IV - WATERSHED CHARACTERISTICS

4-01. General Characteristics

The drainage area of the Los Angeles River and its tributaries above Sepulveda Dam is 152 square miles, comprising the westernmost portion of the Los Angeles County Drainage Area (pl.2-02), and covering virtually the entire San Fernando Valley and surrounding mountain slopes west of Interstate Highway 405 (San Diego Freeway) (pl.2-03).

The drainage area boundary on the south is formed by the Santa Monica Mountains; on the west, but the Simi Hills; on the north, by the Santa Susana Mountains; and on the east by a line extending approximately north and south across the valley and generally along the San Diego Freeway (pl. 2-03).

The headwaters of the Los Angeles River are in the Simi Hills on the west, formed by Chatsworth Creek, Dayton Canyon Wash, Bell Creek, and Arroyo Calabasas (pl. 2-03). Other major tributaries above Sepulveda Dam include Devil Canyon, Brown's Canyon, Limekiln Canyon, Wilbur, and Aliso Canyon Washes; and Caballero and Bull Creeks. The longest watercourse above the dam is Devil Canyon-Brown's Canyon-Los Angels River (See pls. 2-03 and 4-09). This watercourse is about 19 miles long with an average slope of 143 feet per mile.

4-02. Topography

Approximately 85 square miles of the drainage basin above Sepulveda Dam is of relatively steep, mountainous terrain, and about 67 square miles is of comparatively flat valley floor. Elevations in the valley vary from 668 feet at the base of the dam to about, 1,200 feet at the base of the foothills. The average elevation of the Santa Monica Mountains is about 1,700 feet, NGVD; that of the Simi Hills is about 1,800 feet, NGVD; and that of the Santa Susana Mountains is about 2,000 feet, NGVD. The highest point in the drainage area is San Fernando Peak, in the Santa Susana Mountains, having an elevation of 3,741 feet, NGVD.

4-03. Geology and Soils

The dam is located in the San Fernando Valley which lies between the Santa Susana and San Gabriel Mountains to the north, the Santa Monica Mountains to the south, the Verdugo Hills to the east and the Simi Hills to the west. The valley is approximately 20 miles in length and ranges in width from 2 to 12 miles.

The San Gabriel, Verdugo, Santa Susana, and Santa Monica Mountains are part of the Traverse Ranges. The San Gabriel Mountains are generally composed of Mesozoic and older igneous and metamorphic rock. The Verdugo Mountains are in an uplifted sliver of crystalline rock, along the south side of the San Gabriel Mountains. The Santa Monica Mountains are composed mainly of

Cretaceous to Miocene sedimentary and volcanic rock. The Santa Susan Mountains are composed mainly of Miocene to Pleistocene marine and non-marine sedimentary rock. The adjacent Santa Susan Knolls are composed of upper Cretaceous marine sedimentary rock.

The greater part of the San Fernando Valley is overlaid by Recent Alluvium, consisting of unconsolidated and unweathered, poorly graded clay, silt, gravel, and boulders. The eastern half o the plain is largely dominated by Tujunga Wash and contains coarser alluvium than is granitic origin. Along the Los Angeles River above the confluence with Tujunga Wash the alluvium is notably lacking in boulders and in appreciable quantities of coarse gravel. The dam site is almost entirely covered by Recent Alluvium composed of relatively fine material.

Between one and two miles west (upstream) from the spillway site there is a low, topographic ridge lying about midway between the river and Ventura Boulevard. The ridge is nearly a mile long, east and west, and is covered at both ends with older alluvium. About two miles east (downstream) from the spillway site and on the north side of the river there is a somewhat longer east-west ridge along which older alluvium is exposed. Elsewhere throughout the valley, particularly in the northern part, there are numerous small terraces of older alluvium at elevations somewhat above that of recent deposits. These terraces have been raised above the general level of present deposition and are now covered by a reddish-brown soil typical of older alluvium. Recent and older alluvium comprise the unconsolidated formations found within the valley. Both are continental deposits of Quaternary Age.

Underlying the unconsolidated alluvium formations are the Tertiary (Miocene) shales and sandstones which forms the bedrock of this area. The top of bedrock ranges in depth from surface exposures south of Ventura Boulevard to more than 400 feet below the general ground level vicinity in which bedrock was penetrated to depths of several hundred feet. In general, the strike of this bedrock surface is parallel to the course of the Los Angeles River and the dip is northeasterly. The only outcrop of bedrock near the proposed site and north of Ventura Boulevard is at the central part of the low ridge previously mentioned as lying upstream from the spillway site. This outcrop of consolidated formation is classified as Tertiary (Miocene) shale, and lies between the two exposures of older alluvium which occupy either end of the same ridge. Its isolated position is due to an upthrust movement of formations north of the covered fault line parallel to the ridge.

4-04 <u>Sediment</u>

Sediment production within the drainage area abo e Sepulveda Dam varies considerably, according to terrain. In the urbanized valley areas, production is at a minimum, and has been decreasing over the years as the percentage of urbanization has increased. In the steep and largely unurbanized mountain and foothill areas, sediment production is significant, particularly during periods of recurring heavy rains, and especially great after a severe brush or forest fire. Upstream reservoirs and debris basins intercept part of this sediment load (see pl. 2-03).

A 1969 report by the U.S. Army Corps of Engineers, Los Angeles District entitled, Draft: Sedimentation Studies for Sepulveda Flood Control Basin, June 1961 Survey (September 1969) indicates that between November 1944 and June 1961, a total of 141 acre-feet of sediment was deposited into Sepulveda Reservoir. This represents 0.8 percent of the total available storage to elevation 710 feet (spillway crest with crest gates raised). See table 4-11.

The rate of sediment accumulation in Sepulveda Reservoir, according to surveys (see table 4-11) appears to be relatively minor, and is thus considered insignificant to the viability of the project's flood control function.

4-05 Climate

The climate of the drainage area above Sepulveda Dam is generally temperate and semi-arid, with warm dry summers and mild, moist winters.

a. Temperature. Average daily minimum/maximum winter temperatures (degrees Fahrenheit) range from about 40/65 on the valley floor to about 35/55 in the surrounding mountains. The corresponding summer figures are about 65/95 and 60/85 respectively. All-time low/high extremes of temperatures are about 10/120 in portions of the valley and about 5/110 in the mountains.

Table4-01 shows average and extreme temperature data for Burbank, California (located about 9 miles east of Sepulveda Dam)-- the nearest station with complete climatological data. The regular U.S. Weather Bureau station at Burbank was closed in 1965, so the climatological data in table 4-01 extends only through 1964.

b. Precipitation. Plate 4-01 shows the normal annual precipitation over the Sepulveda drainage and surrounding areas. Within the Sepulveda drainage itself, normal annual precipitation ranges from less than 15 inches over much of the valley floor to more than 22 inches atop both the Santa Susan Mountains to the north and the Santa Monica Mountains to the south.

Table 4-01 lists the man and maximum observed monthly precipitation for Burbank, California. Table 4-01 lists the mean and maximum observed monthly precipitation for Burbank, California. Table 4-02 lists the same for Sepulveda Dam and for three stations within the Sepulveda drainage basin. This table shows that there can be great year-to-year variability in monthly, as well as annual, precipitation. Not listed in these tables are the minimum observed monthly precipitation values, which for each station are at most 0.01 or 0.02 inches for every month of the year.

Table 4-03 is a precipitation depth-duration-frequency tabulation for the centroid of the watershed above Sepulveda Reservoir. In it are listed the computed point-value precipitation depths for durations of from 5 minutes to 24 hours, and for return periods from 2 years to 100 years. Data for this table were obtained from the National Oceanic and Atmospheric Administration publication, NOAA Atlas 2.

(1) Winter Storms. Most precipitation in southern California coastal drainages occurs during the cool season, primarily from November though early April, as mid-latitude cyclones from the north Pacific Ocean occasionally move across the West Coast of the United Sates to bring precipitation to southern California. Most of these storms are of the general winter type, with hours of light to moderate steady precipitation, but with occasional heavy showers or thunderstorms. Plate 4-02 depicts the time distribution of precipitation during the intense winter storm of 16-17 February 1980 at Sepulveda Dam and in the upstream watershed.

(2) Summer Storms. Two other types of storms can affect southern California, although they are relatively rare.

(a) Local Thunderstorms. During humid periods between July and September, the deserts and eastern mountains of southern California experience occasional thunderstorms. On a few occasion, these can drift westward into the coastal drainages, including the Sepulveda watershed. These thunderstorms can at times result in very heavy rain for short periods of time over small areas.

(b) General Storms. General summer storms in southern California are quite rare; but on occasion a tropical storm from off the west coast of Mexico can drift far enough northward to bring rain, occasionally heavy, to southern California (sometimes with very heavy thunderstorms embedded). The season in which these storms are the most likely to significantly affect southern California is mid August Through early October, although there have been some effects in southern California from tropical storms as early as late June and as late as early November.

On rare occasions, souther California has received light rain from non-tropical general summer storms, some of which have exhibited some characteristics of general winter storms.

c. Snow. Snow in southern California is relatively uncommon at elevations below 6,000 feet and is extremely rare below ,2000 feet. Although even the valley floor has experienced light snow on isolated occasions, snowfall and snowmelt are not considered to be a significant hydrologic factor in the Sepulveda drainage.

d. Evaporation. Few formal studies of evaporation have been made in the San Fernando Valley; and since Sepulveda Reservoir is normally dry, with any impoundment generally lasting less than 24 hours, evaporation is not a major consideration at this site. Studies for nearby locations indicate that mean daily evaporation ranges about one-quarter inch in winter to about one-half inch in summer. On days of very strong, dry Santa Ana winds, evaporation can be considerably greater than one inch.

e. Wind. The prevailing wind in the San Fernando Valley is the sea breeze. This gentle onshore wind is normally strongest during late spring and summer afternoons, with speeds in the western San Fernando Valley typically 10 to 15 mph.

The Santa Ana is a dry desert wind that blows from out of the northeast, most frequently during late fall and winter. This type of wind does not normally occur when water impounded behind Sepulveda Dam. The characteristic very low humidities and strong gusts of Santa Anas (which can exceed 70 miles per hour at times) usually create very high fire hazards, but can also be instrumental in drying a saturated watershed, thus reducing the flood hazard.

Rainstorm-related winds are the next common type in southern California. Winds from the southeast ahead of an approaching storm average 20-30 mph, with occasional gusts to more than 40 mph. West to northwest winds behind storms can sometimes exceed 35 mph, with higher gusts.

4-06. Storms and Floods

All of the major inflow and impoundment events in the history of Sepulveda Dam have been the result of general winter storms.

Prior to the construction of the dam, there were a number of major storms and floods on the Los Angeles River, including those of January 1862, February and March 1884, January and February 1914, January 1915, February - March 1938. There was also on e significant summer tropical storm that occurred in September 1939, but no widespread flooding on the Los Angeles river resulted from this event.

a. Storm and Flood of February - March 1938. The flood of 27 February - 3 March 1939 was the most destructive of record on the Los Angeles River and several other streams of southern California, and its occurrence played a major role in the justification for the construction of Sepulveda Dam.

The storm developed as a series of low-latitude north Pacific disturbances and brought several bands of very heavy rain to southern California during a 5-day period. The intense band occurring during 1-2 March produced a peak flow of 11,600 cfs on the Los Angeles River at Van Nuys Boulevard (about 1.8 miles below the Sepulveda Dam site–see pl. 2-04), with a total volume of runoff for the 5-day storm estimated to be 16,400 acre-feet at that location. This flow combined with heavy runoff from the Tujunga Wash and other tributaries to produce a very destructive flood on the Los Angeles River through the southeastern San Fernando Valley, downtown Los Angeles, and downstream locations.

b. Storms and Floods since 1941. Several of the major storms and floods that have occurred on the Los Angeles River since the completion of Sepulveda Dam in 1941 are discussed in Section 8-02 of this manual.

4-07 Runoff Characteristics

Runoff from the watershed is characterized by high flood peaks of short duration that result from high-intensity rainfall on the urban watershed. The time of concentration at the dam site is 1.5 hours. Flood hydrographs are typically of less than 12 hours' duration and are always less than 48 hours' duration. Inflow rates drop rapidly between storms, and inflow during the dry summer season is approximately 65 cfs due to outflow from the Donald C. Tillman Water Reclamation Plant. Long-term average inflow to Sepulveda Dam for the period 1930 through 1979 is reported by the U.S. Geological Survey as 24,920 acre-feet per year (or 34.4 cfs). Table 4-04 lists historic peak inflows to the Sepulveda Dam site from 1930 to 1987. Table 4-05 lists the annual maximum of inflows, outflows, and capacity (storage), elevation, and surface area at Sepulveda Dam from 1942 through 1987.

The greater Los Angeles area has historically experienced long-term wet and dry periods. Plate 4-03 illustrates the historic regional response of flood peaks from the 1870's to the 1970's.

Increasing urbanization and upstream channelization have caused inflow peaks and volumes to rise dramatically in recent years. Most of the valley area is urbanized, with a high percentage of the ground surface covered by paving or structures. Urbanization continues to increase in the western San Fernando Valley, but at a somewhat slower rate than that which occurred between 9150 and 1975. IN the residential areas, much of the uncovered soil is under cultivation by grasses, trees, and plants. There remains a small and decreasing amount of commercial agriculture in the valley, especially in the far western portions. The small and diminishing amount of uncultivated native vegetation remaining in the valley consists of grass and scattered shrubs. The watershed currently has about 35 percent impervious cover. Plate 4-04 shows the historical increases in impervious cover over the past 50 years. An increase to about 45 percent impervious cover is projected for the year 2030.

Plate 4-05 shows the historic increase at peak inflow in response to watershed urbanization changes. Average annual peak inflow has risen from approximately 2,000 cfs in 1930 to about 12,000 cfs in 1980, and is expected to continue to rise more moderately over the next 50 years.

Table 4-06 summarizes the effect of watershed urbanization on increasing peak and volume characteristics of reservoir inflow.

For the period of 1970 to 1985 the median annual inflow was 62,797 acre-feet. Table 4-07 provides average monthly inflows for the 1970 to 1988 period. These values are considered representative of current 1987 conditions.

Plate 4-06 presents an inflow frequency curve computed for present watershed conditions and an outflow frequency curve computed for the present operating criteria. Plate 4-07 is an elevation frequency curve for Sepulveda Reservoir, based upon, and adjust for, 1980 conditions. Table 4-08 lists the values of the curves of plates 4-06 and 4-07 at specific return periods (or specific frequencies). These values were obtained from the Draft: Los Angeles County Drainage Area Review: Part I, Hydrology Report (February 1988), a study performed by the U.S. Army Corps of Engineers, Los Angeles District.

In general, antecedent precipitation is required as a prerequisite for the occurrence of large floods from the unurbanized parts of the watershed. With substantial antecedent precipitation resulting from a series of winter storms, precipitation loss rates may decrease to as low as 0.15 inch per hour by the time a major storm occurs. Because much os the watershed is urbanized, however, significant runoff events may occur even when dry antecedent conditions exist.

Unit hydrographs values for the watershed upstream of Sepulveda Dam are tabulated in table 4-09 and shown graphically on plate 4-08.

Unit hydrographs were derived using a rainfall distribution having intensities of 1 inch per hour for each 15-minute period. The derivation is applied to the 152-square mile watershed above the dam.

4-08. Water Quality

Because Sepulveda Reservoir is strictly a flood control project that rarely impounds water for more than 24 hours, it has not appreciable affect on water quality. The nature of the urban storm runoff entering the reservoir is generally of poor quality. Routine base flow (usually less than 10 cfs) is typically high in salinity content, whereas storm runoff is generally low in salinity content. Also passing through Sepulveda Reservoir outlet works is treated effluent from the Donald C. Tillman Water Reclamation Plant (TWRP); average flow produced by the treatment area approximately 65 cfs. In the near future a portion of the reclaimed water produced by TWRP will be delivered for use in the Recreation Lake, Wildlife Lake, and various agricultural sections within Sepulveda Basin (see Sections 2-06.a., 2-06.b., 3-06.d., and 8-04; in addition see table 1-01, Sepulveda Basin Master Plan, Final Environmental Impact Report/Environmental Impact Statement (March 1981) and Sepulveda Basin Recreation Lake: Feature Design Memorandum (March 1987).

Unless flood protection is provided for TWRP (as discussed above in Section 2-06.d.) portions of the plant will become inundated at an elevation of approximately 705 feet, NGVD. Initially, contamination of surface waters from untreated or partially treated wastewater sewage will occur. Continued increase of the water surface elevation will result in plant shut down and diversion of untreated sewage to the Los Angeles Hyperion Treatment Plant.

Instream channel use downstream of Sepulveda Dam is limited. Two diversion exist for groundwater recharge facilities. Generally the quality of urban base flow has been so poor that these facilities are rarely used. A downstream reach with cobblestone invert near Griffith Park has been identified as having some environmental attributes. No actions taken to regulate the discharge rates from Sepulveda Dam will adversely affect this reach.

4-09. Channel and Floodway Characteristics

The channel of the Los Angeles River downstream from Sepulveda Dam is a concrete-lined open channel: rectangular through the San Fernando Valley, and trapezoidal from there to the Pacific Ocean (except for a short rectangular portion just north of downtown Los Angeles) (see pl. 2-04). Along portions of the lower Los Angeles River, the trapezoidal sides are formed by levees that rise above adjacent ground levels.

Channel capacities increase from 16,900 cfs just below Sepulveda Dam to 129,000 cfs from Del Amo Boulevard to the ocean (pl.2-04). Travel times for significant flows are also shown on plate 2-04, and include a total time of 3,2 hours from Sepulveda Dam to the ocean.

4-10. Upstream Structures

a. Chatsworth Reservoir. This now unused reservoir site formerly served as a water-storage facility fro Los Angels Department of Water and Power (DWP). It is located on Chatsworth Creek in the far northwestern portion of the San Fernando Valley, about 10 river miles above Sepulveda Dam (see pls. 2-02 and 2-03). Pertinent Data for Chatsworth Dam and Reservoir are included in Exhibit C of this manual.

Chatsworth Dam, an older earthen facility, was deemed unsafe in 1969, and not water has since been stored in Chatsworth Reservoir (all runoff is passed directly through the outlet). The structure was considered to be unable to withstand a major earthquake—-a point that was underscored by the severe damage sustained by the Lower Van Norman Dam in the February 1971 San Fernando Earthquake (see Section4-10.c.). DWP however, is considering a long term plan to restore Chatsworth Reservoir for water supply impoundment.

It should be noted that whereas the normal outlet for Chatsworth Dam is located at the south-central corner of the reservoir, the emergency spillway is located at the far eastern end of the reservoir, and spillway flow would flood a developed area adjacent to Tampa Avenue in Chatsworth. From there, these waters would drain southward toward Bell Creek and the Los Angeles River, and eventually to Sepulveda Dam.

b. Encino Reservoir. This small reservoir, located in the steep densely developed northern slopes of the Santa Monica Mountains south of the San Fernando Valley (see pls. 2-02 and 2-03), is another water supply reservoir, owned and operat4ed by DWP. Pertinent Data on this reservoir is included in Exhibit C.

Although this reservoir, filled by imported water, does not have a regular outlet, the path of spillway flow, which would flood a residential area, would be northward toward the Los Angeles River and Sepulveda Dam (see pl. 2-03).

c. Los Angeles Reservoir. Another water-supply reservoir, owned and operated by DWP and located upstream of Sepulveda Dam, is Los Angeles Reservoir. Located at the north end of Bull Creek, in the far northern San Fernando Valley about 8 rive miles north of Sepulveda Dam (see pls. 2-02 and 2-03), this reservoir was completed and began storing water in August 1977.

This facility was built as a replacement for the Upper and Lower Van Norman Reservoirs, whose dams were found to be structurally unsound following the February 1971 San Fernando Earthquake. (The Lower Van Norman Dam was severely damaged by the earthquake). Both the Upper and Lower Van Norman Dams have been reconstructed to modern safety standards, but the reservoir basins behind these two dams now serve only for emergency flood control storage. They are now known as the Upper and Lower San Fernando Storm Water Detention Basins. Plate 4-10 (furnished by DWP) depicts the entire Los Angeles and San Fernando Reservoir complex, including reservoirs and bypass channels.

Pertinent Data for Los Angeles Reservoir, which is fed by the main stem of the California Aqueduct, and which serves as a major water supply facility for the greater Los Angels area, included in Exhibit C.

4-11. Downstream Structures

a. Lopez Dam. This dam is constructed on Pacoima Wash in the far northeastern San Fernando Valley, 6.4 miles above the confluence of Pacoima Wash with Tujunga Wash. This gated facility is owned by the Federal Government and maintained by the U.S. Army Corps of Engineers, Los Angeles District, as part of the overall Los Angeles County Drainage Area (LACDA) flood control project. The reservoir drainage area is 34 square miles. Pertinent Data for Lopez Dam are include in Exhibit C.

b. Hansen Dam. Located along Tujunga Wash,9 miles above its confluence with the Los Angles River (see pl. 2-02), Hansen Dam is a major flood control facility owned by the Federal Government and operated and maintained by the U.S. Army Corps of Engineers, Los Angeles District, as part of the LACDA system. The reservoir drainage are is 151.9 square miles.

Like Sepulveda Dam, Hansen Dam controls floods on the downstream portions of the Los Angeles River, as well as on Tujunga Wash, immediately downstream of Hansen Dam. During appreciable flows on the Los Angeles River, these two dams must be operated as a system (see Section 7-05).

c. Whittier Narrows Dam. This unique flood control facility was built by the U.S. Army Corps of Engineers at the narrows of the San Gabriel and Rio Hond in Los Angeles County, just north of Pico Rivera (see pl. 2-02). The facility is Federally owned and is operated and maintained by the Corps of Engineers. The reservoir drainage area is 554 square miles. Pertinent Data for Whittier Narrows Dam are included in Exhibit C.

This dam has the capability of diverting San Gabriel River inflow westward for discharge into Rio Hondo. During moderate and high reservoir impoundment behind the dam, the waters from the two rivers combine within the reservoir, and can be let out into either of the tow downstream channels. Thus a major portion of, and at times the total, inflow from the entire upper Rio Hondo and San Gabriel River drainages can, when necessary or desired, be passed into the lower Rio Hondo, and ultimately into the lower Los Angeles River. During significant flows, however, the outflow from Whittier Narrows Dam is normally discharged into both the Rio Hondo and the San Gabriel River. Thus, along with Hansen Dam, Whittier Narrows Dam is operated in conjunction with Sepulveda Dam to control floods on the lower reaches of the Los Angeles River.

d. Other Facilities. Upstream of each of the three U.S. Army Corps of Engineers dams discussed in Section 4-11.a. through 4-11.c., are once or more additional dams with reservoir (see pl. 2-02 and Exhibit c).

(1) Pacoima Dam. This project is water supply and flood control facility of Los Angeles County Department of Public Works and is located on Pacoima Wash upstream of Lopez Dam. The reservoir drainage area is 28.2 square miles.

(2) Big Tujunga Dam. This project is a water supply and flood control facility of Los Angels County Department of Public Works and is on Big Tujunga Creek above Hansen Dam. The reservoir drainage area is 82.3 square miles.

(3) Santa Fe Dam. This Federally owned, U.S. Army Corps of Engineers-operated flood control facility is on the San Gabriel River upstream of Whittier Narrows Dam. IT is operated in conjunction with Whittier Narrows Dam, and thus, at times, indirectly in conjunction with Hansen and Sepulveda Dams. The reservoir drainage is 236 square miles.

(4) Other Projects. There are numerous other water supply reservoirs upstream of Whittier Narrows and Santa Fe Dams on Rio Hondo, San Gabriel River, and their tributaries. These cam be seen on plate 2-02, and Pertinent Data for these reservoirs are included in Exhibit C.

4-12. Economic Data

a. Population. No population figures area available specifically for the watersheds above or below Sepulveda Dam. The San Fernando Valley is estimate to have a population of approximately 1,081,000, according to the 1980 Census. The population of the greater San Fernando Valley, including Sunland, Tujunga, and Lakeview Terrace, is approximately 1,133,000. Table 4-10 lists the estimated population as of 1979 and the projected population for the years of 1990 and 2000 for each of the four communities surrounding Sepulveda Dam. Sepulveda Reservoir lies in the center of these four communities.

b. Agriculture. Agriculture was at one time a major activity in the San Fernando Valley, both upstream and downstream of Sepulveda Reservoir but declined sharply between 1946 and the early 1970's, as urban growth in the valley displaced the existing farmland.

There remains a very small amount of commercial agriculture in the far western valley, along with many small private orchards, vineyards, and vegetable gardens. There are a few remaining small private horse ranches in the northwestern San Fernando Valley.

About 340 acres of Sepulveda Reservoir Land is leased by the U.S. Army Corps of Engineers to commercial agriculture. The primary products grown here are corn, alfalfa, and other truck crops. These agricultural leases are limited to periods not exceeding 5 years and are subject to termination by the Corps of Engineers if the Corps should require the land for other usage.

c. Industry. Industry has increased dramatically in the San Fernando Valley since World War II, and is scattered throughout all portions of the valley. There is little heavy industry in any portion of the San Fernando Valley. There are a number of moderate-sized factories in the central and northeastern portions of the valley, and a large amount of light industry (especially electronics and related fields) is scattered throughout all portions of the valley.

There is a corridor of commerce along the entire length of Ventura Boulevard, which closely parallels the Los Angles River below Sepulveda Dam.

d. Flood Damages. Flood damage estimates are not available for most floods that occurred in the Sepulveda Dam drainage area. However, estimates are available for the flood of 1938, which caused considerable loss of life and major property damage in the Los Angeles County Drainage Area. Although no lives were lost in the Sepulveda drainage area, $43,300 in property damages occurred. Considerable runoff occurred above and below Sepulveda Dam on 20 February and 3 March 1941. Numerous thunderstorms were observed and flood damage above the dam in the vicinity of Reseda was estimated at $370,960. Since completion of the dam in 1941,, there has been relatively little in the way of damaging flows on the Los Angeles River. There have, however, been a few incidents in recent years in which water has left the channel as the result of hydraulically unstable channel flow. An example of this, which can be seen in Photographs 4-01 and 4-02, occurred along the river 1.5 miles below Sepulveda Dam in February 1980. IN this and other cases, the water approached, but did not enter, residential and commercial property alongside the river. Further downstream on the Los Angeles River through parts of Long Beach, where the contribution from Sepulveda Dam constitutes on ly a relatively small portion of the total flow, the water reached the top of the levees, as can be seen by the debris left on the levees in Photograph 4-03.

An ongoing Corps of Engineers review study for Los Angeles County Drainage Area rivers and reservoir indicates that there is a fairly low level of protection along the middle and lower portions of the Los Angeles River, and that a storm and flood not greatly in excess of those experienced during recent years (including the flood of 1969, 1978, and 1980, and 1983) could overtop the levees on the Lower Los Angeles River.

Table 4-01. Summary of Climatological Data at Burbank, Calif., Sepulveda Flood Control Basin, Los Angeles County Drainage Area, California*

Month	Temperature			Precipitation		
	Mean monthly	Record highest	Record lowest	Mean monthly	Maximum monthly	Minimum monthly
	Degrees Fahrenheit	Degrees Fahrenheit	Degrees Fahrenheit	Inches	Inches	Inches
Jan.....	53.0	87	21	2.95	13.42	(T)
Feb.....	54.7	91	25	3.29	13.84	(T)
Mar.....	57.0	90	32	2.18	10.24	0
Apr.....	60.6	100	33	1.09	4.00	(T)
May.....	63.5	105	36	.16	1.23	(T)
Jun.....	67.4	103	43	.06	.37	(T)
Jul.....	73.5	108	47	0	.03	0
Aug.....	73.7	111	47	.05	.72	0
Sep.....	72.2	111	43	.26	6.63	0
Oct.....	66.0	103	33	.47	2.42	(T)
Nov.....	59.8	95	26	1.09	6.61	0
Dec.....	55.3	92	27	2.42	8.07	(T)
Annual	63.1	111	21	14.02		

* 34°12'N latitude; 118°22'W longitude; elevation 699 feet, NGVD.

T Indicates less than 0.01 inch of precipitation.

NOTE: Period of record is 34 years (1931-1964).

Table 4-02. Summary of Precipitation Data at Sepulveda Dam and Three Stations in Watershed Above Dam.

LACDPW Number	Station Name	Lat (N)	Long (W)	Elev (feet)	Period of Record
446	Aliso Canyon-Oat Mtn	34°18'53"	118°33'25"	2367	1939-1983
735	Bell Canyon	34°11'40"	118°39'23"	895	1946-1983
259D	Chatsworth-Twin Lakes	34°16'43"	118°35'41"	1275	1929-1983
465	Sepulveda Dam	34°09'48"	118°27'59"	727	1939-1983

MEAN AND MAXIMUM OBSERVED MONTHLY AND ANNUAL PRECIPITATION VALUES (INCHES) PLUS MAXIMUM OBSERVED DAILY VALUES (INCHES), BY MONTH:

LACDPW No:	446			735			259D			465		
	Mean	Maximum		Mean	Maximum		Mean	Maximum		Mean	Maximum	
		Monthly	Daily		Monthly	Daily		Monthly	Daily		Monthly	Daily
Jan	4.43	21.59	8.20	2.94	5.31	4.11	3.65	16.32	6.91	2.82	16.26	4.61
Feb	4.66	19.22	6.03	3.09	13.60	4.30	3.83	16.78	4.55	2.96	18.38	5.77
Mar	3.66	13.90	4.40	2.43	13.80	4.70	3.01	10.87	6.10	2.32	13.18	5.53
Apr	1.84	8.35	2.74	1.22	5.65	2.15	1.52	6.94	2.59	1.17	6.66	1.93
May	.52	3.35	1.94	.35	3.20	2.00	.43	2.70	1.44	.33	3.94	2.40
Jun	.11	.42	.42	.07	.44	.35	.09	.50	.50	.07	.16	.16
Jul	.05	.20	.19	.03	.08	.08	.04	.20	.20	.03	.61	.61
Aug	.11	3.47	3.19	.07	2.60	2.50	.09	2.75	2.47	.07	3.00	2.90
Sep	.34	3.53	2.80	.23	2.60	1.80	.28	3.31	3.00	.22	2.25	1.32
Oct	.77	2.95	1.91	.51	1.37	.44	.64	2.52	1.13	.49	1.63	.09
Nov	2.24	18.98	5.05	1.49	6.60	5.24	1.85	14.42	5.23	1.43	12.90	6.16
Dec	3.98	11.00	5.44	2.64	6.16	3.30	3.27	7.36	4.61	2.53	8.67	6.05
Annual	22.71			15.07			18.70			14.44		

NOTES: 1. Minimum observed monthly values are approximately zero at each station.

2. Data were obtained from Los Angeles County Department of Public Works (LACDPW).

Table 4-03. Precipitation Frequency Values (Inches) for Sepulveda Watershed.

	RETURN PERIOD					
DURATION	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5-MIN	0.18	0.23	0.27	0.32	0.35	0.38
10-MIN	0.27	0.36	0.42	0.49	0.54	0.60
15-MIN	0.35	0.46	0.53	0.62	0.69	0.76
30-MIN	0.48	0.63	0.73	0.86	0.95	1.05
1-HR	0.61	0.80	0.92	1.09	1.21	1.33
2-HR	0.85	1.11	1.28	1.51	1.67	1.83
3-HR	1.08	1.41	1.62	1.90	2.11	2.31
6-HR	1.62	2.10	2.42	2.83	3.13	3.42
12-HR	2.24	3.05	3.57	4.26	4.76	5.26
24-HR	2.86	3.99	4.74	5.69	6.40	7.10

NOTES:

1. Values, from NOAA Atlas 2 data, are for a site at the centroid of the watershed above Sepulveda Dam at latitude 34°13'N, longitude 118°34'W, elevation 920 feet.

2. All values are for annual series.

Table 4-04. Sepulveda Dam Inflow History.

Water Year	Peak Inflow (cfs)	Water Year	Peak Inflow (cfs)
1929-30	389	1961-62	16,100
1930-31	1,295	1962-63	8,123
1931-32	2,000	1963-64	4,637
1932-33	1,720	1964-65	6,170
1933-34	7,382	1965-66	17,040
1934-35	885	1966-67	12,879
1935-36	281	1967-68	15,995
1936-37	2,700	1968-69	16,800
1937-38	11,600	1969-70	6,816
1938-39	2,980	1970-71	20,013
1939-40	2,690	1971-72	7,097
1940-41	6,610	1972-73	13,400
1941-42	1,060	1973-74	10,788
1942-43	12,700	1974-75	16,017
1943-44	15,900	1975-76	4,348
1944-45	1,360	1976-77	10,627
1945-46	1,450	1977-78	25,670
1946-47	900	1978-79	17,149
1947-48	310	1979-80	58,970
1948-49	85	1980-81	8,600
1949-50	400	1981-82	12,125
1950-51	290	1982-83	38,675
1951-52	12,400	1983-84	6,281
1952-53	4,680	1984-85	8,276
1953-54	3,200	1985-86	36,938
1954-55	2,400	1986-87	16,520
1955-56	4,300		
1956-57	3,040		
1957-58	8,000		
1958-59	8,020		
1959-60	4,420		
1969-61	4,740		

NOTES:

1. Data prior to 1941 were obtained from Los Angeles County Flood Control District gauging station on the Los Angeles River at Van Nuys Blvd bridge (about 1-1/2 miles below the dam site). Data after Sepulveda Dam was completed (1941 to date) were computed by the Corps of Engineers.

2. 1941-42 and subsequent years are maximum mean hourly discharges.

Table 4-05. Annual Maximum Inflow, Outflow, Elevations Capacity (Storage), and Surface Area at Sepulveda Dam
Los Angeles County Drainage Area, California

May 1985

Water Year	Peak Inflow (cfs)	Date	Peak Outflow (cfs)	Date	Maximum Water Surface Elev. (ft., NGVD)	Date	Maximum Capacity (ac-ft)	Date	% of Capacity to threshold of Spilling with Spillway Gates Raised	Surface Area (Acres)
41-42	1,060	28 DEC	1,040	28 DEC	671.83	28 DEC	10	28 DEC	0.1	2.15
42-43	12,700	23 JAN	2,710	23 JAN	699.29	23 JAN	6,341	23 JAN	36.4	727.28
43-44	15,900	22 FEB	4,740	22 FEB	697.92	22 FEB	5,070	22 FEB	29.1	656.00
44-45	1,360	2 FEB	1,360	2 FEB	675.00	2 FEB	26	2 FEB	0.2	9.15
45-46	1,450	21 DEC	1,450	21 DEC	673.20	21 DEC	15	21 DEC	0.1	3.85
46-47	900	26 DEC	900	26 DEC	671.44	26 DEC	8	26 DEC	0.0	1.80
47-48	310	24 MAR	310	24 MAR	670.27	24 MAR	3	24 MAR	0.0	1.05
48-49	85	17 DEC	85	17 DEC	668.44	17 DEC	0	17 DEC	0.0	0.40
49-50	400	6 FEB	400	6 FEB	669.87	6 FEB	2	6 FEB	0.0	0.85
50-51	290	29 JAN	290	29 JAN	668.80	30 JAN	1	30 JAN	0.0	0.60
51-52	12,400	18 JAN	7,000	15 JAN	692.86	18 JAN	2,600	18 JAN	14.9	422.65
52-53	4,680	15 NOV	1,500	15 NOV	686.00	15 NOV	613	15 NOV	3.5	176.60
53-54	3,200	13 FEB	3,200	13 JAN	676.00	13 FEB	34	13 FEB	0.2	13.50
54-55	2,400	18 JAN	2,400	18 JAN	673.50	18 JAN	16	18 JAN	0.1	4.45
55-56	4,300	26 JAN	4,300	26 JAN	677.83	26 JAN	52	26 JAN	0.3	23.00
56-57	3,040	13 JAN	3,160	13 JAN	676.20	13 JAN	36	13 JAN	0.2	14.40
57-58	8,000	15 DEC	8,000	15 DEC	684.35	15 DEC	346	15 DEC	2.0	120.00
58-59	8,020	6 JAN	9,000	6 JAN	682.90	6 JAN	162	6 JAN	0.9	84.05
59-60	4,420	1 FEB	5,320	11 JAN	678.00	11 JAN	54	11 JAN	0.3	24.10
60-61	4,740	5 NOV	5,700	5 NOV	678.40	5 NOV	58	5 NOV	0.3	27.10
61-62	16,100	12 FEB	13,600	12 FEB	686.50	12 FEB	790	12 FEB	4.0	192.85
62-63	8,123	9 FEB	7,820	9 FEB	671.00	9 FEB	2	9 FEB	0.0	1.50
63-64	4,637	22 JAN	2,830	20 NOV	675.00	20 NOV	14	20 NOV	0.1	9.15
64-65	6,170	9 APR	6,170	9 APR	678.26	9 APR	49	9 APR	0.3	26.05
65-66	17,040	29 DEC	11,150	29 DEC	691.40	29 DEC	2,181	29 DEC	12.2	366.50
66-67	12,879	6 NOV	9,425	6 NOV	687.00	6 NOV	896	6 NOV	5.1	208.35
67-68	15,995	8 MAR	9,375	8 MAR	686.82	8 MAR	857	8 MAR	4.6	202.85
68-69	16,800	25 JAN	11,825	25 JAN	693.30	25 JAN	2,945	25 JAN	16.5	438.95
69-70	6,816	6 NOV	7,150	28 FEB	682.43	28 FEB	205	28 FEB	1.2	75.45
70-71	20,013	29 NOV	1,170	29 NOV	693.03	29 NOV	2,828	29 NOV	15.8	428.90
71-72	7,097	27 DEC	6,850	27 DEC	681.90	27 DEC	172	27 DEC	1.0	67.40
72-73	13,400	11 FEB	9,940	11 FEB	688.38	11 FEB	1,228	11 FEB	6.7	252.55
73-74	10,788	7 JAN	8,681	7 JAN	685.45	7 JAN	590	7 JAN	3.2	157.85
74-75	16,017	4 DEC	9,919	4 DEC	688.33	4 DEC	1,215	4 DEC	6.6	250.90
75-76	4,348	9 FEB	5,150	9 FEB	679.20	9 FEB	70	9 FEB	0.4	34.30
76-77	10,627	2 JAN	8,150	2 JAN	684.36	2 JAN	416	2 JAN	2.4	120.25
77-78	25,670	4 MAR	13,190	4 MAR	697.65	4 MAR	5,253	4 MAR	30.2	635.65
78-79	16,410	27 MAR	9,680	27 MAR	687.62	27 MAR	1,038	27 MAR	6.0	227.65
79-80	58,970	16 FEB	15,100	16 FEB	705.10	16 FEB	11,503	16 FEB	66.6	1074.00
80-81	8,600	29 JAN	7,300	28 JAN	682.69	29 JAN	289	29 FEB	1.2	80.10
81-82	12,125	17 MAR	8,514	17 MAR	685.00	17 MAR	534	17 MAR	3.0	141.80
82-83	38,676	1 MAR	14,397	1 MAR	702.53	1 MAR	8,950	1 MAR	51.4	896
83-84	6,281	25 DEC	6,079	25 DEC	680.62	25 DEC	159	25 DEC	0.9	49.55
84-85	8,276	13 NOV	4,024	13 NOV	683.11	19 DEC				
85-86	36,938	8 MAR	10,310	15 FEB	689.20	15 FEB				
86-87	16,520	17 NOV	4,300	17 NOV	686.80	17 NOV				

NOTE: Computed Values from Corps of Engineers Data.

Table 4-06. Effects of Watershed Urbanization on Inflow to Sepulveda Reservoir.

Inflow Characteristics Average Annual	Average Rate of Inflow	
	0% Impervious* Cover	35% Impervious** Cove.
	(cfs)	(cfs)
Peak	2,000	12,000
Maximum 1-Day Duration	800	3,500
Maximum 2-Day Duration	350	2,100
Maximum 3-Day Duration	300	1,600
Maximum 5-Day Duration	200	1,300

* 1930 watershed conditions. When Sepulveda Dam was completed in 1941, watershed impervious cover was about 3%, and watershed runoff was about the same as for the 0% impervious cover.

** 1980 watershed conditions.

Table 4-07. Sepulveda Dam Runoff Data (all values in ac-ft).

Water Year	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Annual Total
1970	468.0	2656.0	500.0	2884.0	7061.0	6067.0	855.0	682.0	643.0	805.0	688.0	625.0	23934.0
1971	508.0	18530.0	15941.0	2029.0	4437.0	5643.0	2172.0	999.0	815.0	670.0	589.0	928.0	53261.0
1972	972.0	615.0	12248.0	492.0	736.0	591.0	589.0	601.0	577.0	571.0	599.0	686.0	19277.0
1973	428.0	4140.0	1730.0	7940.0	20533.0	5651.0	726.0	887.0	817.0	787.0	450.0	538.0	44627.0
1974	428.0	2168.0	1531.0	19204.0	424.0	6099.0	589.0	700.0	533.0	499.0	436.0	315.0	32926.0
1975	1571.0	284.0	7559.0	478.0	4889.0	10100.0	3025.0	573.0	482.0	500.0	260.0	313.0	30034.0
1976	373.0	401.0	496.0	286.0	6946.0	1545.0	756.0	575.0	563.0	409.0	482.0	3604.0	16436.0
1977	547.0	900.0	1091.0	7410.0	357.0	2628.0	234.0	5320.0	290.0	234.0	3638.0	125.0	22774.0
1978	182.0	224.0	6793.0	20602.0	30456.0	46342.0	3989.0	728.0	657.0	637.0	428.0	1688.0	112726.0
1979	442.0	3350.0	1789.0	17964.0	7256.0	11611.0	1349.0	1166.0	680.0	672.0	617.0	736.0	47632.0
1980	6127.0	4407.0	4592.0	88990.0	52080.0	14507.0	5242.0	3108.0	2184.0	3221.0	3935.0	3808.0	192201.0
1981	5903.0	5712.0	5617.0	8670.0	4374.0	10996.0	4389.0	2459.0	2380.0	2459.0	2848.0	2856.0	58663.0
1982	3961.0	8329.0	4167.0	7031.0	4284.0	12833.0	7139.0	4669.0	2380.0	2459.0	2459.0	3086.0	62797.0
1983	4062.0	13440.0	5819.0	21642.0	16322.0	44727.0	9273.0	4415.0	4320.0	4721.0	4925.0	4897.0	138563.0
1984	3477.0	7307.0	10897.0	3188.0	3681.0	5135.0	4979.0	4959.0	4030.0	2936.0	2848.0	2412.0	55849.0
1985	2584.0	4608.0	10302.0	5865.0	5893.0	6026.0	4760.0	4530.0	2380.0	2642.0	2951.0	2005.0	54546.0
1986	2858.0	8626.0	5345.0	11421.0	17639.0	15544.0	7307.0	6426.0	1785.0	3512.0	3396.0	4447.0	88306.0
1987	4711.0	5835.0	3872.0	5030.0	4082.0	4798.0	3316.0	3197.0	3094.0	3166.0	3209.0	3439.0	47749.0
1988	11847.0	5599.0	8474.0	7626.0	7983.0	5074.0	8039.0	3840.0	3951.0	3935.0	3935.0	3838.0	73841.0
Mean	2707.8	5112.2	5708.6	12565.9	10496.5	11364.1	3617.3	2622.8	1713.7	1833.4	2036.5	2123.5	64011.6
Median	1571	4407	5345	7410	5893	6067	3316	2459	817	805	2459	2005	62797
High	11847.0	18530.0	15941.0	88990.0	52080.0	46342.0	9273.0	6426.0	4320.0	4721.0	4925.0	4897.0	192201.0
Low	182.0	224.0	496.0	286.0	357.0	591.0	234.0	573.0	290.0	234.0	260.0	125.0	16436.0

NOTE: 1. Data are for U.S. Geological Survey gauge, "Los Angeles River at Sepulveda Dam," located immediately downstream of dam. Because impoundment durations are relatively short, these data are representative of both inflow and outflow.

Table 4-08. Rainfall, Inflow, Outflow and Elevation Frequency Values, Sepulveda Reservoir.

Return Period (Years)	24-Hour Rainfall (In)	Rainfall Loss (In)	Excess Rainfall (In)	48-Hour Runoff Volume (Ac-Ft)	48-Hour Rainfall Volume (Ac-Ft)	Peak Inflow (cfs)	Peak Outflow (cfs)	Maximum Elevation (Ft., NGVD)
500	11.23	3.82	7.41	60,049	91,038	108,970	77,584	714.57
200	9.94	3.82	6.12	49,497	80,580	94,735	40,633	713.36
100	8.84	3.77	5.07	41,106	71,663	82,516	16,989	712.24
50	7.37	3.63	3.74	30,334	59,746	54,863	15,645	706.46
25	6.59	3.47	3.12	25,292	53,423	47,327	14,740	703.04
10	5.24	3.18	2.06	16,653	42,479	34,285	12,806	696.44
5	4.41	2.94	1.47	11,930	35,750	26,162	11,481	692.53
2	3.05	2.19	0.86	6,983	24,725	12,851	8,860	685.86

NOTE: Peak inflow, outflow, and max. elevation values represent 1980 watershed conditions. The data were derived from a rainfall-runoff analysis as part of a 1985 Corps of Engineers hydrologic review study. See plates 4-06 and 4-07.

Table 4-09. Unit Hydrograph Ordinates for Watershed Above Sepulveda Dam.

15-min Time Period	Discharge* (cfs)
1	11,115
2	29,758
3	52,124
4	63,490
5	69,358
6	67,854
7	39,574
8	23,494
9	15,314
10	8,538
11	4,706
12	2,186
13	2,186
14	2,186
15	278

*Unit hydrograph derived on the basis of 1 inch per 15-minute period. Application uses a rainfall distribution having intensities of 1 inch per hour for each 15-minute period. Applied to the 152-square mile watershed.

Table 4-10. Population Projections Near Sepulveda Dam.

	10/1/79[1]	1990[2]	2000[2]
Encino - Tarzana	72,478	80,158	83,789
Reseda - W. Van Nuys	79,259	86,530	90,405
Sherman Oaks - Studio City	70,613	73,822	76,588
Van Nuys - North Sherman Oaks	113,016	110,660	114,007
	335,366	351,170	364,789

NOTES: (1) Population Estimate and Housing Inventory as of 1 October 1979, Los Angeles City Planning Department.

(2) Projected Population (1990-2000), Los Angeles City Planning Department, April, 1979.

(3) Sepulveda Dam lies in the center of the four communities indicated above.

Table 4-11. Sediment Survey Data Summary.

Date of Survey	Type of Survey	No. of Ranges or Contour Inc.	Surface Areas (Acres)	Capacity (Ac-Ft)	Period Capacity Loss (Ac-Ft) Period Total	Averg. Annual	Per Sq. Mile Per Year	Depth Designation Range in Ft. below Crest Elevation 42-40	40-30	30-20	20-10	10-Crest
								% of Total Sediment Located Within Depth Designation				
Nov 41	Contour	5 feet	1301	16,720	Original Survey	Original Survey	Original Survey	Original Survey				
Nov 44	Ranges	76	1335	17,437	-717	-239	-1.68	Change from a topographic to a range line survey shows an increase in storage.				
Jun 61	Ranges	76	1335	17,296	141	8.49	0.06	1	0	0	15	84
Dec 80	Contour	2 feet	1348	17,425	-129	-6.61	-0.05	Change from range line to topographic survey shows increase in storage.				

Photo No. 4-01. Flood of 16 February 1980, Los Angeles River at Cedros Street, approximately 1.5 river miles below Sepulveda Dam (view toward downstream, showing overflow of left bank resulting from hydraulic instability due to a side drain in the channel wall).

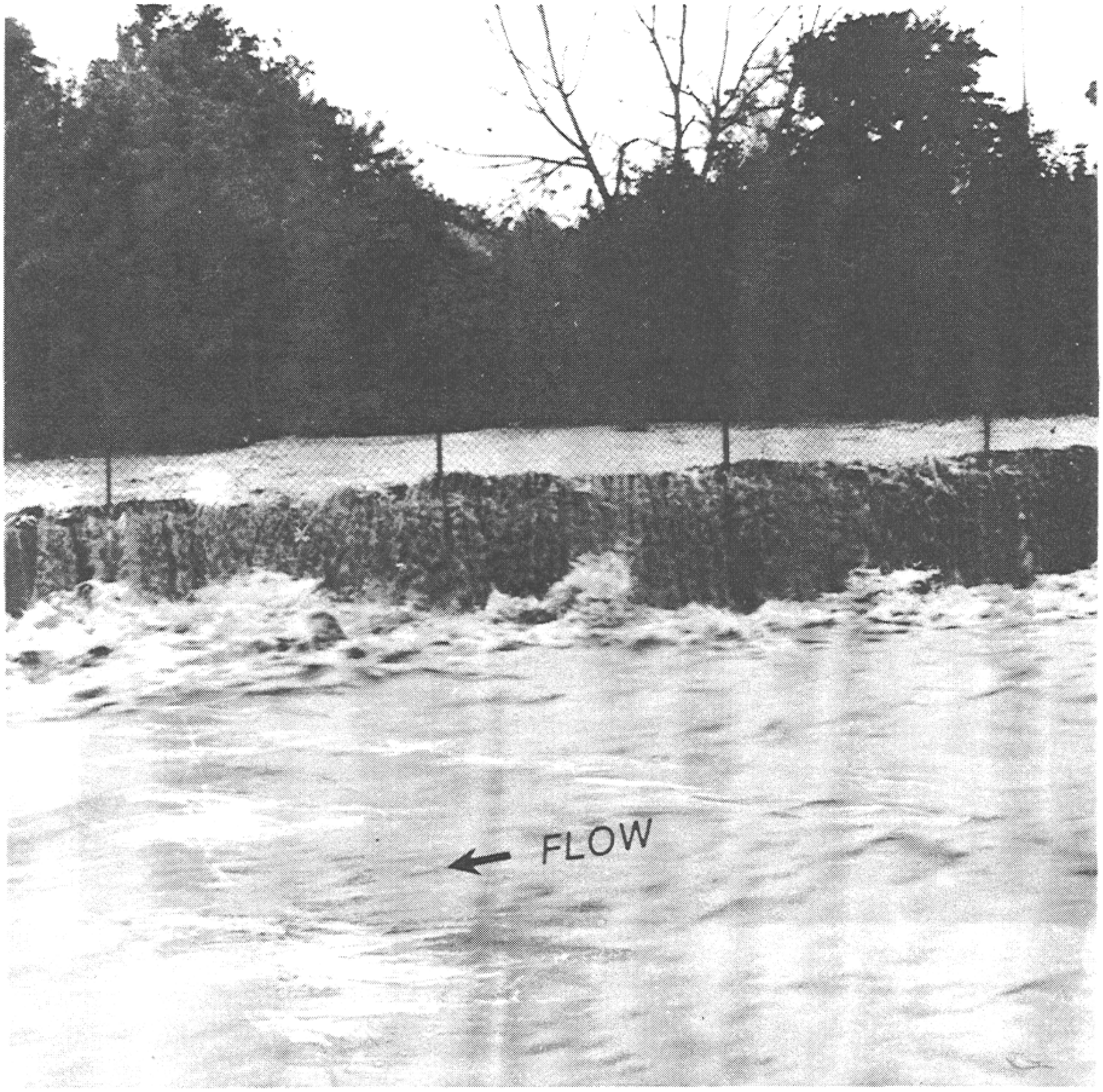

Photo No. 4-02. Flood of 16 February 1980, Los Angeles River at Cedros Street (view toward right bank, from location downstream of channel overflow in Photo No. 4-01).

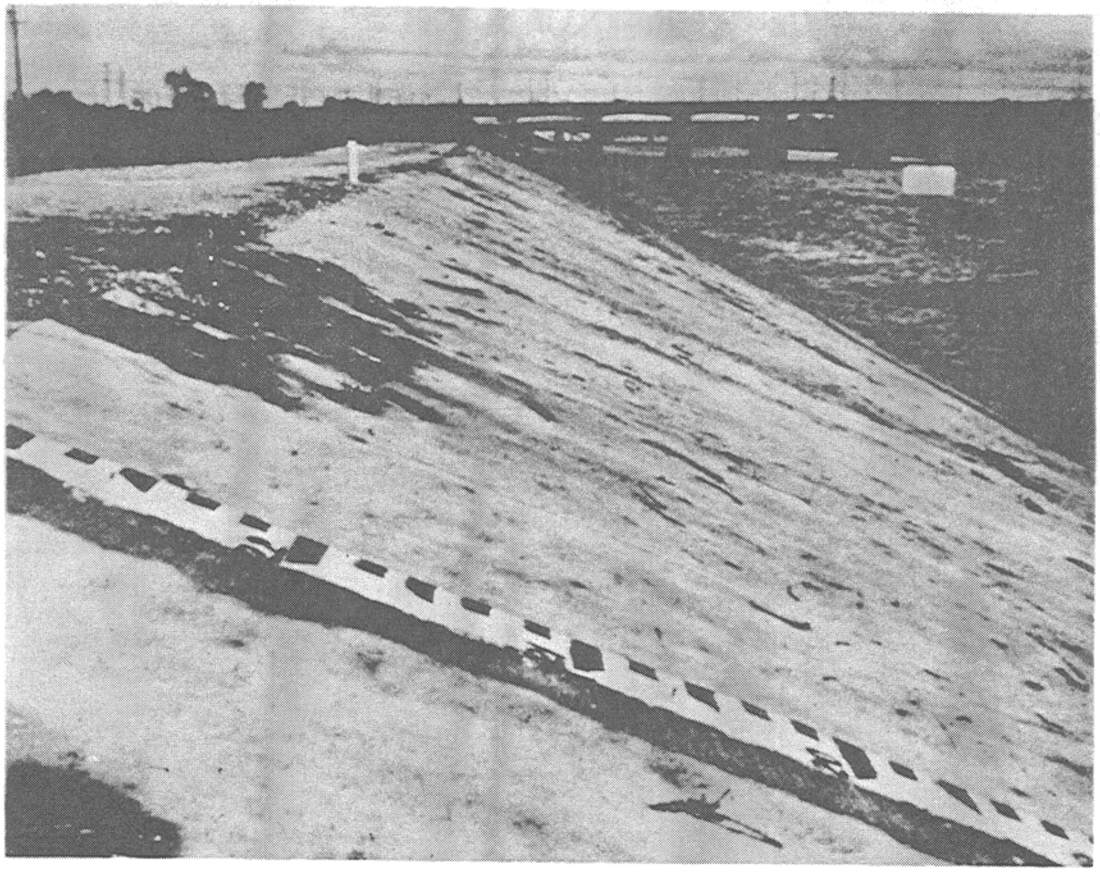

Photo No. 4-03. Aftermath, Flood of 16 February 1980, Los Angeles River below Wardlow Road, Long Beach (view toward downstream, showing debris at top of levee left by flood).