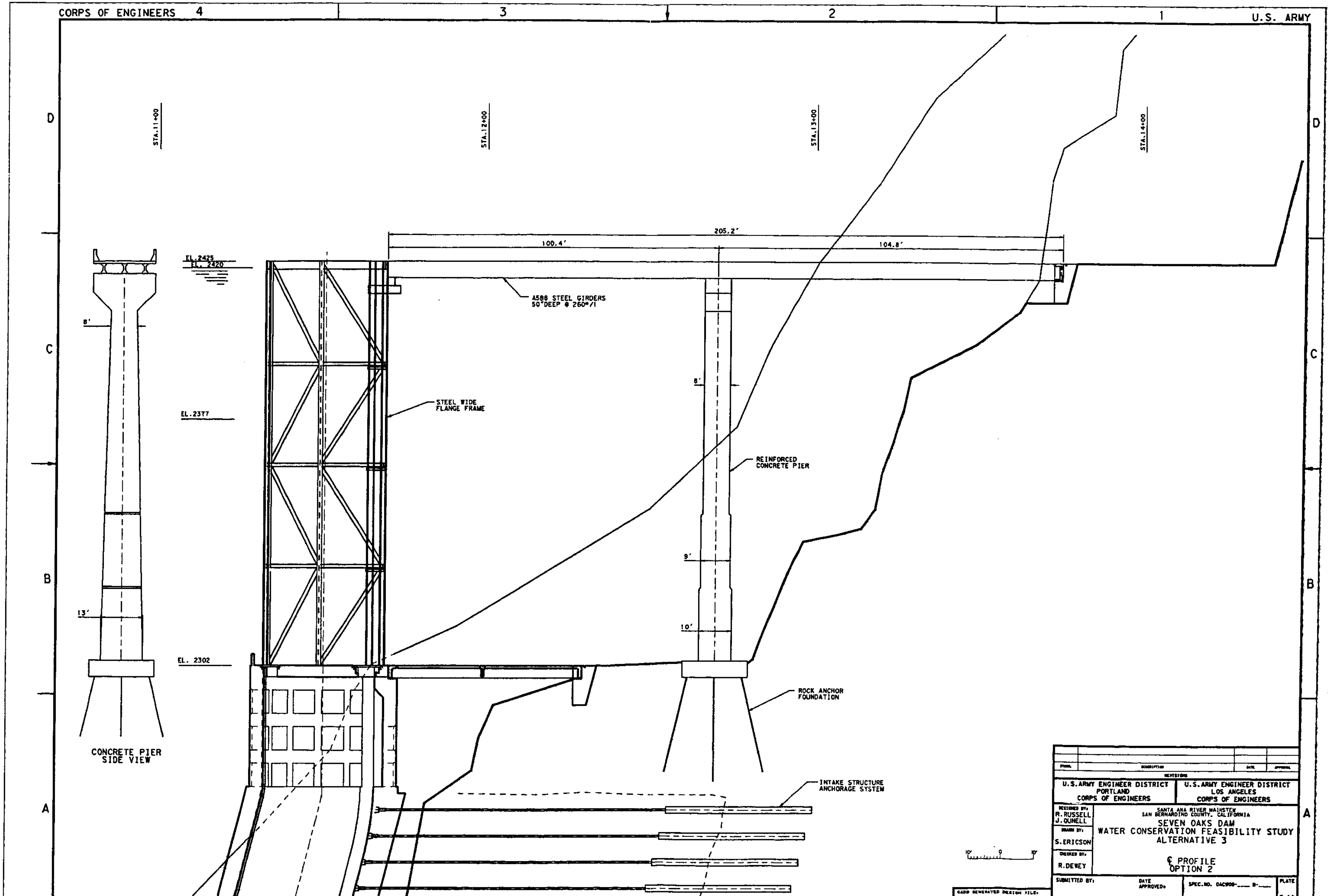

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PORTLAND
CORPS OF ENGINEERS

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LOS ANGELES
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DESIGNED BY: R. RUSSELL, J. QUNELL
DRAWN BY: S. ERICSON
CHECKED BY: R. DEWEY

SANTA ANA RIVER MAINSTEM
SAN BERNARDINO COUNTY, CALIFORNIA
SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY
ALTERNATIVE 3

℄ PROFILE
OPTION 2

SUBMITTED BY: DALE S. MAZAR, P.E.
CHIEF, DESIGN BRANCH
DATE APPROVED: ______
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DISTRICT FILE NO. X
PLATE S-11

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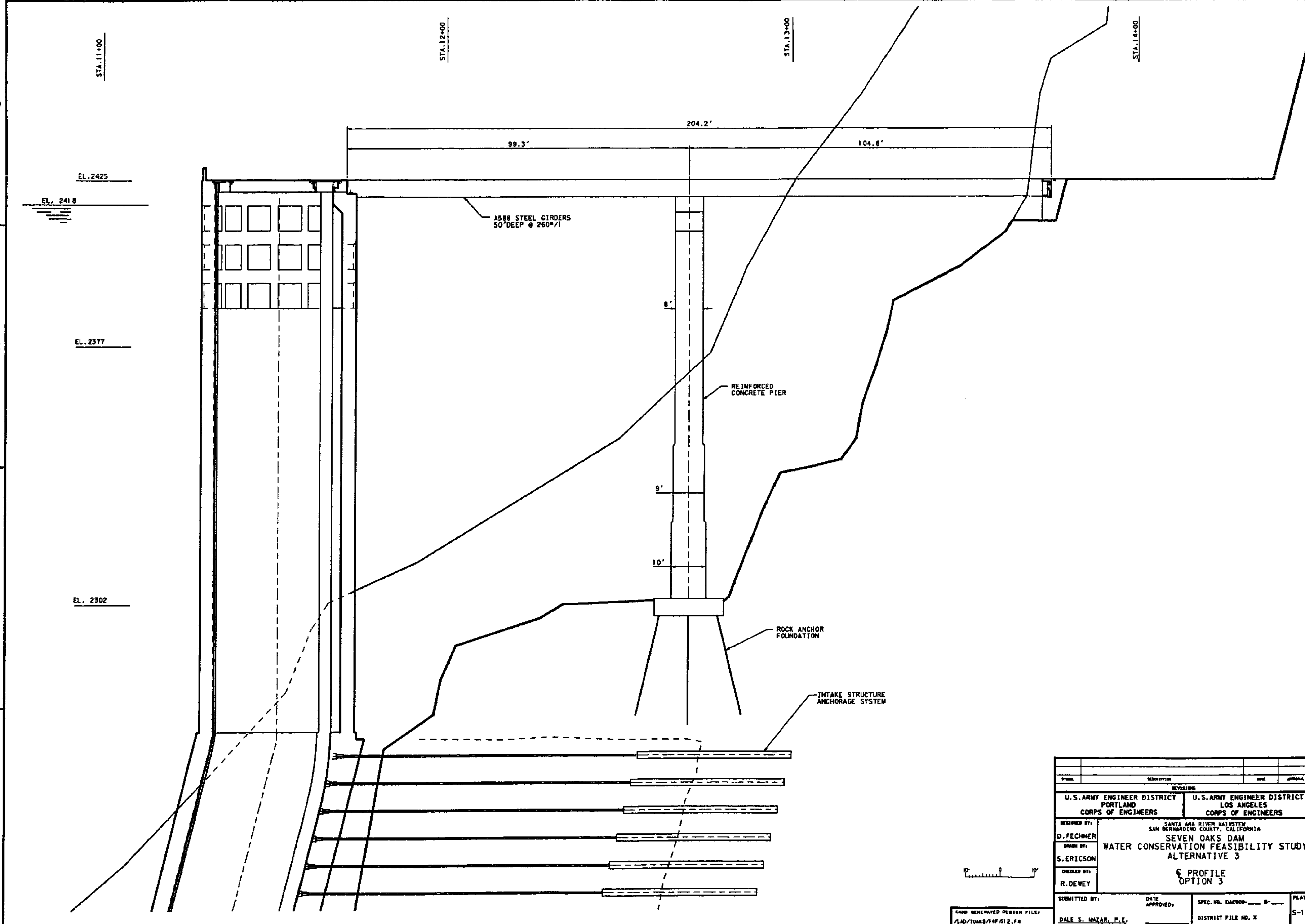

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U.S. ARMY ENGINEER DISTRICT
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LOS ANGELES
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DRAWN BY: S.ERICSON
CHECKED BY: R.DEWEY

SANTA ANA RIVER MAINSTEM
SAN BERNARDINO COUNTY, CALIFORNIA
SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY
ALTERNATIVE 3

℄ PROFILE
OPTION 3

SUBMITTED BY:
DALE S. MAZAR, P.E.
CHIEF, DESIGN BRANCH

DATE APPROVED:

SPEC. NO. DACW09-___ B-___
DISTRICT FILE NO. X

PLATE S-12

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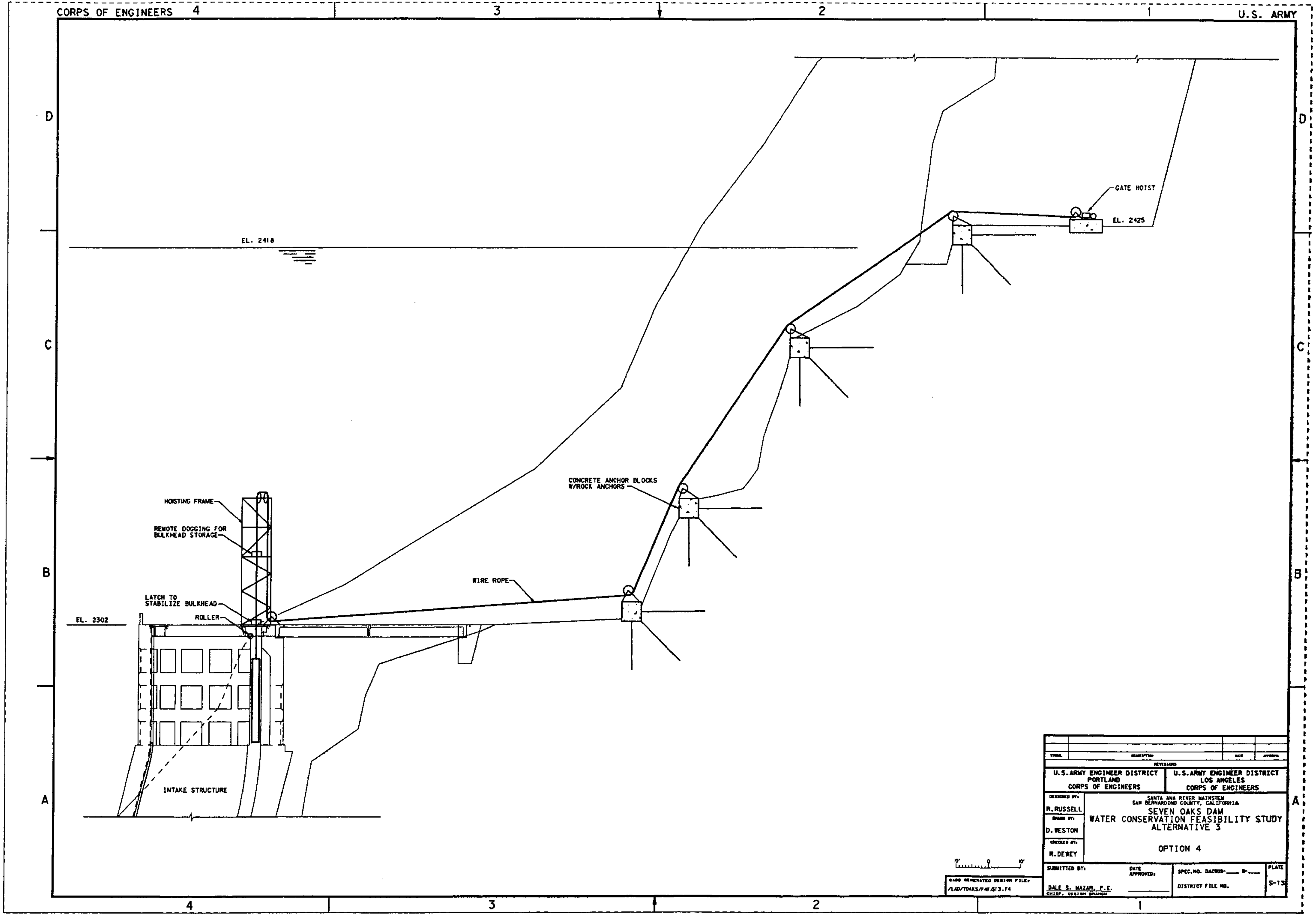
CORPS OF ENGINEERS
U.S. ARMY
EL. 2418
GATE HOIST
EL. 2425
CONCRETE ANCHOR BLOCKS W/ROCK ANCHORS
HOISTING FRAME
REMOTE DOGGING FOR BULKHEAD STORAGE
WIRE ROPE
LATCH TO STABILIZE BULKHEAD
ROLLER
EL. 2302
INTAKE STRUCTURE
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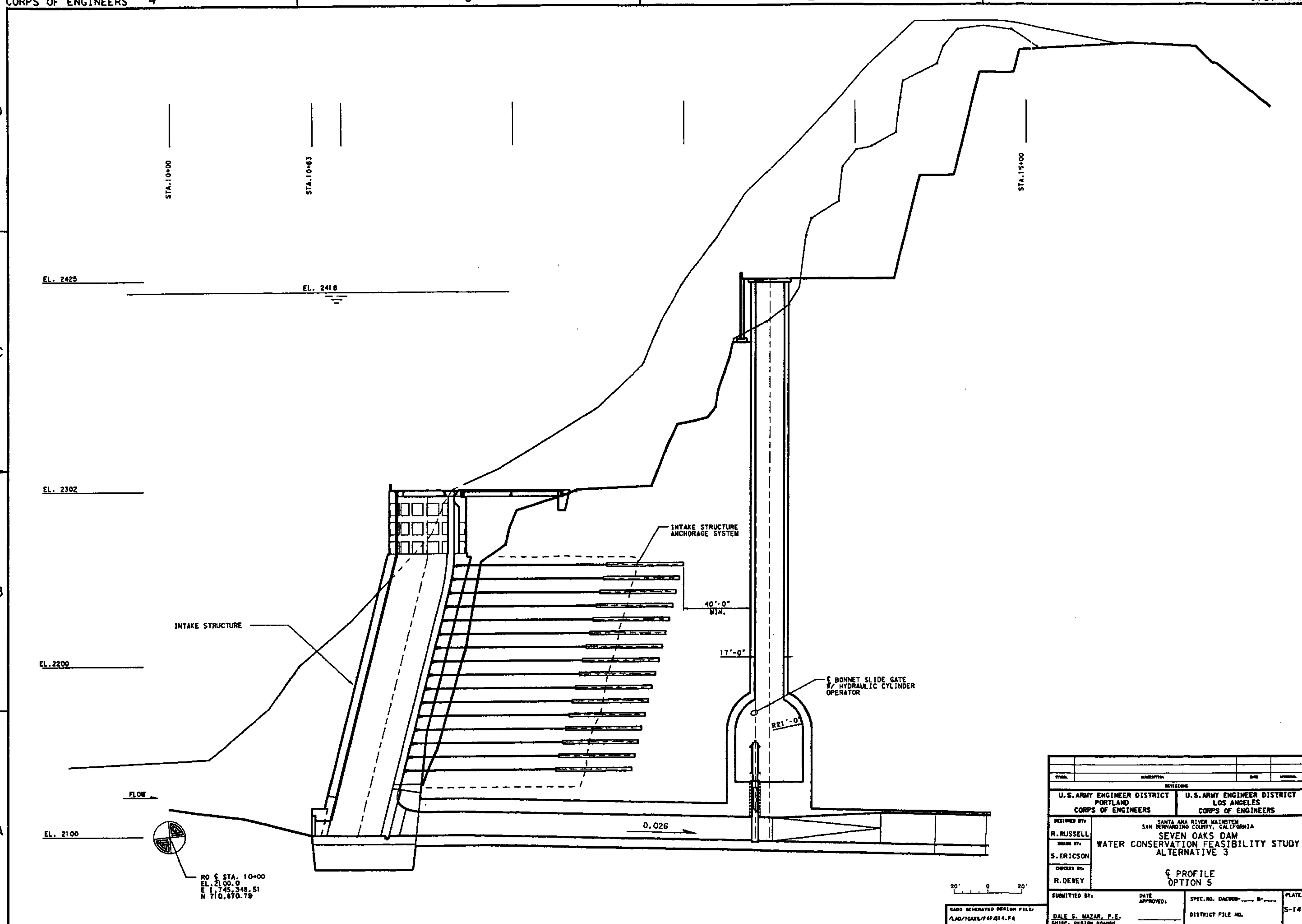
WATER CONSERVATION FEASIBILITY STUDY
ALTERNATIVE 3
OPTION 4
DALE S. MAZAR, P.E.
S-13



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DRAWN BY: S.ERICSON
CHECKED BY: R.DEWEY

SANTA ANA RIVER MAINSTEM
SAN BERNARDINO COUNTY, CALIFORNIA
SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY
ALTERNATIVE 3

℄ PROFILE
OPTION 5

SUBMITTED BY: DALE S. MAZAR, P.E. CHIEF, DESIGN BRANCH
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DISTRICT FILE NO.
PLATE S-14

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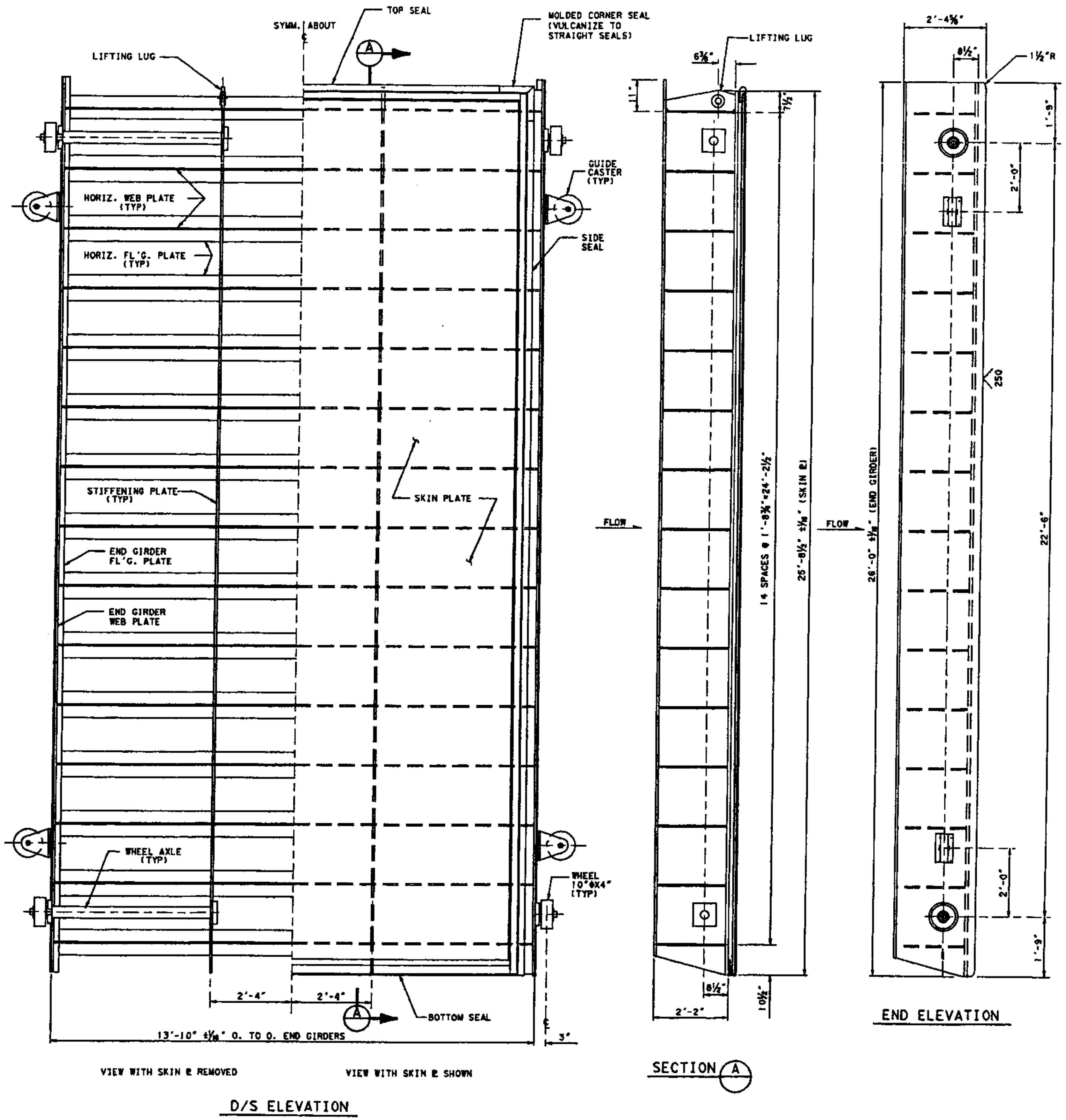

PERTINENT DATA

WATER HEAD DISTANCE	MEMBER SIZES						MISC. ITEMS		
	SKIN PLATE	HORIZ. WEB PLATE	HORIZ. FLANGE PLATE	VERTICAL STIFFENER PLATE	END GIRDER FLANGE PLATE	END GIRDER WEB PLATE	NUMBER OF WHEELS	WHEEL SIZE	AXLE SIZE
318 FEET	1¼	1x23½	1¼x9	⅝x23½	1¼x3	1x 27¾	4	4"x10"ϕ	4"ϕ
275 FEET	1⅛	¾x23¾	1⅛x9	½x23¾	1⅛x3	1x 27¾	4	4"x10"ϕ	4"ϕ
202 FEET (ORIGINAL DESIGN)	1⅛	½x24	⅞x9	½x24	⅞x3	¾x 27¾	4	4"x10"ϕ	4"ϕ

NOTES:

1. ALL STRUCTURAL STEEL SHAPES SHALL MEET REQUIREMENTS FOR ASTM A 572.
2. AFTER FABRICATION, THE BULKHEAD SHALL BE COATED WITH INORGANIC ZINC SILICATE. WHEEL ASSEMBLIES AND SEALS SHALL BE INSTALLED AFTER COATING HAS BEEN APPLIED TO INDIVIDUAL PIECES INCLUDING THE MOUNTING ANGLE AND RETAINER BAR.
3. MOLDED CORNER SEALS SHALL BE VULCANIZED AT JUNCTION WITH TOP, BOTTOM, AND SIDE SEALS.
4. ALL BOLTS, NUTS, AND WASHERS SHALL BE CRES.
5. RUBBER SEALS SHALL BE LINE DRILLED AT ASSEMBLY WITH RETAINER SEAL BARS TO ASSURE TIGHT FIT ON SEAL BOLTS.
6. THE WHEELS SHALL BE PROVIDED WITH MINIMUM WORKING LOAD OF 20,000 LBS EACH AND SHALL BE PROVIDED WITH BUSHINGS, BEARINGS AND GREASE FITTINGS AS NECESSARY.
7. AXLE MATERIAL SHALL BE ASTM A 108 STEEL HEAT TREATED TO 80,000 psi.
8. SKIN PLATE AND SEAL MOUNTING SHALL BE WATER TIGHT.

12" 6" 0 1' 2'

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SYMBOL	DESCRIPTION	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT PORTLAND CORPS OF ENGINEERS | U.S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS

DESIGNED BY: W. CRUMP
DRAWN BY: S. ERICSON
CHECKED BY: R. DEWEY

SANTA ANA RIVER MAINSTEM
SAN BERNARDINO COUNTY, CALIFORNIA

SEVEN OAKS DAM
WATER CONSERVATION FEASIBILITY STUDY

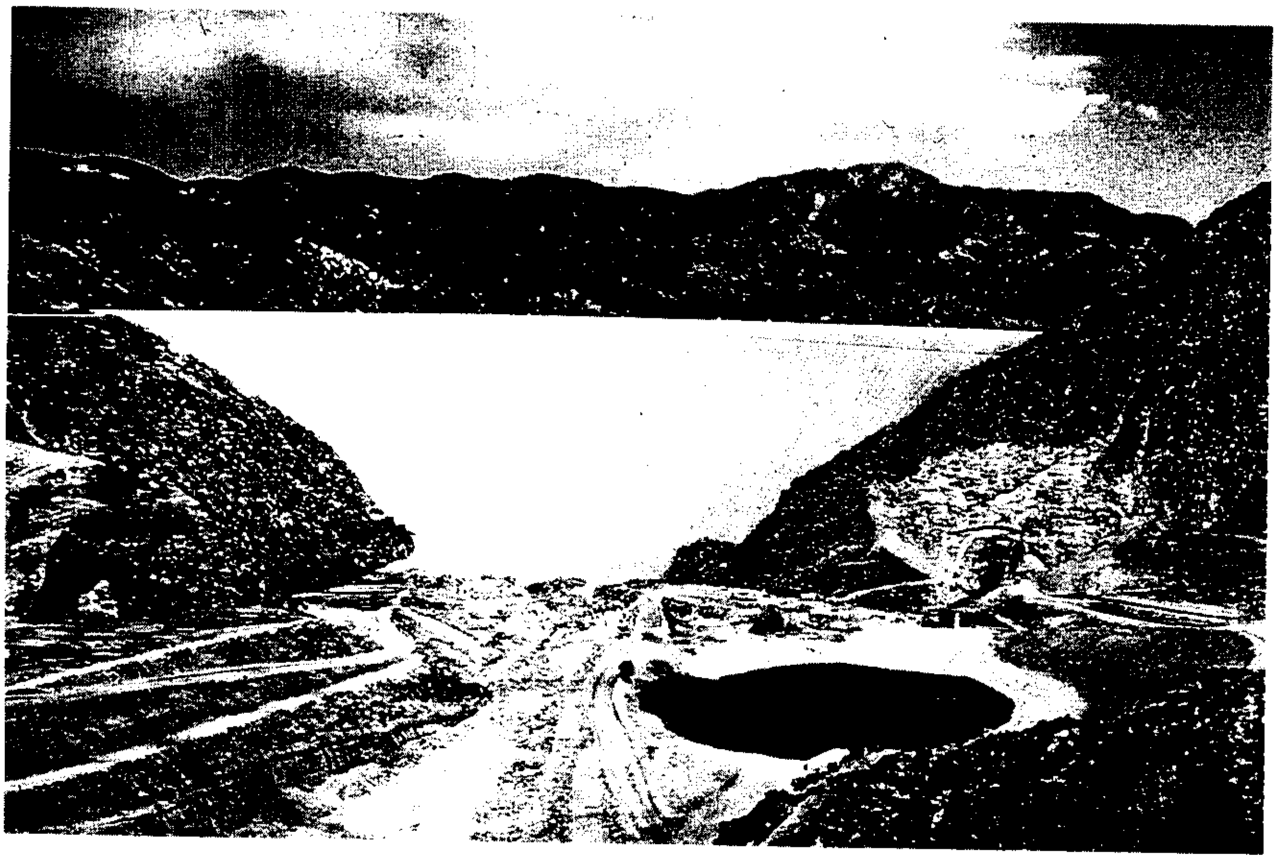
MAINTENANCE BULKHEAD OPTIONS

SUBMITTED BY: DALE S. MAZAR, P.E. CHIEF, DESIGN BRANCH
DATE APPROVED:
SPEC. NO. DACW09-___ B-___
DISTRICT FILE NO.
PLATE S-15

US Army Corps of Engineers®
Los Angeles District

Feasibility Report

Seven Oaks Dam Water Conservation
Santa Ana River Basin, California



Appendix E. Economics
June 1997

TABLE OF CONTENTS

SEVEN OAKS AND PRADO DAMS
WATER CONSERVATION STUDY
ECONOMIC ANALYSIS

I. INTRODUCTION

Seven Oaks Dam is a flood control dam currently being constructed on the Santa Ana River in San Bernardino County, California. This study determines that there are positive net National Economic Development (NED) benefits to modifying the dam and operating it to provide seasonal water conservation storage. The optimal size of the water conservation pool, based upon a NED analysis, is 2,265 feet. Conserved water would be used by member agencies of the San Bernardino Valley Municipal Water District (SBVMWD) and Western Municipal Water District (WMWD). The purpose of this report is to present the evaluation of the costs and benefits associated with providing seasonal water conservation storage at Seven Oaks Dam. The benefits of water conservation at Prado Dam are not analyzed.

II. METHODOLOGY

Benefits for each alternative are calculated as the difference in the average annual cost of municipal and industrial water with and without the proposed water conservation plans. Water demand was forecast and compared to available local groundwater supply under without project conditions. Additional sources of supply in the study area include the State Water Project (SWP), imported water, and reclamation. The cost per acre foot of raw water from these sources was identified. The cost of meeting the anticipated water deficit was projected by ranking the available alternatives by cost, and selecting the least costly. Under with project conditions, conserved water would be an additional local source of water to help meet urban demand.

This report is done in conformance with all applicable regulations. Average annual costs and benefits are calculated using a 7 3/8 percent discount rate and a 50 year project life. Backup data is on file in the Los Angeles District. The price level is October 1996.

III. WITHOUT PROJECT CONDITION

The primary purpose of Seven Oaks Dam is to assist in providing flood protection for communities downstream of the dam as a component of the ongoing Santa Ana River Project. The dam has a gross storage capacity of 145,600 acre feet and can control 177 square miles of watershed. It is designed to control the Reservoir Design Flood of 85,000 cubic feet per second (cfs).

Flood season extends from approximately November through the end of February. March is a transitional month between the flood season and the dry season. Historical data indicate that the months of April through October have low flood potential.

Under the base condition, from November to the end of May, all inflows to the dam are stored until the target debris pool level is attained, after which releases from the dam should equal inflow. Beginning in June, releases from the dam include all inflows plus a release to empty the debris pool by the end of August. Under present conditions, the target debris pool elevation is 2,200 feet (relative to the spillway crest elevation of 2,580 feet), corresponding with a storage capacity of 2,968 acre feet of water. Due to sediment deposition, under future conditions (year 2050), the target debris pool storage will be reduced to 2,189 acre feet.

IV. WITH PROJECT CONDITIONS

Water Conservation Opportunities & Alternatives

After flood season has passed, the flood control space behind the dam could be utilized to conserve runoff and groundwater brought to the surface by the dam to some predisposed target pool level. In the dry summer months, the pool could be drawn down by releasing water through the outlet works to downstream users at a rate more commensurate with their diversion and groundwater recharge requirements.

Four water conservation alternatives have been identified for Seven Oaks Dam. Each alternative results in an increase in water supply yield at Seven Oaks Dam. However, increases in yields at Seven Oaks Dam will have a negative impact on water conservation yields at Prado Dam. Those increases in yields at Seven Oaks which result in offsetting declines in yields at Prado represent a transfer and therefore cannot be counted as benefits. Accordingly, only the portions of the increased yields for the alternatives which do not adversely effect the yields at Prado Dam will be utilized to quantify benefits. The following provides a description of the four water conservation alternatives identified for Seven Oaks Dam.

Alternative 1

Under Alternative 1, the dam would operate under normal flood operations during winter months. Then, at the beginning of March, the seasonal conservation pool would be linearly expanded to a target elevation of 2,300 feet (16,293 acre feet under present conditions, and 7,194 acre feet under future conditions) by the beginning of April. From April through May, all inflow would be released after the target elevation was reached. From June through September, all inflow plus a conservation pool release would be made to ensure the conservation pool was drained by the end of September.

Alternative 2

As with Alternative 1, Alternative 2 would consist of normal flood operations during winter months, with an expansion of the conservation pool during March. However, under Alternative 2, the conservation pool would be expanded to a target conservation elevation of 2,375 feet (35,000 acre feet under present conditions, and 22,050 acre feet under future conditions). All inflow would be

The present value of the supply costs under Alternative 1 over the 50-year period is approximately \$356.8 million. The average annual cost is \$27,084,460 at a discount rate of 7.375%. Thus, annualized water supply cost savings for Alternative 1 are approximately \$676,580.

Alternative 2

This alternative yields increased water supply of 7,473 AF (present) and 5,913 AF (future). SBVMWD has an allocation of 72 percent of this increased yield. Hence, SBVMWD would have rights to 5,381 AF in the year 2000 and approximately 4,257 AF by the year 2049. Table 9, page 12, provides detailed supply and demand projections under Alternative 2. As shown in this table, Seven Oaks water is the next least cost supply alternative. Throughout the 50-year period, groundwater and Seven Oaks withdrawals are maximized. Furthermore, benefits accrue within this time period since SBVMWD is able to reduce its reliance on costly imported water and reclaimed water. See Table 10 below for a cost summary.

Table 10
Projected Water Supply Costs (Alternative 2)

Year	Demand (AF)	Supply (AF)				Total Cost (\$)
		Local Water	7-Oaks	SPW Water	Reclaimed	
2000	173,096	167,000	5,381	715		\$15,556,800
2005	191,377	167,000	5,266	19,111		\$19,109,051
2010	209,658	167,000	5,152	37,506		\$21,872,009
2015	231,064	167,000	5,037	59,027		\$22,799,279
2035	301,342	167,000	4,578	60,000	*69,764	\$58,384,789
2049	301,342	167,000	4,257	60,000	*70,085	\$58,566,222

* Quantity reflects the 11,000 AF reclaimed water and the deficit. This deficit is met at an estimated cost of \$565/AF.

The present value of the supply costs under Alternative 2 over the 50-year period is approximately \$347.5 million. The average annual cost is \$26,380,070 at a discount rate of 7.375%. Thus, annualized water supply cost savings for Alternative 2 are approximately \$1,380,970.

V. BENEFIT ANALYSIS

For this analysis, it is assumed that the water conserved at Seven Oaks Dam will be used by member agencies of SBVMWD and WMWD to meet urban water demand. Future urban water demand for SBVMWD was calculated using IWR-MAIN 6.1 (Institute of Water Resources Municipal and Industrial Needs), a water demand forecast model. This analysis is detailed in Addendum 1 of this appendix. Future urban water demand for WMWD was based on projections from the City of Riverside, one of four WMWD member agencies entitled to water from new conservation, according to the Stipulated Judgment of 1969.

The Stipulated Judgment entered into in 1969 by SBVMWD and WMWD (Riverside Superior Court, Case # 78426) allocated approximately 28 percent of the water available from new conservation in the San Bernardino groundwater basin to member agencies of WMWD, with the remainder being allocated to member agencies of SBVMWD. According to WMWD, the City of Riverside will receive about 80 percent of the 28 percent allocated to WMWD (or 22.5 percent of the total yield). The remaining 5.5 percent will be distributed among the three other member agencies of WMWD, including the Agua Mansa Meeks & Daley Water Company, the Riverside Highlands Water Company, and the Regents of the University of California. Although the ultimate disposition of water rights may differ from the above percentages, they have been utilized for the economic analysis which follows.

As discussed previously, the benefits of water conservation at Seven Oaks Dam are based upon the difference in the cost of urban water supply under with and without project conditions. Discussions of the analysis of benefits for member agencies of SBVMWD and WMWD under with and without project conditions are presented in the following sections.

VI. SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT WATER SUPPLY AND DEMAND ANALYSIS

Introduction

Municipal demand for water in the San Bernardino Valley Municipal Water District (SBVMWD) will exceed local water supplies by the year 2000. In addition, demand is projected to exceed local and imported supplies just after the year 2015. Existing water supply sources such as groundwater, surface water, State Water Project (SWP), and reclaimed water are discussed in the sections which follow. Subsequently, the potential benefits to SBVMWD of water conservation at Seven Oaks dam, which constitutes an alternative source of supply for meeting the projected water shortage, will be analyzed.

Demand Projections

The forecasted water usage for the San Bernardino region from Addendum 1 is shown in Table 2, page 5. These water demand figures represent municipal use only. As shown on Table 2, available demand projection data only covers through the year 2030. For the purpose of this analysis, demand is assumed to remain constant beyond the year 2030.

Table 2 Demand Projection	
Year	Demand (AF)
2000	173,096
2005	191,377
2010	209,658
2015	231,064
2020	252,896
2025	277,124
2030 - 2049	301,342

Local Water Supply Sources and Costs

Groundwater & Surface Runoff

According to representatives of SBVMWD, extractions for urban water use by member agencies of SBVMWD are approximately 167,000 AF/yr. It should be noted that this number is the long term yield and represents the total extractions/diversions from ground and surface water within the study area.

The unit cost of local water varies from $30 to $120 per acre-foot. Since all local supply will be utilized under both with and without project conditions, the cost of local water has no impact on the benefits. Therefore, this cost was not further considered.

Alternative Water Supply Sources and Costs

Based on the demand projection figures listed above, SBVMWD local water supply sources would not meet its municipal demand beginning in the year 2000. In order to alleviate this water shortage under without project conditions, SBVMWD will use alternative water supply sources. These sources include SWP water, importation and reclamation. Under with project conditions, water conservation at Seven Oaks Dam would also be available.

State Project Water

SBVMWD is legally entitled to more than 100,000 AF/yr of SWP water. Since the State Project system does not currently have the capacity to deliver full entitlement to all its contractors in all years, it has been projected that SWP's facilities can only supply about 60% of the full contracted amount or approximately 60,000 AF/yr [Camp Dresser & McKee, Task 1 Memorandum: Review Current

Water Supply Plans and Needs, Ontario, CA, October 1990]. In this analysis, this amount will be used throughout the 50-year study period (2000 - 2049).

The cost of State Water Project water is based on the Department of Water Resources (DWR) annual review of SWP water supply contractors [Bulletin 132-94, Appendix B, July 1994]. The cost constitutes fixed and variable charges. The fixed cost is paid by SBVMWD whether or not the water is fully utilized. Variable charge is the cost that varies with the quantities of water actually delivered to SBVMWD's turnout. The variable unit cost is determined by dividing the variable cost over the water quantity delivered annually to SBVMWD. Furthermore, a $60 cost is incurred by SBVMWD for pumping and distributing this water to SBVMWD's member agencies. This charge is added to the SWP variable cost. Table 3 below shows a summary of the supply and cost projections through the year 2049. Note that DWR has only projected supply and costs for SWP water through the year 2035. It is assumed that the projected supply and cost beyond 2035 would remain constant.

Table 3
State Project Water
Supply and Cost Projections

Year	SPW (AF)	*Variable Cost ($/AF)	Total Fixed ($)
2000	60000	134.55	15,556,800
2005	60000	144.15	16,354,200
2010	60000	147.39	16,344,000
2015	60000	157.37	13,510,200
2035-2049	60000	158.49	9,459,000

*cost reflects the $60 incurred for pumping and distribution.

Reclaimed Water

Although little water is treated for reclamation within SBVMWD area at present, it is expected to become a significant supply source in the near future. Based on the CDM Task II study, a reclaimed supply of about 11,000 AF/yr is feasible by 2015. The cost for reclaimed water ranges between $540 and $590 per acre-foot. An average cost of $565 per acre-foot was used for this analysis.

Other Water Supply Sources

Beginning in year 2017, there will not be enough local water, SWP water, and reclaimed water to meet the projected municipal and industrial demands. It is not known where the additional water will come from at this time. In the analysis, it is assumed that the cost of the water to meet the projected deficit equals at least $565 per acre-foot, the cost of reclaimed water. Thus, this amount was used as the cost of meeting the remaining deficit.

Projected Water Supply Costs (Without Project)

Table 4, page 8, displays a complete analysis of the projected costs of meeting the SBVMWD water demand forecast under without project conditions. As shown in Table 4, it is assumed that groundwater withdrawal will be maximized and will not meet long term domestic water needs throughout the 50-year period. SWP water will be purchased to cover the deficit. However, SWP water will only be sufficient through the year 2014. Beyond the year 2014, reclamation will be implemented to meet the additional water supply. The deficit (numbers shown in parentheses) is assumed to be met through unknown means at an estimated cost equaling the cost of reclamation, $565/AF. Table 5 below provides a summary.

Table 5
Projected Water Supply Costs

Year	Demand (AF)	Supply (AF)			Total Cost
		Local Water	SPW Water	Reclaimed	
2000	173096	167000	6096		$16,377,017
2005	191377	167000	24377		$19,868,145
2010	209658	167000	42658		$22,631,363
2015	231064	167000	60000	4064	$25,248,560
2035	301342	167000	60000	*74,342	$60,971,630
2049	301342	167000	60000	*74,342	$60,971,630

* Quantity reflects the 11,000 AF reclaimed water and the 63,342 AF deficit. This deficit is met at an estimated cost of $565/AF.

The present value of the supply cost for SBVMWD over the 50-year period is approximately $365.7 million. The average annual cost is $27,761,040 at a discount rate of 7.375%.

Projected Water Supply Costs (With Project)

Seven Oaks Water

Seven Oaks Dam is located within the upper Santa Ana River Canyon along the southern margin of the San Bernardino mountains in Southern California. The dam is currently under construction. Once it is completed, the dam will operate for flood control.

TABLE 4

SUPPLY AND DEMAND ANALYSIS FOR SBVMWD
WITHOUT PROJECT CONDITION

Year	Groundwater & Surface Water		State Project Water						Reclamation		Supply	Demand	Surplus (Deficit)	Total
			Variable Component			Non-Variable Component								
	Quantity (AF/YR)	Unit Cost ($/AF)	Quantity (AF/YR)	Cost ($/AF)	Cost (Var) ($/YR)	Quantity (AF/YR)	Fixed ($/AF)	Total(Var+Nvar) ($/YR)	Quantity (AF/YR)	Unit Cost ($/AF)	Quantity (AF/YR)	Quantity (AF/YR)	(AF/YR)	Supply Cost ($/AF)
2000	167,000	$0.00	60,000	$134.55	$4,472,731	60,000	$259.28	$20,029,669			227,000	173,096	53,904	$16,377,017
2001	167,000	$0.00	60,000	$133.04	$4,382,178	60,000	$264.70	$20,264,111			227,000	176,752	50,248	$17,179,406
2002	167,000	$0.00	60,000	$134.24	$4,454,374	60,000	$262.55	$20,207,250			227,000	180,408	46,592	$17,552,890
2003	167,000	$0.00	60,000	$135.29	$4,517,151	60,000	$260.08	$20,121,794			227,000	184,065	42,935	$17,913,524
2004	167,000	$0.00	60,000	$135.86	$4,551,721	60,000	$259.13	$20,099,345			227,000	187,721	39,279	$18,362,955
2005	167,000	$0.00	90,000	$144.15	$7,573,283	60,000	$272.57	$23,927,390			227,000	191,377	35,623	$19,868,145
2006	167,000	$0.00	90,000	$143.49	$7,514,283	60,000	$269.89	$23,707,446			227,000	195,033	31,967	$20,215,855
2007	167,000	$0.00	90,000	$145.20	$7,667,688	60,000	$266.90	$23,681,821			227,000	198,689	28,311	$20,615,243
2008	167,000	$0.00	90,000	$145.47	$7,692,238	60,000	$263.91	$23,527,124			227,000	202,346	24,654	$20,976,383
2009	167,000	$0.00	90,000	$147.94	$7,914,913	60,000	$259.36	$23,476,730			227,000	206,002	20,998	$21,331,556
2010	167,000	$0.00	102,600	$147.39	$8,965,980	60,000	$272.40	$25,310,067			227,000	209,658	17,342	$22,631,363
2011	167,000	$0.00	102,600	$149.62	$9,195,193	60,000	$252.55	$24,348,402			227,000	213,939	13,061	$22,176,013
2012	167,000	$0.00	102,600	$157.91	$10,045,568	60,000	$256.77	$25,451,759			227,000	218,220	8,780	$23,494,350
2013	167,000	$0.00	102,600	$156.20	$9,870,269	60,000	$232.14	$23,798,512			227,000	222,502	4,498	$22,597,812
2014	167,000	$0.00	102,600	$158.52	$10,108,168	60,000	$241.28	$24,585,068			227,000	226,783	217	$23,953,601
2015	167,000	$0.00	102,600	$157.37	$9,990,539	60,000	$225.17	$23,500,872	11,000	$565.00	238,000	231,064	6,936	$25,248,560
2016	167,000	$0.00	102,600	$157.74	$10,028,159	60,000	$225.82	$23,577,565	11,000	$565.00	238,000	235,430	2,570	$27,776,550
2017	167,000	$0.00	102,600	$162.27	$10,492,902	60,000	$220.50	$23,723,005	11,000	$565.00	238,000	239,797	(1,797)	$30,196,505
2018	167,000	$0.00	102,600	$162.24	$10,489,552	60,000	$215.35	$23,410,593	11,000	$565.00	238,000	244,163	(6,163)	$32,352,495
2019	167,000	$0.00	102,600	$161.48	$10,412,072	60,000	$210.22	$23,025,407	11,000	$565.00	238,000	248,530	(10,530)	$34,466,450
2020	167,000	$0.00	102,600	$161.50	$10,414,407	60,000	$193.44	$22,020,859	11,000	$565.00	238,000	252,896	(14,896)	$35,927,640
2021	167,000	$0.00	102,600	$158.67	$10,123,705	60,000	$187.91	$21,398,600	11,000	$565.00	238,000	257,742	(19,742)	$38,164,030
2022	167,000	$0.00	102,600	$159.86	$10,245,551	60,000	$181.67	$21,145,984	11,000	$565.00	238,000	262,587	(24,587)	$40,598,455
2023	167,000	$0.00	102,600	$159.85	$10,244,628	60,000	$181.78	$21,151,161	11,000	$565.00	238,000	267,433	(29,433)	$43,342,445
2024	167,000	$0.00	102,600	$159.83	$10,242,426	60,000	$174.60	$20,718,458	11,000	$565.00	238,000	272,278	(34,278)	$45,647,870
2025	167,000	$0.00	102,600	$159.59	$10,217,661	60,000	$161.19	$19,889,159	11,000	$565.00	238,000	277,124	(39,124)	$47,566,860
2026	167,000	$0.00	102,600	$159.66	$10,225,106	60,000	$155.73	$19,569,143	11,000	$565.00	238,000	281,968	(43,968)	$49,980,320
2027	167,000	$0.00	102,600	$159.64	$10,222,831	60,000	$154.69	$19,504,030	11,000	$565.00	238,000	286,811	(48,811)	$52,653,015
2028	167,000	$0.00	102,600	$159.17	$10,175,157	60,000	$155.45	$19,501,968	11,000	$565.00	238,000	291,655	(53,655)	$55,407,275
2029	167,000	$0.00	102,600	$159.18	$10,175,454	60,000	$152.83	$19,345,017	11,000	$565.00	238,000	296,498	(58,498)	$57,986,970
2030	167,000	$0.00	102,600	$159.65	$10,224,419	60,000	$153.45	$19,431,644	11,000	$565.00	238,000	301,342	(63,342)	$60,789,230
2031	167,000	$0.00	102,600	$159.42	$10,200,134	60,000	$152.07	$19,324,281	11,000	$565.00	238,000	301,342	(63,342)	$60,692,630
2032	167,000	$0.00	102,600	$159.37	$10,195,109	60,000	$152.19	$19,326,233	11,000	$565.00	238,000	301,342	(63,342)	$60,696,830
2033	167,000	$0.00	102,600	$158.83	$10,139,607	60,000	$152.38	$19,282,406	11,000	$565.00	238,000	301,342	(63,342)	$60,675,830
2034	167,000	$0.00	102,600	$159.74	$10,233,816	60,000	$147.59	$19,089,348	11,000	$565.00	238,000	301,342	(63,342)	$60,443,030
2035	167,000	$0.00	102,600	$158.49	$10,105,346	60,000	$157.65	$19,564,096	11,000	$565.00	238,000	301,342	(63,342)	$60,971,630
2036	167,000	$0.00	102,600	$158.49	$10,105,346	60,000	$157.65	$19,564,096	11,000	$565.00	238,000	301,342	(63,342)	$60,971,630
2037	167,000	$0.00	102,600	$158.49	$10,105,346	60,000	$157.65	$19,564,096	11,000	$565.00	238,000	301,342	(63,342)	$60,971,630
2038	167,000	$0.00	102,600	$158.49	$10,105,346	60,000	$157.65	$19,564,096	11,000	$565.00	238,000	301,342	(63,342)	$60,971,630
2039	167,000	$0.00	102,600	$158.49	$10,105,346	60,000	$157.65	$19,564,096	11,000	$565.00	238,000	301,342	(63,342)	$60,971,630
2040	167,000	$0.00	102,600	$158.49	$10,105,346	60,000	$157.65	$19,564,096	11,000	$565.00	238,000	301,342	(63,342)	$60,971,630
2041	167,000	$0.00	102,600	$158.49	$10,105,346	60,000	$157.65	$19,564,096	11,000	$565.00	238,000	301,342	(63,342)	$60,971,630
2042	167,000	$0.00	102,600	$158.49	$10,105,346	60,000	$157.65	$19,564,096	11,000	$565.00	238,000	301,342	(63,342)	$60,971,630
2043	167,000	$0.00	102,600	$158.49	$10,105,346	60,000	$157.65	$19,564,096	11,000	$565.00	238,000	301,342	(63,342)	$60,971,630
2044	167,000	$0.00	102,600	$158.49	$10,105,346	60,000	$157.65	$19,564,096	11,000	$565.00	238,000	301,342	(63,342)	$60,971,630
2045	167,000	$0.00	102,600	$158.49	$10,105,346	60,000	$157.65	$19,564,096	11,000	$565.00	238,000	301,342	(63,342)	$60,971,630
2046	167,000	$0.00	102,600	$158.49	$10,105,346	60,000	$157.65	$19,564,096	11,000	$565.00	238,000	301,342	(63,342)	$60,971,630
2047	167,000	$0.00	102,600	$158.49	$10,105,346	60,000	$157.65	$19,564,096	11,000	$565.00	238,000	301,342	(63,342)	$60,971,630
2048	167,000	$0.00	102,600	$158.49	$10,105,346	60,000	$157.65	$19,564,096	11,000	$565.00	238,000	301,342	(63,342)	$60,971,630
2049	167,000	$0.00	102,600	$158.49	$10,105,346	60,000	$157.65	$19,564,096	11,000	$565.00	238,000	301,342	(63,342)	$60,971,630

Diversion & Distribution Costs $60.00

This cost is added to the variable component of the SPW cost.

Interest Rate: 7.375 %

Present Value: $365,692,943

Avg Annual Cost: $27,761,037

Note: Total Supply Costs do not include costs of groundwater and surface water.

Modification of Seven Oaks Dam would result in an alternative water supply source to SBVMWD. Four water conservation alternatives have been established. Table 6 shows these four alternatives with their increase in expected annual water supply yields under present (year 2000) and future (year 2049) conditions. Note again that only the portion of the increase in yields not impacting yields at Prado Dam have been included for this analysis.

Table 6
Storage Alternatives At Seven Oaks Dam

Storage Alternative	Present Condition Supply Yield (AF)	Future Condition Supply Yield (AF)
Alternative 1	4116	2142
Alternative 2	7473	5913
Alternative 3	9258	8013
Alternative 4	2512	638

<u>Alternative 1</u>

Under this alternative, water supply yields increase by 4,116 AF (present) and 2,142 AF (future). SBVMWD has an allocation of 72 percent of this increased yield. Hence, SBVMWD would have rights to 2,964 AF in the year 2000 and approximately 1,542 AF by the year 2049. Table 7, page 10, provides detailed supply and demand projections under Alternative 1. As shown in this table, Seven Oaks water is the next least cost supply alternative after locally available groundwater. Throughout the 50-year period, groundwater and Seven Oaks withdrawals are maximized. Furthermore, benefits accrue within this time period since SBVMWD is able to reduce its reliance on costly imported water and reclaimed water. See Table 8 below for a cost summary.

TABLE 8
Projected Water Supply Costs (Alternative 1)

Year	Demand (AF)	Supply (AF)				Total Cost ($)
		Local Water	7-Oaks	SPW Water	Reclaimed	
2000	173,096	167,000	2,964	3,132		$15,978,211
2005	191,377	167,000	2,819	21,558		$19,461,786
2010	209,658	167,000	2,673	39,985		$22,237,389
2015	231,064	167,000	2,529	60,000	1,535	$23,819,675
2035	301,342	167,000	1,948	60,000	*72,394	$59,870,829
2049	301,342	167,000	1,542	60,000	*72,800	$60,100,264

* Quantity reflects the 11,000 AF reclaimed water and the deficit. This deficit is met at an estimated cost of $565/AF.

TABLE 7

SUPPLY AND DEMAND ANALYSIS FOR SBVMWD
WITH PROJECT CONDITIONS (ALTERNATIVE 1)

Year	Groundwater & Surface Water Quantity (AF/YR)	Groundwater & Surface Water Unit Cost ($/AF)	7-Oaks Water Quantity (AF/YR)	7-Oaks Water Unit Cost ($/AF)	State Project Water Quantity (AF/YR)	State Project Water *Variable Cost ($/AF)	State Project Water Non-Variable Fixed ($/AF)	State Project Water Total Unit Cost ($/AF)	Reclamation Quantity (AF/YR)	Reclamation Unit Cost ($/AF)	Supply Quantity (AF/YR)	Demand Quantity (AF/YR)	Surplus (Deficit) (AF/YR)	Total Supply Cost ($/AF)
2000	167,000	$0.00	4,116	$0.00	60,000	$134.55	$259.28	$393.83			229,964	173,096	56,868	$15,978,211
2001	167,000	$0.00	4,076	$0.00	60,000	$133.04	$264.70	$397.74			229,935	176,752	53,183	$16,788,934
2002	167,000	$0.00	4,036	$0.00	60,000	$134.24	$262.55	$396.79			229,906	180,408	49,498	$17,162,788
2003	167,000	$0.00	3,996	$0.00	60,000	$135.29	$260.08	$395.37			229,877	184,065	45,812	$17,524,295
2004	167,000	$0.00	3,955	$0.00	60,000	$135.86	$259.13	$394.99			229,848	187,721	42,127	$17,976,026
2005	167,000	$0.00	3,915	$0.00	60,000	$144.15	$272.57	$416.72			229,819	191,377	38,442	$19,461,786
2006	167,000	$0.00	3,875	$0.00	60,000	$143.49	$269.89	$413.38			229,790	195,033	34,757	$19,815,518
2007	167,000	$0.00	3,834	$0.00	60,000	$145.20	$266.90	$412.10			229,760	198,689	31,071	$20,214,491
2008	167,000	$0.00	3,794	$0.00	60,000	$145.47	$263.91	$409.38			229,732	202,346	27,386	$20,578,959
2009	167,000	$0.00	3,754	$0.00	60,000	$147.94	$259.36	$407.30			229,703	206,002	23,701	$20,931,674
2010	167,000	$0.00	3,713	$0.00	60,000	$147.39	$272.40	$419.79			229,673	209,658	20,015	$22,237,389
2011	167,000	$0.00	3,673	$0.00	60,000	$149.62	$252.55	$402.17			229,645	213,939	15,706	$21,780,268
2012	167,000	$0.00	3,633	$0.00	60,000	$157.91	$256.77	$414.68			229,616	218,220	11,396	$23,081,258
2013	167,000	$0.00	3,593	$0.00	60,000	$156.20	$232.14	$388.34			229,587	222,502	7,085	$22,193,723
2014	167,000	$0.00	3,552	$0.00	60,000	$158.52	$241.28	$399.80			229,557	226,783	2,774	$23,548,266
2015	167,000	$0.00	3,512	$0.00	60,000	$157.37	$225.17	$382.54	11,000	$565.00	240,529	231,064	9,465	$23,819,675
2016	167,000	$0.00	3,472	$0.00	60,000	$157.74	$225.82	$383.56	11,000	$565.00	240,500	235,430	5,070	$26,364,050
2017	167,000	$0.00	3,431	$0.00	60,000	$162.27	$220.50	$382.77	11,000	$565.00	240,470	239,797	673	$28,800,955
2018	167,000	$0.00	3,391	$0.00	60,000	$162.24	$215.35	$377.59	11,000	$565.00	240,442	244,163	(3,721)	$30,973,036
2019	167,000	$0.00	3,351	$0.00	60,000	$161.48	$210.22	$371.70	11,000	$565.00	240,413	248,530	(8,117)	$33,103,263
2020	167,000	$0.00	3,311	$0.00	60,000	$161.50	$193.44	$354.94	11,000	$565.00	240,384	252,896	(12,512)	$34,580,725
2021	167,000	$0.00	3,270	$0.00	60,000	$158.67	$187.91	$346.58	11,000	$565.00	240,354	257,742	(17,388)	$36,833,794
2022	167,000	$0.00	3,230	$0.00	60,000	$159.86	$181.67	$341.53	11,000	$565.00	240,326	262,587	(22,261)	$39,284,491
2023	167,000	$0.00	3,190	$0.00	60,000	$159.85	$181.78	$341.63	11,000	$565.00	240,297	267,433	(27,136)	$42,044,753
2024	167,000	$0.00	3,149	$0.00	60,000	$159.83	$174.60	$334.43	11,000	$565.00	240,267	272,278	(32,011)	$44,366,857
2025	167,000	$0.00	3,109	$0.00	60,000	$159.59	$161.19	$320.78	11,000	$565.00	240,238	277,124	(36,886)	$46,302,119
2026	167,000	$0.00	3,069	$0.00	60,000	$159.66	$155.73	$315.39	11,000	$565.00	240,210	281,968	(41,758)	$48,731,851
2027	167,000	$0.00	3,028	$0.00	60,000	$159.64	$154.69	$314.33	11,000	$565.00	240,180	286,811	(46,631)	$51,421,225
2028	167,000	$0.00	2,988	$0.00	60,000	$159.17	$155.45	$314.62	11,000	$565.00	240,151	291,655	(51,504)	$54,191,757
2029	167,000	$0.00	2,948	$0.00	60,000	$159.18	$152.83	$312.01	11,000	$565.00	240,123	296,498	(56,375)	$56,787,724
2030	167,000	$0.00	2,908	$0.00	60,000	$159.65	$153.45	$313.10	11,000	$565.00	240,094	301,342	(61,248)	$59,606,256
2031	167,000	$0.00	2,867	$0.00	60,000	$159.42	$152.07	$311.49	11,000	$565.00	240,064	301,342	(61,278)	$59,526,334
2032	167,000	$0.00	2,827	$0.00	60,000	$159.37	$152.19	$311.56	11,000	$565.00	240,035	301,342	(61,307)	$59,546,806
2033	167,000	$0.00	2,787	$0.00	60,000	$158.83	$152.38	$311.21	11,000	$565.00	240,007	301,342	(61,335)	$59,542,078
2034	167,000	$0.00	2,746	$0.00	60,000	$159.74	$147.59	$307.33	11,000	$565.00	239,977	301,342	(61,365)	$59,325,957
2035	167,000	$0.00	2,706	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	239,948	301,342	(61,394)	$59,870,829
2036	167,000	$0.00	2,666	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	239,920	301,342	(61,422)	$59,887,101
2037	167,000	$0.00	2,626	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	239,891	301,342	(61,451)	$59,903,373
2038	167,000	$0.00	2,585	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	239,861	301,342	(61,481)	$59,920,052
2039	167,000	$0.00	2,545	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	239,832	301,342	(61,510)	$59,936,324
2040	167,000	$0.00	2,505	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	239,804	301,342	(61,538)	$59,952,596
2041	167,000	$0.00	2,464	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	239,774	301,342	(61,568)	$59,969,275
2042	167,000	$0.00	2,424	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	239,745	301,342	(61,597)	$59,985,547
2043	167,000	$0.00	2,384	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	239,716	301,342	(61,626)	$60,001,819
2044	167,000	$0.00	2,343	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	239,687	301,342	(61,655)	$60,018,498
2045	167,000	$0.00	2,303	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	239,658	301,342	(61,684)	$60,034,770
2046	167,000	$0.00	2,263	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	239,629	301,342	(61,713)	$60,051,042
2047	167,000	$0.00	2,223	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	239,601	301,342	(61,741)	$60,067,314
2048	167,000	$0.00	2,182	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	239,571	301,342	(61,771)	$60,083,992
2049	167,000	$0.00	2,142	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	239,542	301,342	(61,800)	$60,100,264

* includes the diversion and distribution costs of $60.00

Interest Rate: 7.375 %

Present Value: $356,780,400
Avg Annual Cost: $27,084,455
Avg Ann. Benefit: $676,582

NOTES: Total Supply Costs do not include costs of groundwater , surface water, and Seven Oaks water.
Only 72% of the Seven Oaks water was used for the analysis. Numbers shown above represent the full amount.

The present value of the supply costs under Alternative 1 over the 50-year period is approximately $356.8 million. The average annual cost is $27,084,460 at a discount rate of 7.375%. Thus, annualized water supply cost savings for Alternative 1 are approximately $676,580.

Alternative 2

This alternative yields increased water supply of 7,473 AF (present) and 5,913 AF (future). SBVMWD has an allocation of 72 percent of this increased yield. Hence, SBVMWD would have rights to 5,381 AF in the year 2000 and approximately 4,257 AF by the year 2049. Table 9, page 12, provides detailed supply and demand projections under Alternative 2. As shown in this table, Seven Oaks water is the next least cost supply alternative. Throughout the 50-year period, groundwater and Seven Oaks withdrawals are maximized. Furthermore, benefits accrue within this time period since SBVMWD is able to reduce its reliance on costly imported water and reclaimed water. See Table 10 below for a cost summary.

Table 10
Projected Water Supply Costs (Alternative 2)

Year	Demand (AF)	Supply (AF)				Total Cost ($)
		Local Water	7-Oaks	SPW Water	Reclaimed	
2000	173,096	167,000	5,381	715		$15,556,800
2005	191,377	167,000	5,266	19,111		$19,109,051
2010	209,658	167,000	5,152	37,506		$21,872,009
2015	231,064	167,000	5,037	59,027		$22,799,279
2035	301,342	167,000	4,578	60,000	*69,764	$58,384,789
2049	301,342	167,000	4,257	60,000	*70,085	$58,566,222

* Quantity reflects the 11,000 AF reclaimed water and the deficit. This deficit is met at an estimated cost of $565/AF.

The present value of the supply costs under Alternative 2 over the 50-year period is approximately $347.5 million. The average annual cost is $26,380,070 at a discount rate of 7.375%. Thus, annualized water supply cost savings for Alternative 2 are approximately $1,380,970.

TABLE 9

SUPPLY AND DEMAND ANALYSIS FOR SBVMWD WITH PROJECT CONDITIONS (ALTERNATIVE 2)

	Groundwater & Surface Water		7-Oaks Water		State Project Water				Reclamation		Supply	Demand	Surplus (Deficit)	Total
						*Variable	Non-Variable							
Year	Quantity (AF/YR)	Unit Cost ($/AF)	Quantity (AF/YR)	Unit Cost ($/AF)	Quantity (AF/YR)	Cost ($/AF)	Fixed ($/AF)	Total Unit Cost ($/AF)	Quantity (AF/YR)	Unit Cost ($/AF)	Quantity (AF/YR)	Quantity (AF/YR)	(AF/YR)	Supply Cost ($/AF)
2000	167,000	$0.00	7,473	$0.00	60,000	$134.55	$259.28	$393.83			232,381	173,096	59,285	$15,556,800
2001	167,000	$0.00	7,442	$0.00	60,000	$133.04	$264.70	$397.74			232,358	176,752	55,606	$16,466,578
2002	167,000	$0.00	7,410	$0.00	60,000	$134.24	$262.55	$396.79			232,335	180,408	51,927	$16,836,720
2003	167,000	$0.00	7,378	$0.00	60,000	$135.29	$260.08	$395.37			232,312	184,065	48,247	$17,194,863
2004	167,000	$0.00	7,346	$0.00	60,000	$135.86	$259.13	$394.99			232,289	187,721	44,568	$17,644,392
2005	167,000	$0.00	7,314	$0.00	60,000	$144.15	$272.57	$416.72			232,266	191,377	40,889	$19,109,051
2006	167,000	$0.00	7,282	$0.00	60,000	$143.49	$269.89	$413.38			232,243	195,033	37,210	$19,463,537
2007	167,000	$0.00	7,250	$0.00	60,000	$145.20	$266.90	$412.10			232,220	198,689	33,531	$19,857,299
2008	167,000	$0.00	7,219	$0.00	60,000	$145.47	$263.91	$409.38			232,198	202,346	29,852	$20,220,230
2009	167,000	$0.00	7,187	$0.00	60,000	$147.94	$259.36	$407.30			232,175	206,002	26,173	$20,565,966
2010	167,000	$0.00	7,155	$0.00	60,000	$147.39	$272.40	$419.79			232,152	209,658	22,494	$21,872,009
2011	167,000	$0.00	7,123	$0.00	60,000	$149.62	$252.55	$402.17			232,129	213,939	18,190	$21,408,612
2012	167,000	$0.00	7,091	$0.00	60,000	$157.91	$256.77	$414.68			232,106	218,220	13,886	$22,688,062
2013	167,000	$0.00	7,059	$0.00	60,000	$156.20	$232.14	$388.34			232,082	222,502	9,580	$21,804,004
2014	167,000	$0.00	7,028	$0.00	60,000	$158.52	$241.28	$399.80			232,060	226,783	5,277	$23,151,490
2015	167,000	$0.00	6,996	$0.00	60,000	$157.37	$225.17	$382.54	11,000	$565.00	232,037	231,064	973	$22,799,279
2016	167,000	$0.00	6,964	$0.00	60,000	$157.74	$225.82	$383.56	11,000	$565.00	243,014	235,430	7,584	$24,943,640
2017	167,000	$0.00	6,932	$0.00	60,000	$162.27	$220.50	$382.77	11,000	$565.00	242,991	239,797	3,194	$27,376,590
2018	167,000	$0.00	6,900	$0.00	60,000	$162.24	$215.35	$377.59	11,000	$565.00	242,968	244,163	(1,195)	$29,545,575
2019	167,000	$0.00	6,868	$0.00	60,000	$161.48	$210.22	$371.70	11,000	$565.00	242,945	248,530	(5,585)	$31,672,548
2020	167,000	$0.00	6,837	$0.00	60,000	$161.50	$193.44	$354.94	11,000	$565.00	242,923	252,896	(9,973)	$33,146,348
2021	167,000	$0.00	6,805	$0.00	60,000	$158.67	$187.91	$346.58	11,000	$565.00	242,900	257,742	(14,842)	$35,395,756
2022	167,000	$0.00	6,773	$0.00	60,000	$159.86	$181.67	$341.53	11,000	$565.00	242,877	262,587	(19,710)	$37,843,199
2023	167,000	$0.00	6,741	$0.00	60,000	$159.85	$181.78	$341.63	11,000	$565.00	242,854	267,433	(24,579)	$40,600,206
2024	167,000	$0.00	6,709	$0.00	60,000	$159.83	$174.60	$334.43	11,000	$565.00	242,830	272,278	(29,448)	$42,918,649
2025	167,000	$0.00	6,677	$0.00	60,000	$159.59	$161.19	$320.78	11,000	$565.00	242,807	277,124	(34,317)	$44,850,656
2026	167,000	$0.00	6,645	$0.00	60,000	$159.66	$155.73	$315.39	11,000	$565.00	242,784	281,968	(39,184)	$47,277,134
2027	167,000	$0.00	6,614	$0.00	60,000	$159.64	$154.69	$314.33	11,000	$565.00	242,762	286,811	(44,049)	$49,962,440
2028	167,000	$0.00	6,582	$0.00	60,000	$159.17	$155.45	$314.62	11,000	$565.00	242,739	291,655	(48,916)	$52,729,717
2029	167,000	$0.00	6,550	$0.00	60,000	$159.18	$152.83	$312.01	11,000	$565.00	242,716	296,498	(53,782)	$55,322,430
2030	167,000	$0.00	6,518	$0.00	60,000	$159.65	$153.45	$313.10	11,000	$565.00	242,693	301,342	(58,649)	$58,137,708
2031	167,000	$0.00	6,486	$0.00	60,000	$159.42	$152.07	$311.49	11,000	$565.00	242,670	301,342	(58,672)	$58,054,125
2032	167,000	$0.00	6,454	$0.00	60,000	$159.37	$152.19	$311.56	11,000	$565.00	242,647	301,342	(58,695)	$58,071,343
2033	167,000	$0.00	6,423	$0.00	60,000	$158.83	$152.38	$311.21	11,000	$565.00	242,625	301,342	(58,717)	$58,062,954
2034	167,000	$0.00	6,391	$0.00	60,000	$159.74	$147.59	$307.33	11,000	$565.00	242,602	301,342	(58,740)	$57,843,171
2035	167,000	$0.00	6,359	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	242,578	301,342	(58,764)	$58,384,789
2036	167,000	$0.00	6,327	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	242,555	301,342	(58,787)	$58,397,806
2037	167,000	$0.00	6,295	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	242,532	301,342	(58,810)	$58,410,824
2038	167,000	$0.00	6,263	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	242,509	301,342	(58,833)	$58,423,842
2039	167,000	$0.00	6,231	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	242,486	301,342	(58,856)	$58,436,859
2040	167,000	$0.00	6,200	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	242,464	301,342	(58,878)	$58,449,470
2041	167,000	$0.00	6,168	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	242,441	301,342	(58,901)	$58,462,488
2042	167,000	$0.00	6,136	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	242,418	301,342	(58,924)	$58,475,505
2043	167,000	$0.00	6,104	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	242,395	301,342	(58,947)	$58,488,523
2044	167,000	$0.00	6,072	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	242,372	301,342	(58,970)	$58,501,540
2045	167,000	$0.00	6,040	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	242,349	301,342	(58,993)	$58,514,558
2046	167,000	$0.00	6,009	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	242,326	301,342	(59,016)	$58,527,169
2047	167,000	$0.00	5,977	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	242,303	301,342	(59,039)	$58,540,186
2048	167,000	$0.00	5,945	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	242,280	301,342	(59,062)	$58,553,204
2049	167,000	$0.00	5,913	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	242,257	301,342	(59,085)	$58,566,222

* includes the diversion and distribution costs of $60.00

Interest Rate: 7.375 %

Present Value: $347,501,605
Avg Annual Cost: $26,380,069
Avg Ann. Benefit: $1,380,968

NOTES: Total Supply Costs do not include costs of groundwater , surface water, and Seven Oaks water.
Only 72% of the Seven Oaks water was used for the analysis. Numbers shown above represent the full amount.

Alternative 3

Under this alternative, water supply yields increase by 9,258 AF (present) and 8,013 AF (future). SBVMWD has an allocation of 72 percent of this increased yield. Hence, SBVMWD would have rights to 6,666 AF in the year 2000 and approximately 5,769 AF by the year 2049. Table 11, page 14, provides detailed supply and demand projections under Alternative 3. As shown in this table, Seven Oaks water is the next least cost supply alternative. Throughout the 50-year period, groundwater withdrawal is maximized. For Seven Oaks water, only 91% of the allowable was used in the year 2000. Beyond that year, Seven Oaks water is fully withdrawn. Furthermore, benefits accrue within this time period since SBVMWD is able to reduce its reliance on costly imported water and reclaimed water. See Table 12 below for a cost summary.

Table 12
Projected Water Supply Costs (Alternative 3)

Year	Demand (AF)	Supply (AF)				Total Cost ($)
		Local Water	7-Oaks	SPW Water	Reclaimed	
2000	173,096	167,000	6,096			$15,556,800
2005	191,377	167,000	6,574	17,803		$18,920,502
2010	209,658	167,000	6,483	36,175		$21,675,833
2015	231,064	167,000	6,391	57,673		$22,586,200
2035	301,342	167,000	6,026	60,000	*68,316	$57,567,121
2049	301,342	167,000	5,769	60,000	*68,573	$57,711,860

* Quantity reflects the 11,000 AF reclaimed water and the deficit. This deficit is met at an estimated cost of $565/AF.

The present value of the supply costs under Alternative 3 over the 50-year period is approximately $342.8 million. The average annual cost is $26,022,470 at a discount rate of 7.375%. Thus, annualized water supply cost savings for Alternative 3 are approximately $1,738,570.

Alternative 4

Under this alternative, supply yields increase by 2,512 AF (present) and 638 AF (future). SBVMWD has an allocation of 72 percent of this increased yield. Hence, SBVMWD would have rights to 1,809 AF in the year 2000 and approximately 459 AF by the year 2049. Table 13, page 15, provides detailed supply and demand projections under Alternative 4. As shown in this table, Seven Oaks water is the next least cost supply alternative after locally available groundwater. Throughout the 50-year period, groundwater and Seven Oaks withdrawals are maximized. Furthermore, benefits accrue within this time period since SBVMWD is able to reduce its reliance on costly imported water and reclaimed water. See Table 14 (page 16) for a cost summary.

TABLE 11

SUPPLY AND DEMAND ANALYSIS FOR SBVMWD
WITH PROJECT CONDITIONS (ALTERNATIVE 3)

Year	Groundwater & Surface Water Quantity (AF/YR)	Groundwater & Surface Water Unit Cost ($/AF)	7-Oaks Water Quantity (AF/YR)	7-Oaks Water Unit Cost ($/AF)	State Project Water Quantity (AF/YR)	State Project Water *Variable Cost ($/AF)	State Project Water Non-Variable Fixed ($/AF)	State Project Water Total Unit Cost ($/AF)	Reclamation Quantity (AF/YR)	Reclamation Unit Cost ($/AF)	Supply Quantity (AF/YR)	Demand Quantity (AF/YR)	Surplus (Deficit) (AF/YR)	Total Supply Cost ($/AF)
2000	167,000	$0.00	9,258	$0.00	60,000	$134.55	$259.28	$393.83			233,665	173,096	60,569	$15,556,800
2001	167,000	$0.00	9,232	$0.00	60,000	$133.04	$264.70	$397.74			233,647	176,752	56,895	$16,295,089
2002	167,000	$0.00	9,207	$0.00	60,000	$134.24	$262.55	$396.79			233,629	180,408	53,221	$16,663,013
2003	167,000	$0.00	9,181	$0.00	60,000	$135.29	$260.08	$395.37			233,610	184,065	49,545	$17,019,257
2004	167,000	$0.00	9,156	$0.00	60,000	$135.86	$259.13	$394.99			233,592	187,721	45,871	$17,467,366
2005	167,000	$0.00	9,131	$0.00	60,000	$144.15	$272.57	$416.72			233,574	191,377	42,197	$18,920,502
2006	167,000	$0.00	9,105	$0.00	60,000	$143.49	$269.89	$413.38			233,556	195,033	38,523	$19,275,135
2007	167,000	$0.00	9,080	$0.00	60,000	$145.20	$266.90	$412.10			233,538	198,689	34,849	$19,665,925
2008	167,000	$0.00	9,054	$0.00	60,000	$145.47	$263.91	$409.38			233,519	202,346	31,173	$20,028,064
2009	167,000	$0.00	9,029	$0.00	60,000	$147.94	$259.36	$407.30			233,501	206,002	27,499	$20,369,798
2010	167,000	$0.00	9,004	$0.00	60,000	$147.39	$272.40	$419.79			233,483	209,658	23,825	$21,675,833
2011	167,000	$0.00	8,978	$0.00	60,000	$149.62	$252.55	$402.17			233,464	213,939	19,525	$21,208,870
2012	167,000	$0.00	8,953	$0.00	60,000	$157.91	$256.77	$414.68			233,446	218,220	15,226	$22,476,462
2013	167,000	$0.00	8,927	$0.00	60,000	$156.20	$232.14	$388.34			233,427	222,502	10,925	$21,593,915
2014	167,000	$0.00	8,902	$0.00	60,000	$158.52	$241.28	$399.80			233,409	226,783	6,626	$22,937,646
2015	167,000	$0.00	8,877	$0.00	60,000	$157.37	$225.17	$382.54			233,391	231,064	2,327	$22,586,200
2015	167,000	$0.00	8,851	$0.00	60,000	$157.74	$225.82	$383.56	11,000	$565.00	244,373	235,430	8,943	$24,175,805
2016	167,000	$0.00	8,826	$0.00	60,000	$162.27	$220.50	$382.77	11,000	$565.00	244,355	239,797	4,558	$26,605,930
2017	167,000	$0.00	8,800	$0.00	60,000	$162.24	$215.35	$377.59	11,000	$565.00	244,336	244,163	173	$28,772,655
2018	167,000	$0.00	8,775	$0.00	60,000	$161.48	$210.22	$371.70	11,000	$565.00	244,318	248,530	(4,212)	$30,896,780
2019	167,000	$0.00	8,750	$0.00	60,000	$161.50	$193.44	$354.94	11,000	$565.00	244,300	252,896	(8,596)	$32,368,140
2020	167,000	$0.00	8,724	$0.00	60,000	$158.67	$187.91	$346.58	11,000	$565.00	244,281	257,742	(13,461)	$34,615,107
2021	167,000	$0.00	8,699	$0.00	60,000	$159.86	$181.67	$341.53	11,000	$565.00	244,263	262,587	(18,324)	$37,059,702
2022	167,000	$0.00	8,673	$0.00	60,000	$159.85	$181.78	$341.63	11,000	$565.00	244,245	267,433	(23,188)	$39,814,269
2023	167,000	$0.00	8,648	$0.00	60,000	$159.83	$174.60	$334.43	11,000	$565.00	244,227	272,278	(28,051)	$42,129,864
2024	167,000	$0.00	8,623	$0.00	60,000	$159.59	$161.19	$320.78	11,000	$565.00	244,209	277,124	(32,915)	$44,059,024
2025	167,000	$0.00	8,597	$0.00	60,000	$159.66	$155.73	$315.39	11,000	$565.00	244,190	281,968	(37,778)	$46,483,060
2026	167,000	$0.00	8,572	$0.00	60,000	$159.64	$154.69	$314.33	11,000	$565.00	244,172	286,811	(42,639)	$49,165,925
2027	167,000	$0.00	8,547	$0.00	60,000	$159.17	$155.45	$314.62	11,000	$565.00	244,154	291,655	(47,501)	$51,930,355
2028	167,000	$0.00	8,521	$0.00	60,000	$159.18	$152.83	$312.01	11,000	$565.00	244,135	296,498	(52,363)	$54,520,627
2029	167,000	$0.00	8,496	$0.00	60,000	$159.65	$153.45	$313.10	11,000	$565.00	244,117	301,342	(57,225)	$57,333,057
2030	167,000	$0.00	8,470	$0.00	60,000	$159.42	$152.07	$311.49	11,000	$565.00	244,098	301,342	(57,244)	$57,247,034
2031	167,000	$0.00	8,445	$0.00	60,000	$159.37	$152.19	$311.56	11,000	$565.00	244,080	301,342	(57,262)	$57,261,404
2032	167,000	$0.00	8,420	$0.00	60,000	$158.83	$152.38	$311.21	11,000	$565.00	244,062	301,342	(57,280)	$57,250,574
2033	167,000	$0.00	8,394	$0.00	60,000	$159.74	$147.59	$307.33	11,000	$565.00	244,044	301,342	(57,298)	$57,028,351
2034	167,000	$0.00	8,369	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	244,026	301,342	(57,316)	$57,567,121
2035	167,000	$0.00	8,343	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	244,007	301,342	(57,335)	$57,577,698
2036	167,000	$0.00	8,318	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	243,989	301,342	(57,353)	$57,587,868
2037	167,000	$0.00	8,293	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	243,971	301,342	(57,371)	$57,598,038
2038	167,000	$0.00	8,267	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	243,952	301,342	(57,390)	$57,608,614
2039	167,000	$0.00	8,242	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	243,934	301,342	(57,408)	$57,618,784
2040	167,000	$0.00	8,216	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	243,916	301,342	(57,426)	$57,629,361
2041	167,000	$0.00	8,191	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	243,898	301,342	(57,444)	$57,639,531
2042	167,000	$0.00	8,166	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	243,880	301,342	(57,462)	$57,649,701
2043	167,000	$0.00	8,140	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	243,861	301,342	(57,481)	$57,660,278
2044	167,000	$0.00	8,115	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	243,843	301,342	(57,499)	$57,670,448
2045	167,000	$0.00	8,089	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	243,824	301,342	(57,518)	$57,681,025
2046	167,000	$0.00	8,064	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	243,806	301,342	(57,536)	$57,691,195
2047	167,000	$0.00	8,039	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	243,788	301,342	(57,554)	$57,701,365
2048	167,000	$0.00	8,013	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	243,770	301,342	(57,572)	$57,711,860

Present Value:	$342,790,940
Avg Annual Cost:	$26,022,466
Avg Ann. Benefit:	$1,738,572

* includes the diversion and distribution costs of $60.00

Interest Rate: 7.375 %

NOTES: Total Supply Costs do not include costs of groundwater , surface water, and Seven Oaks water.
Only 72% of the Seven Oaks water was used for the analysis. Numbers shown above represent the full amount.

SUPPLY AND DEMAND ANALYSIS FOR SBVMWD
WITH PROJECT CONDITIONS (ALTERNATIVE 4)

Year	Groundwater & Surface Water		7-Oaks Water		State Project Water				Reclamation		Supply	Demand	Surplus (Deficit)	Total
	Quantity (AF/YR)	Unit Cost ($/AF)	Quantity (AF/YR)	Unit Cost ($/AF)	Quantity (AF/YR)	*Variable Cost ($/AF)	Non-Variable Fixed ($/AF)	Total Unit Cos ($/AF)	Quantity (AF/YR)	Unit Cost ($/AF)	Quantity (AF/YR)	Quantity (AF/YR)	(AF/YR)	Supply Cost ($/AF)
2000	167,000	$0.00	2,512	$0.00	60,000	$134.55	$259.28	$393.83			228,808	173,096	55,712	$16,133,750
2001	167,000	$0.00	2,473	$0.00	60,000	$133.04	$264.70	$397.74			228,781	176,752	52,029	$16,942,462
2002	167,000	$0.00	2,435	$0.00	60,000	$134.24	$262.55	$396.79			228,753	180,408	48,345	$17,317,567
2003	167,000	$0.00	2,397	$0.00	60,000	$135.29	$260.08	$395.37			228,726	184,065	44,661	$17,680,013
2004	167,000	$0.00	2,359	$0.00	60,000	$135.86	$259.13	$394.99			228,698	187,721	40,977	$18,132,265
2005	167,000	$0.00	2,320	$0.00	60,000	$144.15	$272.57	$416.72			228,670	191,377	37,293	$19,627,414
2006	167,000	$0.00	2,282	$0.00	60,000	$143.49	$269.89	$413.38			228,643	195,033	33,610	$19,980,101
2007	167,000	$0.00	2,244	$0.00	60,000	$145.20	$266.90	$412.10			228,616	198,689	29,927	$20,380,600
2008	167,000	$0.00	2,206	$0.00	60,000	$145.47	$263.91	$409.38			228,588	202,346	26,242	$20,745,376
2009	167,000	$0.00	2,168	$0.00	60,000	$147.94	$259.36	$407.30			228,561	206,002	22,559	$21,100,622
2010	167,000	$0.00	2,129	$0.00	60,000	$147.39	$272.40	$419.79			228,533	209,658	18,875	$22,405,414
2011	167,000	$0.00	2,091	$0.00	60,000	$149.62	$252.55	$402.17			228,506	213,939	14,567	$21,950,685
2012	167,000	$0.00	2,053	$0.00	60,000	$157.91	$256.77	$414.68			228,478	218,220	10,258	$23,260,959
2013	167,000	$0.00	2,015	$0.00	60,000	$156.20	$232.14	$388.34			228,451	222,502	5,949	$22,371,166
2014	167,000	$0.00	1,976	$0.00	60,000	$158.52	$241.28	$399.80			228,423	226,783	1,640	$23,728,027
2015	167,000	$0.00	1,938	$0.00	60,000	$157.37	$225.17	$382.54			228,395	231,064	(2,669)	$22,952,400
2016	167,000	$0.00	1,900	$0.00	60,000	$157.74	$225.82	$383.56	11,000	$565.00	239,368	235,430	3,938	$27,003,630
2017	167,000	$0.00	1,862	$0.00	60,000	$162.27	$220.50	$382.77	11,000	$565.00	239,341	239,797	(456)	$29,439,043
2018	167,000	$0.00	1,823	$0.00	60,000	$162.24	$215.35	$377.59	11,000	$565.00	239,313	244,163	(4,850)	$31,610,899
2019	167,000	$0.00	1,785	$0.00	60,000	$161.48	$210.22	$371.70	11,000	$565.00	239,285	248,530	(9,245)	$33,740,312
2020	167,000	$0.00	1,747	$0.00	60,000	$161.50	$193.44	$354.94	11,000	$565.00	239,258	252,896	(13,638)	$35,216,960
2021	167,000	$0.00	1,709	$0.00	60,000	$158.67	$187.91	$346.58	11,000	$565.00	239,230	257,742	(18,512)	$37,468,809
2022	167,000	$0.00	1,671	$0.00	60,000	$159.86	$181.67	$341.53	11,000	$565.00	239,203	262,587	(23,384)	$39,918,692
2023	167,000	$0.00	1,632	$0.00	60,000	$159.85	$181.78	$341.63	11,000	$565.00	239,175	267,433	(28,258)	$42,678,547
2024	167,000	$0.00	1,594	$0.00	60,000	$159.83	$174.60	$334.43	11,000	$565.00	239,148	272,278	(33,130)	$44,999,431
2025	167,000	$0.00	1,556	$0.00	60,000	$159.59	$161.19	$320.78	11,000	$565.00	239,120	277,124	(38,004)	$46,933,879
2026	167,000	$0.00	1,518	$0.00	60,000	$159.66	$155.73	$315.39	11,000	$565.00	239,093	281,968	(42,875)	$49,362,798
2027	167,000	$0.00	1,479	$0.00	60,000	$159.64	$154.69	$314.33	11,000	$565.00	239,065	286,811	(47,746)	$52,051,358
2028	167,000	$0.00	1,441	$0.00	60,000	$159.17	$155.45	$314.62	11,000	$565.00	239,038	291,655	(52,617)	$54,821,076
2029	167,000	$0.00	1,403	$0.00	60,000	$159.18	$152.83	$312.01	11,000	$565.00	239,010	296,498	(57,488)	$57,416,230
2030	167,000	$0.00	1,365	$0.00	60,000	$159.65	$153.45	$313.10	11,000	$565.00	238,983	301,342	(62,359)	$60,233,948
2031	167,000	$0.00	1,327	$0.00	60,000	$159.42	$152.07	$311.49	11,000	$565.00	238,955	301,342	(62,387)	$60,152,806
2032	167,000	$0.00	1,288	$0.00	60,000	$159.37	$152.19	$311.56	11,000	$565.00	238,927	301,342	(62,415)	$60,172,872
2033	167,000	$0.00	1,250	$0.00	60,000	$158.83	$152.38	$311.21	11,000	$565.00	238,900	301,342	(62,442)	$60,167,330
2034	167,000	$0.00	1,212	$0.00	60,000	$159.74	$147.59	$307.33	11,000	$565.00	238,873	301,342	(62,469)	$59,949,988
2035	167,000	$0.00	1,174	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	238,845	301,342	(62,497)	$60,494,047
2036	167,000	$0.00	1,135	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	238,817	301,342	(62,525)	$60,509,912
2037	167,000	$0.00	1,097	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	238,790	301,342	(62,552)	$60,525,370
2038	167,000	$0.00	1,059	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	238,762	301,342	(62,580)	$60,540,829
2039	167,000	$0.00	1,021	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	238,735	301,342	(62,607)	$60,556,287
2040	167,000	$0.00	982	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	238,707	301,342	(62,635)	$60,572,152
2041	167,000	$0.00	944	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	238,680	301,342	(62,662)	$60,587,611
2042	167,000	$0.00	906	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	238,652	301,342	(62,690)	$60,603,069
2043	167,000	$0.00	868	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	238,625	301,342	(62,717)	$60,618,528
2044	167,000	$0.00	830	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	238,598	301,342	(62,744)	$60,633,986
2045	167,000	$0.00	791	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	238,570	301,342	(62,772)	$60,649,851
2046	167,000	$0.00	753	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	238,542	301,342	(62,800)	$60,665,310
2047	167,000	$0.00	715	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	238,515	301,342	(62,827)	$60,680,768
2048	167,000	$0.00	677	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	238,487	301,342	(62,855)	$60,696,226
2049	167,000	$0.00	638	$0.00	60,000	$158.49	$157.65	$316.14	11,000	$565.00	238,460	301,342	(62,882)	$60,711,929

* includes the diversion and distribution costs of $60.00

Interest Rate: 7.375 %

Present Value: $360,448,720
Avg Annual Cost: $27,362,930
Avg Ann. Benefit: $398,107

NOTES: Total Supply Costs do not include costs of groundwater, surface water, and Seven Oaks water.
Only 72% of the Seven Oaks water was used for the analysis. Numbers shown above represent the full amount.

Table 14 Projected Water Supply Costs (Alternative 4)						
Year	Demand (AF)	Supply (AF)				Total Cost ($)
		Local Water	7-Oaks	SPW Water	Reclaimed	
2000	173,096	167,000	1,809	4,287		$16,133,750
2005	191,377	167,000	1,670	22,707		$19,627,414
2010	209,658	167,000	1,533	41,125		$22,405,414
2015	231,064	167,000	1,395	60,000	2,669	$22,952,400
2035	301,342	167,000	845	60,000	*73,497	$60,494,047
2049	301,342	167,000	459	60,000	*73,883	$60,711,929

* Quantity reflects the 11,000 AF reclaimed water and the deficit. This deficit is met at an estimated cost of $565/AF.

The present value of the supply costs under Alternative 4 over the 50-year period is approximately $360.4 million. The average annual cost is $27,362,930 at a discount rate of 7.375%. Thus, annualized water supply cost savings for Alternative 4 are approximately $398,110.

Summary

The table below summarizes the annual benefits to SBVMWD of each of the four water conservation alternatives for Seven Oaks Dam.

Table 15 Summary Of Annual Benefits		
Storage Alternative	Annual Supply Costs	Total Annual Benefits
Without Project	$27,761,040	---
Alternative 1	$27,084,460	$676,580
Alternative 2	$26,380,070	$1,380,970
Alternative 3	$26,022,470	$1,738,570
Alternative 4	$27,362,930	$398,110

VII. CITY OF RIVERSIDE
WATER SUPPLY AND DEMAND ANALYSIS

Demand Projections

The City of Riverside's Water Supply Plan ("WSP") [1995 Water Supply Report, City of Riverside Public Utilities Department, 1995] provides information regarding Riverside's historical and projected water demand and supply. The table below displays Riverside's domestic water demand (excluding irrigation demand) from 1990 through 1994.

Table 16
City of Riverside
Historical Domestic Water Demand

Year	Demand (Acre Feet)
1990	68,583
1991	65,621
1992	63,105
1993	63,599
1994	66,516

As shown above, Riverside's domestic water demand declined slightly during 1991 and 1992, but increased in both 1993 and 1994. Riverside's WSP attributed the declines in demand to water conservation measures during the recent drought.

The WSP contains preliminary water demand projections for the City through the year 2015. These projections assume that demand will increase from a base of about 67,000 acre feet (AF) in 1995 by 0.5% annually through the year 2000, 1.0% annually through the year 2005, and 1.7% annually through the year 2015. The following table summarizes the demand projections contained in the WSP.

Table 17
City of Riverside
Projected Domestic Water Demand

Year	Demand (Acre Feet)
1995	67,000
2000	68,692
2005	72,197
2010	78,545
2015	85,452

Demand projections beyond the year 2015 were not available. For purposes of this analyses, demand is assumed to remain constant beyond the year 2015.

Existing Water Supply Sources & Costs

Riverside currently obtains all but a small portion of its potable water from the groundwater basins in the area. Potable water is obtained from wells located in the Bunker Hill, Riverside North and Riverside South basins. During 1994, about 66% of the City's domestic water supply was obtained from Bunker Hill Basins. The City has water rights to a total of 37,526 AF per year of water from Bunker Hill Basins. Riverside basins provided almost all of the remaining water supplied to the City during 1994. The City has a total of 26,871 AF of groundwater extraction entitlements from Riverside area basins. Thus, the City has rights to a combined total of 64,397 AF of groundwater from Bunker Hill and Riverside area basins, which is not sufficient to cover the City's projected water demand.

In addition to the above supply sources, the City can obtain water from the Gage Exchange. The Gage Exchange consists of the delivery of potable water to the City from the Gage Canal Company in exchange for non-potable irrigation water. Under current arrangements, the amount of Gage Exchange water the City can obtain is limited to 6,400 AF. However, the WSP has projected that the City will be able to obtain up to 13,984 AF of potable water from the Gage Exchange by the year 2010. The City has additional water credits to pump non-potable water from Riverside Basins, which will be exchanged for the potable water from the Gage Canal Company. However, these water credits will eventually run out (current projections estimate these credits will be exhausted by the year 2010). It is uncertain at this time whether the City would continue to obtain the necessary non-potable water for exchange from the Riverside Basins once the water credits run out.

The City of Riverside currently charges approximately $350/AF to customers. Representatives of the City's Public Utilities Department (PUD) have indicated that this amount reflects the costs of supplying water to these customers from its existing groundwater sources. Of this amount, roughly $50/AF represents pumping costs. The remaining $300/AF represents distribution, capital expenditures, administration and other overhead costs. Note that these cost estimates do not incorporate the additional costs the City may incur for Gage Exchange water once the City's water credits for non-potable water from Riverside Basins are exhausted.

Alternative Water Supply Sources & Costs

The WSP projects that the City's existing groundwater supply of 64,397 AF and the Gage Exchange water as described above will not be sufficient to meet demand. Accordingly, the City will have to turn to alternative supply sources. According to representatives of PUD, the two primary alternatives to these sources include purchasing imported water from the Western Metropolitan Water District (WMWD) and reclamation.

Imported Water

The FY 1996 cost to Riverside for non-interruptible treated water delivered from WMWD is \$426/AF. However, a new rate charge structure will soon be implemented. Under the new rate structure, an additional demand charge will be levied on purchases made beyond a certain allocation amount. According to PUD officials, Riverside will be able to purchase up to 3,600 AF of water at the charge of \$426/AF. Beyond this amount, an additional demand charge will be incurred. The total amount of this additional demand charge has been estimated by PUD officials at about \$1,000/AF. However, MWD representatives indicated that the additional costs would not be charged in a lump sum amount, but would rather be amortized over a period of years. Although the exact amount of the charges which the City would incur for purchases beyond the 3,600 AF limit is uncertain at this time, PUD officials estimate that it will be substantially higher than the cost of \$426/AF for purchases below the 3,600 AF limit.

These costs do not include distribution and overhead costs, which must be added in order to compare the cost of imported water with the current costs for groundwater. The PUD has estimated that these costs total about \$300/AF. Thus, the total water supply cost for imported WMWD water, including distribution and overhead, is approximately \$726/AF for purchases up to the 3,600 AF limit, and even higher for purchases beyond that limit.

Reclaimed Water

The costs of reclaimed water can vary significantly based upon a number of factors, including the location at which the water is reclaimed and treatment requirements. In fact, representatives of PUD have stated that the cost could range anywhere from \$400/AF to \$4,000/AF. Based upon preliminary research conducted by the PUD, the average supply cost for reclamated water has been estimated at \$800/AF, including distribution and overhead costs.

The estimated cost of reclamated water of \$800/AF is not significantly higher than the total costs of imported water (including distribution and overhead) below the 3,600 AF limit of \$726/AF. Since the costs of imported water are expected to increase significantly beyond the 3,600 AF limit, it has been assumed that the City would turn to reclamation for supply requirements once both existing groundwater supplies and the 3,600 AF limit of WMWD water has been reached.

Projected Water Supply Costs (Without Project)

Table 18, page 20, displays the projected costs of meeting the City's water demand forecast under without project conditions through the year 2049. As shown on Table 18, it is assumed that groundwater resources will be insufficient to meet domestic water demand by the year 2010. At this time, it is assumed that WMWD water will be purchased to cover the shortfall. By the year 2013, the limit at which the City's total cost for WMWD water is equal to \$726/AF will be reached. The additional supply required to meet demand once this limit is reached is assumed to be met through reclamation at an estimated cost of \$800/AF. Table 19, page 21, provides a summary.

TABLE 18
City of Riverside: Water Supply & Demand Analyses
Without Project Conditions

	SUPPLY											DEMAND*	COST
	Groundwater					Reclaimed Water		Imported Water		7-Oaks			
	Bunker Hill Basin	*Riverside Basins*	*Gage Exchange***										
Year	Acre Ft.	Acre Ft.	Acre Ft.	Total	Cost/AF	Acre Ft.	Cost/AF	Acre Ft.	Cost/AF	Acre Ft.	Cost/AF	Acre Ft.	$$
2000	37,526	26,871	4,295	68,692	$350	0	$800	0	$726	--	--	68,692	$24,042,200
2001	37,526	26,871	4,982	69,379	$350	0	$800	0	$726	--	--	69,379	$24,282,650
2002	37,526	26,871	5,676	70,073	$350	0	$800	0	$726	--	--	70,073	$24,525,550
2003	37,526	26,871	6,376	70,773	$350	0	$800	0	$726	--	--	70,773	$24,770,550
2004	37,526	26,871	7,084	71,481	$350	0	$800	0	$726	--	--	71,481	$25,018,350
2005	37,526	26,871	7,799	72,196	$350	0	$800	0	$726	--	--	72,196	$25,268,600
2006	37,526	26,871	9,026	73,423	$350	0	$800	0	$726	--	--	73,423	$25,698,050
2007	37,526	26,871	10,275	74,672	$350	0	$800	0	$726	--	--	74,672	$26,135,200
2008	37,526	26,871	11,544	75,941	$350	0	$800	0	$726	--	--	75,941	$26,579,350
2009	37,526	26,871	12,835	77,232	$350	0	$800	0	$726	--	--	77,232	$27,031,200
2010	37,526	26,871	13,984	78,381	$350	0	$800	164	$726	--	--	78,545	$27,552,414
2011	37,526	26,871	13,984	78,381	$350	0	$800	1,499	$726	--	--	79,880	$28,521,624
2012	37,526	26,871	13,984	78,381	$350	0	$800	2,857	$726	--	--	81,238	$29,507,532
2013	37,526	26,871	13,984	78,381	$350	638	$800	3,600	$726	--	--	82,619	$30,557,350
2014	37,526	26,871	13,984	78,381	$350	2,043	$800	3,600	$726	--	--	84,024	$31,681,350
2015	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2016	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2017	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2018	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2019	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2020	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2021	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2022	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2023	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2024	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2025	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2026	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2027	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2028	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2029	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2030	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2031	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2032	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2033	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2034	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2035	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2036	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2037	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2038	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2039	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2040	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2041	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2042	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2043	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2044	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2045	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2046	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2047	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2048	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
2049	37,526	26,871	13,984	78,381	$350	3,471	$800	3,600	$726	--	--	85,452	$32,823,750
Present Value (Year 2000 @ 7.375%)													$372,600,712
Annualized (50 Years @ 7.375%)													$28,285,430

* *Domestic Demand (Does Not Include Irrigation Demand).*
** *Acre feet (AF) of potable water. 1.25 AF of non-potable water must be exchanged for each AF of potable water.*

Table 19 City of Riverside Projected Water Supply Costs (Without Project Conditions)					
		Supply			
Year(s)	**Demand**	**Groundwater**	**Imported**	**Reclaimed**	**Cost ($1,000's)**
2000	68,692	68,692	0	0	$24,042
2005	72,197	72,197	0	0	$25,269
2010	78,545	78,381	164	0	$27,552
2013	82,619	78,381	3,600	638	$30,557
2015-2049	85,452	78,381	3,600	3,471	$32,824

The present value of water supply costs for Riverside over the 50-year period (year 2000-2049) totals approximately $372.6 million. Annualized at a discount rate of 7.375%, this represents $28,285,430 in annualized water supply costs under the without project condition.

Projected Water Supply Costs (With Project)

<u>Alternative 1</u>

Table 20, page 22, provides detailed supply and demand projections under Alternative 1. Alternative 1 yields total additional water supply of 4,116 AF under base year conditions (year 2000) and 2,142 AF under future conditions (year 2049). WMWD would have rights to 28 percent of the increased yield. Riverside's allocation is 22.5 percent. Thus, in the base year, Riverside would have rights to approximately 926 AF of water. By the year 2049, Riverside's share would total approximately 491 AF.

Based upon conversations with PUD officials, it is assumed that Riverside would obtain its share of the Seven-Oaks water supply through groundwater basins. Accordingly, the supply costs of Seven Oaks water to the City is assumed to be approximately the same as that currently incurred for its existing groundwater supply ($350/AF). Benefits accrue during years 2010 through 2049, since the City is able to reduce its reliance on more-costly imported and reclaimed water. See Table 21, page 23, for a summary.

TABLE 20
City of Riverside: Water Supply & Demand Analyses
With Project Conditions (Alternative 1)

	SUPPLY											DEMAND*	COST
	Groundwater					Reclaimed Water		Imported Water		7-Oaks			
	Bunker Hill Basin	Riverside Basins	Gage Exchange**										
Year	Acre Ft.	Acre Ft.	Acre Ft.	Total	Cost/AF	Acre Ft.	Cost/AF	Acre Ft.	Cost/AF	Acre Ft.	Cost/AF	Acre Ft.	$$
2000	37,526	26,871	3,369	67,766	$350	0	$800	0	$726	926	$350	68,692	$24,042,200
2001	37,526	26,871	4,065	68,462	$350	0	$800	0	$726	917	$350	69,379	$24,282,650
2002	37,526	26,871	4,768	69,165	$350	0	$800	0	$726	908	$350	70,073	$24,525,550
2003	37,526	26,871	5,476	69,873	$350	0	$800	0	$726	900	$350	70,773	$24,770,550
2004	37,526	26,871	6,193	70,590	$350	0	$800	0	$726	891	$350	71,481	$25,018,350
2005	37,526	26,871	6,917	71,314	$350	0	$800	0	$726	882	$350	72,196	$25,268,600
2006	37,526	26,871	8,153	72,550	$350	0	$800	0	$726	873	$350	73,423	$25,698,050
2007	37,526	26,871	9,411	73,808	$350	0	$800	0	$726	864	$350	74,672	$26,135,200
2008	37,526	26,871	10,689	75,086	$350	0	$800	0	$726	855	$350	75,941	$26,579,350
2009	37,526	26,871	11,989	76,386	$350	0	$800	0	$726	846	$350	77,232	$27,031,200
2010	37,526	26,871	13,311	77,708	$350	0	$800	0	$726	837	$350	78,545	$27,490,750
2011	37,526	26,871	13,984	78,381	$350	0	$800	671	$726	828	$350	79,880	$28,210,124
2012	37,526	26,871	13,984	78,381	$350	0	$800	2,037	$726	820	$350	81,238	$29,199,373
2013	37,526	26,871	13,984	78,381	$350	(0)	$800	3,427	$726	811	$350	82,619	$30,205,319
2014	37,526	26,871	13,984	78,381	$350	1,241	$800	3,600	$726	802	$350	84,024	$31,320,539
2015	37,526	26,871	13,984	78,381	$350	2,678	$800	3,600	$726	793	$350	85,452	$32,466,937
2016	37,526	26,871	13,984	78,381	$350	2,687	$800	3,600	$726	784	$350	85,452	$32,470,935
2017	37,526	26,871	13,984	78,381	$350	2,696	$800	3,600	$726	775	$350	85,452	$32,474,933
2018	37,526	26,871	13,984	78,381	$350	2,705	$800	3,600	$726	766	$350	85,452	$32,478,931
2019	37,526	26,871	13,984	78,381	$350	2,714	$800	3,600	$726	757	$350	85,452	$32,482,930
2020	37,526	26,871	13,984	78,381	$350	2,723	$800	3,600	$726	748	$350	85,452	$32,486,928
2021	37,526	26,871	13,984	78,381	$350	2,731	$800	3,600	$726	740	$350	85,452	$32,490,926
2022	37,526	26,871	13,984	78,381	$350	2,740	$800	3,600	$726	731	$350	85,452	$32,494,924
2023	37,526	26,871	13,984	78,381	$350	2,749	$800	3,600	$726	722	$350	85,452	$32,498,922
2024	37,526	26,871	13,984	78,381	$350	2,758	$800	3,600	$726	713	$350	85,452	$32,502,920
2025	37,526	26,871	13,984	78,381	$350	2,767	$800	3,600	$726	704	$350	85,452	$32,506,919
2026	37,526	26,871	13,984	78,381	$350	2,776	$800	3,600	$726	695	$350	85,452	$32,510,917
2027	37,526	26,871	13,984	78,381	$350	2,785	$800	3,600	$726	686	$350	85,452	$32,514,915
2028	37,526	26,871	13,984	78,381	$350	2,794	$800	3,600	$726	677	$350	85,452	$32,518,913
2029	37,526	26,871	13,984	78,381	$350	2,802	$800	3,600	$726	669	$350	85,452	$32,522,911
2030	37,526	26,871	13,984	78,381	$350	2,811	$800	3,600	$726	660	$350	85,452	$32,526,909
2031	37,526	26,871	13,984	78,381	$350	2,820	$800	3,600	$726	651	$350	85,452	$32,530,907
2032	37,526	26,871	13,984	78,381	$350	2,829	$800	3,600	$726	642	$350	85,452	$32,534,906
2033	37,526	26,871	13,984	78,381	$350	2,838	$800	3,600	$726	633	$350	85,452	$32,538,904
2034	37,526	26,871	13,984	78,381	$350	2,847	$800	3,600	$726	624	$350	85,452	$32,542,902
2035	37,526	26,871	13,984	78,381	$350	2,856	$800	3,600	$726	615	$350	85,452	$32,546,900
2036	37,526	26,871	13,984	78,381	$350	2,865	$800	3,600	$726	606	$350	85,452	$32,550,898
2037	37,526	26,871	13,984	78,381	$350	2,874	$800	3,600	$726	597	$350	85,452	$32,554,896
2038	37,526	26,871	13,984	78,381	$350	2,882	$800	3,600	$726	589	$350	85,452	$32,558,895
2039	37,526	26,871	13,984	78,381	$350	2,891	$800	3,600	$726	580	$350	85,452	$32,562,893
2040	37,526	26,871	13,984	78,381	$350	2,900	$800	3,600	$726	571	$350	85,452	$32,566,891
2041	37,526	26,871	13,984	78,381	$350	2,909	$800	3,600	$726	562	$350	85,452	$32,570,889
2042	37,526	26,871	13,984	78,381	$350	2,918	$800	3,600	$726	553	$350	85,452	$32,574,887
2043	37,526	26,871	13,984	78,381	$350	2,927	$800	3,600	$726	544	$350	85,452	$32,578,885
2044	37,526	26,871	13,984	78,381	$350	2,936	$800	3,600	$726	535	$350	85,452	$32,582,884
2045	37,526	26,871	13,984	78,381	$350	2,945	$800	3,600	$726	526	$350	85,452	$32,586,882
2046	37,526	26,871	13,984	78,381	$350	2,954	$800	3,600	$726	517	$350	85,452	$32,590,880
2047	37,526	26,871	13,984	78,381	$350	2,962	$800	3,600	$726	509	$350	85,452	$32,594,878
2048	37,526	26,871	13,984	78,381	$350	2,971	$800	3,600	$726	500	$350	85,452	$32,598,876
2049	37,526	26,871	13,984	78,381	$350	2,980	$800	3,600	$726	491	$350	85,452	$32,602,874
Present Value (Year 2000 @ 7.375%)													$370,715,374
Annualized (50 Years @ 7.375%)													$28,142,308
Annual Savings (vs. Without Project Condition)													$143,123

** Domestic Demand (Does Not Include Irrigation Demand).*

*** Acre feet (AF) of potable water. 1.25 AF of non-potable water must be exchanged for each AF of potable water.*

Table 21 City of Riverside Projected Water Supply Costs (Alternative 1)						
		Supply				
Year	Demand	Groundwater	Imported	Reclaimed	7-Oaks	Cost ($1,000's)
2000	68,692	67,766	0	0	926	$24,042
2010	78,545	77,708	0	0	837	$27,491
2020	85,452	78,381	3,600	2,723	748	$32,487
2030	85,452	78,381	3,600	2,811	660	$32,527
2040	85,452	78,381	3,600	2,900	571	$32,567
2049	85,452	78,381	3,600	2,980	491	$32,603

The present value of water supply costs for Riverside over the 50-year period (year 2000-2049) totals approximately $370.7 million under Alternative 1. Annualized at a discount rate of 7.375%, this represents $28,142,310 in annualized water supply costs. Thus, Alternative 1 results in annualized water supply cost savings of approximately $143,120.

Alternative 2

Table 22, page 24, provides detailed supply and demand projections under Alternative 2. Alternative 2 yields total additional water supply of 7,473 AF under base year conditions (year 2000) and 5,913 AF under future conditions (year 2049). Riverside would have rights to an allocation of 22.5 percent of the increased yield. Thus, in the base year, Riverside would have rights to approximately 1,682 AF of water. By the year 2049, Riverside's share would total approximately 1,337 AF. As with Alternative 1, benefits accrue during years 2010 through 2049, since the City is able to reduce its reliance on more-costly imported and reclaimed water. See Table 23 below for a summary.

Table 23 City of Riverside Projected Water Supply Costs (Alternative 2)						
		Supply				
Year	Demand	Groundwater	Imported	Reclaimed	7-Oaks	Cost ($1,000's)
2000	68,692	67,010	0	0	1,682	$24,042
2010	78,545	76,934	0	0	1,611	$27,491
2020	85,452	78,381	3,600	1,930	1,541	$32,130
2030	85,452	78,381	3,600	2,000	1,471	$32,162
2040	85,452	78,381	3,600	2,070	1,401	$32,193
2049	85,452	78,381	3,600	2,134	1,337	$32,222

TABLE 22
City of Riverside: Water Supply & Demand Analyses
With Project Conditions (Alternative 2)

	SUPPLY											DEMAND*	COST
	Groundwater					Reclaimed Water		Imported Water		7-Oaks			
	Bunker Hill Basin	Riverside Basins	Gage Exchange**										
Year	Acre Ft.	Acre Ft.	Acre Ft.	Total	Cost/AF	Acre Ft.	Cost/AF	Acre Ft.	Cost/AF	Acre Ft.	Cost/AF	Acre Ft.	$$
2000	37,526	26,871	2,613	67,010	$350	0	$800	0	$726	1,682	$350	68,692	$24,042,200
2001	37,526	26,871	3,308	67,705	$350	0	$800	0	$726	1,674	$350	69,379	$24,282,650
2002	37,526	26,871	4,009	68,406	$350	0	$800	0	$726	1,667	$350	70,073	$24,525,550
2003	37,526	26,871	4,716	69,113	$350	0	$800	0	$726	1,660	$350	70,773	$24,770,550
2004	37,526	26,871	5,431	69,828	$350	0	$800	0	$726	1,653	$350	71,481	$25,018,350
2005	37,526	26,871	6,153	70,550	$350	0	$800	0	$726	1,646	$350	72,196	$25,268,600
2006	37,526	26,871	7,387	71,784	$350	0	$800	0	$726	1,639	$350	73,423	$25,698,050
2007	37,526	26,871	8,643	73,040	$350	0	$800	0	$726	1,632	$350	74,672	$26,135,200
2008	37,526	26,871	9,919	74,316	$350	0	$800	0	$726	1,625	$350	75,941	$26,579,350
2009	37,526	26,871	11,217	75,614	$350	0	$800	0	$726	1,618	$350	77,232	$27,031,200
2010	37,526	26,871	12,537	76,934	$350	0	$800	0	$726	1,611	$350	78,545	$27,490,750
2011	37,526	26,871	13,879	78,276	$350	0	$800	0	$726	1,604	$350	79,880	$27,958,000
2012	37,526	26,871	13,984	78,381	$350	0	$800	1,260	$726	1,597	$350	81,238	$28,906,965
2013	37,526	26,871	13,984	78,381	$350	0	$800	2,648	$726	1,590	$350	82,619	$29,912,211
2014	37,526	26,871	13,984	78,381	$350	460	$800	3,600	$726	1,583	$350	84,024	$30,968,906
2015	37,526	26,871	13,984	78,381	$350	1,895	$800	3,600	$726	1,576	$350	85,452	$32,114,465
2016	37,526	26,871	13,984	78,381	$350	1,902	$800	3,600	$726	1,569	$350	85,452	$32,117,625
2017	37,526	26,871	13,984	78,381	$350	1,909	$800	3,600	$726	1,562	$350	85,452	$32,120,785
2018	37,526	26,871	13,984	78,381	$350	1,916	$800	3,600	$726	1,555	$350	85,452	$32,123,945
2019	37,526	26,871	13,984	78,381	$350	1,923	$800	3,600	$726	1,548	$350	85,452	$32,127,105
2020	37,526	26,871	13,984	78,381	$350	1,930	$800	3,600	$726	1,541	$350	85,452	$32,130,264
2021	37,526	26,871	13,984	78,381	$350	1,937	$800	3,600	$726	1,534	$350	85,452	$32,133,424
2022	37,526	26,871	13,984	78,381	$350	1,944	$800	3,600	$726	1,527	$350	85,452	$32,136,584
2023	37,526	26,871	13,984	78,381	$350	1,951	$800	3,600	$726	1,520	$350	85,452	$32,139,744
2024	37,526	26,871	13,984	78,381	$350	1,958	$800	3,600	$726	1,513	$350	85,452	$32,142,904
2025	37,526	26,871	13,984	78,381	$350	1,965	$800	3,600	$726	1,506	$350	85,452	$32,146,064
2026	37,526	26,871	13,984	78,381	$350	1,972	$800	3,600	$726	1,499	$350	85,452	$32,149,223
2027	37,526	26,871	13,984	78,381	$350	1,979	$800	3,600	$726	1,492	$350	85,452	$32,152,383
2028	37,526	26,871	13,984	78,381	$350	1,986	$800	3,600	$726	1,485	$350	85,452	$32,155,543
2029	37,526	26,871	13,984	78,381	$350	1,993	$800	3,600	$726	1,478	$350	85,452	$32,158,703
2030	37,526	26,871	13,984	78,381	$350	2,000	$800	3,600	$726	1,471	$350	85,452	$32,161,863
2031	37,526	26,871	13,984	78,381	$350	2,007	$800	3,600	$726	1,464	$350	85,452	$32,165,022
2032	37,526	26,871	13,984	78,381	$350	2,014	$800	3,600	$726	1,457	$350	85,452	$32,168,182
2033	37,526	26,871	13,984	78,381	$350	2,021	$800	3,600	$726	1,450	$350	85,452	$32,171,342
2034	37,526	26,871	13,984	78,381	$350	2,028	$800	3,600	$726	1,443	$350	85,452	$32,174,502
2035	37,526	26,871	13,984	78,381	$350	2,035	$800	3,600	$726	1,436	$350	85,452	$32,177,662
2036	37,526	26,871	13,984	78,381	$350	2,042	$800	3,600	$726	1,429	$350	85,452	$32,180,821
2037	37,526	26,871	13,984	78,381	$350	2,049	$800	3,600	$726	1,422	$350	85,452	$32,183,981
2038	37,526	26,871	13,984	78,381	$350	2,056	$800	3,600	$726	1,415	$350	85,452	$32,187,141
2039	37,526	26,871	13,984	78,381	$350	2,063	$800	3,600	$726	1,408	$350	85,452	$32,190,301
2040	37,526	26,871	13,984	78,381	$350	2,070	$800	3,600	$726	1,401	$350	85,452	$32,193,461
2041	37,526	26,871	13,984	78,381	$350	2,077	$800	3,600	$726	1,394	$350	85,452	$32,196,620
2042	37,526	26,871	13,984	78,381	$350	2,084	$800	3,600	$726	1,387	$350	85,452	$32,199,780
2043	37,526	26,871	13,984	78,381	$350	2,091	$800	3,600	$726	1,380	$350	85,452	$32,202,940
2044	37,526	26,871	13,984	78,381	$350	2,098	$800	3,600	$726	1,373	$350	85,452	$32,206,100
2045	37,526	26,871	13,984	78,381	$350	2,105	$800	3,600	$726	1,366	$350	85,452	$32,209,260
2046	37,526	26,871	13,984	78,381	$350	2,112	$800	3,600	$726	1,359	$350	85,452	$32,212,420
2047	37,526	26,871	13,984	78,381	$350	2,120	$800	3,600	$726	1,351	$350	85,452	$32,215,579
2048	37,526	26,871	13,984	78,381	$350	2,127	$800	3,600	$726	1,344	$350	85,452	$32,218,739
2049	37,526	26,871	13,984	78,381	$350	2,134	$800	3,600	$726	1,337	$350	85,452	$32,221,899
Present Value (Year 2000 @ 7.375%)													$368,718,177
Annualized (50 Years @ 7.375%)													$27,990,694
Annual Savings (vs. Without Project Condition)													$294,737

* *Domestic Demand (Does Not Include Irrigation Demand).*
** *Acre feet (AF) of potable water. 1.25 AF of non-potable water must be exchanged for each AF of potable water.*

The present value of water supply costs for Riverside over the 50-year period (year 2000-2049) totals approximately $368.7 million under Alternative 2. Annualized at a discount rate of 7.375%, this represents $27,990,690 in annualized water supply costs. Thus, Alternative 2 results in annualized water supply cost savings of approximately $294,740.

Alternative 3

Table 24, page 26, provides detailed supply and demand projections under Alternative 3. Alternative 3 yields total additional water supply of 9,258 AF under base year conditions (year 2000) and 8,013 AF under future conditions (year 2049). Riverside would have rights to an allocation of 22.5 percent of the increased yield. Thus, in the base year, Riverside would have rights to approximately 2,083 AF of water. By the year 2049, Riverside's share would total approximately 1,809 AF. As with Alternatives 1 and 2, benefits accrue during years 2010 through 2049, since the City is able to reduce its reliance on more-costly imported and reclaimed water. See Table 25 below for a summary.

Table 25
City of Riverside
Projected Water Supply Costs (Alternative 3)

		Supply				
Year	**Demand**	**Groundwater**	**Imported**	**Reclaimed**	**7-Oaks**	**Cost ($1,000's)**
2000	68,692	66,609	0	0	2,083	$24,042
2010	78,545	76,518	0	0	2,027	$27,491
2020	85,452	78,381	3,600	1,500	1,971	$31,937
2030	85,452	78,381	3,600	1,556	1,915	$31,962
2040	85,452	78,381	3,600	1,612	1,859	$31,987
2049	85,452	78,381	3,600	1,662	1,809	$32,010

The present value of water supply costs for Riverside over the 50-year period (year 2000-2049) totals approximately $367.7 million under Alternative 3. Annualized at a discount rate of 7.375%, this represents $27,912,650 in annualized water supply costs. Thus, Alternative 3 results in annualized water supply cost savings of approximately $372,780.

Alternative 4

Table 26, page 27, provides detailed supply and demand projections under Alternative 4. Alternative 4 yields total additional water supply of 2,512 AF under base year conditions (year 2000) and 638 AF under future conditions (year 2049). Riverside would have rights to an allocation of 22.5 percent of the increased yield. Thus, in the base year, Riverside would have rights to approximately 565AF of water. By the year 2049, Riverside's share would total approximately 152 AF. As with Alternatives 1 through 3, benefits accrue during years 2010 through 2049, since the City is able to reduce its reliance on more-costly imported and reclaimed water. See Table 27 for a summary.

TABLE 24
City of Riverside: Water Supply & Demand Analyses
With Project Conditions (Alternative 3)

	SUPPLY											DEMAND*	COST
	Groundwater					Reclaimed Water		Imported Water		7-Oaks			
	Bunker Hill Basin	Riverside Basins	Gage Exchange**										
Year	Acre Ft.	Acre Ft.	Acre Ft.	Total	Cost/AF	Acre Ft.	Cost/AF	Acre Ft.	Cost/AF	Acre Ft.	Cost/AF	Acre Ft.	$$
2000	37,526	26,871	2,212	66,609	$350	0	$800	0	$726	2,083	$350	68,692	$24,042,200
2001	37,526	26,871	2,905	67,302	$350	0	$800	0	$726	2,077	$350	69,379	$24,282,650
2002	37,526	26,871	3,604	68,001	$350	0	$800	0	$726	2,072	$350	70,073	$24,525,550
2003	37,526	26,871	4,310	68,707	$350	0	$800	0	$726	2,066	$350	70,773	$24,770,550
2004	37,526	26,871	5,023	69,420	$350	0	$800	0	$726	2,061	$350	71,481	$25,018,350
2005	37,526	26,871	5,744	70,141	$350	0	$800	0	$726	2,055	$350	72,196	$25,268,600
2006	37,526	26,871	6,977	71,374	$350	0	$800	0	$726	2,049	$350	73,423	$25,698,050
2007	37,526	26,871	8,231	72,628	$350	0	$800	0	$726	2,044	$350	74,672	$26,135,200
2008	37,526	26,871	9,506	73,903	$350	0	$800	0	$726	2,038	$350	75,941	$26,579,350
2009	37,526	26,871	10,802	75,199	$350	0	$800	0	$726	2,033	$350	77,232	$27,031,200
2010	37,526	26,871	12,121	76,518	$350	0	$800	0	$726	2,027	$350	78,545	$27,490,750
2011	37,526	26,871	13,462	77,859	$350	0	$800	0	$726	2,021	$350	79,880	$27,958,000
2012	37,526	26,871	13,984	78,381	$350	0	$800	841	$726	2,016	$350	81,238	$28,749,605
2013	37,526	26,871	13,984	78,381	$350	0	$800	2,228	$726	2,010	$350	82,619	$29,754,317
2014	37,526	26,871	13,984	78,381	$350	38	$800	3,600	$726	2,005	$350	84,024	$30,779,297
2015	37,526	26,871	13,984	78,381	$350	1,472	$800	3,600	$726	1,999	$350	85,452	$31,924,217
2016	37,526	26,871	13,984	78,381	$350	1,478	$800	3,600	$726	1,993	$350	85,452	$31,926,737
2017	37,526	26,871	13,984	78,381	$350	1,483	$800	3,600	$726	1,988	$350	85,452	$31,929,256
2018	37,526	26,871	13,984	78,381	$350	1,489	$800	3,600	$726	1,982	$350	85,452	$31,931,776
2019	37,526	26,871	13,984	78,381	$350	1,494	$800	3,600	$726	1,977	$350	85,452	$31,934,296
2020	37,526	26,871	13,984	78,381	$350	1,500	$800	3,600	$726	1,971	$350	85,452	$31,936,816
2021	37,526	26,871	13,984	78,381	$350	1,506	$800	3,600	$726	1,965	$350	85,452	$31,939,336
2022	37,526	26,871	13,984	78,381	$350	1,511	$800	3,600	$726	1,960	$350	85,452	$31,941,856
2023	37,526	26,871	13,984	78,381	$350	1,517	$800	3,600	$726	1,954	$350	85,452	$31,944,376
2024	37,526	26,871	13,984	78,381	$350	1,522	$800	3,600	$726	1,949	$350	85,452	$31,946,896
2025	37,526	26,871	13,984	78,381	$350	1,528	$800	3,600	$726	1,943	$350	85,452	$31,949,416
2026	37,526	26,871	13,984	78,381	$350	1,534	$800	3,600	$726	1,937	$350	85,452	$31,951,936
2027	37,526	26,871	13,984	78,381	$350	1,539	$800	3,600	$726	1,932	$350	85,452	$31,954,456
2028	37,526	26,871	13,984	78,381	$350	1,545	$800	3,600	$726	1,926	$350	85,452	$31,956,975
2029	37,526	26,871	13,984	78,381	$350	1,550	$800	3,600	$726	1,921	$350	85,452	$31,959,495
2030	37,526	26,871	13,984	78,381	$350	1,556	$800	3,600	$726	1,915	$350	85,452	$31,962,015
2031	37,526	26,871	13,984	78,381	$350	1,562	$800	3,600	$726	1,909	$350	85,452	$31,964,535
2032	37,526	26,871	13,984	78,381	$350	1,567	$800	3,600	$726	1,904	$350	85,452	$31,967,055
2033	37,526	26,871	13,984	78,381	$350	1,573	$800	3,600	$726	1,898	$350	85,452	$31,969,575
2034	37,526	26,871	13,984	78,381	$350	1,578	$800	3,600	$726	1,893	$350	85,452	$31,972,095
2035	37,526	26,871	13,984	78,381	$350	1,584	$800	3,600	$726	1,887	$350	85,452	$31,974,615
2036	37,526	26,871	13,984	78,381	$350	1,590	$800	3,600	$726	1,881	$350	85,452	$31,977,135
2037	37,526	26,871	13,984	78,381	$350	1,595	$800	3,600	$726	1,876	$350	85,452	$31,979,655
2038	37,526	26,871	13,984	78,381	$350	1,601	$800	3,600	$726	1,870	$350	85,452	$31,982,175
2039	37,526	26,871	13,984	78,381	$350	1,606	$800	3,600	$726	1,865	$350	85,452	$31,984,694
2040	37,526	26,871	13,984	78,381	$350	1,612	$800	3,600	$726	1,859	$350	85,452	$31,987,214
2041	37,526	26,871	13,984	78,381	$350	1,618	$800	3,600	$726	1,853	$350	85,452	$31,989,734
2042	37,526	26,871	13,984	78,381	$350	1,623	$800	3,600	$726	1,848	$350	85,452	$31,992,254
2043	37,526	26,871	13,984	78,381	$350	1,629	$800	3,600	$726	1,842	$350	85,452	$31,994,774
2044	37,526	26,871	13,984	78,381	$350	1,634	$800	3,600	$726	1,837	$350	85,452	$31,997,294
2045	37,526	26,871	13,984	78,381	$350	1,640	$800	3,600	$726	1,831	$350	85,452	$31,999,814
2046	37,526	26,871	13,984	78,381	$350	1,646	$800	3,600	$726	1,825	$350	85,452	$32,002,334
2047	37,526	26,871	13,984	78,381	$350	1,651	$800	3,600	$726	1,820	$350	85,452	$32,004,854
2048	37,526	26,871	13,984	78,381	$350	1,657	$800	3,600	$726	1,814	$350	85,452	$32,007,374
2049	37,526	26,871	13,984	78,381	$350	1,662	$800	3,600	$726	1,809	$350	85,452	$32,009,894
Present Value (Year 2000 @ 7.375%)													$367,690,150
Annualized (50 Years @ 7.375%)													$27,912,652
Annual Savings (vs. Without Project Condition)													$372,778

** Domestic Demand (Does Not Include Irrigation Demand).*
*** Acre feet (AF) of potable water. 1.25 AF of non-potable water must be exchanged for each AF of potable water.*

TABLE 26
City of Riverside: Water Supply & Demand Analyses
With Project Conditions (Alternative 4)

	SUPPLY											DEMAND*	COST
	Groundwater					Reclaimed Water		Imported Water		7-Oaks			
	Bunker Hill Basin	*Riverside Basins*	*Gage Exchange***										
Year	Acre Ft.	Acre Ft.	Acre Ft.	Total	Cost/AF	Acre Ft.	Cost/AF	Acre Ft.	Cost/AF	Acre Ft.	Cost/AF	Acre Ft.	$$
2000	37,526	26,871	3,730	68,127	$350	0	$800	0	$726	565	$350	68,692	$24,042,200
2001	37,526	26,871	4,425	68,822	$350	0	$800	0	$726	557	$350	69,379	$24,282,650
2002	37,526	26,871	5,128	69,525	$350	0	$800	0	$726	548	$350	70,073	$24,525,550
2003	37,526	26,871	5,836	70,233	$350	0	$800	0	$726	540	$350	70,773	$24,770,550
2004	37,526	26,871	6,553	70,950	$350	0	$800	0	$726	531	$350	71,481	$25,018,350
2005	37,526	26,871	7,276	71,673	$350	0	$800	0	$726	523	$350	72,196	$25,268,600
2006	37,526	26,871	8,511	72,908	$350	0	$800	0	$726	515	$350	73,423	$25,698,050
2007	37,526	26,871	9,769	74,166	$350	0	$800	0	$726	506	$350	74,672	$26,135,200
2008	37,526	26,871	11,046	75,443	$350	0	$800	0	$726	498	$350	75,941	$26,579,350
2009	37,526	26,871	12,346	76,743	$350	0	$800	0	$726	489	$350	77,232	$27,031,200
2010	37,526	26,871	13,667	78,064	$350	0	$800	0	$726	481	$350	78,545	$27,490,750
2011	37,526	26,871	13,984	78,381	$350	0	$800	1,027	$726	472	$350	79,880	$28,344,007
2012	37,526	26,871	13,984	78,381	$350	0	$800	2,393	$726	464	$350	81,238	$29,333,084
2013	37,526	26,871	13,984	78,381	$350	182	$800	3,600	$726	456	$350	82,619	$30,352,362
2014	37,526	26,871	13,984	78,381	$350	1,596	$800	3,600	$726	447	$350	84,024	$31,480,156
2015	37,526	26,871	13,984	78,381	$350	3,032	$800	3,600	$726	439	$350	85,452	$32,626,349
2016	37,526	26,871	13,984	78,381	$350	3,041	$800	3,600	$726	430	$350	85,452	$32,630,142
2017	37,526	26,871	13,984	78,381	$350	3,049	$800	3,600	$726	422	$350	85,452	$32,633,935
2018	37,526	26,871	13,984	78,381	$350	3,058	$800	3,600	$726	413	$350	85,452	$32,637,729
2019	37,526	26,871	13,984	78,381	$350	3,066	$800	3,600	$726	405	$350	85,452	$32,641,522
2020	37,526	26,871	13,984	78,381	$350	3,074	$800	3,600	$726	397	$350	85,452	$32,645,315
2021	37,526	26,871	13,984	78,381	$350	3,083	$800	3,600	$726	388	$350	85,452	$32,649,108
2022	37,526	26,871	13,984	78,381	$350	3,091	$800	3,600	$726	380	$350	85,452	$32,652,902
2023	37,526	26,871	13,984	78,381	$350	3,100	$800	3,600	$726	371	$350	85,452	$32,656,695
2024	37,526	26,871	13,984	78,381	$350	3,108	$800	3,600	$726	363	$350	85,452	$32,660,488
2025	37,526	26,871	13,984	78,381	$350	3,117	$800	3,600	$726	354	$350	85,452	$32,664,281
2026	37,526	26,871	13,984	78,381	$350	3,125	$800	3,600	$726	346	$350	85,452	$32,668,074
2027	37,526	26,871	13,984	78,381	$350	3,133	$800	3,600	$726	338	$350	85,452	$32,671,868
2028	37,526	26,871	13,984	78,381	$350	3,142	$800	3,600	$726	329	$350	85,452	$32,675,661
2029	37,526	26,871	13,984	78,381	$350	3,150	$800	3,600	$726	321	$350	85,452	$32,679,454
2030	37,526	26,871	13,984	78,381	$350	3,159	$800	3,600	$726	312	$350	85,452	$32,683,247
2031	37,526	26,871	13,984	78,381	$350	3,167	$800	3,600	$726	304	$350	85,452	$32,687,041
2032	37,526	26,871	13,984	78,381	$350	3,176	$800	3,600	$726	295	$350	85,452	$32,690,834
2033	37,526	26,871	13,984	78,381	$350	3,184	$800	3,600	$726	287	$350	85,452	$32,694,627
2034	37,526	26,871	13,984	78,381	$350	3,192	$800	3,600	$726	279	$350	85,452	$32,698,420
2035	37,526	26,871	13,984	78,381	$350	3,201	$800	3,600	$726	270	$350	85,452	$32,702,214
2036	37,526	26,871	13,984	78,381	$350	3,209	$800	3,600	$726	262	$350	85,452	$32,706,007
2037	37,526	26,871	13,984	78,381	$350	3,218	$800	3,600	$726	253	$350	85,452	$32,709,800
2038	37,526	26,871	13,984	78,381	$350	3,226	$800	3,600	$726	245	$350	85,452	$32,713,593
2039	37,526	26,871	13,984	78,381	$350	3,235	$800	3,600	$726	236	$350	85,452	$32,717,386
2040	37,526	26,871	13,984	78,381	$350	3,243	$800	3,600	$726	228	$350	85,452	$32,721,180
2041	37,526	26,871	13,984	78,381	$350	3,251	$800	3,600	$726	220	$350	85,452	$32,724,973
2042	37,526	26,871	13,984	78,381	$350	3,260	$800	3,600	$726	211	$350	85,452	$32,728,766
2043	37,526	26,871	13,984	78,381	$350	3,268	$800	3,600	$726	203	$350	85,452	$32,732,559
2044	37,526	26,871	13,984	78,381	$350	3,277	$800	3,600	$726	194	$350	85,452	$32,736,353
2045	37,526	26,871	13,984	78,381	$350	3,285	$800	3,600	$726	186	$350	85,452	$32,740,146
2046	37,526	26,871	13,984	78,381	$350	3,294	$800	3,600	$726	177	$350	85,452	$32,743,939
2047	37,526	26,871	13,984	78,381	$350	3,302	$800	3,600	$726	169	$350	85,452	$32,747,732
2048	37,526	26,871	13,984	78,381	$350	3,311	$800	3,600	$726	160	$350	85,452	$32,751,526
2049	37,526	26,871	13,984	78,381	$350	3,319	$800	3,600	$726	152	$350	85,452	$32,755,319
Present Value (Year 2000 @ 7.375%)													$371,607,255
Annualized (50 Years @ 7.375%)													$28,210,014
Annual Savings (vs. Without Project Condition)													$75,417

* *Domestic Demand (Does Not Include Irrigation Demand).*

** *Acre feet (AF) of potable water. 1.25 AF of non-potable water must be exchanged for each AF of potable water.*

Table 27 City of Riverside Projected Water Supply Costs (Alternative 4)						
		Supply				
Year	Demand	Groundwater	Imported	Reclaimed	7-Oaks	Cost ($1,000's)
2000	68,692	68,127	0	0	565	$24,042
2010	78,545	78,064	0	0	481	$27,491
2020	85,452	78,381	3,600	3,074	397	$32,645
2030	85,452	78,381	3,600	3,159	312	$32,683
2040	85,452	78,381	3,600	3,243	228	$32,721
2049	85,452	78,381	3,600	3,319	152	$32,755

The present value of water supply costs for Riverside over the 50-year period (year 2000-2049) totals approximately $371.6 million under Alternative 4. Annualized at a discount rate of 7.375%, this represents $28,210,010 in annualized water supply costs. Thus, Alternative 4 results in annualized water supply cost savings of approximately $75,420.

Summary

The following table summarizes the benefits to the City of Riverside for each of the four water conservation alternatives for Seven Oaks Dam.

Table 28 City of Riverside Summary of Benefits for Alternatives		
Alternative	Annual Water Supply Costs	Total Annual Benefits
Without Project	$28,285,430	--
Alternative 1	$28,142,310	$143,120
Alternative 2	$27,990,690	$294,740
Alternative 3	$27,912,650	$372,780
Alternative 4	$28,210,010	$75,420

Note: Figures not exact due to rounding.

VIII. REMAINING WATER CONSERVATION BENEFITS

As discussed in the previous sections, SBVMWD's and the City of Riverside's allocations of the additional water supply yields from the four alternatives equate to 72% and 22.5%, respectively. The additional 5.5% of the increased yields will be apportioned to three other member agencies of WMWD. It has been assumed for this analysis that the benefits these agencies would realize in terms of reduced water supply costs would be similar those equated for SBVMWD and the City of Riverside. Accordingly, benefits have been calculated for the remaining portion of the increased yields based upon the benefits calculated in the prior sections for SBVMWD and Riverside. The following methodology was employed:

1) Benefits (equal to reductions in water supply costs) for both SBVMWD and the City of Riverside were calculated for each year under each of the alternatives.

2) Annual benefits from 1) above were divided by the increased yields which generated them to compute annual benefits per acre foot for both SBVMWD and Riverside.

3) A weighted average benefit/AF was calculated based upon SBVMWD's and Riverside's respective portions of the increased yields.

4) Yearly weighted average benefits/AF were multiplied by the remaining 5.5% in increased yields to compute annual benefits for each alternative.

5) The net present value of the annual benefits was annualized over 50 years at a discount rate of 7.375%.

Tables 29 through 32 (pp. 30-33) detail these calculations for each of the four alternatives. Table 33 below summarizes the results.

Table 33
Summary of Remaining Benefits

Year	Alternative 1	Alternative 2	Alternative 3	Alternative 4
2000	$23,209	$47,736	$47,741	$14,161
2010	$26,574	$47,820	$59,230	$16,788
2020	$98,363	$202,514	$259,020	$52,105
2030	$86,681	$193,296	$251,665	$41,026
2040	$75,000	$184,070	$244,310	$29,956
2049	$64,513	$175,776	$237,662	$19,972
NPV	$630,760	$1,286,540	$1,620,180	$337,140
Annualized	$47,880	$97,670	$122,990	$25,590

TABLE 29
BENEFIT ANALYSIS: REMAINING 5.5% OF INCREASED YIELD
With Project Conditions (Alternative 1)

Year	Benefit/AF Riverside	Benefit/AF SBVMWD	Wtd. Average	Remaining Allocation (AF)	Benefits
2000	$0	$135	$103	226	$23,209
2001	$0	$133	$101	224	$22,729
2002	$0	$134	$102	222	$22,712
2003	$0	$135	$103	220	$22,665
2004	$0	$136	$104	218	$22,536
2005	$0	$144	$110	216	$23,673
2006	$0	$143	$109	213	$23,327
2007	$0	$145	$111	211	$23,365
2008	$0	$145	$111	209	$23,167
2009	$0	$148	$113	207	$23,316
2010	$74	$147	$130	205	$26,574
2011	$376	$150	$204	203	$41,215
2012	$376	$158	$210	200	$42,039
2013	$434	$156	$222	198	$44,072
2014	$450	$159	$228	196	$44,671
2015	$450	$565	$538	194	$104,204
2016	$450	$565	$538	192	$103,036
2017	$450	$565	$538	189	$101,868
2018	$450	$565	$538	187	$100,685
2019	$450	$565	$538	185	$99,524
2020	$450	$565	$538	183	$98,363
2021	$450	$565	$538	181	$97,211
2022	$450	$565	$538	179	$96,017
2023	$450	$565	$538	176	$94,856
2024	$450	$565	$538	174	$93,704
2025	$450	$565	$538	172	$92,543
2026	$450	$565	$538	170	$91,349
2027	$450	$565	$538	168	$90,198
2028	$450	$565	$538	166	$89,037
2029	$450	$565	$538	163	$87,842
2030	$450	$565	$538	161	$86,681
2031	$450	$565	$538	159	$85,530
2032	$450	$565	$538	157	$84,369
2033	$450	$565	$538	155	$83,175
2034	$450	$565	$538	153	$82,023
2035	$450	$565	$538	150	$80,862
2036	$450	$565	$538	148	$79,668
2037	$450	$565	$538	146	$78,507
2038	$450	$565	$538	144	$77,355
2039	$450	$565	$538	142	$76,194
2040	$450	$565	$538	140	$75,000
2041	$450	$565	$538	137	$73,848
2042	$450	$565	$538	135	$72,687
2043	$450	$565	$538	133	$71,526
2044	$450	$565	$538	131	$70,341
2045	$450	$565	$538	129	$69,180
2046	$450	$565	$538	126	$68,019
2047	$450	$565	$538	124	$66,825
2048	$450	$565	$538	122	$65,673
2049	$450	$565	$538	120	$64,513
Present Value (Year 2000 @ 7.375%)					$630,759
Annualized (50 Years @ 7.375%)					$47,883

TABLE 30
BENEFIT ANALYSIS: REMAINING 5.5% OF INCREASED YIELD
With Project Conditions (Alternative 2)

Year	Benefit/AF Riverside	Benefit/AF SBVMWD	Wtd. Average	Remaining Allocation (AF)	Benefits
2000	$0	$152	$116	411	$47,736
2001	$0	$133	$101	409	$41,490
2002	$0	$134	$102	408	$41,689
2003	$0	$135	$103	406	$41,838
2004	$0	$136	$104	404	$41,837
2005	$0	$144	$110	402	$44,201
2006	$0	$143	$109	401	$43,811
2007	$0	$145	$111	399	$44,143
2008	$0	$145	$111	397	$44,035
2009	$0	$148	$113	396	$44,589
2010	$38	$147	$121	394	$47,820
2011	$351	$150	$198	392	$77,508
2012	$376	$158	$210	390	$81,928
2013	$406	$156	$216	389	$83,810
2014	$450	$159	$228	387	$88,207
2015	$450	$486	$478	385	$184,024
2016	$450	$565	$538	384	$206,217
2017	$450	$565	$538	382	$205,294
2018	$450	$565	$538	380	$204,371
2019	$450	$565	$538	378	$203,447
2020	$450	$565	$538	377	$202,514
2021	$450	$565	$538	375	$201,590
2022	$450	$565	$538	373	$200,665
2023	$450	$565	$538	372	$199,741
2024	$450	$565	$538	370	$198,850
2025	$450	$565	$538	368	$197,926
2026	$450	$565	$538	366	$197,002
2027	$450	$565	$538	365	$196,069
2028	$450	$565	$538	363	$195,144
2029	$450	$565	$538	361	$194,220
2030	$450	$565	$538	360	$193,296
2031	$450	$565	$538	358	$192,372
2032	$450	$565	$538	356	$191,448
2033	$450	$565	$538	354	$190,515
2034	$450	$565	$538	353	$189,591
2035	$450	$565	$538	351	$188,699
2036	$450	$565	$538	349	$187,775
2037	$450	$565	$538	348	$186,851
2038	$450	$565	$538	346	$185,927
2039	$450	$565	$538	344	$185,003
2040	$450	$565	$538	342	$184,070
2041	$450	$565	$538	341	$183,146
2042	$450	$565	$538	339	$182,221
2043	$450	$565	$538	337	$181,297
2044	$450	$565	$538	336	$180,373
2045	$450	$565	$538	334	$179,449
2046	$450	$565	$538	332	$178,549
2047	$450	$565	$538	330	$177,625
2048	$450	$565	$538	329	$176,701
2049	$450	$565	$538	327	$175,776
Present Value (Year 2000 @ 7.375%)					$1,286,543
Annualized (50 Years @ 7.375%)					$97,666

TABLE 31
BENEFIT ANALYSIS: REMAINING 5.5% OF INCREASED YIELD
With Project Conditions (Alternative 3)

Year	Benefit/AF Riverside	Benefit/AF SBVMWD	Wtd. Average	Remaining Allocation (AF)	Benefits
2000	$0	$123	$94	509	$47,741
2001	$0	$133	$101	508	$51,472
2002	$0	$134	$102	506	$51,797
2003	$0	$135	$103	505	$52,061
2004	$0	$136	$104	504	$52,138
2005	$0	$144	$110	502	$55,170
2006	$0	$143	$109	501	$54,767
2007	$0	$145	$111	500	$55,268
2008	$0	$145	$111	498	$55,220
2009	$0	$148	$113	497	$56,003
2010	$30	$147	$120	495	$59,230
2011	$279	$150	$180	494	$89,130
2012	$376	$158	$210	493	$103,395
2013	$399	$156	$214	491	$105,215
2014	$450	$159	$228	490	$111,682
2015	$450	$417	$425	489	$207,444
2016	$450	$565	$538	487	$261,964
2017	$450	$565	$538	486	$261,228
2018	$450	$565	$538	485	$260,492
2019	$450	$565	$538	483	$259,756
2020	$450	$565	$538	482	$259,020
2021	$450	$565	$538	480	$258,293
2022	$450	$565	$538	479	$257,558
2023	$450	$565	$538	478	$256,798
2024	$450	$565	$538	476	$256,062
2025	$450	$565	$538	475	$255,326
2026	$450	$565	$538	474	$254,599
2027	$450	$565	$538	472	$253,863
2028	$450	$565	$538	471	$253,128
2029	$450	$565	$538	469	$252,401
2030	$450	$565	$538	468	$251,665
2031	$450	$565	$538	467	$250,938
2032	$450	$565	$538	465	$250,202
2033	$450	$565	$538	464	$249,466
2034	$450	$565	$538	463	$248,707
2035	$450	$565	$538	461	$247,971
2036	$450	$565	$538	460	$247,244
2037	$450	$565	$538	459	$246,508
2038	$450	$565	$538	457	$245,772
2039	$450	$565	$538	456	$245,046
2040	$450	$565	$538	454	$244,310
2041	$450	$565	$538	453	$243,550
2042	$450	$565	$538	452	$242,814
2043	$450	$565	$538	450	$242,078
2044	$450	$565	$538	449	$241,352
2045	$450	$565	$538	448	$240,616
2046	$450	$565	$538	446	$239,889
2047	$450	$565	$538	445	$239,153
2048	$450	$565	$538	443	$238,417
2049	$450	$565	$538	442	$237,662
Present Value (Year 2000 @ 7.375%)					$1,620,176
Annualized (50 Years @ 7.375%)					$122,993

TABLE 32
BENEFIT ANALYSIS: REMAINING 5.5% OF INCREASED YIELD
With Project Conditions (Alternative 4)

Year	Benefit/AF Riverside	Benefit/AF SBVMWD	Wtd. Average	Remaining Allocation (AF)	Benefits
2000	$0	$135	$103	138	$14,161
2001	$0	$133	$101	136	$13,793
2002	$0	$134	$102	134	$13,707
2003	$0	$135	$103	132	$13,602
2004	$0	$136	$104	130	$13,446
2005	$0	$144	$110	128	$14,040
2006	$0	$143	$109	126	$13,750
2007	$0	$145	$111	124	$13,686
2008	$0	$145	$111	122	$13,483
2009	$0	$148	$113	120	$13,480
2010	$128	$147	$143	118	$16,788
2011	$376	$150	$204	115	$23,501
2012	$376	$158	$210	113	$23,798
2013	$450	$156	$226	111	$25,182
2014	$450	$159	$228	109	$24,910
2015	$450	$565	$538	107	$57,649
2016	$450	$565	$538	105	$56,541
2017	$450	$565	$538	103	$55,422
2018	$450	$565	$537	101	$54,311
2019	$450	$565	$538	99	$53,225
2020	$450	$565	$538	97	$52,105
2021	$450	$565	$538	95	$51,018
2022	$450	$565	$538	93	$49,899
2023	$450	$565	$538	91	$48,788
2024	$450	$565	$537	89	$47,668
2025	$450	$565	$538	87	$46,582
2026	$450	$565	$538	85	$45,462
2027	$450	$565	$538	83	$44,352
2028	$450	$565	$537	80	$43,232
2029	$450	$565	$538	78	$42,145
2030	$450	$565	$538	76	$41,026
2031	$450	$565	$538	74	$39,939
2032	$450	$565	$538	72	$38,829
2033	$450	$565	$538	70	$37,709
2034	$450	$565	$537	68	$36,589
2035	$450	$565	$538	66	$35,503
2036	$450	$565	$538	64	$34,392
2037	$450	$565	$538	62	$33,273
2038	$450	$565	$538	60	$32,186
2039	$450	$565	$538	58	$31,066
2040	$450	$565	$538	56	$29,956
2041	$450	$565	$537	54	$28,836
2042	$450	$565	$538	52	$27,750
2043	$450	$565	$538	50	$26,630
2044	$450	$565	$537	47	$25,510
2045	$450	$565	$537	45	$24,399
2046	$450	$565	$538	43	$23,313
2047	$450	$565	$537	41	$22,193
2048	$450	$566	$538	39	$21,108
2049	$450	$565	$537	37	$19,972
Present Value (Year 2000 @ 7.375%)			$3,427		$337,141
Annualized (50 Years @ 7.375%)			$260		$25,594

IX. TOTAL BENEFITS

The following table summarizes total benefits by alternative.

Table 34 Seven Oaks Dam Summary of Annual Benefits*				
Alternative	**SBVMWD**	**City of Riverside**	**Remainder**	**Total Benefits**
1	$677,000	$143,000	$48,000	$868,000
2	$1,381,000	$295,000	$98,000	$1,774,000
3	$1,739,000	$373,000	$123,000	$2,235,000
4	$398,000	$75,000	$26,000	$499,000

** All benefit amounts rounded to the nearest $1,000.*

X. PROJECT COSTS

The construction cost of the four alternatives will be amortized over the 50 year project life. Interest during construction (IDC) and gross investment is shown in the following table. IDC is taken for construction costs, P, E & D, and S & A, but is not taken on real estate costs. Gross investment is then amortized at 7 and 3/8 percent to get expected annual cost. Operation and maintenance cost is then added to arrive at total annual cost. Table 35 which follows presents costs for the four alternatives assuming a separate contract for construction of the facilities needed for water conservation is awarded, rather than a modification of the existing construction contract.

Table 35 Seven Oaks Water Conservation Study Total Annual Costs				
Cost	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
Real Estate	$658,000	$1,340,000	$2,060,000	$613,000
Construction	$7,449,000	$19,534,000	$25,985,000	$1,534,000
Interest (IDC)	$224,000	$834,000	$1,270,000	$32,000
Total First Cost:	$8,331,000	$21,708,000	$29,315,000	$2,179,000
Annual Cost (50yr @ 7 3/8%)	$632,000	$1,648,000	$2,225,000	$165,000
O & M Cost:	$42,000	$111,000	$140,000	$37,000
Total Annual Cost:	$674,000	$1,759,000	$2,365,000	$202,000

XI. BENEFIT-COST ANALYSIS

Total annual costs for each alternative are compared to expected annual benefits to arrive at a benefit-cost ratio. The alternative with the greatest net benefits is considered the NED plan. Table 36 displays the benefit-cost ratio for each alternative and the NED plan.

Table 36
Seven Oaks Water Conservation Study
Benefit / Cost Ratio

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Avg Annual Benefits	$868,000	$1,774,000	$2,235,000	$499,000
Avg Annual Costs	$674,000	$1,759,000	$2,365,000	$202,000
Net Benefits	$194,000	$15,000	($130,000)	$297,000
B / C Ratio	1.29	1.01	0.95	2.47

As shown above, Alternative 4 has the highest net benefits and is therefore considered the NED plan.

ADDENDUM 1

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
WATER DEMAND ANALYSIS

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
WATER DEMAND ANALYSIS

INTRODUCTION

To predict future water demand for San Bernardino Valley Municipal Water District (SBVMWD), a software program, IWR-MAIN 6.1, was used. IWR-MAIN 6.1 is a computer program which can estimate existing municipal and industrial (M&I) water demands and forecast future M&I water use, allowing for savings from conservation techniques anticipated being used in the future. (Planning and Management Consultants, Ltd., IWR-MAIN Water Demand Analysis Software: User's Manual and System Description, June 1994.) The version of IWR-MAIN which was used for this study includes demand coefficients specific to Southern California and had been previously calibrated for Southern California water use.

Water use in 1990 for SBVMWD was estimated using the Southern California version together with demographic, housing, income, employment, and weather statistics from the service area. Actual 1990 water use was compared to calculated water use, and the calculated water use was calibrated based on actual usage. The model was then used to project future water demands, using projections of population, housing, income, employment, and weather factors. This base projection was then adjusted assuming that passive water conservation measures will be implemented, reducing the future water demand. The following table shows the water demand for SBVMWD, adjusted for passive conservation measures. For the commercial and manufacturing subsectors, water use was further refined by two-digit SIC code. This detailed information is presented in Addendum 2, Detailed Report: Nonresidential Water Demand.

In the remaining portion of this section on water demand for SBVMWD, information about IWR-MAIN 6.1 and its inputs is first presented, then the validation process is discussed, and finally passive conservation procedures are reviewed.

Table 1

San Bernardino Valley Municipal Water District
Forecasted Water Use 1990-2030 (Restricted)
Acre Feet Per Year

	1990	1995	2000	2005	2010	2015	2020	2025	2030
Residential									
Single Family	80,225	95,313	106,750	118,713	130,755	144,846	158,971	174,620	190,347
Multi-Family	16,612	18,774	20,644	22,493	24,374	26,626	28,877	31,409	33,940
Total Residential	96,837	114,087	127,394	141,206	155,129	171,472	187,849	206,029	224,287
Non-Residential									
Commercial	14,215	16,477	18,415	20,286	22,033	24,094	26,514	29,213	31,902
Manufacturing	2,532	2,756	2,991	3,226	3,450	3,685	3,932	4,201	4,447
Government	3,562	3,349	3,528	3,696	3,887	4,089	4,257	4,425	4,548
Total Nonres.	20,308	22,582	24,934	27,208	29,370	31,868	34,702	37,839	40,897
Unaccounted For	15,973	18,639	20,768	22,963	25,159	27,724	30,345	33,257	36,158
Total Municipal	133,118	155,308	173,096	191,377	209,658	231,064	252,896	277,124	301,342

INPUT DATA

IWR-MAIN 6.1 estimates water use using econometric demand models. Estimated water use is disaggregated by sector (residential and nonresidential). The two sectors are further divided into subsectors (single family and multifamily for the residential sector; and commercial, manufacturing, and public for the nonresidential sector). In addition, unaccounted-for water (including fire fighting, construction, distribution losses, and unmetered use) was estimated.

Residential Water Use

In IWR-MAIN, residential water use for each household is a multiplicative function of median household income (I), average persons per household (H), average housing density (L), average maximum daily temperature (T), total rainfall for the season (R), the marginal price of water and wastewater (P), and occupied housing units (N). The following equation is used in IWR-MAIN to calculate average water use in gallons per day (Q) for single family and multifamily households.

$$Q = \alpha * I^{\beta_I} * H^{\beta_H} * L^{\beta_L} * T^{\beta_T} * R^{\beta_R} * P^{\beta_P} * N$$

Elasticities (ß), or coefficients, for each of these factors were determined in a previous study of Southern California residential water use [Planning and Management Consultants, Ltd. (PMCL), Municipal and Industrial Water Use in the Metropolitan Water District Service Area: Interim Report No. 5 (draft), Carbondale, IL, May 1995]. The elasticities generated by this study are more representative of the SBVMWD area than national level elasticities. The elasticities for each factor describe how water use by household changes when the factor changes. The following table presents the elasticities used in this report. Intercepts (α) for each equation are discussed in the section on "Validation," below.

Table 2 Elasticities of Residential Water Use				
Variable	**Single Family Summer**	**Single Family Winter**	**Multi-family Summer**	**Multi-family Winter**
Household Income	0.3219	0.2811	0.2752	0.3201
Persons/Household	0.3530	0.5130	0.4270	0.5230
Housing Density	-0.8810	-0.7159	-0.4384	-0.1814
Max. Daily Temp.	1.2741	1.1168	0.8122	0.3579
Total Rainfall	-0.1639	-0.0626	-0.0148	-0.0228
Marginal Price	-0.1770	-0.1972	-0.1560	0.0073

Study area specific information for most of the explanatory variables was developed to conduct this analysis. Where applicable, data were obtained by residential subsector (single family and multifamily), season (summer and winter), and year (1990 - 2030, in five year increments). The following sections of this report describe and present each of the explanatory variables. Most of the data were obtained from a report developed solely for this study, [Northwest Economic Associates (NEA), Data for Water Conservation Benefit Report, Sacramento, CA, 1994.] The report includes detailed information on how each variable was derived and projected for the SBVMWD service area. It can be found in Addendum 3.

Median household income for the San Bernardino Valley Municipal Water District was obtained from census tract data for 1990. Projections of median household income are not available at the county or sub-county levels from any government sources. Estimation of projected median household income for the SBVMWD service area is based on the 1990 figure, adjusted for changes in per capita income and household size. Data on 1990 and projected median household income are in 1990 dollars. More information on this procedure is available in [NEA, 1994], Addendum 3.

Since [NEA, 1994] did not include median household income by subsector, further analysis was performed to obtain this information. Factors to adjust median household income for all housing types were calculated using Public Use Microdata Samples (PUMS) from the 1990 census for San Bernardino County. PUMS data is more detailed than census tract data, and includes income and type of residence. Ratios of single family income to total median household income and multifamily income to total median household income were computed. The ratios were then multiplied by the average median household income for the SBVMWD service area. The following table presents 1990 and projected median household income for the census tracts within SBVMWD in 1990 dollars. It also presents median household income for single family and multifamily residences.

Table 3 San Bernardino Valley Municipal Water District Median Household Income $1990			
Year	**Median Household Income**	**Single Family**	**Multi-Family**
1990	$32,360	$36,890	$21,034
1995	$32,205	$36,713	$20,933
2000	$33,443	$38,125	$21,738
2005	$33,585	$38,287	$21,830
2010	$33,724	$38,445	$21,921
2015	$33,961	$38,716	$22,075
2020	$34,197	$38,985	$22,228
2025	$34,433	$39,254	$22,381
2030	$34,668	$39,522	$22,534

The number of persons per household for all housing types combined can be tabulated directly from Census data. However, the Census does not provide the same information by single-family and multiple-family occupied residences. Consequently, it was necessary to estimate the number of persons per household by subsector using other information provided by Census. The number of persons per household was projected using the figures for 1990, adjusted by changes in average household size projected by Southern California Association of Governments [Southern California Association of Governments (SCAG), Growth Management Chapter, Regional Comprehensive Plan, Los Angeles, 1994]. For more information, see [NEA, 1994], Addendum 3. The following table shows 1990 and projected average household size for single family and multifamily residences.

Table 4
Household Size
SBVMWD Service Area

Year	Single Family	Multiple Family	All
1990	3.0477	2.8211	2.9780
1995	3.1192	2.8926	3.0495
2000	3.1907	2.9641	3.1210
2005	3.1587	2.9321	3.0890
2010	3.1267	2.9001	3.0570
2015	3.1037	2.8771	3.0340
2020	3.0807	2.8541	3.0110
2025	3.0577	2.8311	2.9880
2030	3.0347	2.8081	2.9650

Average housing density in units per acre was developed using a sample of lots from a real estate data base, for some cities, and estimates from city planners for other cities. The estimated number of units per acre for single family and multifamily homes for each city was weighted by the city's population to derive the average housing density used for this study. For single family residences, an average of 4.64 units per acre was used. For multifamily residences, 14.67 units per acre was used. These values were used for the entire period of analysis.

Average maximum daily temperature and total rainfall for 1990 and the long-term average by season was obtained from [National Oceanic and Atmospheric Administration (NOAA), "Monthly Summarized Station and Divisional Data," Climatological Data California: December 1990, Volume 94, Numbers 1-12]. For 1990, data for the weather station at San Bernardino County Hospital was used. This station is most representative of the City of San Bernardino, which was used to calibrate estimated residential water demand in 1990 (see discussion under "Validation," below). The weather data for the forecast years were based upon averaging the long term averages from stations at Redlands and the hospital. These two weather stations represent the entire water district, which is more appropriate for forecasting future water use.

The temperature and rainfall by month for the summer months (May through October) and the winter months (November through April) were averaged to obtain summer and winter average maximum daily temperatures and total rainfall. (An analysis of water use by month determined the months to be included in the summer versus winter seasons.) For more information on the weather data, see [NEA, 1994], Addendum 3. The following table presents the temperature and rainfall data used in the model.

Table 5 Weather Data				
	Max. Daily Temperature		Total Rainfall	
Year	Summer	Winter	Summer	Winter
1990	88.3	68.3	0.43	7.68
Long-Term Average	89.0	70.0	0.28	11.50

The marginal prices of water and wastewater used in the model are weighted averages. The weighted averages are based upon the residential rates and water usage of nine major retailers in SBVMWD in 1990. The average daily household water use by subsector and season for the City of San Bernardino was used to determine the marginal price for each of the nine retailers. This was done because only the City of San Bernardino provided water use data in sufficient detail to make the necessary calculations. The following table presents the marginal price of water and wastewater for the two residential subsectors by season.

Table 6 Marginal Price of Water And Wastewater Per 1,000 Gallons				
	Single Family		Multi-Family	
Retailer	Summer	Winter	Summer	Winter
Loma Linda	$0.88	$0.88	$0.88	$0.88
San Bernardino	$0.80	$0.80	$0.80	$0.80
East Valley	$1.07	$1.07	$1.07	$1.07
West San Bern.	$0.84	$0.84	$0.84	$0.84
Rialto	$0.84	$0.84	$0.84	$0.84
Riverside-Highland	$0.79	$0.79	$0.79	$0.79
Colton	$0.67	$0.53	$0.53	$0.53
Redlands	$0.63	$0.63	$0.63	$0.29
Yucaipa Valley	$0.75	$0.75	$0.75	$0.75

The 1990 marginal price of water and wastewater for the nine retailers was weighted by their 1990 residential use by subsector and season. To calculate residential water use by sector and season for the nine retailers, the distribution of water use from the City of San Bernardino was used as necessary. The following table presents the estimated water use by residential subsector and season for each of the nine retailers. It also provides the weighted marginal price by subsector and season.

Table 7
1990 Residential Use (MG)
and Marginal Price

	Single Family		Multi-Family		
Retailer	Summer	Winter	Summer	Winter	Total
Loma Linda	407	244	91	72	814
San Bernardino	4,325	2,593	970	771	8,658
East Valley	1,605	962	360	286	3,213
West San Bern.	1,289	772	289	230	2,580
Rialto	462	277	104	82	925
Riverside-Highland	799	479	179	142	1,600
Colton	1,232	739	276	220	2,466
Redlands	2,508	1,503	562	447	5,020
Yucaipa Valley	635	381	142	113	1,271
Total	13,261	7,950	2,973	2,363	26,548
Weighted Marginal Cost/Kgal	$0.79	$0.78	$0.78	$0.72	

The total number of occupied housing units for all housing types for 1990 was taken directly from the data base for census tracts within the service area. To obtain the number of occupied housing units by subsector, the total was adjusted by the percentage of total housing units which are single family and multifamily. These figures were taken from [U. S. Department of Commerce, County Business Patterns, Government Printing Office, Washington D.C., 1993] and from [San Bernardino County Department of Economic and Community Development (SBDECD), Demographic Profile 1993, San Bernardino, 1994].

The projected number of occupied housing units is a function of both the population and the number of individuals per housing unit. The projections of the number of persons per household are discussed above. Background on the population projections can be found in [NEA, 1994], Addendum 3. The following table presents the population and number of occupied housing units for selected years.

Table 8 Population and Occupied Housing Units				
		Occupied Housing Units		
Year	Population	Single Family	Multiple Family	Total
1990	546,229	129,457	53,962	183,419
1995	633,092	146,526	61,077	207,603
2000	733,767	165,936	69,167	235,103
2005	833,717	190,492	79,403	269,895
2010	931,932	215,162	89,686	304,848
2015	1,045,057	243,109	101,335	344,444
2020	1,156,407	271,067	112,989	384,056
2025	1,277,759	301,817	125,807	427,625
2030	1,397,439	332,647	138,658	471,305

Nonresidential Water Use

Nonresidential water use includes commercial, manufacturing, and government use. IWR-MAIN computed commercial and manufacturing water use by two-digit Standard Industrial Code (SIC). For each subsector, estimated water use (Q) is based upon two factors: a coefficient for gallons per employee per day (GED), and the number of employees (N). The following equation is used in IWR-MAIN to calculate average water use in gallons per day (Q) for each two-digit SIC:

$$Q = GED * N$$

The coefficients for the number of gallons per employee per day for nearly all industries are from [PMCL, 1995]. Data on water use by the largest single users of water in the City of San Bernardino were obtained. The largest users included government agencies, schools, and hospitals. Since hospitals make up only part of the two-digit SIC for health services, the IWR-MAIN default values were used for health care. The average annual GED was calculated for the City of San Bernardino government and school accounts based upon 1993 and 1994 water use and number of employees. The average annual GED was further divided into summer and winter use using monthly statistics from the City on water use for the government and school categories. The coefficients for gallons per employee per day are listed in Addendum 4, GED Coefficients.

Unaccounted For Water

This sector addresses all remaining water uses that occur in the study area that have been not been addressed by the two defined sectors: residential and nonresidential. For this study area, remaining water use can be calculated as the difference between total water production and water sales. (Sales to other agencies are made between members of SBVMWD, but this water use is included in the residential and nonresidential use sectors.) Unaccounted for water is computed by IWR-MAIN as a percentage of total water use. The default value is 15 percent, with typical values ranging from 10 to 20 percent [PMCL, personal communication].

For this study, estimates of unaccounted for water were computed for the nine major water retailers in SBVMWD. The City of San Bernardino had the most through data for this computation. Their data included water production and sales by month for 1990 through 1994. Other retailers had less data, ranging from several years of annual production and sales data to no information on metered sales. The water retailers with no information on metered water use were asked to provide an estimate of their unaccounted for water percentage. The unaccounted for water for each water district ranged from 3.9 percent to 17 percent. These figures were then weighted according by their average annual water production, and averaged. The average unaccounted for water, using this method, is 8.6 percent. Further evaluation and calibration of the model (see Validation and Calibration, below) resulted in this value being changed to 12 percent, to better represent actual unaccounted for water use.

VALIDATION AND CALIBRATION

After the historic and projected data were entered into the computer software program, and the first projection of water use made, several methods were used to validate and calibrate the model. All input data were checked several times to ensure the proper values were used. The actual values for gallons per household per day (GPD) for 1990 by season were used to calibrate the predictive equation for residential water use. Projections of GPD were checked for reasonableness. Estimated 1990 and projected nonresidential water use was also checked for reasonableness. GED coefficients for the largest water users in the study area were computed and used. Finally, total estimated use for 1990 was checked against historical data, and unaccounted for water adjusted.

Much of the validation process and results have already been described above in the section, Input Data. The weather data set, study area-specific GED coefficients, and unaccounted for water factor have all been discussed. Changes made to these variables were a result of the validation process. The following two sections, "Gallons per Household per Day," and "Total Water Use 1990" provide additional information on this process and changes made to the IWR-MAIN default and input values.

Gallons per Household per Day

Using detailed information from the City of San Bernardino, actual values for gallons of water used per household per day (GPD) were computed by season for each residential subsector: single family and multifamily. This information was computed for the years 1990 through 1994. Detailed information on water use from other member agencies was not available, so the City of San Bernardino was used as a sample.

The GPD figures for 1990 were used to calibrate the predictive equations for residential water use. The following table shows the actual gallons per household per day by residential subsector and season consumed in 1990.

Table 9
City of San Bernardino
Gallons Per Day Per Household
1990

	Summer	Winter
Single Family	686.63	419.91
Multifamily	304.52	245.01

Calibrating the residential predictive equations in IWR-MAIN 6.1 is an iterative process. First, the residential water use was predicted using the default intercepts in the model. Then, the GPD predicted by IWR-MAIN for 1990 were compared to actual 1990 City of San Bernardino GPD's. Using the difference between the predicted and actual values, calibrated intercepts for the residential predictive equations were calculated. When the calibrated intercepts were entered into the program and used to re-estimate residential water use, the predicted 1990 GPD by subsector and season equaled the actual 1990 GPD by sector and season. The intercepts (α) for each subsector and season are presented in the table below.

Table 10
Residential Intercepts

	Summer	Winter
Single Family	1.5411	2.4794
Multifamily	6.8583	20.2577

To validate the predicted residential water use, actual GPD values for the five year period 1990 through 1994 were compared to the predicted GPD. The following table presents the historical GPD for the City of San Bernardino and the predicted GPD for the study area. Actual City of San Bernardino and predicted SBVMWD GPD are the same for 1990. Values for 1991 through 1994 are estimates of actual City of San Bernardino GPD. Values for 1995 through 2030 are predicted GPD for SBVMWD from IWR-MAIN. As seen from this table, the predicted GPD increase in the future, as expected. The GPD peaks in the year 2000, the same year as persons per household. The gradual decline in GPD from 2000 to 2035 mirrors the decline in persons per household.

Table 11
Gallons Per Day Per Household
Historic and Predicted

	Single Family Residences		Multifamily Residences	
Year	**Summer**	**Winter**	**Summer**	**Winter**
1990	687	420	305	245
1991	661	387	324	232
1992	688	350	308	226
1993	678	379	309	231
1994	694	319	328	225
1995	749	425	311	247
2000	764	434	318	254
2005	763	433	317	253
2010	761	431	316	251
2015	761	431	315	251
2020	760	430	315	251
2025	760	429	314	250
2030	760	428	314	250

Total Water Use

Validation of predicted residential water use was performed by comparing detailed information on actual residential water use in the City of San Bernardino to predicted water use. This type of comparison could not be made for the nonresidential sector. Therefore, total historic water use for the study area was compared to predicted water use from IWR-MAIN. This comparison also allows a determination of the suitability of using data from the City of San Bernardino as a sample of the entire study area.

For 1990, total water use was available for the nine major member agencies of SBVMWD which provide municipal and industrial water. SBVMWD includes 15 member agencies which provide urban water supply within the study area. Total urban water use in 1990 for the nine agencies equaled 128,111 acre feet. That compares favorably with the predicted urban water use from IWR-MAIN of 133,118 acre-feet. It is expected that water use for the entire SBVMWD would be greater than the water use of nine of the member agencies.

Total 1990 urban water use for all 15 agencies is not readily available. However, total 1989 urban water use is available. According to [Camp Dresser & McKee, Task 1 Memorandum: Review Current Water Supply Plans and Needs, Ontario, CA, October 1990], 1989 urban water demand was 137,214 acre feet for the 15 member agencies in the study area. On average, for the nine major water retailers, 1990 water demand was approximately 95 percent of 1989 demand. When total 1989 use is adjusted accordingly, estimated total 1990 urban demand equals approximately 131,000 acre-feet for the entire SBVMWD study area. This estimate also compares favorably with the IWR-MAIN prediction of 133,118 acre-feet in 1990.

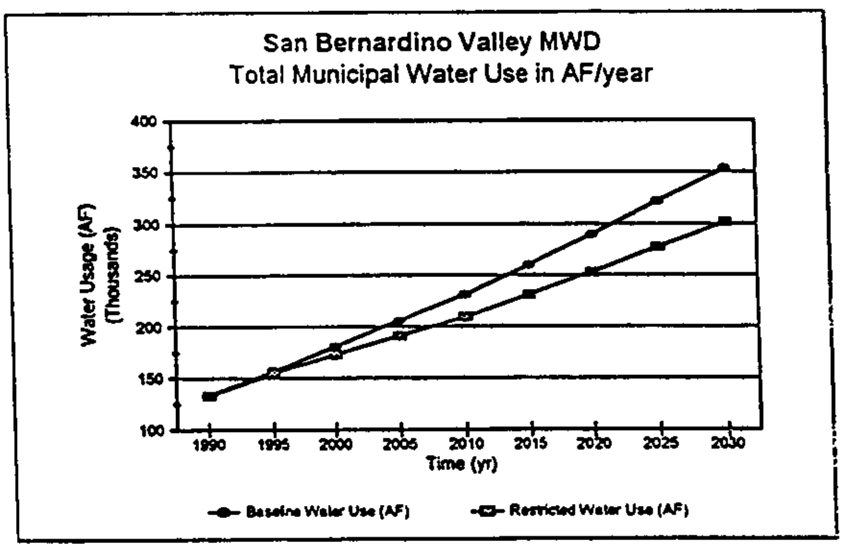
Passive Conservation

The forecast of future water use considers the effect of passive water conservation from more efficient water use in the future. Passive water conservation occurs when water users shift to more efficient use of water without the influence of an active conservation program. For example, passive conservation occurs when structures are remodeled or retrofitted, and more efficient fixtures are installed due to the plumbing code ordinance. Natural replacement rates show the number of fixtures which are replaced due to remodeling, demolition, or obsolescence.

Conservation savings are based on the amount a fixture is used (eg. 7.4 flushes per household per day), the mechanical parameters of the fixtures (eg. 1.6 gallons per flush), the percentage of the customers using each type of fixture (nonconserving, conserving, and ultraconserving), and the natural replacement rate of the fixtures. IWR-MAIN computes passive savings by first generating a baseline forecast, which does not include conservation. Then passive savings are estimated as a reduction in the baseline. The following table presents the baseline and conservation forecasts.

Table 12 San Bernardino Valley Municipal Water District Total Municipal Water Use in AF/yr			
	Baseline	Restricted	
Year	Forecast	Forecast	Difference
1990	133,141	133,130	11
1995	157,112	155,308	1,804
2000	181,150	173,096	8,054
2005	206,421	191,388	15,033
2010	231,478	209,636	21,842
2015	260,266	231,042	29,224
2020	289,480	252,896	36,584
2025	321,505	277,124	44,381
2030	353,440	301,353	52,087

As can be seen from the following graph, passive savings do not exist in 1990, and grow to equal 15 percent of the baseline water use forecast in 2035. This result is reasonable.



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ADDENDUM 2

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
DATA FOR WATER CONSERVATION BENEFIT REPORT

Data for Water Conservation Benefit Report

Prepared for
U. S. Army Corps of Engineers
Los Angeles Office

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October 24, 1994

Introduction

The Seven Oaks Dam, when completed, will be an important component of the Santa Ana River Mainstem Flood Control System. The reservoir behind the dam will have a water storage capacity of over 145,000 acre-feet. The dam and reservoir will be within the service area of the San Bernardino Valley Municipal Water District (SBVMWD).

SBVMWD is responsible for ground water management, water importation, and long-range water supply planning in western San Bernardino County. SBVMWD provides water to approximately 575,000 people in its 328 square mile service area, which lies within San Bernardino County[1]. The service area includes the cities of Bloomington, Colton, East Highland, Grand Terrace, Highland, Loma Linda, Mentone, Redlands, Rialto, Yucaipa, and San Bernardino. It collectively represents one of the most rapidly-growing regional economies in the country. From 1980 to 1990, population in the area expanded 4.1 percent per year, while the rest of California grew 2.3 percent per year.

San Bernardino County is part of the "Inland Empire," which also includes Riverside County. Together they comprise a "Metropolitan Statistical Area" (MSA), which determines the aggregation level for some types of economic data available from different government sources. Employment data on an establishment basis (i.e. by employment by place of work) is published by the California Employment Development Department (EDD) for the MSA, but not for the two counties individually. For this study, data for San Bernardino County alone were obtained from EDD on a special request basis. Other employment data for San Bernardino County were taken from County Business Patterns [U.S. Department of Commerce 1993] and Regional Economic Information System [U.S. Department of Commerce 1994].

[1] SBVMWD also provides water to the city of Riverside. By agreement with the Corps, however, the data which follow relate only to areas served within San Bernardino County.

Generally, government economic information and data below the county level (e.g. for the service area of the SBVMWD) are very limited. Some sub-county demographic and income data series are available, however, from the U.S. Bureau of the Census decennial Census of Population and Housing. Employment data at the 1-digit SIC industry level are also available, although these are by place of residence rather than by place of employment. Since the employment data required for this project are by place of work rather than place of residence, the Census data were combined with other sources using procedures discussed below.

The immediately-following section discusses the literature and data surveyed for this project. Subsequent sections present the data collected or modified as specified in the Scope of Work included in the Request for Quotations. Data, data sources, and methodologies (where applicable) for deriving the specific data required are presented generally in the order shown in the Scope of Work, with some exceptions as noted.

SBVMWD is a wholesaler providing water to nine principal retail water agencies within San Bernardino County. As such, SBVMWD does not have water use, water conservation, best management practices, and pricing information. Therefore, a questionnaire was developed to obtain that information from the nine individual agencies. The questionnaire used to obtain water use and water pricing information is in Appendix A. The tabulations of responses to questions on conservation and best management practices are included within the text.

Review of Existing Literature

NEA has, in house, an electronic, GIS-compatible data base containing a variety of economic and demographic information on San Bernardino, Los Angeles, Kern, and Inyo Counties. The data base contains verified data from the 1990 Census of Population and Housing and was purchased from Donnelley Marketing Information Services. The data are organized by census tracts and consequently provide a detailed level of resolution for addressing questions at the sub-county level. For this study, the data base for San Bernardino County was "clipped" to include only the 98 census tracts in the SBVMWD service area. The resultant data base was then put into a Lotus 1-2-3 spreadsheet for use in other calculations.

In addition to the above, NEA obtained the latest publications and data on the study area from a variety of sources. These included the Southern California Association of Governments (SCAG), the California State Department of Finance (CDOF) and Employment Development Department (EDD), the San Bernardino County Department of Economic and Community Development (SBDECD), and the National Weather Service.

SCAG recently published its 1994 Regional Growth Management Plan [SCAG 1994]. It includes statistical and supporting data on population, employment, and housing for its various sub-regions, one of which is San Bernardino County. The publication provides projections through the year 2015. CDOF in 1993 published population forecasts through the year 2040 for California counties [CDOF 1993]. EDD annually publishes employment data (by place of work) for the combined Riverside and San Bernardino Counties Metropolitan Statistical Area. Since the study area for this project is in San Bernardino County, NEA requested and obtained from EDD in Sacramento tabulations of employment data for San Bernardino County for the years 1985 and 1990. Those data were used in combination with the census tract data to derive estimates of employment by place of work within the SBVMWD service area. The assumptions and approach are discussed in more detail below.

Literature from the National Oceanographic and Atmospheric Administration's National Weather Service was reviewed for pertinent information on the Redlands and the San Bernardino County Hospital weather stations, which are within the SBVMWD service area. The publications used are cited in the "Weather Data" section of this report.

Relevant publications also were obtained from SBVMWD. These included the Official Statement [Bartle Wells Associates 1994] issued in connection with the 1994 refunding of SBVMWD bonds; the Annual Report of the Western-San Bernardino Watermaster [Western-San Bernardino Watermaster 1993]; Preliminary Evaluation of Water Conservation and Hydropower Costs for the Upper Santa Ana River Dam [U.S. Army Corps of Engineers

1984]; and Final Reconnaissance Report for the Seven Oaks and Prado Dams Water Conservation Study [U.S. Army Corps of Engineers 1992]. Other sources were reviewed in a meeting with SBVMWD personnel on September 27, 1994.

Historical Data

1990 Urban Water Use

SBVMWD is a wholesaler of water to nine retail agencies within San Bernardino County. In 1990, the urban water use of those nine agencies was 128,111 acre-feet (See Table 1).

1990 Population, Occupied Housing by Type and Total, Persons per Household by Type of House, and Median Household Income

Population

Population in the SBVMWD service area was 546,229 in 1990 (see Table 2). This figure was taken directly from the data base for census tracts within the service area. For comparison, total San Bernardino County population in that year was 1,418,380. Hence, population in the SBVMWD service area was 38.5 percent of that in the county.

Occupied Housing, by Type and Total

There were 183,419 occupied housing units in the SBVMWD service area in 1990 (see Table 2). This figure was taken directly from the data base for census tracts within the service area. There were 494,753 occupied housing units in all San Bernardino County in 1990. Hence, those in the SBVMWD service area represented 37.1 percent of those in the county.

In 1990, the 129,457 single-family residences were 70.6 percent of all occupied housing units in the SBVMWD service area (see Table 2). The remaining 53,962 or 29.4 percent were in multiple-family units. These figures were taken from [U.S. Department of Commerce, Bureau of the Census 1993] and from [SBDECD 1994]. Single-family residences represented 71.2 percent and multiple-family residences represented 28.8 percent of all housing units in San Bernardino County in 1990.

Table 1
1990 Water Use by Retail Agencies
Served by SBVMWD in San Bernardino County

Water Agency	1990 Urban Water Use (Acre-Feet)
City of Colton Public Works Utilities	8,612
City of Loma Linda Department of Public Works	4,100
City of Rialto Water Department	7,658
City of Redlands Municipal Utilities Department	25,290
City of San Bernardino Water Department	43,601
East Valley Water District	16,180
West San Bernardino County Water District	12,990
Riverside Highland Water Company	3,280
Yucaipa Valley Water District	6,400
TOTAL	128,111

Table 2
Selected Population, Housing, and Income Measures
SBVMWD Service Area, 1990

Measure	Number
Population	546,229
Occupied Housing Units	
Single Family	129,457
Multiple Family	53,962
Total	183,419
Persons per Household	
Single Family	3.045
Multiple Family	2.818
Total	2.978
Median Household Income ($)	$32,360

Source: U.S. Department of Commerce, 1993, *1990 Census of Population and Housing*

Persons per Household by Type of House

The number of persons per occupied house (for all housing types combined) can be tabulated directly from Census data. However, the Census does not provide the same information by single-family and multiple-family occupied residences. Consequently, it was necessary to estimate the number of occupied single- and multiple-family residences and the population in each of those sets of households within the SBVMWD service area. The estimation was based on census-tract data for the following variables:

- Number of housing units: total, single family, and multiple family
- Number of occupied housing units: total, owner-occupied, and renter-occupied
- Number of vacant units: total (data not available separately for single- and multiple-family residences)
- Median number of persons per housing unit: owner occupied and renter occupied.

With the above data, the number of persons per household, for single-family and multiple-family houses, was calculated in several steps.

1. Estimate number of occupied single-family and multiple-family housing units.

   Within the SBVMWD service area, single-family houses make up 70.6 percent of all housing units (including both occupied and vacant) and multiple-family houses make up the remaining 29.4 percent. It was assumed that the composition of vacant units was equivalent, that is 70.6 percent and 29.4 percent, respectively. Hence, the numbers of occupied single-family and multiple-family houses were estimated by multiplying these percentages by the total number of total occupied housing units in the SBVMWD service area, which was 183,419. Single-family houses were therefore estimated to be 129,457 of these units, and multiple-family houses were estimated to be 53,962 (See Table 2).

2. Estimate the population in occupied single-family and multiple-family housing units

This estimation required the use of Census data on the median number of persons per housing unit for owner-occupied versus renter-occupied housing units.[2] A factor was calculated to convert the median figure to an average figure. The factor was derived as the ratio of the 1990 average and median number of persons per household in all occupied houses in the SBVMWD service area, 2.978 and 2.616, respectively. The resultant factor, 1.13851, was then used to convert median to average household size. Population was then estimated in four separate calculations.

Population in Single-Family Residences

(1) Owner-occupied: (Average # persons per household)

X (# Owner-occupied units/Total occupied units)

X (# Single-family units)

= (3.245) X (117,645/183,419) X (129,457)

= 269,471

(2) Renter-occupied: (Average # persons per household)

X (# Renter-occupied units/Total occupied units)

X (# Single-family units)

= (2.686) X (65,774/183,419) X (129,457)

= 124,676

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[2] The Bureau of the Census does not publish data on average number of persons per occupied single-family and multiple-family residences.

Population in Multiple-Family Residences

(3) Owner-occupied: (Average # persons per household)

X (# Owner-occupied units/Total occupied units)

X (# Multiple-family units)

= (2.483) X (117,645/183,419) X (53,962)

= 85,941

(4) Renter-occupied: (Average # persons per household)

X (# Renter-occupied units/Total occupied units)

X (# Multiple-family units)

= (3.418) X (65,774/183,419) X (53,962)

= 66,141

The above figures were then aggregated to calculate total population in single-family and multiple-family residences. The estimated population in single-family residences was 394,147 and that in multiple-family residences was 152,082.

3. Estimate the number of persons per occupied household, by type of house.

Number per house in single-family residences: = 394,147/129,457 = 3.045

Number per house in multiple-family residences = 152,082/53,962 = 2.818

Number per house in all residences = 546,229/183,419 = 2.978 (See Table 2).

Median Household Income

Data on median household income are available by individual census tract. Since the SBVMWD service area has 98 census tracts, a "weighted" median income was calculated.[3] For each tract, the reported median household income was multiplied by the number of occupied housing units. The result was summed over the 98 tracts and divided by the total number of occupied housing units. The resultant "weighted" median household income was $32,360 (see Table 2).

1985 and 1990 Employment by 1-Digit SIC Codes

Data on employment by place of work are not available at sub-county levels from government sources. For this study, such data were required for eight major SIC categories: Manufacturing and Industrial; Construction; Transportation and Public Utilities; Wholesale Trade; Retail Trade; Finance, Insurance, and Real Estate; Services; and Government. The estimates were developed using county-level figures from EDD and census tract data.

Special tabulations of 1985 and 1990 San Bernardino County employment data were obtained from EDD. These data are for employment by place of work rather than by place of residence. EDD provided 1-, 2-, and 3-digit SIC code employment data for the two years, although in some industries the more detailed data were withheld for confidentiality issues.

Census data for tracts in the SBVMWD service area were used to calculate for each 1-digit industry the following ratio:

$EHH_i = EHH_{SBVMWD\,i} / EHH_{SBCTOT\,i}$, where i = 1,2,...8 corresponds to major SIC 1-digit categories, and where

$EHH_{SBVMWDi}$ is household employment in 1-digit industry i in the SBVMWD, and

$EHH_{SBCTOTi}$ is household employment in 1-digit industry i for all San Bernardino County.

This method assumes for each 1-digit industry that the ratio of employment within SBVMWD households to that in all San Bernardino County households is representative of 1-digit employment on a place-of-work basis. Such an assumption seems entirely reasonable.

[3] Among the 98 individual census tracts, median household income ranged from $8,120 to $65,872.

The resultant employment estimates are shown in Table 3. Each major category (industry) is shown with its respective proportion of total employment; the proportions range from 0.318 for manufacturing to 0.440 for services. Total employment by place of work (excluding agriculture, forestry, and mining) within the SBVMWD service area was estimated to be 111,534 in 1985 and 153,270 in 1990.

Table 3
1985 and 1990 Employment in SBVMWD Service Area, By 1-Digit SIC Code

One-Digit Code	Industry and EHH	SIC Codes Included	1985 Employment	1990 Employment
C	Construction (.348)	1500-1799	7,396	12,103
D	Manufacturing (.718)	2000-3999	11,659	19,706
E	Transportation & Public Utilities (.351)	4000-4999	6,903	10,035
F	Wholesale Trade (.3721)	5000-5199	4,325	7,706
G	Retail Trade (.374)	5200-5999	24,592	33,390
H	Finance, Insurance & Real Estate (.353)	6000-6799	3,854	6,147
I	Services (.440)	7000-8999	42,951	53,145
J	Government (.402)	9100-9799	9,854	11,038
	TOTAL (.383)		111,534	153,270

1990 Employment at 2- and 3-Digit SIC Code Levels

The 2- and 3-digit SIC code employment estimates for the SBVMWD service area were developed by assuming that the ratios EHH_i (i=1,2, ... n) calculated for 1-digit industries apply uniformly to 2- and 3-digit industries as well. Hence for each 2- and 3-digit industry, employment within the SBVMWD service area was estimated as:

$EMP_{SBVMWDi\ 2or3} = EHH_i \times EMP_{SBCTOTi\ 2or3}$, where

$EHHi$ is as defined previously, and

$EMP_{SBCTOTi2or3}$ is establishment employment in the relevant 2- or 3-digit industry within 1-digit industry i for San Bernardino County.

The employment estimates are shown in Table 4. Data are shown for all 2- and 3-digit industries for which data were provided by EDD. In some cases, data were withheld by EDD for confidentiality reasons, and estimates could not be developed for the SBVMWD area; these are indicated by (D). All 3-digit estimates are aggregated to their respective 2-digit industries, and all 2-digit estimates are aggregated to their respective 1-digit industries. Both the number of employed and percent of employed are tabulated for each industry. The percent relates the number of employed for a specific industry to total 1990 employment of 153,270.

1985 and 1990 Total Employment Excluding Agriculture, Forestry, and Mining

See Table 3

1990 Median Household Income in 1990 Dollars

See Table 2

Table 4
1990 Employment in SBVMWD Service Area

SIC Code	Industry	SBVMWD 1990 Employment Number	SBVMWD 1990 Employment Percent of Total
	Construction	12,103	7.90%
15	General Construction	2,337	1.52%
152	Residential	1,775	1.16%
153	Operative Builders	36	0.02%
154	Non-Residential	526	0.34%
16	Heavy Construction	1,882	1.23%
161	Highway & Street	806	0.53%
162	Other	1,076	0.70%
17	Special Trades	7,885	5.14%
171	Plumbing, Heating & A/C	889	0.58%
172	Painting & Paper Hanging	340	0.22%
173	Electrical Work	955	0.62%
174	Masonry, Stonework & Related	1,856	1.21%
175	Carpentry & Floor Work	1,004	0.66%
176	Roofing, Siding & Sheet Metal Work	499	0.33%
177	Concrete Work	1,045	0.68%
178	Water Well Drilling	34	0.02%
179	Misc. Special Trades	1,264	0.82%
	Manufacturing	19,706	12.86%
20	Food & Kindred Products	1,399	0.91%
22	Textile Mill Products	34	0.02%
23	Apparel & Other Finished Products	530	0.35%
232	Men's & Boy's Furnishings, Work Clothing & Allied Clothing	125	0.08%
233	Women's, Misses, and Junior's Outerwear	239	0.16%
239	Misc. Fabricated Textile Products	166	0.11%
24	Lumber & Wood Products, Exc. Furniture	1,445	0.94%
25	Furniture & Fixtures	822	0.54%
51	Household Furniture	643	0.42%
52	Office Furniture	14	0.01%
53	Public Building & Related Furniture	(D)	(D)
54	Partitions, Shelving, Lockers, & Office and Store Fixtures	146	0.10%
59	Misc. Furniture & Fixtures	19	0.01%

Table 4
1990 Employment in SBVMWD Service Area

SIC Code	Industry	SBVMWD 1990 Employment Number	SBVMWD 1990 Employment Percent of Total
26	Paper & Allied Products		
262	Paper Mills	585	0.38%
265	Paperboard Containers & Boxes	35	0.02%
267	Converted Paper & Paperboard Prod, Exc. Containers & Boxes	269	0.18%
		280	0.18%
27	Printing & Publishing		
		1,330	0.87%
28	Chemicals & Allied Products		
		742	0.48%
29	Petroleum Refining & Related Industries		
		31	0.02%
30	Rubber & Plastic Products		
301	Tires & Inner Tubes	1,459	0.95%
305	Gaskets, Packing, & Sealing Dev. & Rubber & Plastic Hose & Belting	(D)	(D)
306	Fabricated Rubber Products, NEC (*)	130	0.09%
308	Misc. Plastics Products	111	0.07%
		1,218	0.79%
1	Leather & Leather Products		
		7	0.00%
32	Stone, Clay, Glass & Concrete Products		
		1,428	-0.93%
33	Primary Metal Industries		
		1,003	0.65%
34	Metal Products, Exc. Mchy. & Transport Eqp't		
341	Metal Cans & Shipping Containers	2,226	1.45%
342	Cutlery, Handtools, & General Hardware	(D)	(D)
343	Heating Eqp't, Exc. Electric & Warm Air, & Plumbing Fixtures	227	0.15%
344	Fabricated Structural Metal Products	201	0.13%
345	Screw Machine Products, & Bolts, Nuts, Screws, Rivets & Washers	774	0.50%
346	Metal Forgings & Stampings	75	0.05%
347	Coating, Engraving, & Allied Services	212	0.14%
348	Ordance & Accessories, Exc. Vehicles & Guided Missiles	251	0.16%
349	Misc. Fabricated Metal Products	137	0.09%
		350	0.23%
35	Industrial & Commercial Mchy. & Computer Eqp't		
		1,317	0.86%
36	Electronic/Electrical Eqp't, Exc. Computer Eqp't		
		888	0.58%
37	Transportation Eqp't		
		3,745	2.44%
38	Instruments & Related Eqp't		
		305	0.20%

Table 4
1990 Employment in SBVMWD Service Area

SIC Code	Industry	SBVMWD 1990 Employment Number	Percent of Total
39	Misc. Manufacturing	410	0.27%
	Transportation & Public Utilities	10,035	6.55%
41	Local & Interurban Passenger Transit	670	0.44%
411	Local & Suburban	342	0.22%
412	Taxicabs	60	0.04%
413	Intercity & Rural Bus	(D)	(D)
414	Bus Charter Service	72	0.05%
415	School Buses	196	0.13%
42	Motor Freight Transport. & Warehousing	3,225	2.10%
421	Trucking & Courier, Exc. Air	2,881	1.88%
422	Public Warehousing & Storage	344	0.22%
423	Terminals for Motor Freight Transport.	(D)	(D)
43	U.S. Postal Service	1,273	0.83%
44	Water Transportation	19	0.01%
45	Air Transportation	639	0.42%
451	Scheduled & Courier Service	263	0.17%
452	Nonscheduled	99	0.06%
458	Airports, Flying Fields & Services	277	0.18%
46	Pipelines, Exc. Natural Gas		
47	Transportation Services	180	0.12%
472	Arrangement of Passenger Transport.	129	0.08%
473	Arrangement of Freight & Cargo Transport.	40	0.03%
478	Misc. Transportation Services	11	0.01%
48	Communications	1,878	1.23%
481	Telephone	1,565	1.02%
482	Telegraph & Other Message Comm.	(D)	(D)
483	Radio & Television Broadcasting Stations	137	0.09%
484	Cable & Other Pay Television Services.	176	0.11%
49	Electric, Gas & Sanitary Services	2,150	1.40%

Table 4
1990 Employment in SBVMWD Service Area

SIC Code	Industry	SBVMWD 1990 Employment Number	SBVMWD 1990 Employment Percent of Total
	Wholesale Trade	7,706	5.03%
50	Durable Goods	4,613	3.01%
501	Motor Vehicles, Parts & Supplies	1,052	0.69%
502	Furniture & Homefurnishings	213	0.14%
503	Lumber & Other Const. Mat'ls	742	0.48%
504	Professional & Comm'l Eqp't & Supplies	458	0.30%
505	Metals & Minerals, Exc. Petroleum	239	0.16%
506	Electrical Goods	477	0.31%
507	Hardware, Plumbing, & Heating Eqp't	287	0.19%
508	Mch'y, Eqp't & Supplies	749	0.49%
509	Misc. Durable Goods	396	0.26%
51	Nondurable Goods	3,093	2.02%
511	Paper & Paper Products	118	0.08%
512	Drugs, Proprietaries & Sundries	168	0.11%
513	Apparel, Piece Goods & Notions	155	0.10%
514	Groceries & Related Products	1,458	0.95%
515	Farm Product - Raw Materials	59	0.04%
516	Chemicals & Allied Products	101	0.07%
517	Petroleum & Petroleum Products	128	0.08%
518	Beer, Wine & Distilled Beverages	266	0.17%
519	Misc. Nondurable Goods	639	0.42%
	Retail Trade	33,390	21.78%
52	Building Mat'ls & Garden Supplies	1,467	0.96%
521	Lumber & Other Bldg. Materials Dealers	952	0.62%
523	Paint, Glass, & Wallpaper Stores	124	0.08%
525	Hardware Stores	200	0.13%
526	Retail Nurseries & Garden Stores	124	0.08%
527	Mobile Home Dealers	67	0.04%
53	General Merchandise	5,500	3.59%
531	Department Stores	4,393	2.87%
533	Variety Stores	163	0.11%
539	Misc. Gen'l Merchandise Stores	944	0.62%

Table 4
1990 Employment in SBVMWD Service Area

SIC Code	Industry	SBVMWD 1990 Employment Number	Percent of Total
54	Food Stores	5,020	3.28%
541	Grocery Stores	4,619	3.01%
542	Meat & Fish Markets	55	0.04%
543	Fruit & Vegetable Markets	17	0.01%
544	Candy, Nut & Confectionery Stores	37	0.02%
545	Dairy Products Stores	44	0.03%
546	Retail Bakeries	195	0.13%
549	Misc. Food Stores	54	0.04%
55	Automotive Dealers & Service Stations	4,486	2.93%
551	New & Used Car Dealers	1,711	1.12%
552	Used Car (Only) Dealers	57	0.04%
553	Auto & Home Supply Stores	993	0.65%
554	Gasoline Service Stations	1,557	1.02%
555	Boat Dealers	29	0.02%
556	Recreation Vehicle Dealers	38	0.02%
557	Motorcycle Dealers	82	0.05%
559	Automotive Dealers, NEC (*)	19	0.01%
56	Apparel & Accessory Stores	1,826	-1.19%
561	Men's & Boy's Clothing	44	0.03%
562	Women's Clothing	333	0.22%
563	Women's Accessory & Specialty	59	0.04%
564	Children's & Infants' Wear	77	0.05%
565	Family Clothing	978	0.64%
566	Shoes	279	0.18%
569	Misc. Apparel & Accessory Stores	56	0.04%
57	Furniture & Home Furnishings Stores	1,421	0.93%
571	Home Furniture & Furnishings	798	0.52%
572	Household Appliances	121	0.08%
573	Radio, Television & Computer Stores	502	0.33%
58	Eating & Drinking Places	10,469	6.83%

Table 4
1990 Employment in SBVMWD Service Area

SIC Code	Industry	SBVMWD 1990 Employment Number	SBVMWD 1990 Employment Percent of Total
59	Misc. Retail	3,199	2.09%
591	Drug Stores & Proprietary Stores	956	0.62%
592	Liquor Stores	220	0.14%
593	Used Merchandise Stores	83	0.05%
594	Misc. Shopping Goods Stores	1,168	0.76%
596	Nonstore Retailers	233	0.15%
598	Fuel Dealers	14	0.01%
599	Retail Stores, NEC (*)	524	0.34%
	Finance, Insurance, Real Estate	6,147	4.01%
60	Depository Inst.	2,136	1.39%
602	Commercial Banks	1,396	0.91%
603	Savings Inst.	492	0.32%
606	Credit Unions	163	0.11%
609	Functions Related to Depository Banking	86	0.06%
61	Nondepository Credit Inst.	771	0.50%
611	Federal & Fed.-Sponsored Credit Agen.	41	0.03%
614	Personal Credit Inst.	165	0.11%
615	Business Credit Inst.	10	-0.01%
616	Mortgage Bankers & Brokers	556	0.36%
62	Security & Commodity Brokers	117	0.08%
621	Security Brokers & Dealers	82	0.05%
622	Commodity Brokers & Dealers	9	0.01%
628	Svcs. Allied with Security & Commodity	(D)	(D)
	Brokers	25	0.02%
63	Insurance Carriers	853	0.56%
64	Insurance Agents & Brokers	563	0.37%
65	Real Estate	1,656	1.08%
651	Real Estate Operators & Lessors	467	0.30%
653	Real Estate Agents & Managers	939	0.61%
654	Title Abstract Offices	(D)	(D)
655	Land Subdividers & Developers	249	0.16%

Table 4
1990 Employment in SBVMWD Service Area

SIC Code	Industry	SBVMWD 1990 Employment Number	Percent of Total
67	Holding & Other Investment Offices	52	0.03%
671	Holding Offices	11	0.01%
673	Trusts	17	0.01%
679	Misc. Investing	23	0.02%
	Services	53,145	34.67%
70	Hotels & Other Lodging Places	1,922	1.25%
701	Hotels & Motels	1,749	1.14%
702	Rooming & Boarding Houses	33	0.02%
703	Camps & Recr. Vehicle Parks	88	0.06%
704	Membership Organization Hotels & Lodging Houses	52	0.03%
72	Personal Services	1,375	0.90%
721	Laundry, Cleaning & Garment Svcs	511	0.33%
722	Portrait Photographic Studios	64	0.04%
723	Beauty Shops	518	0.34%
724	Barber Shops	22	0.01%
725	Shoe Repair Shops & Shoeshine Parlors	6	0.00%
726	Funeral Service & Crematories	39	0.03%
729	Misc. Personal Svcs	216	0.14%
73	Business Services	6,865	4.48%
731	Advertising	63	0.04%
732	Credit Reporting & Collection Agencies	56	0.04%
733	Mailing, Reproduction & Steno. Services	213	0.14%
734	Dwelling & Other Building Services	1,157	0.76%
735	Misc. Eqp't Rental & Leasing	320	0.21%
736	Personnel Supply Services	3,092	2.02%
737	Computer & Data Processing Services	469	0.31%
738	Misc. Business Services	1,496	0.98%
75	Automotive Repair, Services, & Parking	1,826	1.19%
751	Automotive Rentals, No Drivers	388	0.25%
752	Automobile Parking	(D)	(D)
753	Automotive Repair Shops	1,052	0.69%
754	Automotive Services, Exc. Repair	387	0.25%

ADDENDUM 3

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
DETAILED REPORT: NONRESIDENTIAL WATER DEMAND

Workspace: SBV1
Program: RR3
Date: August 18, 1995

Detailed Report R3 (Nonresidential SIC) for 1990

Nonresidential Group	Description	Number of Employees Summer	Number of Employees Winter	Water Use Per Unit (GPD) Summer	Water Use Per Unit (GPD) Winter	Water Use Per Unit (GPD) Ann. Avg.	Average Water Use (MGD) Summer	Average Water Use (MGD) Winter	Average Water Use (MGD) Ann. Avg.	Tot. Ann. Sewer (MGD)
Construction										
15	GENERAL BUILDING CONTRACTORS	2337	2337	39.89	30.09	34.99	0.093	0.070	0.082	0.057
16	HEAVY CONSTRUCT.- EX. BUILDING	1882	1882	9.85	7.43	8.64	0.019	0.014	0.016	0.011
17	SPECIAL TRADE CONTRACTORS	7885	7885	50.29	37.93	44.11	0.397	0.299	0.348	0.244
Construction	Total	12104	12104	41.99	31.68	36.83	0.508	0.383	0.446	0.313
Manufacturing										
20	FOOD AND KINDRED PRODUCTS	1399	1399	178.06	145.68	161.87	0.249	0.204	0.226	0.172
22	TEXTILE MILL PRODUCTS	34	34	598.51	489.69	544.10	0.020	0.017	0.018	0.014
23	APPAREL AND OTHER TEXTILE PRODUCTS	530	530	24.40	36.71	30.55	0.013	0.019	0.016	0.013
24	LUMBER AND WOOD PRODUCTS	1445	1445	44.51	36.68	40.59	0.064	0.053	0.059	0.045
25	FURNITURE AND FIXTURES	822	822	40.76	33.34	37.05	0.034	0.027	0.030	0.023
26	PAPER AND ALLIED PRODUCTS	585	585	565.77	462.91	514.34	0.331	0.271	0.301	0.228
27	PRINTING AND PUBLISHING	1330	1330	45.98	37.62	41.80	0.061	0.050	0.056	0.042
28	CHEMICALS AND ALLIED PRODUCTS	742	742	295.91	242.11	269.01	0.220	0.180	0.200	0.151
29	PETROLEUM AND COAL PRODUCTS	31	31	1929.82	1578.94	1754.38	0.060	0.049	0.054	0.041
30	RUBBER AND MIS. PLASTICS PRODUCTS	1459	1459	99.14	81.12	90.13	0.145	0.118	0.131	0.100
31	LEATHER AND LEATHER PRODUCTS	7	7	28.78	23.54	26.16	0.000	0.000	0.000	0.000
32	STONE- CLAY- AND GLASS PRODUCTS	1428	1428	253.18	207.14	230.16	0.362	0.296	0.329	0.249
33	PRIMARY METAL INDUSTRIES	1003	1003	86.03	70.39	78.21	0.086	0.071	0.078	0.060
34	FABRICATED METAL PRODUCTS	2226	2226	174.20	142.52	158.36	0.388	0.317	0.353	0.267
35	INDUSTRIAL MACHINERY AND EQUIPMENT	1317	1317	52.78	43.18	47.98	0.070	0.057	0.063	0.048
36	ELECTRONIS & OTHER ELECTRIC EQUIPMENT	888	888	98.43	80.53	89.48	0.087	0.072	0.079	0.060
37	TRANSPORTATION EQUIPMENT	3745	3745	68.89	56.46	62.67	0.258	0.211	0.235	0.178
38	INSTRUMENTS & RELATED PRODUCTS	305	305	57.89	47.37	52.63	0.018	0.014	0.016	0.012
39	MISC. MANUFACTURING INDUSTRIES	410	410	42.84	35.05	38.95	0.018	0.014	0.016	0.012
Manufacturing	Total	19706	19706	125.97	103.55	114.76	2.482	2.041	2.261	1.716
1	LOCAL & INTERURBAN PASSEN. TRANS.	670	670	17.52	13.21	15.37	0.012	0.009	0.010	0.007
2	TRUCKING AND WAREHOUSING	3225	3225	113.73	85.79	99.76	0.367	0.277	0.322	0.226
3	U.S. POSTAL SERVICE	1273	1273	56.20	42.40	49.30	0.072	0.054	0.063	0.044
4	WATER TRANSPORTATION	19	19	167.18	126.12	146.65	0.003	0.002	0.003	0.002
5	TRANSPORTATION BY AIR	639	639	120.14	90.64	105.39	0.077	0.058	0.067	0.047
7	TRANSPORTATION SERVICES	180	180	73.75	55.63	64.69	0.013	0.010	0.012	0.008
3	COMMUNICATIONS	1878	1878	30.18	22.76	26.47	0.057	0.043	0.050	0.035
[illegible]	ELECTRIC- GAS- & SANITARY SERV.	2150	2150	58.14	43.86	51.00	0.125	0.094	0.110	0.077
Transportation	Total	10035	10035	72.24	54.50	63.37	0.725	0.547	0.636	0.447

Wholesale

50	WHOLESALE T [illegible]-DURABLE GOODS	4613	4613	21.51	16.2[illegible]	18.87	0.099	0.075	0.087	0.061
51	WHOLESALE T[illegible]E-NONDURABLE GOODS	3093	3093	182.94	138.00	160.47	0.566	0.427	0.496	0.349
Wholesale	Total	7706	7706	86.30	65.11	75.70	0.665	0.502	0.583	0.410
Retail										
52	BUILD. MATERIALS & GARDEN SUPPL.	1467	1467	24.00	18.10	21.05	0.035	0.027	0.031	0.022
53	GENERAL MERCHANDISE STORES	5500	5500	26.11	19.69	22.90	0.144	0.108	0.126	0.088
54	FOOD STORES	5020	5020	149.65	112.89	131.27	0.751	0.567	0.659	0.463
55	AUTO. DEALERS & SERVICE STATIONS	4486	4486	40.55	30.59	35.57	0.182	0.137	0.160	0.112
56	APPAREL AND ACCESSORY STORES	1826	1826	54.40	41.04	47.72	0.099	0.075	0.087	0.061
57	FURNITURE & HOMEFURNISH. STORES	1421	1421	65.33	49.29	57.31	0.093	0.070	0.081	0.057
58	EATING AND DRINKING PLACES	10469	10469	149.03	112.43	130.73	1.560	1.177	1.369	0.962
59	MISCELLANEOUS RETAIL	3199	3199	24.56	18.52	21.54	0.079	0.059	0.069	0.048
etail	Total	33390	33390	88.14	66.49	77.31	2.943	2.220	2.581	1.814
inances										
60	DEPOSITORY INSTITUTIONS	2136	2136	51.87	39.13	45.50	0.111	0.084	0.097	0.068
61	NONDEPOSITORY INSTITUTIONS	771	771	228.47	172.35	200.41	0.176	0.133	0.155	0.109
62	SECURITY & COMMODITY BROKERS	117	117	67.15	50.65	58.90	0.008	0.006	0.007	0.005
63	INSURACE CARRIERS	853	853	155.38	117.22	136.30	0.133	0.100	0.116	0.082
64	INSUR. AGENTS- BROKERS & SERVICE	563	563	107.16	80.84	94.00	0.060	0.046	0.053	0.037
65	REAL ESTATE	1656	1656	80.71	60.89	70.80	0.134	0.101	0.117	0.082
67	HOLDING & OTHER INVESTMENT OFF.	52	52	80.71	60.89	70.80	0.004	0.003	0.004	0.003
inances	Total	6148	6148	101.74	76.75	89.25	0.626	0.472	0.549	0.386
70	HOTELS & OTHER LODGING PLACES	1922	1922	216.22	163.12	189.67	0.416	0.314	0.365	0.256
72	PERSONAL SERVICES	1375	1375	609.51	459.81	534.66	0.838	0.632	0.735	0.516
73	BUSINESS SERVICES	6865	6865	75.87	57.23	66.55	0.521	0.393	0.457	0.321
75	AUTO REPAIR- SERVICES- AND PARK.	1826	1826	84.27	63.57	73.92	0.154	0.116	0.135	0.095
76	MISC. REPAIR SERVICES	544	544	68.91	51.99	60.45	0.037	0.028	0.033	0.023
78	MOTION PICTURES	511	511	128.71	97.09	112.90	0.066	0.050	0.058	0.041
9	AMUSEMENT & RECREATION SERVICES	1876	1876	542.49	409.25	475.87	1.018	0.768	0.893	0.627
0	HEALTH SERVICES	15326	15326	105.56	79.64	92.60	1.618	1.221	1.419	0.997
1	LEGAL SERVICES	639	639	86.98	65.62	76.30	0.056	0.042	0.049	0.034
2	EDUCATIONAL SERVICES	15027	15027	238.37	179.83	209.10	3.582	2.702	3.142	2.208
3	SOCIAL SERVICES	2372	2372	109.86	82.88	96.37	0.261	0.197	0.229	0.161
4	MUSEUMS- BOTANICAL- ZOO. GARDENS	13	13	240.87	181.71	211.29	0.003	0.002	0.003	0.002
6	MEMBERSHIP ORGANIZATIONS	1093	1093	147.86	111.54	129.70	0.162	0.122	0.142	0.100
7	ENGINEERING & MANAGEMENT SERVICES	2833	2833	98.22	74.10	86.16	0.278	0.210	0.244	0.171
8	PRIVATE HOUSEHOLDS	905	905	0.00	0.00	0.00	0.000	0.000	0.000	0.000
9	SERVICES	18	18	92.91	69.70	81.31	0.002	0.001	0.001	0.001
rvices	Total	53145	53145	169.54	127.90	148.72	9.010	6.797	7.904	5.553
olic Administration										
	PUBLIC ADMINISTRATION (91-97)	11038	11038	334.89	241.92	288.40	3.697	2.670	3.183	1.883
olic Administration	Total	11038	11038	334.89	241.92	288.40	3.697	2.670	3.183	1.883
al Nonresidential		153272	153272	134.76	101.99	118.38	20.656	15.632	18.144	12.521

Detailed Report R3 (Nonresidential SIC) for 1995

Nonresidential Group	Description	Number of Employees Summer	Number of Employees Winter	Water Use Per Unit (GPD) Summer	Water Use Per Unit (GPD) Winter	Water Use Per Unit (GPD) Ann. Avg.	Average Water Use (MGD) Summer	Average Water Use (MGD) Winter	Average Water Use (MGD) Ann. Avg.	Tot. Ann. Sewer (MGD)
Construction										
15	GENERAL BUILDING CONTRACTORS	2706	2706	39.89	30.09	34.99	0.108	0.081	0.095	0.067
16	HEAVY CONSTRUCT.- EX. BUILDING	2179	2179	9.85	7.43	8.64	0.021	0.016	0.019	0.013
17	SPECIAL TRADE CONTRACTORS	9133	9133	50.29	37.93	44.11	0.459	0.346	0.403	0.283
Construction	Total	14020	14020	41.99	31.68	36.83	0.589	0.444	0.516	0.363
&										
20	FOOD AND KINDRED PRODUCTS	1533	1533	178.06	145.68	161.87	0.273	0.223	0.248	0.188
22	TEXTILE MILL PRODUCTS	37	37	598.51	489.69	544.10	0.022	0.018	0.020	0.015
23	APPAREL AND OTHER TEXTILE PRODUCTS	580	580	24.40	36.71	30.55	0.014	0.021	0.018	0.014
24	LUMBER AND WOOD PRODUCTS	1583	1583	44.51	36.68	40.59	0.070	0.058	0.064	0.049
25	FURNITURE AND FIXTURES	901	901	40.76	33.34	37.05	0.037	0.030	0.033	0.025
26	PAPER AND ALLIED PRODUCTS	641	641	565.77	462.91	514.34	0.363	0.297	0.330	0.250
27	PRINTING AND PUBLISHING	1457	1457	45.98	37.62	41.80	0.067	0.055	0.061	0.046
28	CHEMICALS AND ALLIED PRODUCTS	813	813	295.91	242.11	269.01	0.241	0.197	0.219	0.166
29	PETROLEUM AND COAL PRODUCTS	34	34	1929.82	1578.94	1754.38	0.066	0.054	0.060	0.045
30	RUBBER AND MIS. PLASTICS PRODUCTS	1599	1599	99.14	81.12	90.13	0.159	0.130	0.144	0.109
31	LEATHER AND LEATHER PRODUCTS	7	7	28.78	23.54	26.16	0.000	0.000	0.000	0.000
32	STONE- CLAY- AND GLASS PRODUCTS	1565	1565	253.18	207.14	230.16	0.396	0.324	0.360	0.273
33	PRIMARY METAL INDUSTRIES	1099	1099	86.03	70.39	78.21	0.095	0.077	0.086	0.065
34	FABRICATED METAL PRODUCTS	2439	2439	174.20	142.52	158.36	0.425	0.348	0.386	0.293
35	INDUSTRIAL MACHINERY AND EQUIPMENT	1443	1443	52.78	43.18	47.98	0.076	0.062	0.069	0.053
36	ELECTRONIS & OTHER ELECTRIC EQUIPMENT	973	973	98.43	80.53	89.48	0.096	0.078	0.087	0.066
37	TRANSPORTATION EQUIPMENT	4104	4104	68.89	56.46	62.67	0.283	0.232	0.257	0.195
38	INSTRUMENTS & RELATED PRODUCTS	334	334	57.89	47.37	52.63	0.019	0.016	0.018	0.013
39	MISC. MANUFACTURING INDUSTRIES	449	449	42.84	35.05	38.95	0.019	0.016	0.018	0.013
Manufacturing	Total	21599	21599	125.97	103.55	114.76	2.721	2.237	2.479	1.881
Transportation										
41	LOCAL & INTERURBAN PASSEN. TRANS.	772	772	17.52	13.21	15.37	0.014	0.010	0.012	0.008
42	TRUCKING AND WAREHOUSING	3719	3719	113.73	85.79	99.76	0.423	0.319	0.371	0.261
43	U.S. POSTAL SERVICE	1468	1468	56.20	42.40	49.30	0.083	0.062	0.072	0.051
44	WATER TRANSPORTATION	21	21	167.18	126.12	146.65	0.004	0.003	0.003	0.002
45	TRANSPORTATION BY AIR	737	737	120.14	90.64	105.39	0.089	0.067	0.078	0.055
47	TRANSPORTATION SERVICES	207	207	73.75	55.63	64.69	0.015	0.012	0.013	0.009
48	COMMUNICATIONS	2166	2166	30.18	22.76	26.47	0.065	0.049	0.057	0.040
49	ELECTRIC- GAS- & SANITARY SERV.	2479	2479	58.14	43.86	51.00	0.144	0.109	0.126	0.089
ransportation	Total	11575	11575	72.24	54.50	63.37	0.836	0.631	0.734	0.515
holesale										
0	WHOLESALE TRADE-DURABLE GOODS	5235	5235	21.51	16.23	18.87	0.113	0.085	0.099	0.069
1	WHOLESALE TRADE-NONDURABLE GOODS	3510	3510	182.94	138.00	160.47	0.642	0.484	0.563	0.396
holesale	Total	8746	8746	86.30	65.11	75.70	0.755	0.569	0.662	0.465 &
2	BUILD. MATERIALS & GARDEN SUPPL.	1701	1701	24.00	18.10	21.05	0.041	0.031	0.036	0.025

53	GENERAL MERCHANDISE STORES	6379	6379	26.11	19.69	22.90	0.167	0.126	0.146	0.103
54	FOOD STORES	5823	5823	149.65	112.89	131.27	0.871	0.657	0.764	0.537
55	AUTO. DEALER. - SERVICE STATIONS	5203	5203	40.55	30.59	35.57	0.211	0.159	0.185	0.130
56	APPAREL AND ACCESSORY STORES	2118	2118	54.40	41.04	47.72	0.115	0.087	0.101	0.071
57	FURNITURE & HOMEFURNISH. STORES	1648	1648	65.33	49.29	57.31	0.108	0.081	0.094	0.066
58	EATING AND DRINKING PLACES	12143	12143	149.03	112.43	130.73	1.810	1.365	1.588	1.115
59	MISCELLANEOUS RETAIL	3710	3710	24.56	18.52	21.54	0.091	0.069	0.080	0.056
etail	Total	38731	38731	88.14	66.49	77.31	3.414	2.575	2.994	2.104
inances										
60	DEPOSITORY INSTITUTIONS	2408	2408	51.87	39.13	45.50	0.125	0.094	0.110	0.077
61	NONDEPOSITORY INSTITUTIONS	869	869	228.47	172.35	200.41	0.199	0.150	0.174	0.122
62	SECURITY & COMMODITY BROKERS	131	131	67.15	50.65	58.90	0.009	0.007	0.008	0.005
63	INSURACE CARRIERS	961	961	155.38	117.22	136.30	0.149	0.113	0.131	0.092
64	INSUR. AGENTS- BROKERS & SERVICE	634	634	107.16	80.84	94.00	0.068	0.051	0.060	0.042
65	REAL ESTATE	1866	1866	80.71	60.89	70.80	0.151	0.114	0.132	0.093
67	HOLDING & OTHER INVESTMENT OFF.	58	58	80.71	60.89	70.80	0.005	0.004	0.004	0.003
nances	Total	6931	6931	101.74	76.75	89.25	0.705	0.532	0.619	0.435
rvices										
70	HOTELS & OTHER LODGING PLACES	2268	2268	216.22	163.12	189.67	0.490	0.370	0.430	0.302
2	PERSONAL SERVICES	1622	1622	609.51	459.81	534.66	0.989	0.746	0.868	0.610
3	BUSINESS SERVICES	8101	8101	75.87	57.23	66.55	0.615	0.464	0.539	0.379
5	AUTO REPAIR- SERVICES- AND PARK.	2155	2155	84.27	63.57	73.92	0.182	0.137	0.159	0.112
6	MISC. REPAIR SERVICES	642	642	68.91	51.99	60.45	0.044	0.033	0.039	0.027
8	MOTION PICTURES	603	603	128.71	97.09	112.90	0.078	0.059	0.068	0.048
9	AMUSEMENT & RECREATION SERVICES	2214	2214	542.49	409.25	475.87	1.201	0.906	1.054	0.740
0	HEALTH SERVICES	18087	18087	105.56	79.64	92.60	1.909	1.440	1.675	1.177
1	LEGAL SERVICES	754	754	86.98	65.62	76.30	0.066	0.049	0.058	0.040
2	EDUCATIONAL SERVICES	17734	17734	238.37	179.83	209.10	4.227	3.189	3.708	2.605
3	SOCIAL SERVICES	2799	2799	109.86	82.88	96.37	0.308	0.232	0.270	0.190
4	MUSEUMS- BOTANICAL- ZOO. GARDENS	15	15	240.87	181.71	211.29	0.004	0.003	0.003	0.002
5	MEMBERSHIP ORGANIZATIONS	1289	1289	147.86	111.54	129.70	0.191	0.144	0.167	0.118
7	ENGINEERING & MANAGEMENT SERVICES	3343	3343	98.22	74.10	86.16	0.328	0.248	0.288	0.202
8	PRIVATE HOUSEHOLDS	1068	1068	0.00	0.00	0.00	0.000	0.000	0.000	0.000 &
vices	Total	62720	62720	169.54	127.90	148.72	10.633	8.022	9.328	6.553
lic Administration										
	PUBLIC ADMINISTRATION (91-97)	10373	10373	334.89	241.92	288.40	3.474	2.509	2.992	1.770
lic Administration	Total	10373	10373	334.89	241.92	288.40	3.474	2.509	2.992	1.770
l Nonresidential		174695	174695	132.38	100.28	116.33	23.127	17.519	20.323	14.086

iled Report R3 (Nonresidential SIC) for 2000

esidential Group	Description	Number of Employees		Water Use Per Unit (GPD)			Average Water Use (MGD)			Tot. Ann.
		Summer	Winter	Summer	Winter	Ann. Avg.	Summer	Winter	Ann. Avg.	Sewer (MGD)

onstruction									
15 GENERAL BUILDING CONTRACTORS	3100	3100	39.89	30.09	34.99	0.124	0.093	0.108	0.076
16 HEAVY CONSTRUCT.- EX. BUILDING	2496	2496	9.85	7.43	8.64	0.025	0.019	0.022	0.015
17 SPECIAL TRADE CONTRACTORS	10459	10459	50.29	37.93	44.11	0.526	0.397	0.461	0.324
onstruction Total	16056	16056	41.99	31.68	36.83	0.674	0.509	0.591	0.416
anufacturing									
20 FOOD AND KINDRED PRODUCTS	1703	1703	178.06	145.68	161.87	0.303	0.248	0.276	0.209
22 TEXTILE MILL PRODUCTS	41	41	598.51	489.69	544.10	0.025	0.020	0.023	0.017
23 APPAREL AND OTHER TEXTILE PRODUCTS	645	645	24.40	36.71	30.55	0.016	0.024	0.020	0.015
24 LUMBER AND WOOD PRODUCTS	1759	1759	44.51	36.68	40.59	0.078	0.065	0.071	0.054
25 FURNITURE AND FIXTURES	1001	1001	40.76	33.34	37.05	0.041	0.033	0.037	0.028
26 PAPER AND ALLIED PRODUCTS	712	712	565.77	462.91	514.34	0.403	0.330	0.366	0.278
27 PRINTING AND PUBLISHING	1619	1619	45.98	37.62	41.80	0.074	0.061	0.068	0.051
8 CHEMICALS AND ALLIED PRODUCTS	903	903	295.91	242.11	269.01	0.267	0.219	0.243	0.184
9 PETROLEUM AND COAL PRODUCTS	37	37	1929.82	1578.94	1754.38	0.073	0.060	0.066	0.050
0 RUBBER AND MIS. PLASTICS PRODUCTS	1776	1776	99.14	81.12	90.13	0.176	0.144	0.160	0.122
1 LEATHER AND LEATHER PRODUCTS	8	8	28.78	23.54	26.16	0.000	0.000	0.000	0.000
2 STONE- CLAY- AND GLASS PRODUCTS	1739	1739	253.18	207.14	230.16	0.440	0.360	0.400	0.304
3 PRIMARY METAL INDUSTRIES	1221	1221	86.03	70.39	78.21	0.105	0.086	0.096	0.072
4 FABRICATED METAL PRODUCTS	2711	2711	174.20	142.52	158.36	0.472	0.386	0.429	0.326
5 INDUSTRIAL MACHINERY AND EQUIPMENT	1604	1604	52.78	43.18	47.98	0.085	0.069	0.077	0.058 &
7 TRANSPORTATION EQUIPMENT	4561	4561	68.89	56.46	62.67	0.314	0.258	0.286	0.217
8 INSTRUMENTS & RELATED PRODUCTS	371	371	57.89	47.37	52.63	0.022	0.018	0.020	0.015
9 MISC. MANUFACTURING INDUSTRIES	499	499	42.84	35.05	38.95	0.021	0.018	0.019	0.015
ufacturing Total	24000	24000	125.97	103.55	114.76	3.023	2.485	2.754	2.090
nsportation									
LOCAL & INTERURBAN PASSEN. TRANS.	883	883	17.52	13.21	15.37	0.015	0.012	0.014	0.010
TRUCKING AND WAREHOUSING	4250	4250	113.73	85.79	99.76	0.483	0.365	0.424	0.298
U.S. POSTAL SERVICE	1677	1677	56.20	42.40	49.30	0.094	0.071	0.083	0.058
WATER TRANSPORTATION	25	25	167.18	126.12	146.65	0.004	0.003	0.004	0.003
TRANSPORTATION BY AIR	842	842	120.14	90.64	105.39	0.101	0.076	0.089	0.062
TRANSPORTATION SERVICES	237	237	73.75	55.63	64.69	0.017	0.013	0.015	0.011
COMMUNICATIONS	2475	2475	30.18	22.76	26.47	0.075	0.056	0.066	0.046
ELECTRIC- GAS- & SANITARY SERV.	2833	2833	58.14	43.86	51.00	0.165	0.124	0.145	0.102
nsportation Total	13225	13225	72.24	54.50	63.37	0.955	0.721	0.838	0.589
lesale									
WHOLESALE TRADE-DURABLE GOODS	5918	5918	21.51	16.23	18.87	0.127	0.096	0.112	0.078
WHOLESALE TRADE-NONDURABLE GOODS	3968	3968	182.94	138.00	160.47	0.726	0.548	0.637	0.447
lesale Total	9887	9887	86.30	65.11	75.70	0.853	0.644	0.748	0.526
il									
BUILD. MATERIALS & GARDEN SUPPL.	1962	1962	24.00	18.10	21.05	0.047	0.036	0.041	0.029
GENERAL MERCHANDISE STORES	7355	7355	26.11	19.69	22.90	0.192	0.145	0.168	0.118
FOOD STORES	6713	6713	149.65	112.89	131.27	1.005	0.758	0.881	0.619
AUTO. DEALERS & SERVICE STATIONS	5999	5999	40.55	30.59	35.57	0.243	0.184	0.213	0.150
APPAREL AND ACCESSORY STORES	2442	2442	54.40	41.04	47.72	0.133	0.100	0.117	0.082

7	FURNITURE & F' 'FURNISH. STORES	1900	1900	65.33	49.29	57.31	0.124	0.094	0.109	0.077
8	EATING AND DR ..ING PLACES	14001	14001	149.03	112.43	130.73	2.087	1.574	1.830	1.286
9	MISCELLANEOUS RETAIL	4278	4278	24.56	18.52	21.54	0.105	0.079	0.092	0.065
tail	Total	44657	44657	88.14	66.49	77.31	3.936	2.969	3.453	2.426
nances										
0	DEPOSITORY INSTITUTIONS	2725	2725	51.87	39.13	45.50	0.141	0.107	0.124	0.087
1	NONDEPOSITORY INSTITUTIONS	983	983	228.47	172.35	200.41	0.225	0.170	0.197	0.139
2	SECURITY & COMMODITY BROKERS	149	149	67.15	50.65	58.90	0.010	0.008	0.009	0.006 &
4	INSUR. AGENTS- BROKERS & SERVICE	718	718	107.16	80.84	94.00	0.077	0.058	0.068	0.047
5	REAL ESTATE	2113	2113	80.71	60.89	70.80	0.171	0.129	0.150	0.105
7	HOLDING & OTHER INVESTMENT OFF.	66	66	80.71	60.89	70.80	0.005	0.004	0.005	0.003
nances	Total	7846	7846	101.74	76.75	89.25	0.798	0.602	0.700	0.492
rvices										
0	HOTELS & OTHER LODGING PLACES	2621	2621	216.22	163.12	189.67	0.567	0.428	0.497	0.349
2	PERSONAL SERVICES	1875	1875	609.51	459.81	534.66	1.143	0.862	1.003	0.705
3	BUSINESS SERVICES	9364	9364	75.87	57.23	66.55	0.710	0.536	0.623	0.438
5	AUTO REPAIR- SERVICES- AND PARK.	2490	2490	84.27	63.57	73.92	0.210	0.158	0.184	0.129
6	MISC. REPAIR SERVICES	742	742	68.91	51.99	60.45	0.051	0.039	0.045	0.032
8	MOTION PICTURES	697	697	128.71	97.09	112.90	0.090	0.068	0.079	0.055
9	AMUSEMENT & RECREATION SERVICES	2558	2558	542.49	409.25	475.87	1.388	1.047	1.218	0.856
0	HEALTH SERVICES	20905	20905	105.56	79.64	92.60	2.207	1.665	1.936	1.360
1	LEGAL SERVICES	871	871	86.98	65.62	76.30	0.076	0.057	0.067	0.047
2	EDUCATIONAL SERVICES	20497	20497	238.37	179.83	209.10	4.886	3.686	4.286	3.011
3	SOCIAL SERVICES	3235	3235	109.86	82.88	96.37	0.355	0.268	0.312	0.219
4	MUSEUMS- BOTANICAL- ZOO. GARDENS	17	17	240.87	181.71	211.29	0.004	0.003	0.004	0.003
5	MEMBERSHIP ORGANIZATIONS	1490	1490	147.86	111.54	129.70	0.220	0.166	0.193	0.136
7	ENGINEERING & MANAGEMENT SERVICES	3864	3864	98.22	74.10	86.16	0.380	0.286	0.333	0.234
8	PRIVATE HOUSEHOLDS	1234	1234	0.00	0.00	0.00	0.000	0.000	0.000	0.000
9	SERVICES	24	24	92.91	69.70	81.31	0.002	0.002	0.002	0.001
vices	Total	72491	72491	169.54	127.90	148.72	12.290	9.271	10.781	7.574
lic Administration										
	PUBLIC ADMINISTRATION (91-97)	11015	11015	334.89	241.92	288.40	3.689	2.665	3.177	1.879
lic Administration	Total	11015	11015	334.89	241.92	288.40	3.689	2.665	3.177	1.879
l Nonresidential		199177	199177	131.64	99.74	115.69	26.219	19.866	23.042	15.991

iled Report R3 (Nonresidential SIC) for 2005

esidential Group	Description	Number of Employees Summer	Winter	Water Use Per Unit (GPD) Summer	Winter	Ann. Avg.	Average Water Use (MGD) Summer	Winter	Ann. Avg.	Tot. Ann. Sewer (MGD)
	GENERAL BUILDING CONTRACTORS	3478	3478	39.89	30.09	34.99	0.139	0.105	0.122	0.086
	HEAVY CONSTRUCT.- EX. BUILDING	2800	2800	9.85	7.43	8.64	0.028	0.021	0.024	0.017
	SPECIAL TRADE CONTRACTORS	11735	11735	50.29	37.93	44.11	0.590	0.445	0.518	0.364
struction	Total	18014	18014	41.99	31.68	36.83	0.756	0.571	0.664	0.466

6

anufacturing										
20	FOOD AND KINDRED PRODUCTS	1868	1868	178.06	145.68	161.87	0.333	0.272	0.302	0.230
22	TEXTILE MILL PRODUCTS	45	45	598.51	489.69	544.10	0.027	0.022	0.025	0.019
23	APPAREL AND OTHER TEXTILE PRODUCTS	708	708	24.40	36.71	30.55	0.017	0.026	0.022	0.017
24	LUMBER AND WOOD PRODUCTS	1930	1930	44.51	36.68	40.59	0.086	0.071	0.078	0.059
25	FURNITURE AND FIXTURES	1098	1098	40.76	33.34	37.05	0.045	0.037	0.041	0.031
26	PAPER AND ALLIED PRODUCTS	781	781	565.77	462.91	514.34	0.442	0.362	0.402	0.305
27	PRINTING AND PUBLISHING	1776	1776	45.98	37.62	41.80	0.082	0.067	0.074	0.056
28	CHEMICALS AND ALLIED PRODUCTS	991	991	295.91	242.11	269.01	0.293	0.240	0.267	0.202
29	PETROLEUM AND COAL PRODUCTS	41	41	1929.82	1578.94	1754.38	0.080	0.065	0.073	0.055
30	RUBBER AND MIS. PLASTICS PRODUCTS	1948	1948	99.14	81.12	90.13	0.193	0.158	0.176	0.133
11	LEATHER AND LEATHER PRODUCTS	9	9	28.78	23.54	26.16	0.000	0.000	0.000	0.000
2	STONE- CLAY- AND GLASS PRODUCTS	1907	1907	253.18	207.14	230.16	0.483	0.395	0.439	0.333
3	PRIMARY METAL INDUSTRIES	1339	1339	86.03	70.39	78.21	0.115	0.094	0.105	0.080
4	FABRICATED METAL PRODUCTS	2973	2973	174.20	142.52	158.36	0.518	0.424	0.471	0.357
5	INDUSTRIAL MACHINERY AND EQUIPMENT	1759	1759	52.78	43.18	47.98	0.093	0.076	0.084	0.064
6	ELECTRONIS & OTHER ELECTRIC EQUIPMENT	1186	1186	98.43	80.53	89.48	0.117	0.096	0.106	0.081
7	TRANSPORTATION EQUIPMENT	5002	5002	68.89	56.46	62.67	0.345	0.282	0.314	0.238
8	INSTRUMENTS & RELATED PRODUCTS	407	407	57.89	47.37	52.63	0.024	0.019	0.021	0.016
9	MISC. MANUFACTURING INDUSTRIES	547	547	42.84	35.05	38.95	0.023	0.019	0.021	0.016
nufacturing	Total	26323	26323	125.97	103.55	114.76	3.316	2.726	3.021	2.292
ansportation										
1	LOCAL & INTERURBAN PASSEN. TRANS.	989	989	17.52	13.21	15.37	0.017	0.013	0.015	0.011
2	TRUCKING AND WAREHOUSING	4762	4762	113.73	85.79	99.76	0.542	0.409	0.475	0.334
3	U.S. POSTAL SERVICE	1879	1879	56.20	42.40	49.30	0.106	0.080	0.093	0.065
4	WATER TRANSPORTATION	28	28	167.18	126.12	146.65	0.005	0.004	0.004	0.003
5	TRANSPORTATION BY AIR	943	943	120.14	90.64	105.39	0.113	0.086	0.099	0.070
7	TRANSPORTATION SERVICES	265	265	73.75	55.63	64.69	0.020	0.015	0.017	0.012
8	COMMUNICATIONS	2773	2773	30.18	22.76	26.47	0.084	0.063	0.073	0.052
9	ELECTRIC- GAS- & SANITARY SERV.	3174	3174	58.14	43.86	51.00	0.185	0.139	0.162	0.114
lesale										
	WHOLESALE TRADE-DURABLE GOODS	6597	6597	21.51	16.23	18.87	0.142	0.107	0.124	0.087
	WHOLESALE TRADE-NONDURABLE GOODS	4423	4423	182.94	138.00	160.47	0.809	0.610	0.710	0.499
lesale	Total	11021	11021	86.30	65.11	75.70	0.951	0.718	0.834	0.586
ail										
	BUILD. MATERIALS & GARDEN SUPPL.	2210	2210	24.00	18.10	21.05	0.053	0.040	0.047	0.033
	GENERAL MERCHANDISE STORES	8286	8286	26.11	19.69	22.90	0.216	0.163	0.190	0.133
	FOOD STORES	7563	7563	149.65	112.89	131.27	1.132	0.854	0.993	0.698
	AUTO. DEALERS & SERVICE STATIONS	6759	6759	40.55	30.59	35.57	0.274	0.207	0.240	0.169
	APPAREL AND ACCESSORY STORES	2751	2751	54.40	41.04	47.72	0.150	0.113	0.131	0.092
	FURNITURE & HOMEFURNISH. STORES	2141	2141	65.33	49.29	57.31	0.140	0.106	0.123	0.086
	EATING AND DRINKING PLACES	15773	15773	149.03	112.43	130.73	2.351	1.773	2.062	1.449
	MISCELLANEOUS RETAIL	4819	4819	24.56	18.52	21.54	0.118	0.089	0.104	0.073
ail	Total	50308	50308	88.14	66.49	77.31	4.434	3.345	3.889	2.733

nances									
DEPOSITORY INS..TUTIONS	3036	3036	51.87	39.13	45.50	0.158	0.119	0.138	0.097
NONDEPOSITORY INSTITUTIONS	1096	1096	228.47	172.35	200.41	0.250	0.189	0.220	0.154
SECURITY & COMMODITY BROKERS	166	166	67.15	50.65	58.90	0.011	0.008	0.010	0.007
INSURACE CARRIERS	1212	1212	155.38	117.22	136.30	0.188	0.142	0.165	0.116
INSUR. AGENTS- BROKERS & SERVICE	800	800	107.16	80.84	94.00	0.086	0.065	0.075	0.053
REAL ESTATE	2354	2354	80.71	60.89	70.80	0.190	0.143	0.167	0.117
HOLDING & OTHER INVESTMENT OFF.	73	73	80.71	60.89	70.80	0.006	0.005	0.005	0.004
nances Total	8740	8740	101.74	76.75	89.25	0.889	0.671	0.780	0.548
vices									
HOTELS & OTHER LODGING PLACES	2958	2958	216.22	163.12	189.67	0.640	0.483	0.561	0.394
PERSONAL SERVICES	2116	2116	609.51	459.81	534.66	1.290	0.973	1.131	0.795
BUSINESS SERVICES	10565	10565	75.87	57.23	66.55	0.802	0.605	0.703	0.494
AUTO REPAIR- SERVICES- AND PARK.	2810	2810	84.27	63.57	73.92	0.237	0.179	0.208	0.146
MISC. REPAIR SERVICES	837	837	68.91	51.99	60.45	0.058	0.044	0.051	0.036
MOTION PICTURES	786	786	128.71	97.09	112.90	0.101	0.076	0.089	0.062
AMUSEMENT & RECREATION SERVICES	2887	2887	542.49	409.25	475.87	1.566	1.182	1.374	0.965
HEALTH SERVICES	23587	23587	105.56	79.64	92.60	2.490	1.878	2.184	1.535 &
EDUCATIONAL SERVICES	23127	23127	238.37	179.83	209.10	5.513	4.159	4.836	3.398
SOCIAL SERVICES	3650	3650	109.86	82.88	96.37	0.401	0.303	0.352	0.247
MUSEUMS- BOTANICAL- ZOO. GARDENS	20	20	240.87	181.71	211.29	0.005	0.004	0.004	0.003
MEMBERSHIP ORGANIZATIONS	1682	1682	147.86	111.54	129.70	0.249	0.188	0.218	0.153
ENGINEERING & MANAGEMENT SERVICES	4360	4360	98.22	74.10	86.16	0.428	0.323	0.376	0.264
PRIVATE HOUSEHOLDS	1392	1392	0.00	0.00	0.00	0.000	0.000	0.000	0.000
SERVICES	27	27	92.91	69.70	81.31	0.003	0.002	0.002	0.002
vices Total	81793	81793	169.54	127.90	148.72	13.867	10.461	12.164	8.546
lic Administration									
PUBLIC ADMINISTRATION (91-97)	11663	11663	334.89	241.92	288.40	3.906	2.822	3.364	1.990
lic Administration Total	11663	11663	334.89	241.92	288.40	3.906	2.822	3.364	1.990
l Nonresidential	222680	222680	131.08	99.33	115.21	29.190	22.120	25.655	17.821

iled Report R3 (Nonresidential SIC) for 2010

esidential Group Description	Number of Employees		Water Use Per Unit (GPD)			Average Water Use (MGD)			Tot. Ann.
	Summer	Winter	Summer	Winter	Ann. Avg.	Summer	Winter	Ann. Avg.	Sewer (MGD)
truction									
GENERAL BUILDING CONTRACTORS	3836	3836	39.89	30.09	34.99	0.153	0.115	0.134	0.094
HEAVY CONSTRUCT.- EX. BUILDING	3089	3089	9.85	7.43	8.64	0.030	0.023	0.027	0.019
SPECIAL TRADE CONTRACTORS	12944	12944	50.29	37.93	44.11	0.651	0.491	0.571	0.401
truction Total	19871	19871	41.99	31.68	36.83	0.834	0.629	0.732	0.514
facturing									
FOOD AND KINDRED PRODUCTS	2029	2029	178.06	145.68	161.87	0.361	0.296	0.329	0.249

22	TEXTILE MILL PRODUCTS	49	49	598.51	489.69	544.10	0.030	0.024	0.027	0.020
23	APPAREL AND OTHER TEXTILE PRODUCTS	769	769	24.40	36.71	30.55	0.019	0.028	0.023	0.018
24	LUMBER AND WOOD PRODUCTS	2096	2096	44.51	36.68	40.59	0.093	0.077	0.085	0.065
25	FURNITURE AND FIXTURES	1192	1192	40.76	33.34	37.05	0.049	0.040	0.044	0.034
26	PAPER AND ALLIED PRODUCTS	848	848	565.77	462.91	514.34	0.480	0.393	0.437	0.331
27	PRINTING AND PUBLISHING	1929	1929	45.98	37.62	41.80	0.089	0.073	0.081	0.061
28	CHEMICALS AND ALLIED PRODUCTS	1076	1076	295.91	242.11	269.01	0.319	0.261	0.290	0.220 &
30	RUBBER AND MIS. PLASTICS PRODUCTS	2117	2117	99.14	81.12	90.13	0.210	0.172	0.191	0.145
1	LEATHER AND LEATHER PRODUCTS	10	10	28.78	23.54	26.16	0.000	0.000	0.000	0.000
2	STONE- CLAY- AND GLASS PRODUCTS	2072	2072	253.18	207.14	230.16	0.525	0.429	0.477	0.362
3	PRIMARY METAL INDUSTRIES	1455	1455	86.03	70.39	78.21	0.125	0.102	0.114	0.086
4	FABRICATED METAL PRODUCTS	3229	3229	174.20	142.52	158.36	0.563	0.460	0.511	0.388
5	INDUSTRIAL MACHINERY AND EQUIPMENT	1910	1910	52.78	43.18	47.98	0.101	0.083	0.092	0.070
6	ELECTRONIS & OTHER ELECTRIC EQUIPMENT	1288	1288	98.43	80.53	89.48	0.127	0.104	0.115	0.087
7	TRANSPORTATION EQUIPMENT	5433	5433	68.89	56.46	62.67	0.374	0.307	0.341	0.258
8	INSTRUMENTS & RELATED PRODUCTS	442	442	57.89	47.37	52.63	0.026	0.021	0.023	0.018
9	MISC. MANUFACTURING INDUSTRIES	594	594	42.84	35.05	38.95	0.025	0.021	0.023	0.018
nufacturing	Total	28593	28593	125.97	103.55	114.76	3.602	2.961	3.281	2.490
ansportation										
1	LOCAL & INTERURBAN PASSEN. TRANS.	1091	1091	17.52	13.21	15.37	0.019	0.014	0.017	0.012
2	TRUCKING AND WAREHOUSING	5255	5255	113.73	85.79	99.76	0.598	0.451	0.524	0.368
3	U.S. POSTAL SERVICE	2074	2074	56.20	42.40	49.30	0.117	0.088	0.102	0.072
4	WATER TRANSPORTATION	31	31	167.18	126.12	146.65	0.005	0.004	0.005	0.003
5	TRANSPORTATION BY AIR	1041	1041	120.14	90.64	105.39	0.125	0.094	0.110	0.077
7	TRANSPORTATION SERVICES	293	293	73.75	55.63	64.69	0.022	0.016	0.019	0.013
8	COMMUNICATIONS	3060	3060	30.18	22.76	26.47	0.092	0.070	0.081	0.057
9	ELECTRIC- GAS- & SANITARY SERV.	3503	3503	58.14	43.86	51.00	0.204	0.154	0.179	0.126
ansportation	Total	16354	16354	72.24	54.50	63.37	1.181	0.891	1.036	0.728
lesale										
0	WHOLESALE TRADE-DURABLE GOODS	7258	7258	21.51	16.23	18.87	0.156	0.118	0.137	0.096
1	WHOLESALE TRADE-NONDURABLE GOODS	4866	4866	182.94	138.00	160.47	0.890	0.672	0.781	0.549
lesale	Total	12125	12125	86.30	65.11	75.70	1.046	0.789	0.918	0.645
ail										
	BUILD. MATERIALS & GARDEN SUPPL.	2444	2444	24.00	18.10	21.05	0.059	0.044	0.051	0.036
	GENERAL MERCHANDISE STORES	9165	9165	26.11	19.69	22.90	0.239	0.181	0.210	0.147
	FOOD STORES	8365	8365	149.65	112.89	131.27	1.252	0.944	1.098	0.772
	AUTO. DEALERS & SERVICE STATIONS	7476	7476	40.55	30.59	35.57	0.303	0.229	0.266	0.187
	APPAREL AND ACCESSORY STORES	3043	3043	54.40	41.04	47.72	0.166	0.125	0.145	0.102
	FURNITURE & HOMEFURNISH. STORES	2368	2368	65.33	49.29	57.31	0.155	0.117	0.136	0.095
	EATING AND DRINKING PLACES	17446	17446	149.03	112.43	130.73	2.600	1.962	2.281	1.602 &
ail	Total	55645	55645	88.14	66.49	77.31	4.904	3.700	4.302	3.022
ances										
	DEPOSITORY INSTITUTIONS	3340	3340	51.87	39.13	45.50	0.173	0.131	0.152	0.107
	NONDEPOSITORY INSTITUTIONS	1205	1205	228.47	172.35	200.41	0.275	0.208	0.242	0.170
	SECURITY & COMMODITY BROKERS	183	183	67.15	50.65	58.90	0.012	0.009	0.011	0.008

63	INSURACE CARP'ERS	1334	1334	155.38	117.22	136.30	0.207	0.156	0.182	0.128
64	INSUR. AGENT JROKERS & SERVICE	880	880	107.16	80.84	94.00	0.094	0.071	0.083	0.058
65	REAL ESTATE	2589	2589	80.71	60.89	70.80	0.209	0.158	0.183	0.129
67	HOLDING & OTHER INVESTMENT OFF.	81	81	80.71	60.89	70.80	0.007	0.005	0.006	0.004
inances	Total	9615	9615	101.74	76.75	89.25	0.978	0.738	0.858	0.603
ervices										
70	HOTELS & OTHER LODGING PLACES	3270	3270	216.22	163.12	189.67	0.707	0.534	0.620	0.436
72	PERSONAL SERVICES	2340	2340	609.51	459.81	534.66	1.426	1.076	1.251	0.879
73	BUSINESS SERVICES	11682	11682	75.87	57.23	66.55	0.886	0.669	0.777	0.546
75	AUTO REPAIR- SERVICES- AND PARK.	3107	3107	84.27	63.57	73.92	0.262	0.198	0.230	0.161
76	MISC. REPAIR SERVICES	925	925	68.91	51.99	60.45	0.064	0.048	0.056	0.039
78	MOTION PICTURES	869	869	128.71	97.09	112.90	0.112	0.084	0.098	0.069
79	AMUSEMENT & RECREATION SERVICES	3192	3192	542.49	409.25	475.87	1.732	1.307	1.519	1.067
30	HEALTH SERVICES	26081	26081	105.56	79.64	92.60	2.753	2.077	2.415	1.697
31	LEGAL SERVICES	1087	1087	86.98	65.62	76.30	0.095	0.071	0.083	0.058
32	EDUCATIONAL SERVICES	25572	25572	238.37	179.83	209.10	6.096	4.599	5.347	3.757
33	SOCIAL SERVICES	4036	4036	109.86	82.88	96.37	0.443	0.335	0.389	0.273
34	MUSEUMS- BOTANICAL- ZOO. GARDENS	22	22	240.87	181.71	211.29	0.005	0.004	0.005	0.003
36	MEMBERSHIP ORGANIZATIONS	1860	1860	147.86	111.54	129.70	0.275	0.207	0.241	0.169
37	ENGINEERING & MANAGEMENT SERVICES	4821	4821	98.22	74.10	86.16	0.474	0.357	0.415	0.292
38	PRIVATE HOUSEHOLDS	1540	1540	0.00	0.00	0.00	0.000	0.000	0.000	0.000
39	SERVICES	30	30	92.91	69.70	81.31	0.003	0.002	0.002	0.002
rvices	Total	90442	90442	169.54	127.90	148.72	15.333	11.567	13.450	9.450
blic Administration										
	PUBLIC ADMINISTRATION (91-97)	12341	12341	334.89	241.92	288.40	4.133	2.986	3.559	2.106
blic Administration	Total	12341	12341	334.89	241.92	288.40	4.133	2.986	3.559	2.106
al Nonresidential		244986	244986	130.67	99.03	114.85	32.013	24.262	28.137	19.558

ailed Report R3 (Nonresidential SIC) for 2015

residential Group	Description	Number of Employees Summer	Winter	Water Use Per Unit (GPD) Summer	Winter	Ann. Avg.	Average Water Use (MGD) Summer	Winter	Ann. Avg.	Tot. Ann. Sewer (MGD)
nstruction										
5	GENERAL BUILDING CONTRACTORS	4246	4246	39.89	30.09	34.99	0.169	0.128	0.149	0.104
5	HEAVY CONSTRUCT.- EX. BUILDING	3419	3419	9.85	7.43	8.64	0.034	0.025	0.030	0.021
7	SPECIAL TRADE CONTRACTORS	14328	14328	50.29	37.93	44.11	0.721	0.544	0.632	0.444
nstruction	Total	21995	21995	41.99	31.68	36.83	0.924	0.697	0.810	0.569
ufacturing										
	FOOD AND KINDRED PRODUCTS	2201	2201	178.06	145.68	161.87	0.392	0.321	0.356	0.270
	TEXTILE MILL PRODUCTS	53	53	598.51	489.69	544.10	0.032	0.026	0.029	0.022
	APPAREL AND OTHER TEXTILE PRODUCTS	833	833	24.40	36.71	30.55	0.020	0.031	0.025	0.020
	LUMBER AND WOOD PRODUCTS	2273	2273	44.51	36.68	40.59	0.101	0.083	0.092	0.070
	FURNITURE AND FIXTURES	1293	1293	40.76	33.34	37.05	0.053	0.043	0.048	0.036
	PAPER AND ALLIED PRODUCTS	920	920	565.77	462.91	514.34	0.521	0.426	0.473	0.359
	PRINTING AND PUBLISHING	2092	2092	45.98	37.62	41.80	0.096	0.079	0.087	0.066

8	CHEMICALS AND ALLIED PRODUCTS	1167	1167	295.91	242.11	269.01	0.345	0.283	0.314	0.238
9	PETROLEUM AND COAL PRODUCTS	48	48	1929.82	1578.94	1754.38	0.094	0.077	0.086	0.065
0	RUBBER AND MIS. PLASTICS PRODUCTS	2295	2295	99.14	81.12	90.13	0.228	0.186	0.207	0.157
1	LEATHER AND LEATHER PRODUCTS	11	11	28.78	23.54	26.16	0.000	0.000	0.000	0.000
2	STONE- CLAY- AND GLASS PRODUCTS	2246	2246	253.18	207.14	230.16	0.569	0.465	0.517	0.392
3	PRIMARY METAL INDUSTRIES	1578	1578	86.03	70.39	78.21	0.136	0.111	0.123	0.094
4	FABRICATED METAL PRODUCTS	3502	3502	174.20	142.52	158.36	0.610	0.499	0.555	0.421
5	INDUSTRIAL MACHINERY AND EQUIPMENT	2072	2072	52.78	43.18	47.98	0.109	0.089	0.099	0.075
5	ELECTRONIS & OTHER ELECTRIC EQUIPMENT	1397	1397	98.43	80.53	89.48	0.138	0.113	0.125	0.095
7	TRANSPORTATION EQUIPMENT	5892	5892	68.89	56.46	62.67	0.406	0.333	0.369	0.280
3	INSTRUMENTS & RELATED PRODUCTS	479	479	57.89	47.37	52.63	0.028	0.023	0.025	0.019
?	MISC. MANUFACTURING INDUSTRIES	645	645	42.84	35.05	38.95	0.028	0.023	0.025	0.019
ufacturing	Total	31006	31006	125.97	103.55	114.76	3.906	3.211	3.558	2.700
nsportation										
	LOCAL & INTERURBAN PASSEN. TRANS.	1210	1210	17.52	13.21	15.37	0.021	0.016	0.019	0.013
	TRUCKING AND WAREHOUSING	5827	5827	113.73	85.79	99.76	0.663	0.500	0.581	0.408 &
	WATER TRANSPORTATION	34	34	167.18	126.12	146.65	0.006	0.004	0.005	0.004
	TRANSPORTATION BY AIR	1154	1154	120.14	90.64	105.39	0.139	0.105	0.122	0.085
	TRANSPORTATION SERVICES	325	325	73.75	55.63	64.69	0.024	0.018	0.021	0.015
	COMMUNICATIONS	3393	3393	30.18	22.76	26.47	0.102	0.077	0.090	0.063
	ELECTRIC- GAS- & SANITARY SERV.	3884	3884	58.14	43.86	51.00	0.226	0.170	0.198	0.139
nsportation	Total	18132	18132	72.24	54.50	63.37	1.310	0.988	1.149	0.807
lesale										
	WHOLESALE TRADE-DURABLE GOODS	8001	8001	21.51	16.23	18.87	0.172	0.130	0.151	0.106
	WHOLESALE TRADE-NONDURABLE GOODS	5365	5365	182.94	138.00	160.47	0.981	0.740	0.861	0.605
lesale	Total	13367	13367	86.30	65.11	75.70	1.154	0.870	1.012	0.711
ail										
	BUILD. MATERIALS & GARDEN SUPPL.	2714	2714	24.00	18.10	21.05	0.065	0.049	0.057	0.040
	GENERAL MERCHANDISE STORES	10176	10176	26.11	19.69	22.90	0.266	0.200	0.233	0.164
	FOOD STORES	9288	9288	149.65	112.89	131.27	1.390	1.049	1.219	0.857
	AUTO. DEALERS & SERVICE STATIONS	8300	8300	40.55	30.59	35.57	0.337	0.254	0.295	0.207
	APPAREL AND ACCESSORY STORES	3378	3378	54.40	41.04	47.72	0.184	0.139	0.161	0.113
	FURNITURE & HOMEFURNISH. STORES	2629	2629	65.33	49.29	57.31	0.172	0.130	0.151	0.106
	EATING AND DRINKING PLACES	19370	19370	149.03	112.43	130.73	2.887	2.178	2.532	1.779
	MISCELLANEOUS RETAIL	5918	5918	24.56	18.52	21.54	0.145	0.110	0.127	0.090
il	Total	61779	61779	88.14	66.49	77.31	5.445	4.108	4.776	3.356
nces										
	DEPOSITORY INSTITUTIONS	3681	3681	51.87	39.13	45.50	0.191	0.144	0.167	0.118
	NONDEPOSITORY INSTITUTIONS	1328	1328	228.47	172.35	200.41	0.304	0.229	0.266	0.187
	SECURITY & COMMODITY BROKERS	201	201	67.15	50.65	58.90	0.014	0.010	0.012	0.008
	INSURACE CARRIERS	1470	1470	155.38	117.22	136.30	0.228	0.172	0.200	0.141
	INSUR. AGENTS- BROKERS & SERVICE	970	970	107.16	80.84	94.00	0.104	0.078	0.091	0.064
	REAL ESTATE	2853	2853	80.71	60.89	70.80	0.230	0.174	0.202	0.142
	HOLDING & OTHER INVESTMENT OFF.	89	89	80.71	60.89	70.80	0.007	0.005	0.006	0.004
nces	Total	10595	10595	101.74	76.75	89.25	1.078	0.813	0.946	0.664

ervices									
70 HOTELS & OTHER LODGING PLACES	3636	3636	216.22	163.12	189.67	0.786	0.593	0.690	0.485
72 PERSONAL SERVICES	2601	2601	609.51	459.81	534.66	1.585	1.196	1.391	0.977 &
75 AUTO REPAIR- SERVICES- AND PARK.	3454	3454	84.27	63.57	73.92	0.291	0.220	0.255	0.179
76 MISC. REPAIR SERVICES	1029	1029	68.91	51.99	60.45	0.071	0.054	0.062	0.044
78 MOTION PICTURES	966	966	128.71	97.09	112.90	0.124	0.094	0.109	0.077
79 AMUSEMENT & RECREATION SERVICES	3549	3549	542.49	409.25	475.87	1.925	1.452	1.689	1.187
10 HEALTH SERVICES	28994	28994	105.56	79.64	92.60	3.061	2.309	2.685	1.886
11 LEGAL SERVICES	1208	1208	86.98	65.62	76.30	0.105	0.079	0.092	0.065
12 EDUCATIONAL SERVICES	28428	28428	238.37	179.83	209.10	6.777	5.112	5.944	4.176
13 SOCIAL SERVICES	4487	4487	109.86	82.88	96.37	0.493	0.372	0.432	0.304
4 MUSEUMS- BOTANICAL- ZOO. GARDENS	24	24	240.87	181.71	211.29	0.006	0.004	0.005	0.004
6 MEMBERSHIP ORGANIZATIONS	2067	2067	147.86	111.54	129.70	0.306	0.231	0.268	0.188
7 ENGINEERING & MANAGEMENT SERVICES	5359	5359	98.22	74.10	86.16	0.526	0.397	0.462	0.324
8 PRIVATE HOUSEHOLDS	1712	1712	0.00	0.00	0.00	0.000	0.000	0.000	0.000
9 SERVICES	34	34	92.91	69.70	81.31	0.003	0.002	0.003	0.002
rvices Total	100541	100541	169.54	127.90	148.72	17.046	12.859	14.952	10.505
blic Administration									
PUBLIC ADMINISTRATION (91-97)	13045	13045	334.89	241.92	288.40	4.369	3.156	3.762	2.226
blic Administration Total	13045	13045	334.89	241.92	288.40	4.369	3.156	3.762	2.226
al Nonresidential	270460	270460	130.26	98.73	114.49	35.230	26.701	30.966	21.538

ailed Report R3 (Nonresidential SIC) for 2020

residential Group Description	Number of Employees Summer	Winter	Water Use Per Unit (GPD) Summer	Winter	Ann. Avg.	Average Water Use (MGD) Summer	Winter	Ann. Avg.	Tot. Ann. Sewer (MGD)
nstruction									
GENERAL BUILDING CONTRACTORS	4691	4691	39.89	30.09	34.99	0.187	0.141	0.164	0.115
HEAVY CONSTRUCT.- EX. BUILDING	3777	3777	9.85	7.43	8.64	0.037	0.028	0.033	0.023
SPECIAL TRADE CONTRACTORS	15827	15827	50.29	37.93	44.11	0.796	0.600	0.698	0.490
struction Total	24296	24296	41.99	31.68	36.83	1.020	0.770	0.895	0.629
ufacturing									
FOOD AND KINDRED PRODUCTS	2378	2378	178.06	145.68	161.87	0.423	0.346	0.385	0.292
TEXTILE MILL PRODUCTS	57	57	598.51	489.69	544.10	0.035	0.028	0.031	0.024 &
LUMBER AND WOOD PRODUCTS	2456	2456	44.51	36.68	40.59	0.109	0.090	0.100	0.076
FURNITURE AND FIXTURES	1397	1397	40.76	33.34	37.05	0.057	0.047	0.052	0.039
PAPER AND ALLIED PRODUCTS	994	994	565.77	462.91	514.34	0.563	0.460	0.511	0.388
PRINTING AND PUBLISHING	2260	2260	45.98	37.62	41.80	0.104	0.085	0.095	0.072
CHEMICALS AND ALLIED PRODUCTS	1261	1261	295.91	242.11	269.01	0.373	0.305	0.339	0.257
PETROLEUM AND COAL PRODUCTS	52	52	1929.82	1578.94	1754.38	0.102	0.083	0.092	0.070
RUBBER AND MIS. PLASTICS PRODUCTS	2480	2480	99.14	81.12	90.13	0.246	0.201	0.224	0.170
LEATHER AND LEATHER PRODUCTS	11	11	28.78	23.54	26.16	0.000	0.000	0.000	0.000
STONE- CLAY- AND GLASS PRODUCTS	2427	2427	253.18	207.14	230.16	0.615	0.503	0.559	0.424

33	PRIMARY METAL INDUSTRIES	1704	1704	86.03	70.39	78.21	0.147	0.120	0.133	0.101
34	FABRICATED METAL PRODUCTS	3783	3783	174.20	142.52	158.36	0.659	0.539	0.599	0.455
35	INDUSTRIAL MACHINERY AND EQUIPMENT	2238	2238	52.78	43.18	47.98	0.118	0.097	0.107	0.081
36	ELECTRONIS & OTHER ELECTRIC EQUIPMENT	1509	1509	98.43	80.53	89.48	0.149	0.122	0.135	0.102
37	TRANSPORTATION EQUIPMENT	6365	6365	68.89	56.46	62.67	0.439	0.359	0.399	0.303
38	INSTRUMENTS & RELATED PRODUCTS	518	518	57.89	47.37	52.63	0.030	0.025	0.027	0.021
39	MISC. MANUFACTURING INDUSTRIES	696	696	42.84	35.05	38.95	0.030	0.024	0.027	0.021
lanufacturing	Total	33497	33497	125.97	103.55	114.76	4.219	3.469	3.844	2.917
ransportation										
41	LOCAL & INTERURBAN PASSEN. TRANS.	1339	1339	17.52	13.21	15.37	0.023	0.018	0.021	0.014
42	TRUCKING AND WAREHOUSING	6448	6448	113.73	85.79	99.76	0.733	0.553	0.643	0.452
43	U.S. POSTAL SERVICE	2545	2545	56.20	42.40	49.30	0.143	0.108	0.125	0.088
44	WATER TRANSPORTATION	38	38	167.18	126.12	146.65	0.006	0.005	0.006	0.004
45	TRANSPORTATION BY AIR	1277	1277	120.14	90.64	105.39	0.153	0.116	0.135	0.095
47	TRANSPORTATION SERVICES	359	359	73.75	55.63	64.69	0.027	0.020	0.023	0.016
48	COMMUNICATIONS	3754	3754	30.18	22.76	26.47	0.113	0.085	0.099	0.070
49	ELECTRIC- GAS- & SANITARY SERV.	4298	4298	58.14	43.86	51.00	0.250	0.189	0.219	0.154
ansportation	Total	20064	20064	72.24	54.50	63.37	1.449	1.093	1.271	0.893
iolesale										
50	WHOLESALE TRADE-DURABLE GOODS	8880	8880	21.51	16.23	18.87	0.191	0.144	0.168	0.118
51	WHOLESALE TRADE-NONDURABLE GOODS	5954	5954	182.94	138.00	160.47	1.089	0.822	0.955	0.671
iolesale	Total	14834	14834	86.30	65.11	75.70	1.280	0.966	1.123	0.789
tail										
2	BUILD. MATERIALS & GARDEN SUPPL.	3018	3018	24.00	18.10	21.05	0.072	0.055	0.064	0.045 &
4	FOOD STORES	10329	10329	149.65	112.89	131.27	1.546	1.166	1.356	0.953
5	AUTO. DEALERS & SERVICE STATIONS	9230	9230	40.55	30.59	35.57	0.374	0.282	0.328	0.231
6	APPAREL AND ACCESSORY STORES	3757	3757	54.40	41.04	47.72	0.204	0.154	0.179	0.126
7	FURNITURE & HOMEFURNISH. STORES	2923	2923	65.33	49.29	57.31	0.191	0.144	0.168	0.118
8	EATING AND DRINKING PLACES	21540	21540	149.03	112.43	130.73	3.210	2.422	2.816	1.978
9	MISCELLANEOUS RETAIL	6582	6582	24.56	18.52	21.54	0.162	0.122	0.142	0.100
tail	Total	68703	68703	88.14	66.49	77.31	6.055	4.568	5.312	3.732
nances										
)	DEPOSITORY INSTITUTIONS	4073	4073	51.87	39.13	45.50	0.211	0.159	0.185	0.130
I	NONDEPOSITORY INSTITUTIONS	1470	1470	228.47	172.35	200.41	0.336	0.253	0.295	0.207
?	SECURITY & COMMODITY BROKERS	223	223	67.15	50.65	58.90	0.015	0.011	0.013	0.009
3	INSURACE CARRIERS	1626	1626	155.38	117.22	136.30	0.253	0.191	0.222	0.156
	INSUR. AGENTS- BROKERS & SERVICE	1073	1073	107.16	80.84	94.00	0.115	0.087	0.101	0.071
	REAL ESTATE	3157	3157	80.71	60.89	70.80	0.255	0.192	0.224	0.157
	HOLDING & OTHER INVESTMENT OFF.	99	99	80.71	60.89	70.80	0.008	0.006	0.007	0.005
iances	Total	11724	11724	101.74	76.75	89.25	1.193	0.900	1.046	0.735
vices										
	HOTELS & OTHER LODGING PLACES	4067	4067	216.22	163.12	189.67	0.880	0.663	0.771	0.542
	PERSONAL SERVICES	2909	2909	609.51	459.81	534.66	1.774	1.338	1.556	1.093
	BUSINESS SERVICES	14528	14528	75.87	57.23	66.55	1.102	0.832	0.967	0.679

75 AUTO REPAIR- SERVICES- AND PARK.	3864	3864	84.27	63.57	73.92	0.326	0.246	0.286	0.201
76 MISC. REPAIR SERVICES	1151	1151	68.91	51.99	60.45	0.079	0.060	0.070	0.049
78 MOTION PICTURES	1081	1081	128.71	97.09	112.90	0.139	0.105	0.122	0.086
79 AMUSEMENT & RECREATION SERVICES	3970	3970	542.49	409.25	475.87	2.154	1.625	1.889	1.327
80 HEALTH SERVICES	32434	32434	105.56	79.64	92.60	3.424	2.583	3.003	2.110
81 LEGAL SERVICES	1352	1352	86.98	65.62	76.30	0.118	0.089	0.103	0.072
82 EDUCATIONAL SERVICES	31802	31802	238.37	179.83	209.10	7.581	5.719	6.650	4.672
83 SOCIAL SERVICES	5019	5019	109.86	82.88	96.37	0.551	0.416	0.484	0.340
84 MUSEUMS- BOTANICAL- ZOO. GARDENS	27	27	240.87	181.71	211.29	0.007	0.005	0.006	0.004
86 MEMBERSHIP ORGANIZATIONS	2313	2313	147.86	111.54	129.70	0.342	0.258	0.300	0.211
87 ENGINEERING & MANAGEMENT SERVICES	5995	5995	98.22	74.10	86.16	0.589	0.444	0.517	0.363
88 PRIVATE HOUSEHOLDS	1915	1915	0.00	0.00	0.00	0.000	0.000	0.000	0.000
89 SERVICES	38	38	92.91	69.70	81.31	0.004	0.003	0.003	0.002
Services Total	112472	112472	169.54	127.90	148.72	19.068	14.385	16.727	11.751 &
G PUBLIC ADMINISTRATION (91-97)	13687	13687	334.89	241.92	288.40	4.584	3.311	3.947	2.335
Public Administration Total	13687	13687	334.89	241.92	288.40	4.584	3.311	3.947	2.335
Total Nonresidential	299277	299277	129.88	98.44	114.16	38.869	29.461	34.165	23.782

Detailed Report R3 (Nonresidential SIC) for 2025

Nonresidential Group Description	Number of Employees Summer	Winter	Water Use Per Unit (GPD) Summer	Winter	Ann. Avg.	Average Water Use (MGD) Summer	Winter	Ann. Avg.	Tot. Ann. Sewer (MGD)
Construction									
15 GENERAL BUILDING CONTRACTORS	5174	5174	39.89	30.09	34.99	0.206	0.156	0.181	0.127
16 HEAVY CONSTRUCT.- EX. BUILDING	4166	4166	9.85	7.43	8.64	0.041	0.031	0.036	0.025
17 SPECIAL TRADE CONTRACTORS	17457	17457	50.29	37.93	44.11	0.878	0.662	0.770	0.541
Construction Total	26798	26798	41.99	31.68	36.83	1.125	0.849	0.987	0.693
Manufacturing									
20 FOOD AND KINDRED PRODUCTS	2563	2563	178.06	145.68	161.87	0.457	0.374	0.415	0.315
22 TEXTILE MILL PRODUCTS	62	62	598.51	489.69	544.10	0.037	0.031	0.034	0.026
23 APPAREL AND OTHER TEXTILE PRODUCTS	971	971	24.40	36.71	30.55	0.024	0.036	0.030	0.023
24 LUMBER AND WOOD PRODUCTS	2648	2648	44.51	36.68	40.59	0.118	0.097	0.108	0.082
25 FURNITURE AND FIXTURES	1506	1506	40.76	33.34	37.05	0.061	0.050	0.056	0.042
26 PAPER AND ALLIED PRODUCTS	1072	1072	565.77	462.91	514.34	0.607	0.496	0.551	0.418
27 PRINTING AND PUBLISHING	2437	2437	45.98	37.62	41.80	0.112	0.092	0.102	0.077
28 CHEMICALS AND ALL:ED PRODUCTS	1359	1359	295.91	242.11	269.01	0.402	0.329	0.366	0.278
29 PETROLEUM AND COAL PRODUCTS	56	56	1929.82	1578.94	1754.38	0.110	0.090	0.100	0.076
30 RUBBER AND MIS. PLASTICS PRODUCTS	2673	2673	99.14	81.12	90.13	0.265	0.217	0.241	0.183
31 LEATHER AND LEATHER PRODUCTS	12	12	28.78	23.54	26.16	0.000	0.000	0.000	0.000
32 STONE- CLAY- AND GLASS PRODUCTS	2617	2617	253.18	207.14	230.16	0.663	0.542	0.602	0.457
33 PRIMARY METAL INDUSTRIES	1838	1838	86.03	70.39	78.21	0.158	0.129	0.144	0.109
34 FABRICATED METAL PRODUCTS	4079	4079	174.20	142.52	158.36	0.711	0.581	0.646	0.490
35 INDUSTRIAL MACHINERY AND EQUIPMENT	2413	2413	52.78	43.18	47.98	0.127	0.104	0.116	0.088
36 ELECTRON[illegible] OTHER ELECTRIC EQUIPMENT	1627	1627	98.43	8[illegible]	89.48	0.160	0.131	0.146	0.110
37 TRANSP[illegible]N EQUIPMENT	6863	6863	68.89	[illegible]	62.67	0.473	0.387	0.430	0.326

38 INSTRUMENTS & RELATED PRODUCTS	559	559	57.89	47.37	52.63	0.032	0.026	0.029	0.022 &
Manufacturing Total	36114	36114	125.97	103.55	114.76	4.549	3.740	4.144	3.145
Transportation									
41 LOCAL & INTERURBAN PASSEN. TRANS.	1480	1480	17.52	13.21	15.37	0.026	0.020	0.023	0.016
42 TRUCKING AND WAREHOUSING	7124	7124	113.73	85.79	99.76	0.810	0.611	0.711	0.499
43 U.S. POSTAL SERVICE	2812	2812	56.20	42.40	49.30	0.158	0.119	0.139	0.097
44 WATER TRANSPORTATION	42	42	167.18	126.12	146.65	0.007	0.005	0.006	0.004
45 TRANSPORTATION BY AIR	1411	1411	120.14	90.64	105.39	0.170	0.128	0.149	0.105
47 TRANSPORTATION SERVICES	397	397	73.75	55.63	64.69	0.029	0.022	0.026	0.018
48 COMMUNICATIONS	4149	4149	30.18	22.76	26.47	0.125	0.094	0.110	0.077
49 ELECTRIC- GAS- & SANITARY SERV.	4749	4749	58.14	43.86	51.00	0.276	0.208	0.242	0.170
Transportation Total	22170	22170	72.24	54.50	63.37	1.602	1.208	1.405	0.987
Wholesale									
50 WHOLESALE TRADE-DURABLE GOODS	9840	9840	21.51	16.23	18.87	0.212	0.160	0.186	0.130
51 WHOLESALE TRADE-NONDURABLE GOODS	6597	6597	182.94	138.00	160.47	1.207	0.911	1.059	0.744
Wholesale Total	16438	16438	86.30	65.11	75.70	1.419	1.070	1.244	0.874
Retail									
52 BUILD. MATERIALS & GARDEN SUPPL.	3351	3351	24.00	18.10	21.05	0.080	0.061	0.071	0.050
53 GENERAL MERCHANDISE STORES	12566	12566	26.11	19.69	22.90	0.328	0.247	0.288	0.202
54 FOOD STORES	11469	11469	149.65	112.89	131.27	1.716	1.295	1.506	1.058
55 AUTO. DEALERS & SERVICE STATIONS	10249	10249	40.55	30.59	35.57	0.416	0.314	0.365	0.256
56 APPAREL AND ACCESSORY STORES	4172	4172	54.40	41.04	47.72	0.227	0.171	0.199	0.140
57 FURNITURE & HOMEFURNISH. STORES	3246	3246	65.33	49.29	57.31	0.212	0.160	0.186	0.131
58 EATING AND DRINKING PLACES	23920	23920	149.03	112.43	130.73	3.565	2.689	3.127	2.197
59 MISCELLANEOUS RETAIL	7309	7309	24.56	18.52	21.54	0.179	0.135	0.157	0.111
Retail Total	76291	76291	88.14	66.49	77.31	6.724	5.072	5.898	4.144
Finances									
60 DEPOSITORY INSTITUTIONS	4501	4501	51.87	39.13	45.50	0.233	0.176	0.205	0.144
61 NONDEPOSITORY INSTITUTIONS	1624	1624	228.47	172.35	200.41	0.371	0.280	0.326	0.229
62 SECURITY & COMMODITY BROKERS	246	246	67.15	50.65	58.90	0.017	0.012	0.015	0.010
63 INSURACE CARRIERS	1797	1797	155.38	117.22	136.30	0.279	0.211	0.245	0.172
64 INSUR. AGENTS- BROKERS & SERVICE	1186	1186	107.16	80.84	94.00	0.127	0.096	0.112	0.078
65 REAL ESTATE	3489	3489	80.71	60.89	70.80	0.282	0.212	0.247	0.174 &
Finances Total	12955	12955	101.74	76.75	89.25	1.318	0.994	1.156	0.812
Services									
70 HOTELS & OTHER LODGING PLACES	4543	4543	216.22	163.12	189.67	0.982	0.741	0.862	0.605
72 PERSONAL SERVICES	3250	3250	609.51	459.81	534.66	1.981	1.494	1.738	1.221
73 BUSINESS SERVICES	16227	16227	75.87	57.23	66.55	1.231	0.929	1.080	0.759
75 AUTO REPAIR- SERVICES- AND PARK.	4316	4316	84.27	63.57	73.92	0.364	0.274	0.319	0.224
76 MISC. REPAIR SERVICES	1285	1285	68.91	51.99	60.45	0.089	0.067	0.078	0.055
78 MOTION PICTURES	1207	1207	128.71	97.09	112.90	0.155	0.117	0.136	0.096
79 AMUSEMENT & RECREATION SERVICES	4434	4434	542.49	409.25	475.87	2.406	1.815	2.110	1.483
80 HEALTH SERVICES	36226	36226	105.56	79.64	92.60	3.824	2.885	3.355	2.357
81 LEGAL SERVICES	1510	1510	86.98	65.62	76.30	0.131	0.099	0.115	0.081

82	EDUCATIONAL SERVICES	35519	35519	238.37	179.83	209.10	8.467	6.387	7.427	5.218
83	SOCIAL SERVICES	5606	5606	109.86	82.88	96.37	0.616	0.465	0.540	0.380
84	MUSEUMS- BOTANICAL- ZOO. GARDENS	30	30	240.87	181.71	211.29	0.007	0.006	0.006	0.005
86	MEMBERSHIP ORGANIZATIONS	2583	2583	147.86	111.54	129.70	0.382	0.288	0.335	0.235
87	ENGINEERING & MANAGEMENT SERVICES	6696	6696	98.22	74.10	86.16	0.658	0.496	0.577	0.405
88	PRIVATE HOUSEHOLDS	2139	2139	0.00	0.00	0.00	0.000	0.000	0.000	0.000
89	SERVICES	42	42	92.91	69.70	81.31	0.004	0.003	0.003	0.002
Services	Total	125621	125621	169.54	127.90	148.72	21.298	16.067	18.682	13.125
Public Administration										
G	PUBLIC ADMINISTRATION (91-97)	14296	14296	334.89	241.92	288.40	4.788	3.458	4.123	2.439
Public Administration	Total	14296	14296	334.89	241.92	288.40	4.788	3.458	4.123	2.439
Total Nonresidential		330683	330683	129.50	98.16	113.83	42.822	32.459	37.640	26.221

Detailed Report R3 (Nonresidential SIC) for 2030

Nonresidential Group	Description	Number of Employees Summer	Number of Employees Winter	Water Use Per Unit (GPD) Summer	Water Use Per Unit (GPD) Winter	Water Use Per Unit (GPD) Ann. Avg.	Average Water Use (MGD) Summer	Average Water Use (MGD) Winter	Average Water Use (MGD) Ann. Avg.	Tot. Ann. Sewer (MGD)
Construction										
15	GENERAL BUILDING CONTRACTORS	5648	5648	39.89	30.09	34.99	0.225	0.170	0.198	0.139
16	HEAVY CONSTRUCT.- EX. BUILDING	4549	4549	9.85	7.43	8.64	0.045	0.034	0.039	0.028 &
Construction	Total	29257	29257	41.99	31.68	36.83	1.229	0.927	1.078	0.757
Manufacturing										
20	FOOD AND KINDRED PRODUCTS	2734	2734	178.06	145.68	161.87	0.487	0.398	0.443	0.336
22	TEXTILE MILL PRODUCTS	66	66	598.51	489.69	544.10	0.040	0.033	0.036	0.027
23	APPAREL AND OTHER TEXTILE PRODUCTS	1035	1035	24.40	36.71	30.55	0.025	0.038	0.032	0.025
24	LUMBER AND WOOD PRODUCTS	2824	2824	44.51	36.68	40.59	0.126	0.104	0.115	0.087
25	FURNITURE AND FIXTURES	1606	1606	40.76	33.34	37.05	0.065	0.054	0.060	0.045
26	PAPER AND ALLIED PRODUCTS	1143	1143	565.77	462.91	514.34	0.647	0.529	0.588	0.446
27	PRINTING AND PUBLISHING	2599	2599	45.98	37.62	41.80	0.120	0.098	0.109	0.082
28	CHEMICALS AND ALLIED PRODUCTS	1450	1450	295.91	242.11	269.01	0.429	0.351	0.390	0.296
29	PETROLEUM AND COAL PRODUCTS	60	60	1929.82	1578.94	1754.38	0.117	0.096	0.106	0.081
30	RUBBER AND MIS. PLASTICS PRODUCTS	2851	2851	99.14	81.12	90.13	0.283	0.231	0.257	0.195
31	LEATHER AND LEATHER PRODUCTS	13	13	28.78	23.54	26.16	0.000	0.000	0.000	0.000
32	STONE- CLAY- AND GLASS PRODUCTS	2791	2791	253.18	207.14	230.16	0.707	0.578	0.642	0.487
33	PRIMARY METAL INDUSTRIES	1960	1960	86.03	70.39	78.21	0.169	0.138	0.153	0.116
34	FABRICATED METAL PRODUCTS	4350	4350	174.20	142.52	158.36	0.758	0.620	0.689	0.523
35	INDUSTRIAL MACHINERY AND EQUIPMENT	2574	2574	52.78	43.18	47.98	0.136	0.111	0.124	0.094
36	ELECTRONIS & OTHER ELECTRIC EQUIPMENT	1735	1735	98.43	80.53	89.48	0.171	0.140	0.155	0.118
37	TRANSPORTATION EQUIPMENT	7319	7319	68.89	56.46	62.67	0.504	0.413	0.459	0.348
38	INSTRUMENTS & RELATED PRODUCTS	596	596	57.89	47.37	52.63	0.035	0.028	0.031	0.024
39	MISC. MANUFACTURING INDUSTRIES	801	801	42.84	35.05	38.95	0.034	0.028	0.031	0.024
Manufacturing	Total	38515	38515	125.97	103.55	114.76	4.852	3.988	4.420	3.354

Transportation

41 LOCAL & INTERURBAN PASSEN. TRANS.	1618	1618	17.52	13.21	15.37	0.028	0.021	0.025	0.017
42 TRUCKING AND WAREHOUSING	7792	7792	113.73	85.79	99.76	0.886	0.669	0.777	0.546
43 U.S. POSTAL SERVICE	3075	3075	56.20	42.40	49.30	0.173	0.130	0.152	0.107
44 WATER TRANSPORTATION	45	45	167.18	126.12	146.65	0.008	0.006	0.007	0.005
45 TRANSPORTATION BY AIR	1543	1543	120.14	90.64	105.39	0.185	0.140	0.163	0.114
47 TRANSPORTATION SERVICES	434	434	73.75	55.63	64.69	0.032	0.024	0.028	0.020
48 COMMUNICATIONS	4537	4537	30.18	22.76	26.47	0.137	0.103	0.120	0.084
49 ELECTRIC- GAS- & SANITARY SERV.	5194	5194	58.14	43.86	51.00	0.302	0.228	0.265	0.186
Transportation Total	24246	24246	72.24	54.50	63.37	1.752	1.321	1.536	1.079
Wholesale &									
51 WHOLESALE TRADE-NONDURABLE GOODS	7236	7236	182.94	138.00	160.47	1.324	0.999	1.161	0.816
Wholesale Total	18029	18029	86.30	65.11	75.70	1.556	1.174	1.365	0.959
Retail									
52 BUILD. MATERIALS & GARDEN SUPPL.	3684	3684	24.00	18.10	21.05	0.088	0.067	0.078	0.054
53 GENERAL MERCHANDISE STORES	13811	13811	26.11	19.69	22.90	0.361	0.272	0.316	0.222
54 FOOD STORES	12606	12606	149.65	112.89	131.27	1.887	1.423	1.655	1.163
55 AUTO. DEALERS & SERVICE STATIONS	11265	11265	40.55	30.59	35.57	0.457	0.345	0.401	0.282
56 APPAREL AND ACCESSORY STORES	4585	4585	54.40	41.04	47.72	0.249	0.188	0.219	0.154
57 FURNITURE & HOMEFURNISH. STORES	3568	3568	65.33	49.29	57.31	0.233	0.176	0.205	0.144
58 EATING AND DRINKING PLACES	26290	26290	149.03	112.43	130.73	3.918	2.956	3.437	2.415
59 MISCELLANEOUS RETAIL	8033	8033	24.56	18.52	21.54	0.197	0.149	0.173	0.122
Retail Total	83850	83850	88.14	66.49	77.31	7.390	5.575	6.483	4.554
Finances									
60 DEPOSITORY INSTITUTIONS	4922	4922	51.87	39.13	45.50	0.255	0.193	0.224	0.157
61 NONDEPOSITORY INSTITUTIONS	1776	1776	228.47	172.35	200.41	0.406	0.306	0.356	0.250
62 SECURITY & COMMODITY BROKERS	269	269	67.15	50.65	58.90	0.018	0.014	0.016	0.011
63 INSURACE CARRIERS	1965	1965	155.38	117.22	136.30	0.305	0.230	0.268	0.188
64 INSUR. AGENTS- BROKERS & SERVICE	1297	1297	107.16	80.84	94.00	0.139	0.105	0.122	0.086
65 REAL ESTATE	3816	3816	80.71	60.89	70.80	0.308	0.232	0.270	0.190
67 HOLDING & OTHER INVESTMENT OFF.	119	119	80.71	60.89	70.80	0.010	0.007	0.008	0.006
Finances Total	14168	14168	101.74	76.75	89.25	1.442	1.087	1.264	0.888
Services									
70 HOTELS & OTHER LODGING PLACES	5021	5021	216.22	163.12	189.67	1.086	0.819	0.953	0.669
72 PERSONAL SERVICES	3592	3592	609.51	459.81	534.66	2.190	1.652	1.921	1.350
73 BUSINESS SERVICES	17937	17937	75.87	57.23	66.55	1.361	1.027	1.194	0.839
75 AUTO REPAIR- SERVICES- AND PARK.	4771	4771	84.27	63.57	73.92	0.402	0.303	0.353	0.248
76 MISC. REPAIR SERVICES	1421	1421	68.91	51.99	60.45	0.098	0.074	0.086	0.060
78 MOTION PICTURES	1335	1335	128.71	97.09	112.90	0.172	0.130	0.151	0.106
79 AMUSEMENT & RECREATION SERVICES	4901	4901	542.49	409.25	475.87	2.659	2.006	2.333	1.639
80 HEALTH SERVICES	40044	40044	105.56	79.64	92.60	4.227	3.189	3.708	2.605
81 LEGAL SERVICES	1669	1669	86.98	65.62	76.30	0.145	0.110	0.127	0.090
82 EDUCATIONAL SERVICES	39263	39263	238.37	179.83	209.10	9.359	7.061	8.210	5.768
83 SOCIAL SERVICES	6197	6197	109.86	82.88	96.37	0.681	0.514	0.597	0.420 &
86 MEMBERSHIP ORGANIZATIONS	2855	2855	147.86	111.54	129.70	0.422	0.319	0.370	0.260
87 ENGINEERING & MANAGEMENT SERVICES	7402	7402	98.22	74.10	86.16	0.727	0.548	0.638	0.448

88 PRIVATE HOUSFHOLDS	2364	2364	0.00	0.(	0.00	0.000	0.000	0.000	0.000
89 SERVICES	47	47	92.91	69.7υ	81.31	0.004	0.003	0.004	0.003
Services Total	138860	138860	169.54	127.90	148.72	23.542	17.760	20.651	14.509
Public Administration									
G PUBLIC ADMINISTRATION (91-97)	14731	14731	334.89	241.92	288.40	4.933	3.564	4.248	2.513
Public Administration Total	14731	14731	334.89	241.92	288.40	4.933	3.564	4.248	2.513
otal Nonresidential	361656	361656	129.11	97.87	113.49	46.695	35.396	41.045	28.615

ηd: August 18, 1995ĕ

ADDENDUM 4

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
GED COEFFICIENTS

SEASON	SIC	DESCRIP	GED COEF.
S	15	GENERAL BUILDING CONTRACTORS	39.8886
W	15	GENERAL BUILDING CONTRACTORS	30.0914
S	16	HEAVY CONSTRUCT.- EX. BUILDING	9.8496
W	16	HEAVY CONSTRUCT.- EX. BUILDING	7.4304
S	17	SPECIAL TRADE CONTRACTORS	50.2854
W	17	SPECIAL TRADE CONTRACTORS	37.9346
S	20	FOOD AND KINDRED PRODUCTS	178.0570
W	20	FOOD AND KINDRED PRODUCTS	145.6830
S	21	TOBACCO PRODUCTS	239.0300
W	21	TOBACCO PRODUCTS	195.3200
S	22	TEXTILE MILL PRODUCTS	598.5100
W	22	TEXTILE MILL PRODUCTS	489.6900
S	23	APPAREL AND OTHER TEXTILE PRODUCTS	24.3980
W	23	APPAREL AND OTHER TEXTILE PRODUCTS	36.7110
S	24	LUMBER AND WOOD PRODUCTS	44.5060
W	24	LUMBER AND WOOD PRODUCTS	36.6840
S	25	FURNITURE AND FIXTURES	40.7550
W	25	FURNITURE AND FIXTURES	33.3450
S	26	PAPER AND ALLIED PRODUCTS	565.7740
W	26	PAPER AND ALLIED PRODUCTS	462.9060
S	27	PRINTING AND PUBLISHING	45.9800
W	27	PRINTING AND PUBLISHING	37.6200
S	28	CHEMICALS AND ALLIED PRODUCTS	295.9110
W	28	CHEMICALS AND ALLIED PRODUCTS	242.1090
S	29	PETROLEUM AND COAL PRODUCTS	1929.8180
W	29	PETROLEUM AND COAL PRODUCTS	1578.9420
S	30	RUBBER AND MIS. PLASTICS PRODUCTS	99.1430
W	30	RUBBER AND MIS. PLASTICS PRODUCTS	81.1170
S	31	LEATHER AND LEATHER PRODUCTS	28.7760
W	31	LEATHER AND LEATHER PRODUCTS	23.5440
S	32	STONE- CLAY- AND GLASS PRODUCTS	253.1760

SEASON	SIC	DESCRIP	GED COEF.
W	32	STONE- CLAY- AND GLASS PRODUCTS	207.1440
S	33	PRIMARY METAL INDUSTRIES	86.0310
W	33	PRIMARY METAL INDUSTRIES	70.3890
S	34	FABRICATED METAL PRODUCTS	174.1960
W	34	FABRICATED METAL PRODUCTS	142.5240
S	35	INDUSTRIAL MACHINERY AND EQUIPMENT	52.7780
W	35	INDUSTRIAL MACHINERY AND EQUIPMENT	43.1820
S	36	ELECTRONIS & OTHER ELECTRIC EQUIPMENT	98.4280
W	36	ELECTRONIS & OTHER ELECTRIC EQUIPMENT	80.5320
S	37	TRANSPORTATION EQUIPMENT	68.8930
W	37	TRANSPORTATION EQUIPMENT	56.4570
S	38	INSTRUMENTS & RELATED PRODUCTS	57.8930
W	38	INSTRUMENTS & RELATED PRODUCTS	47.3670
S	39	MISC. MANUFACTURING INDUSTRIES	42.8450
W	39	MISC. MANUFACTURING INDUSTRIES	35.0550
S	40	RAILROAD TRANSPORTATION	77.0640
W	40	RAILROAD TRANSPORTATION	58.1360
S	41	LOCAL & INTERURBAN PASSEN. TRANS.	17.5218
W	41	LOCAL & INTERURBAN PASSEN. TRANS.	13.2096
S	42	TRUCKING AND WAREHOUSING	113.7264
W	42	TRUCKING AND WAREHOUSING	85.7936
S	43	U.S. POSTAL SERVICE	56.2020
W	43	U.S. POSTAL SERVICE	42.3980
S	44	WATER TRANSPORTATION	167.1810
W	44	WATER TRANSPORTATION	126.1190
S	45	TRANSPORTATION BY AIR	120.1446
W	45	TRANSPORTATION BY AIR	90.6354
S	46	PIPELINES- EXCEPT NATURAL GAS	56.2020
W	46	PIPELINES- EXCEPT NATURAL GAS	42.3980
S	47	TRANSPORTATION SERVICES	73.7466
W	47	TRANSPORTATION SERVICES	55.6334

SEASON	SIC	DESCRIP	GED COEF.
S	48	COMMUNICATIONS	30.1758
W	48	COMMUNICATIONS	22.7642
S	49	ELECTRIC- GAS- & SANITARY SERV.	58.1400
W	49	ELECTRIC- GAS- & SANITARY SERV.	43.8600
S	50	WHOLESALE TRADE-DURABLE GOODS	21.5118
W	50	WHOLESALE TRADE-DURABLE GOODS	16.2282
S	51	WHOLESALE TRADE-NONDURABLE GOODS	182.9358
W	51	WHOLESALE TRADE-NONDURABLE GOODS	138.0042
S	52	BUILD. MATERIALS & GARDEN SUPPL.	23.9970
W	52	BUILD. MATERIALS & GARDEN SUPPL.	18.1030
S	53	GENERAL MERCHANDISE STORES	26.1060
W	53	GENERAL MERCHANDISE STORES	19.6940
S	54	FOOD STORES	149.6478
W	54	FOOD STORES	112.8922
S	55	AUTO. DEALERS & SERVICE STATIONS	40.5498
W	55	AUTO. DEALERS & SERVICE STATIONS	30.5902
S	56	APPAREL AND ACCESSORY STORES	54.4008
W	56	APPAREL AND ACCESSORY STORES	41.0392
S	57	FURNITURE & HOMEFURNISH. STORES	65.3334
W	57	FURNITURE & HOMEFURNISH. STORES	49.2866
S	58	EATING AND DRINKING PLACES	149.0322
W	58	EATING AND DRINKING PLACES	112.4278
S	59	MISCELLANEOUS RETAIL	24.5556
W	59	MISCELLANEOUS RETAIL	18.5244
S	60	DEPOSITORY INSTITUTIONS	51.8700
W	60	DEPOSITORY INSTITUTIONS	39.1300
S	61	NONDEPOSITORY INSTITUTIONS	228.4674
W	61	NONDEPOSITORY INSTITUTIONS	172.3526
-S	62	SECURITY & COMMODITY BROKERS	67.1460
W	62	SECURITY & COMMODITY BROKERS	50.6540
S	63	INSURACE CARRIERS	155.3820

SEASON	SIC	DESCRIP	GED COEF.
W	63	INSURACE CARRIERS	117.2180
S	64	INSUR. AGENTS- BROKERS & SERVICE	107.1600
W	64	INSUR. AGENTS- BROKERS & SERVICE	80.8400
S	65	REAL ESTATE	80.7120
W	65	REAL ESTATE	60.8880
S	67	HOLDING & OTHER INVESTMENT OFF.	80.7120
W	67	HOLDING & OTHER INVESTMENT OFF.	60.8880
S	70	HOTELS & OTHER LODGING PLACES	216.2238
W	70	HOTELS & OTHER LODGING PLACES	163.1162
S	72	PERSONAL SERVICES	609.5124
W	72	PERSONAL SERVICES	459.8076
S	73	BUSINESS SERVICES	75.8670
W	73	BUSINESS SERVICES	57.2330
S	75	AUTO REPAIR- SERVICES- AND PARK.	84.2688
W	75	AUTO REPAIR- SERVICES- AND PARK.	63.5712
S	76	MISC. REPAIR SERVICES	68.9130
W	76	MISC. REPAIR SERVICES	51.9870
S	78	MOTION PICTURES	128.7060
W	78	MOTION PICTURES	97.0940
S	79	AMUSEMENT & RECREATION SERVICES	542.4918
W	79	AMUSEMENT & RECREATION SERVICES	409.2482
S	80	HEALTH SERVICES	105.5640
W	80	HEALTH SERVICES	79.6360
S	81	LEGAL SERVICES	86.9820
W	81	LEGAL SERVICES	65.6180
S	82	EDUCATIONAL SERVICES	238.3740
W	82	EDUCATIONAL SERVICES	179.8260
S	83	SOCIAL SERVICES	109.8618
W	83	SOCIAL SERVICES	32.8782
S	84	MUSEUMS- BOTANICAL- ZOO. GARDENS	240.8706
W	84	MUSEUMS- BOTANICAL- ZOO. GARDENS	181.7094

SEASON	SIC	DESCRIP	GED COEF.
S	86	MEMBERSHIP ORGANIZATIONS	147.8580
W	86	MEMBERSHIP ORGANIZATIONS	111.5420
S	87	ENGINEERING & MANAGEMENT SERVICES	98.2224
W	87	ENGINEERING & MANAGEMENT SERVICES	74.0976
S	88	PRIVATE HOUSEHOLDS	0.0000
W	88	PRIVATE HOUSEHOLDS	0.0000
S	89	SERVICES	92.9100
W	89	SERVICES	69.7030
S	G	PUBLIC ADMINISTRATION (91-97)	334.8900
W	G	PUBLIC ADMINISTRATION (91-97)	241.9200

Table 6B
Population Growth Rate Assumption

Interval	San Bernardino County Compound Annual Growth	Growth Rate Relative to 2000-2005
2005-2010	2.252%	.8707
2010-2015	2.318%	.8960
2015-2020	2.046%	.7907
2020-2025	2.016%	.7792
2025-2030	1.807%	.6984

Population in the SBVMWD service area is expected to increase from 546,229 in 1990 to 931,932 in 2010 and 1,397,439 in 2030. Over the 40-year period, the compound growth rate is 2.376 percent per year. CDOF [CDOF 1993] projects a 2.732 percent annual compound growth rate for San Bernardino County from 1990-2030, and the projected SBVMWD service area projection is consistent with that figure. It is also consistent with the SCAG estimates.

Housing

Projected Occupied Housing, Total and by Type

The projected number of occupied housing units is a function of both the population and the number of individuals per housing unit. Population projections for the SBVMWD service area were discussed above. The projected numbers of individuals per single- and multiple-family housing unit were estimated using the figures for 1990 (presented in Table 2), adjusted by changes in average household size projected by SCAG [SCAG 1994]. It was assumed that the change forecasted by SCAG would apply to both single-family and multiple-family residences. It was also assumed that the proportions of single-family and multiple-family households from 1990, i.e. 0.7058 and 0.2942 respectively, would remain constant in the future. Household size data are shown in Table 6C. Average household size is expected to increase modestly from current levels by 2000, then to decline by 2030 to levels comparable to those in 1990.

The projected numbers of occupied housing units, by type, are shown for the SBVMWD service area in Table 6A. Single-family units are expected to increase from 129,457 in 1990 to 332,647 in 2030, while multi-family units are expected to increase from 53,962 to 138,658 over the same period. The total number of occupied housing units in the service area is projected to increase from 183,419 in 1990 to 471,305 in 2030.

Table 6C
Projected Household Size, Single-Family and Multiple-Family Units, SBVMWD Service Area, Selected Years

	Average Persons / Household		
Year	Single Family	Multiple Family	All
1990	3.0477	2.8211	2.9780
1995	3.1192	2.8926	3.0495
2000	3.1907	2.9641	3.1210
2005	3.1587	2.9321	3.0890
2010	3.1267	2.9001	3.0570
2015	3.1037	2.8771	3.0340
2020	3.0807	2.8541	3.0110
2025	3.0577	2.8311	2.9880
2030	3.0347	2.8081	2.9650

Employment by Eight Major 1-Digit SIC Codes and Total

Long-term employment projections at the 1-digit or more detailed levels for San Bernardino County are not available from local, state, or federal agencies. SCAG [SCAG 1994] projects total employment for San Bernardino County through 2015, but not by industry. The U.S. Department of Commerce ("Commerce") projects employment by 1-digit industry through 2040 for the combined Riverside-San Bernardino Metropolitan Statistical Area (MSA). The latter are developed as part of that agency's Regional Economic Information System (REIS) [U.S. Department of Commerce, Economics and Statistics Administration, Bureau of Economic Analysis]. Employment projections in this study were based on a methodology using data from both sources.

Several factors were considered in deciding upon the projections and projection methodology to use for the SBVMWD service area. First is that only SCAG and REIS provide non-proprietary projections at the county or sub-county level of both population and employment. SCAG makes projections through 2015 and REIS has projections through 2040. REIS employment projections are available by 1-digit industry, while SCAG employment projections are for total employment only without industry disaggregation. Second is that projections for 1995 and later years that are based in part on actual data from 1990-1992 or 1990-1993 will incorporate the effects of the long recession in California and Southern California particularly. Third is that long-run projections, particularly for more than 20 years into the future, are extremely uncertain.

The most current REIS projections were purchased from Commerce for this project. The projections for the Riverside-San Bernardino MSA were used to calculate the ratio of population to nonfarm employment (also excluding agricultural services, forestry, and mining) for five-year intervals from 1995-2015. The REIS projections of population to nonfarm employment were compared to those of SCAG and were found to be consistent in magnitude and pattern. Since the SCAG data were available only through 2015, the REIS-based ratio in that year was held constant for later-year projections. The figures used and their reciprocal ratios of employment to population are shown in Table 7.

Table 7
Population/Employment Ratios Used for Projections

Year	Population Employment Ratio	Employment Population Ratio
1990	3.564	0.281
1995	3.624	0.276
2000	3.684	0.271
2005	3.744	0.267
2010	3.804	0.263
2015	3.864	0.259
2020	3.864	0.259
2025	3.864	0.259
2030	3.864	0.259

The ratio of employment-to-population was multiplied by projected population for each selected year to project total employment. The REIS 1-digit industry projections for the Riverside-San Bernardino MSA were used to calculate the composition of projected employment by industry in each year, and the percentages were multiplied by total employment to project 1-digit employment in the SBVMWD service area. The results are shown in Table 8.

Total employment in the SBVMWD service area is projected to increase from 153,270 in 1990 to 361,656 in 2030, a 136 percent increase. Employment in services is expected to grow more rapidly in both absolute and relative terms than any other sector, rising 16[illegible] percent or by almost 86,000 jobs. Manufacturing is expected to increase 95 percent, while retail trade employment increases 151 percent. The slowest growth is expected to be in public administration (government), which is projected to increase by 33 percent from 11,038 to 14,731.

Projected Median Household Income in $1990

Projections of median household income are not available at the county or sub-county levels from any government sources. Estimation of projected median household income for the SBVMWD service area is based in this study on the reported 1990 figure (from the Census), adjusted for inflation and changes in household size. The procedure is described below.

Median household income in 1990 for the SBVMWD service area was estimated to be $32,360. The projection for 1995 was calculated as:

$MEDHHI_{95} = MEDHHI_{90} * [1+\%chg(PCI_{90\text{-}95})] * [1+\%chg(POP/HH_{90\text{-}95})]$, where

$\%chg(PCI_{90\text{-}95})$ = percent change in per capita income between 1990 and 1995, and

$\%chg(POP/HH_{90\text{-}95})$ = percent change in number of persons per occupied household.

The calculations for later years were calculated in similar fashion, using the previous year as the basis for the adjustment. The results are shown in Table 9.

The projected percent change in per capita income was based on actual changes in that variable from 1985 through 1992. The change from 1990 through 1995 was based on the actual 1.1 percent compounded annual percent change from 1990 through 1992, which was assumed to increase to a 3.3 percent annual rate by 1995. The 3.3 percent annual rate is the midpoint between the annual growth rate over the growth period in the mid-to-late 1980s and the slower period from 1985-1992. The projected percent change thereafter was based on an annual 3.3 percent growth in per capita personal income. The percent change used for each five-year period from 1995-2030 was therefore 17.6 percent.

Table 8
Employment in SBVMWD Service Area
By Place of Work, Selected Years

Industry	1990	1995	2000	2005	2010	2015	2020	2025	2030
Construction	12,103	14,020	16,056	18,014	19,871	21,995	24,296	26,798	29,257
Manufacturing	19,706	21,599	24,000	26,323	28,593	31,006	33,497	36,114	38,515
Transportation & Public Utilities	10,035	11,575	13,225	14,818	16,354	18,132	20,064	22,170	24,246
Wholesale Trade	7,706	8,746	9,887	11,021	12,125	13,367	14,834	16,438	18,029
Retail Trade	33,390	38,731	44,657	50,308	55,645	61,779	68,703	76,291	83,850
Finance, Insurance, and Real Estate	6,147	6,931	7,846	8,740	9,615	10,595	11,724	12,955	14,168
Services	53,145	62,720	72,491	81,793	90,442	100,541	112,472	125,621	138,860
Public Administration	11,038	10,373	11,015	11,663	12,341	13,045	13,687	14,296	14,731
TOTAL	153,270	174,694	199,177	222,681	244,988	270,459	299,278	330,683	361,656

The low annual rate from 1990-1992 is attributable to the recession in Southern California. It is reasonable to assume that once the recession has ended, a return to growth trends in the late 1980s will occur. Growth at that time was already tempered from increases in the early 1980s because of the slowdown in defense spending beginning by 1985-1986.

The projected percent change in persons per occupied household was based on the figures shown previously in Table 6C. For example, the average number per household in 1990 was 2.978, and the average estimated for 1995 is 3.0495. The change over that 5-year period is 2.4 percent:

$$[(3.0495 - 2.0978) \div 2.0978] - 1$$

The income estimates in nominal dollar terms were converted to 1990 dollars with an annual estimated inflation factor of 3 percent. While such a figure is low relative to Southern California inflation in the late 1970s and early 1980s, it is representative of price increases in the late 1980s. The resultant median household income figures in 1990 dollars are shown in Table 9.

Table 9
Projected Median Household Income, SBVMWD Service Area, Selected Years

Year	Median Household Income (1990$)
1990	$32,360
1995	$32,205
2000	$33,443
2005	$33,585
2010	$33,724
2015	$33,961
2020	$34,197
2025	$34,433
2030	$34,668

Water Conservation Data

Information on both current conservation practices and future conservation practices (BMPs) was collected from each of the San Bernardino County retail agencies receiving water from SBVMWD. The results are shown in Table 10. Current and future practices are numbered and are explained at the end of the table.

Table 10
Water Conservation Data for Retail Water Agencies
Served by SBVMWD

	Agencies[1/]									% of Water Use Impacted by Practices
Current Practices[2/]	CO	LL	RL	RD	SB	EV	WC	RH	YV	
1	X	X	X	X	X	X	X	X	X	100%
2		X	X	X		X	X	X	X	59.3%
3	X	X	X					X	X	23.6%
4		X	X		X	X	X	X	X	73.6%
5	X		X	X	X	X	X	X	X	96.8%
6										0%
7										0%
8			X	X	X	X	X	X	X	90.1%
9			X						X	11.0%
Future Practices[3/]	CO	LL	RL	RD	SB	EV	WC	RH	YV	% of Water Use Impacted by Practices
1	X							X		9.4%
2						X				12.6%
3	X	X	X	X	X	X	X	X	X	100%
4										0%
5		X		X		X				35.5%
6		X	X	X	X	X	X	X	X	93.3%
7		X	X		X	X	X	X	X	73.6%
8										0%
9							X			10.1%
10	X	X	X					X	X	23.6%
11	X							X		9.4%
12		X		X	X		X	X		69.7%
13	X	X	X					X	X	23.6%
14										0%

1/ Agencies:
CO = City of Colton Public Works Utilities
LL = City of Loma Linda Department of Public Works
RL = City of Rialto Water Department
RD = City of Redlands Municipal Utilities Department
SB = City of San Bernardino Water Department
EV = East Valley Water District
WC = West San Bernardino County Water District
RH = Riverside Highland Water Company
YV = Yucaipa Valley Water District

2/ Current Practices
1) Metered use
2) Leak detection and repair
3) Block or tiered pricing structure
4) Education programs
5) Drought contingency planning
6) Recycling
7) Reuse
8) Active upstream watershed management
9) Conjunctive use of ground water and surface water

3/ Future Practices/Best Management Practices
1) Interior and exterior water audits
2) New and retrofit plumbing
3) Distribution system water audits, leak detection and repair
4) Large landscape water audits and incentives
5) Landscape water conservation requirements for new and existing developments
6) Public information
7) School education
8) Commercial and industrial water conservation
9) New commercial and industrial water use review
10) Conservation pricing
11) Water waste prohibition
12) Water conservation coordinator
13) Financial incentives
14) Ultra-low flush toilet replacement program

Summer and Winter Variables

Neither the economic and demographic data nor the water price data varied by time of year. Census data on number of persons per household and median household income are annual averages. Similarly, unit use water charges, water service charges, wastewater charges, and marginal price of water for commercial and industrial users, (where those data were available) were invariant throughout the year. Consequently, the following data apply to both summer and winter seasons unless otherwise noted.

1990 Unit Use Water Charge

The retail agencies served by SBVMWD have widely-different unit water pricing structures. Some have a single flat rate per hundred cubic feet consumed, regardless of quantity consumed. Others have two or more pricing tiers that apply over various ranges of consumption, e.g. above 500 or 1,000 or 3,000 cubic feet per month. Because of these variations, an average unit use charge could not be derived as a simple average of single prices. Instead, an average unit use charge per hundred cubic feet was calculated using the methodology described below.

Average monthly consumption by type of household (single- and multiple-family) was calculated for each agency based either on information provided directly by the agency or by assigning the average among the agencies which did provide monthly consumption data. For those agencies with a single charge per unit of use regardless of usage or for which only a single unit usage charge was applied because of average monthly consumption, the average charge per unit of use was simply the flat rate charge. For those agencies with increasing price tiers, an average cost per hundred cubic feet was calculated based on average monthly consumption of households served by the agency and the amount that would be priced within each tier.

After an average charge per hundred cubic feet was so estimated for each agency, a weighted average was calculated. The weights used were the 1990 urban water usage figures from Table 1. The result is an average unit use charge in 1990 of $0.56 per hundred cubic feet (excluding service charges and other charges not related directly to units of water consumed). The results are shown in Table 11.

Table 11
1990 Unit Use Water Charge, by Agency

Water Agency	1990 Urban Water Use (Acre-Feet)	Average Cost Per 100 cu.ft.
LL	4,100	$0.66
SB	43,601	$0.60
EV	16,180	$0.80
WC	12,990	$0.63
RL	7,658	$0.57
RH	3,280	$0.59
CO	8,612	$0.40
RD	25,290	$0.36
YV	6,400	$0.56
Total/Average	128,111	$0.56

1/ LL = City of Loma Linda Department of Public Works
SB = City of San Bernardino Water Department
EV = East Valley Water District
WC = West San Bernardino County Water District
RL = City of Rialto Water Department
RH = Riverside Highland Water Company
CO = City of Colton Public Utilities
RD = City of Redlands Municipal Utilities Department
YV = Yucaipa Valley Water District

1990 Water Service Charge

All water agencies served by SBVMWD have different water service charges depending upon the meter size of the user. The most common meter size for single-family residential users is one inch, and for these users the average 1990 service charge was $9.55 per month. The same average was applicable for multiple-family structures in which each household unit had its own meter. In some cases, however, several household units within a multiple-family structure used a single, larger meter. The average service charge in 1990, by size of meter, is shown below.

Table 12
1990 Average Water Service Charge, by Size of Meter

Size of Meter (Inches)	Service Charge ($/Month)
2	$25.21
3	54.18
4	84.42
6	139.64
8	197.67

Average Water Use Consumption

The water agencies surveyed were unable to provide data on summer versus winter average consumption. One-third of the agencies provided average consumption separately for multiple- versus single-family units. Among those agencies which did provide single-family versus multiple-family use, average monthly use throughout the year in 1990 was as follows:

Single-family units	26.87 ccf (hundreds of cubic feet)
Multiple-family units	13.31 ccf.

Marginal Price of Water for Commercial and Industrial Water Users

The average marginal price of water for commercial and industrial water users in the SBVMWD service area in 1990 was $0.614 per hundred cubic feet. The range was from $0.47 to $0.88 per hundred cubic feet.

Wastewater Charges if Based on Water Consumption

Residential wastewater charges in the SBVMWD service area were and are a monthly flat rate, with charges varying among the agencies providing the service. However, charges for commercial and industrial wastewater are based on water use, and in 1990 averaged $0.88 per hundred cubic feet.

Weather Data

There are two weather stations of the National Weather Service within the SBVMWD service area: Redlands and San Bernardino County Hospital. The temperature, rainfall, and cooling degree-days data requested in the Scope of Work are tabulated for both stations in the subsequent discussion.

Average Daily Summer Temperature for 1990 and Long-Term Average

The average daily maximum summer temperature for 1990 and the long term are shown in Table 13. In 1990, the average summer maxima for Redlands and San Bernardino County Hospital were 89.7 degrees and 88.3 degrees, respectively. The average of the two was 89.0 degrees. The long-term average summer maxima for Redlands and San Bernardino County Hospital were 88.4 degrees and 89.6 degrees, respectively. The average of the two was 89.0 degrees.

Average Daily Winter Temperature for 1990 and Long-Term Average

The average daily maximum winter temperature for 1990 and the long term are shown in Table 13. In 1990, the average winter maxima for Redlands and San Bernardino County Hospital were 70.1 degrees and 68.3 degrees, respectively. The average of the two was 68.7 degrees. The long-term average winter maxima for Redlands and San Bernardino County Hospital were 69.7 degrees and 70.2 degrees, respectively. The average of the two was 69.9 degrees.

Total Summer Rainfall for 1990 and Long-Term Average

The total summer rainfall for 1990 and the long term are shown in Table 14. In 1990, the total summer rainfalls for Redlands and San Bernardino County Hospital were 1.36 inches and 0.43 inches, respectively. The average of the two was 0.90 inches. The long-term average summer rainfalls for Redlands and San Bernardino County Hospital were 0.26 inches and 0.29 inches, respectively. The average of the two was 0.28 inches.

Table 13
Temperature

	Redlands Maximum Temperature (°F)		San Bernardino Co. Hosp. Maximum Temperature (°F)		Average of 2 Stations Maximum Temperature (°F)	
	Avg. Daily	Mo. Normal Mean	Avg. Daily	Mo. Normal Mean	Avg. Daily	Mo. Normal Mean
Month	1990	Long-Term	1990	Long-Term	1990	Long-Term
May	79.3	79.4	78.1	80.8	78.7	80.1
June	92.9	87.5	91.5	88.8	92.2	88.2
July	96.6	95.8	95.3	97.0	96.0	96.4
August	91.8	95.2	90.8	96.4	91.3	95.8
September	91.0	90.1	89.4	91.3	90.2	90.7
October	86.4	82.2	84.4	83.1	85.4	82.7
Avg. Summer	89.7	88.4	88.3	89.6	89.0	89.0
November	76.0	72.6	72.4	72.8	74.2	72.7
December	65.1	66.4	63.2	66.9	64.2	66.7
January	68.2	66.0	65.4	66.9	66.8	66.5
February	65.5	68.7	64.1	69.1	64.8	68.9
March	71.1	69.3	69.6	70.0	70.4	69.7
April	74.6	75.0	74.9	75.5	74.8	75.3
Avg. Winter	70.1	69.7	68.3	70.2	69.2	70.0

Source: National Oceanic and Atmospheric Administration (NOAA), "Monthly Summarized Station and Divisional Data," *Climatological Data California: December 1990*, Volume 94, Number 1-12.

Total Winter Rainfall for 1990 and Long-Term Average

The total winter rainfall for 1990 and the long term are shown in Table 14. In 1990, the total winter rainfalls for Redlands and San Bernardino County Hospital were 6.14 inches and 7.68 inches, respectively. The average of the two was 6.91 inches. The long-term average winter rainfalls for Redlands and San Bernardino County Hospital were 11.30 inches and 11.70 inches, respectively. The average of the two was 11.50 inches.

Annual Cooling Degree Days

The annual cooling degree days for 1990 and the long term are shown in Table 15. In 1990, cooling degree days for Redlands and San Bernardino County Hospital were 1938 and 1794, respectively. The average of the two was 1,866 cooling degree days. The long-term average annual cooling degree days for Redlands and San Bernardino County Hospital were 1,571 and 1,718, respectively. The average of the two was 1,645 cooling degree days.

Table 14
Rainfall

Month	Redlands Rainfall (in.)		San Bernardino Co. Hosp. Rainfall (in.)		Average of 2 Stations Rainfall (in.)	
	Total	Average	Total	Average	Total	Average
	1990	Long-Term[1]	1990	Long-Term	1990	Long-Term
May	.66	.49	.41	.54	.54	.52
June	.12	.07	.02	.08	.07	.08
July	.41	.10	.00	.04	.41	.07
August	.10	.15	.00	.13	.10	.14
September	.01	.41	.00	.49	.01	.45
October	.06	.37	.00	.52	.06	.45
Summer	1.36	.26	.43	.29	.90	.28
November	.26	1.33	.27	1.62	.27	1.48
December	.04	1.69	.00	.00	.04	1.69
January	1.93	2.79	1.88	3.49	1.90	3.14
February	2.40	2.20	3.16	2.77	2.78	2.49
March	.69	2.12	.83	2.50	.76	2.31
April	.82	1.17	1.54	1.32	1.18	1.25
Winter	6.14	11.30	7.68	11.70	6.91	11.50

1) Monthly Precip. +/- Departure = Normal (Avg.) Precip.

Source: National Oceanic and Atmospheric Administration (NOAA), "Total Precipitation and Departures from Normal (inches)," *Climatological Data Annual Summary: California 1990*, Volume 94 Number 13.

Table 15
Annual Cooling Degree Days

Redlands		San Bernardino Co. Hosp		Average of 2 Stations	
1990	Long-Term Average	1990	Long-Term Average	1990	Long-Term Average
1938	1571	1794	1718	1866	1645

Source: National Oceanic and Atmospheric Administration (NOAA), "Monthly and Seasonal Cooling Degree Days," *Climatological Data Annual Summary: California 1990*, Volume 94 Number 13.

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Appendix A

DATA NEEDED FROM WATER AGENCIES
ALL DATA ARE FOR 1990 ONLY

Variable — Units

1. Water Use in Service Area — Acre-Feet__________
   a. Urban — Acre-Feet__________
   b. Agriculture — Acre-Feet__________
   c. Total — Acre-Feet__________

2. Summer Variables
   a. Unit water charge $/100 cubic feet__________

      (broken out as below, if available)

      1) Single family $/100 cubic feet __________

      2) Multi family $/100 cubic feet __________

   b. Water service charge $/month

      (broken out as below, if available)

      1) Single family $/month __________

      2) Multi family $/month __________

   c. Average water consumption per household (broken out as below, if available)

      1) Single family 100s of cubic feet/month __________

2) Multi family 100s of cubic feet/month ___________

d. Marginal (that is, incremental) price of water for

Commercial and Industrial water users

$/100 cubic feet ___________

e. Wastewater charges assessed based on water consumption

$/month or $/100 cubic feet ___________

3. Winter Variables

a. Unit water charge $/100 cubic feet___________

(broken out as below, if available)

1) Single family $/100 cubic feet ___________

2) Multi family $/100 cubic feet ___________

b. Water service charge $/month

(broken out as below, if available)

1) Single family $/month ___________

2) Multi family $/month ___________

c. Average water consumption per household (broken out as below, if available)

1) Single family 100s of cubic feet/month ___________

2) Multi family 100s of cubic feet/month ___________

d. Marginal (that is, incremental) price of water for

Commercial and Industrial water users

$/100 cubic feet ___________

e. Wastewater charges assessed based on water consumption

$/month or $/100 cubic feet ___________

Person Completing Survey: ______________________________

Phone: ___________________

Fax: ___________________

COMMENTS OR NOTES ON DATA PROVIDED

(Please indicate by Question number and letter)

Table 4
1990 Employment in SBVMWD Service Area

SIC Code	Industry	SBVMWD 1990 Employment Number	Percent of Total
76	Misc. Repair Services	544	0.35%
762	Electrical Repair Shops	139	0.09%
763	Watch, Clock & Jewelry Repair	4	0.00%
764	Reupholstery & Furniture Repair	19	0.01%
769	Misc. Repair Shops & Related Services	383	0.25%
78	Motion Pictures	511	0.33%
781	Motion Picture Prod. & Allied Services	148	0.10%
782	Motion Picture Dist. & Allied Services	(D)	(D)
783	Motion Picture Theaters	185	0.12%
784	Video Tape Rental	178	0.12%
79	Amusement & Recr. Services	1,876	1.22%
791	Dance Sudios, Schools, & Halls	25	0.02%
792	Producers, Orchestras, Entertainers	81	0.05%
793	Bowling Centers	191	0.12%
794	Commercial Sports	27	0.02%
799	Misc. Amusement & Recr. Services	1,552	1.01%
80	Health Services	15,326	10.00%
801	Doctor Offices & Clinics	2,403	1.57%
802	Dentist Offices & Clinics	879	0.57%
803	Osteopath Offices & Clinics	27	0.02%
804	Other Health Prac. Offices & Clinics	438	0.29%
805	Nursing & Personal Care Facilities	1,856	1.21%
806	Hospitals	9,148	5.97%
807	Medical & Dental Laboratories	201	0.13%
808	Home Health Care Services	118	0.08%
809	Misc. Health & Allied Svcs NEC (*)	256	0.17%
81	Legal Services	639	0.42%
82	Educational Services	15,027	9.80%
821	Elementary & Secondary Schools	11,632	7.59%
822	Colleges, Universities, Profess. Schools	2,936	1.92%
823	Libraries	161	0.11%
824	Vocational Schools	117	0.08%
829	Schools & Educ. Services NEC (*)	180	0.12%

Table 4
1990 Employment in SBVMWD Service Area

SIC Code	Industry	SBVMWD 1990 Employment Number	Percent of Total
83	Social Services	2,372	1.55%
832	Individual & Family Social Services	504	0.33%
833	Job Training & Related Services	586	0.38%
835	Child Day Care Services	424	0.28%
836	Residential Care	595	0.39%
839	Social Services NEC (*)	263	0.17%
84	Museums, Art Galleries, Gardens	13	0.01%
841	Museums & Art Galleries	13	0.01%
842	Arboreta & Botanical/Zoological Gardens	(D)	(D)
86	Membership Organizations	1,093	0.71%
861	Business Associations	75	0.05%
862	Professional Membership Organiz.	13	0.01%
863	Labor Unions & Similar Organizations	129	0.08%
864	Civic, Social & Fraternal Associations	580	0.38%
865	Political Organizations	(D)	(D)
866	Religious Organizations	200	0.13%
869	Membership Organizations NEC (*)	96	0.06%
87	Engineering, Accounting, Research, Management & Related Services	2,833	1.85%
871	Engineering & Architectural Services	827	0.54%
872	Accounting, Auditing & Bookkeeping	480	0.31%
873	Research & Testing Services	716	0.47%
874	Management & Public Relations	810	0.53%
88	Private Households	905	0.59%
89	Services NEC (*)	18	0.01%
	Public Administration	11,038	7.20%
91	Executive, Legislative, & General Gov't, Exc. Finance	4,023	2.63%
912	Legislative Bodies	(D)	(D)
913	Executive & Legislative Bodies Combined	3,974	2.59%
919	General Government NEC (*)	49	0.03%
92	Justice, Public Order & Safety	2,880	1.88%
921	Courts	(D)	(D)
922	Public Order & Safety	2,880	1.88%

Table 4
1990 Employment in SBVMWD Service Area

SIC Code	Industry	SBVMWD 1990 Employment Number	Percent of Total
93	Public Finance & Taxation	191	0.12%
94	Administration of Human Resource Programs	348	0.23%
95	Administration of Environ. Quality & Housing Programs	384	0.25%
951	Admin. of Environ. Quality Programs	362	0.24%
953	Admin. of Housing & Urban Dev. Programs	22	0.01%
96	Administration of Economic Programs	649	0.42%
961	Administration of General Econ. Programs	12	0.01%
962	Regulation & Admin. of Transport. Programs	458	0.30%
963	Regulation & Admin. of Utilities	(D)	(D)
964	Regulation of Agricul. Mktg. & Commodities	123	0.08%
965	Regulation, Licensing, & Inspection of Misc. Commercial Sectors	57	0.04%
97	National Security & Int'l Affairs	2,562	1.67%
	ALL INDUSTRIES	153,270	100.00%

Consumer Price Index for 1990

The U.S. Bureau of Labor Statistics (BLS) publishes the Consumer Price Index (CPI) for regions throughout the United States. The most commonly-used level is for "All Urban Consumers." The relevant CPI for the SBVMWD service area is that for Southern California, which BLS labels the "Los Angeles-Anaheim-Riverside" area. Table 5A shows the CPI for the Southern California area, by year, from 1985 - 1993.

Table 5A
Consumer Price Index, All Urban Consumers
Los Angeles - Anaheim - Riverside
Annual Averages, 1985-1993 (1982-1984 = 100)

Year	Index
1985	108.4
1986	111.9
1987	116.7
1988	122.1
1989	128.3
1990	135.9
1991	141.4
1992	146.5
1993	150.3

Source: U.S. Bureau of Labor Statistics, 1994, *Consumer Price Index for Los Angeles - Anaheim - Riverside Area*

Projected Data

Projected Population

The California Department of Finance (CDOF) has published forecasts of San Bernardino County population through 2040 [CDOF 1993]. The Southern California Association of Governments (SCAG) has published population forecasts for sub-county regions and all of San Bernardino County [SCAG 1989] and all of San Bernardino County without sub-county disaggregation [SCAG 1994]. In addition, the San Bernardino County Department of Economic Development [SBDECD] has projected population for the County through 2000. Currently, however, long-term population projections are not available below the county level from government sources. While several individual cities within the County have projected population through 2000, none goes beyond that year, nor are the projections necessarily consistent among the cities. Population projections in this report are based on all of the sources cited above as well as actual population reported by CDOF through January 1994 [CDOF 1994].

Projections for 1995 and 2000

The 1995 and 2000 population projections were based primarily on publications of the CDOF. In particular, CDOF publishes annually estimates of January 1 population of California counties and principal cities, including eight incorporated cities within the SBVMWD service area: Colton, Grand Terrace, Highland, Loma Linda, Redlands, Rialto, San Bernardino, and Yucaipa. The figures for January 1, 1994 [CDOF 1994] for those cities (aggregated) and San Bernardino County were compared to the respective 1990 figures to derive a compound annual growth rate over the four-year period. The data are shown below. The calculated compound growth rate was used to project the 1995 and 2000 population in the SBVMWD service area (See Table 6A).

Table 5B
Factors Used In Selecting Projected Population Growth Rate

	1990 Population	1994 Population	Compound Growth Rate
8 Cities	432,768	487,000	2.9955%
SB County	1,418,380	1,591,800	2.9257%

Table 6A
Projected Population, and Housing, Measures,
SBVMWD Service Area, Selected Years

		Occupied Housing Units		
Year	Population	Single Family	Multiple Family	Total
1990	546,229	129,457	53,962	183,419
1995	633,092	146,526	61,077	207,603
2000	733,767	165,936	69,167	235,103
2005	833,717	190,492	79,403	269,895
2010	931,932	215,162	89,686	304,848
2015	1,045,057	243,109	101,335	344,444
2020	1,156,407	271,067	112,989	384,056
2025	1,277,759	301,817	125,807	427,625
2030	1,397,439	332,647	138,658	471,305

Projections for 2005 and Later Years

Projections for 2005 and later years were based on [SCAG 1989], [SCAG 1994], and [CDOF 1993]. SCAG's previous population forecasts through 2010 [SCAG 1989] included projections for the "West San Bernardino Valley" urbanized area, part of which is the SBVMWD service area, and other regions of the county as well as the county overall. At that time, compound annual growth from 1990-2010 was anticipated to average 2.374 percent and 2.58 percent, respectively, in the West San Bernardino Valley area and San Bernardino County. The more recent SCAG forecast [SCAG 1994] provides population projections only for San Bernardino County in total and not for sub-county areas. It shows that compound annual growth for the county from 1990-2010 is anticipated to be 2.812 percent. A ratio of the 1994 and 1989 San Bernardino County estimates,

$$(.02812) \div (.02580) = 1.089716,$$

was used to update the compound annual growth rate for the West San Bernardino Valley urbanized area contained in [SCAG 1989]:

$$(1.089716) \times (.02374) = .025869$$

The result, i.e. 2.5869 percent per year, was applied to the estimated figure for 2000 to project population in the SBVMWD service area for 2005.

Population projections for later years were based on the product of the estimated 2005 figure and the 2000-2005 compound annual growth rate weighted by the growth rate relative to 2000-2005 shown in [CDOF 1993]. Growth in the county by 5-year periods and the ratio of growth rates relative to that anticipated from 2000-2005 are shown in Table 6B.

US Army Corps
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Los Angeles District

Feasibility Report

Seven Oaks Dam Water Conservation
Santa Ana River Basin, California

Appendix F. Real Estate
June 1997

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REAL ESTATE APPENDIX
SEVEN OAKS DAM WATER CONSERVATION STUDY

A. INTRODUCTION. This Appendix presents the results of real estate studies accomplished for the Seven Oaks Dam Water Conservation Feasibility Study, San Bernardino County, California. The feasibility study is investigating the modification of the Seven Oaks Dam for the purpose of water conservation. This includes determining modifications of dam features, operations, and defining Federal and non-Federal responsibilities including any lands, easements, rights-of-way, and relocations required to implement water conservation.

The Seven Oaks Dam was authorized for construction by the U.S. Army Corps of Engineers, as part of Santa Ana River Mainstem Flood Control Project by the Water Resources Development Act of 1986, 99th Congress 2nd Session, P.L. 99-662. The dam, which is presently under construction, was authorized and is presently being implemented for the single purpose of providing flood protection for the Santa Ana River Basin. The without-project condition for the water conservation study, therefore, assumes that any modifications for operating the dam for water conservation will occur after construction of the Seven Oaks Dam is completed and turned over to the non-Federal flood control sponsors for operation and maintenance for flood control purposes. This is estimated to be during the year 1999.

Accordingly, any real estate requirements needed to implement a selected plan for water conservation is based on all real estate arrangements being completed for the Seven Oaks Dam and Flood Control Basin feature of the Santa Ana River Flood Control project. Any additional requirements for water conservation presented in this appendix are focused on any additional seperable requirements that may be needed beyond the flood control purpose.

B. SEVEN OAKS FLOOD CONTROL PROJECT

1. PROJECT AREA. The Seven Oaks study area is located at a narrowing of the Santa Ana Canyon about one mile upstream from the canyon mouth. The location is approximately 8 miles

northeast of the city of Redlands in San Bernardino County, CA. This 550-foot-high earth-rockfill dam, with a gross capacity of 145,600 AF, will be located in the steep-walled Upper Santa Ana River Canyon, approximately one (1) mile from the canyon mouth at the confluence of the Santa Ana River and Government Canyon. The site elevation at the canyon floor is approximately 2060 feet. The Seven Oaks Dam and reservoir are located predominately within the boundaries of the San Bernardino National Forest. The dam will control a drainage area of approximately 177 square miles.

2. STATUS OF FLOOD CONTROL REAL ESTATE ARRANGEMENTS. The properties required for the Seven Oaks Dam and reservoir for the purpose of flood control are being obtained in accordance with the Local Cooperation Agreement (LCA) executed on December 13,1989 with the non-Federal sponsors including the Counties of Orange, Riverside, and San Bernardino. Article IIC of the LCA states:

"C. Pursuant to Section 103(a)(1) of the Act, U.S.C. 2213(a)(1) and in accordance with Article III of this Agreement the sponsors shall provide all lands, easements, rights-of way, excavation material disposal areas, and perform relocations (excluding railroad bridges and approaches thereto) required for construction of the project as determined by the Government, except that acquisition and restoration of enhancement lands shall be the sole responsibility of the Government ..."

Article IIC provides cost-sharing arrangements between the Counties for acquiring the necessary interests in constructing the Seven Oaks Dam and Basin, and its associated mitigation.

The ultimate real estate arrangements for properties associated with the Seven Oaks Dam and flood control basin still need to be negotiated by the Santa Ana Flood Control Project (SARP) partners, the Army Corps of Engineers, and the U.S. Forest Service. Properties owned or leased by Southern California Edison and other interests for construction of the Seven Oaks Dam and mitigation of impacts have been acquired by the SARP non-Federal sponsors for flood control. The Forest Service has issued a permit for construction activities associated with the Seven Oaks Dam.

The Corps of Engineers is negotiating with the U.S. Forest Service to transfer title to certain parcels to the Corps through an inter-agency transfer at no cost to the Government for properties on which the Seven Oaks Dam and associated facilities are located. Negotiations also include arrangements for the flood control basin. It is anticipated that the Forest Service will grant a permanent flowage easement for the flood control reservoir.

C. WATER CONSERVATION REQUIREMENTS

1. ALTERNATIVE PLANS. The alternative plans being considered for water conservation at the Seven Oaks Dam are all limited to modifying operation of the dam to allow for seasonal storage for water conservation. The plans have all been formulated so that the flood control operations of the pool will not be impacted. The alternatives involve capturing late flood season flows to reach the alternative conservation target elevations from beginning of March through end of May at which time releases will be made to empty the pool by September. The no-action flood control operation would also begin releases in June with emptying of the pool by August. A description of the alternative plans and operations are presented in Table 1.

2. REAL ESTATE REQUIREMENTS FOR WATER CONSERVATION

a. Dam Modifications. Modifications to existing Flood Control Dam features are described in the main report and Design Appendix. These modifications vary from limited relocations of the access road to the Edison Power Plant, to major modifications to the intake structure and bulkheads. The construction of these modifications will require staging areas as shown in Table 1. They will be located adjacent to actual construction areas. The staging areas and construction areas are located within the Seven Oaks Dam and Basin flood control project. The SARP non-Federal sponsors will be required to negotiate with the ultimate owners of the Seven Oaks Dam and facilities for construction and staging areas for permits as needed for construction modifications and activities.

Table 1. Plan Descriptions and Real Estate Requirements

	No Action	PLAN 1	PLAN 2	PLAN 3	PLAN 4
Target Pool Elevation	2200	2300	2375	2418	2265
Water Conservation Storage (acre-ft)	None	16,000	35,000	50,000	10,270
June Releases	10	65	145	208	42
July Releases	20	70	145	208	42
August Releases	20	70	145	208	42
September Releases	0	70	145	208	42
Real Estate Req.-Seasonal Detention Basin (acres)	0	182	424	570	175
Staging Area (acres)	0	1	5	5	1
Construction Time (Yrs)	0	1	2	2	1

b. Water Conservation Pool. The water conservation pool for each of the alternatives is located within the flood control basin associated with the Santa Ana River Mainstem Flood Control Project. The number of acres presented in Table 1 for water conservation reflect the maximum increase in acreage, above the flood control target pool, but still within the anticipated flowage easement for the flood control project.

Negotiations are underway between the Corps of Engineers and the U.S. Forest Service for a permanent easement to be provided to the Corps of Engineers for flood control operations within the flood control basin. The Corps will include any provisional requirements, such as debris removal, associated with the easement to the non-Federal flood control sponsors as part of turning over the operation and maintenance responsibilities for the flood control project. It is expected that any additional real estate requirements needed for water conservation will be obtained from the U.S. Forest Service by non-Federal interests either as a special use permit or other mutually accepted mechanism.

The estimates for storage and releases shown in Table 1 are baseline conditions, which reflect conditions at the time of completion of the flood control project and initiating operation for water conservation. It is expected that as sediment fills the debris pool, the seasonal storage available for water conservation will be reduced for each alternative. It is also noted that the use of the Seven Oaks Dam and Basin for water conservation is dependent on hydologic conditions in any given year. Consequently, during those years with minimal rainfall and snowpack after March, there will be limited, if any, use of the seasonal storage area available for water conservation .

c. PL 91-646 Relocation. None

d. Minerals. None

e. Facility and Utility Relocations. Most relocations will have been accomplished as a result of the building of the Seven Oaks Dam for flood control purposes. The only impact expected from the alternative plans for water conservation would be periodic inundation of an access road to the Southern California Electric power house 1. It is emphasized that there are other roads available within the area to provide access to the powerhouse facility. These roads will require additional time of about one to two hours to reach the powerhouse as compared to the existing access road. Edison representatives indicated that this additional time is of some concern, particularly if an emergency situation requires prompt access. Consequently, it is expected that non-federal interests will need to negotiate with Edison on any mitigation needed for the impact on the access road. A worst case mitigation is the relocation of the existing road to minimize any period of inundation associated with water conservation. the cost for constructing the road relocation has been included for each alternative as a project cost. There is no significant impact expected on real estate costs as the land is owned by the Forest Service and acquisition of this land will be included in their permit to the sponsors.

f. Environmental Mitigation. As indicated in the Environmental Impact Statement/Environmental Impact Report, any habitat impacts related to the water conservation alternatives are located within the 50-year flood pool. These impacts have been mitigated at a 100 percent loss as part of the Santa Ana Flood Control Project. Accordingly, no mitigation is required for operating the project for water conservation.

g. Hazardous, Toxic, and Radioactive Wastes. There are no known HTRW dump sites in the basin.

3. REAL ESTATE VALUES: The real estate values are based on a general survey of similar property types applying recognized appraisal principles. The Administrative and Contingency estimates are based on the Government's and sponsor's estimates of labor costs involved with providing the required lands, easements, rights-of-way, including providing supporting documentation and certification of land for construction.

The real estate values presented are based on present fair market value. However, these values are somewhat speculative because the required lands under any water conservation alternative will already have been provided to local sponsors and the Corps for the flood control project. In addition, the uncertainty on the use of the water conservation pools because of uncertainty in hydrologic conditions in any year, as well as the expected future debris accumulations impacting on available seasonal storage should impact on actual real estate value. The values and costs of real estate associated with water conservation could range from nothing to fair market value. If the Forest Service were to insist on fair market value (notwithstanding that the same acreage is within the debris pool and therefore subject to inundation for flood control), costs might run in the vicinity of $2500 per acre. The following estimate for each alternative reflect the full fair market value of real estate associated with water conservation.

REAL ESTATE COST ESTIMATES
SEVEN OAKS DAM WATER CONSERVATION PLANS

Table 2. Real Estate Costs, Alternative 1

A. LAND (182± ACRES)	
(Up to $ 2,500.00 @ 182 ACRES)	$455,000.00
DAMAGES (10%)	45,500.00
TEMPORARY STAGING AREA (1 ACRE)	
($ 2,500 @ 9% RETURN / 1 YR)	450.00
RESIDENTIAL	0
COMMERCIAL	0
TOTAL LAND COST	***$ 500,950.00***
B. ADMINISTRATIVE COSTS (5%)	25,048.00
C. CONTINGENCY (25%)	131,500.00
TOTAL ESTIMATED COST (rounded)	***$658,000.00***

Table 3. Real Estate Costs, Alternative 2

A.	LAND (424± ACRES)	
	(**Up to** $ 2,500.00 @ 424 ACRES)	$ 1,060,000.00
	DAMAGES (10%)	106,000.00
	TEMPORARY STAGING AREA (5 ACRES)	
	($ 12,500 @ 9% RETURN / 2 YRS)	2,250.00
	RESIDENTIAL	0
	COMMERCIAL	0
	TOTAL LAND COST	*$ 1,168,250.00*
B.	ADMINISTRATIVE COSTS (5%)	58,412.00
C.	CONTINGENCY (25%)	292,063.00
	TOTAL ESTIMATED COST rounded)	***$ 1,519,000.00***

Table 4. Real Estate Costs, Alternative 3

A.	LAND (570± ACRES)	
	(**Up to** $ 2,500.00 @ 570 ACRES)	$ 1,425,000.00
	DAMAGES (10%)	142,500.00
	TEMPORARY STAGING AREA (3 ACRES)	
	($ 7,500 @ 9% RETURN / 2 YRS)	1,350.00
	RESIDENTIAL	0
	COMMERCIAL	0
	TOTAL LAND COST	***$ 1,567,850.00***
B.	ADMINISTRATIVE COSTS (5%)	78,393.00
C.	CONTINGENCY (25%)	391,963.00
	TOTAL ESTIMATED COST (rounded)	***$ 2,038,000.00***

Table 5. Real Estate Costs, Alternative 4

A.	LAND (175± ACRES)	
	(**Up to** $ 2,500.00 @ 175 ACRES)	$437,500.00
	DAMAGES (10%)	43,750.00
	TEMPORARY STAGING AREA (1 ACRES)	
	($ 2,500 @ 9% RETURN / 1 YR)	450.00
	RESIDENTIAL	0
	COMMERCIAL	0
	TOTAL LAND COST	***$ 481,700.00***
B.	ADMINISTRATIVE COSTS (5%)	24,850.00
C.	CONTINGENCY (25%)	120,425.00
	TOTAL ESTIMATED COST (rounded)	***$627,000.00***

Alternative Plans
Seven Oaks Dam Water Conservation Feasibility Study