PART A

GENERAL INFORMATION

WHITTIER NARROWS FLOOD-CONTROL RESERVOIR

SAN GABRIEL RIVER BASIN, CALIF.

1 OCTOBER 1957

TABLE OF CONTENTS

PART A

GENERAL INFORMATION

TABLES

TABLE OF CONTENTS--Continued

PLATES

PART A

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1. Authority.--The authority for the preparation of this manual is contained in paragraph 4220.01, Orders and Regulations, Office, Chief of Engineers (ER 1110-2-240, 1130-2-301). Detailed instructions pertaining to the contents of the manual are contained in part CXXXVI of the Engineering Manual, Civil Works Construction, dated August 1951 and title "Reservoir Regulation" (EM 1110-2-3600).

2. Scope.--This manual contains general descriptive information pertaining to the drainage area and project, information on the Los Angeles District's organization and methods for effecting hydraulic operation of the project, detailed information on plans of operation, and pertinent data required for the operation of the project.

3. Project history and authorization.--The San Gabriel River and the Rio Hondo flow through a natural gap in the hills that form the southern boundary of the San Gabriel Valley. This gap is known as Whittier Narrows. A dam across the Narrows for the purpose of flood control and conservation was considered by the Los Angeles County Flood Control District early in 1930. This organization made studies and prepared plans for construction of the dam until about 1934 when an application was made to the Federal Emergency Administration of the Public Works for loans and grants to construct the dam. A special board of review, appointed by the Public Works Administration to review the application, rendered an adverse report due to technical reasons. On 27 March 1935, the application was withdrawn.

4. The Flood Control Act of 22 June 1936 included authorization for work on the San Gabriel River and Rio Hondo as approved by the Chief of Engineers U.S. Army. The Whittier Narrows project was included as a unit of the general comprehensive plan for flood control in the Los Angeles County drainage area in the district engineer's report of 5 February 1940 titled "Survey Report, Flood Control, Los Angeles and San Gabriel Rivers and Their Tributaries and Ballona Creek, California." The above comprehensive plan was approved in the Flood Control Act of 18 August 1941.

5. Considerable local opposition developed to the construction of the dam, and appropriations for construction were delayed. The House Committee on Flood Control on 16 April 1946 requested the Chief of Engineers to make a restudy of the Whittier Narrows project. Alternate plans were developed and after several meetings and hearings the final plan was adopted. The 1949 Appropriations Bill included $250,000 to start construction on the project. Subsequent appropriations were made and the project is scheduled for completion in 1957.

6. Physiographic characteristics.--Whittier Narrows flood-control reservoir is located on the San Gabriel River and the Rio Hondo, approximately 10 miles east of the city of Los Angeles and 3 miles south of the city of El Monte. Location of the Project is shown on plate A-1. The drainage area of 554 square miles is 60 percent mountains, 30 percent valley, and 10 percent hills. The rugged San Gabriel Mountains form the northern boundary of the drainage area. Most of the valley area is between the mountains and a range of low hills along the east, south, and west sides of the drainage area. Elevations in the drainage area vary from about 200 feet above sea level at Whittier Narrows to more than 10,000 feet at San Antonio Peak on the northeast boundary, and from about 400 to 1,400 feet along the hills forming the southern boundary. A topographic map of the area is shown on plate A-2.

7. San Gabriel River originates on the southern slopes of the San Gabriel Mountains. It flows through precipitous canyons to the base of the mountains, and thence across a broad alluvial cone and the San Gabriel Valley to Whittier Narrows. The Rio Hondo, a distributary of San Gabriel River, branches from the river near the middle of the San Gabriel Valley and flows southwest to Whittier Narrows. From the Whittier Narrows, San Gabriel River flows south to the Pacific Ocean, and the Rio Hondo flows southwest to the Los Angeles River. The steep, high southern front of the San Gabriel Mountains is drained by several tributaries of the San Gabriel River and the Rio Hondo. The longest watercourse above Whittier Narrows Dam is 39.5 miles. The average gradient of San Gabriel River in the mountains is 260 feet per mile. The average gradients of San Gabriel River and the Rio Hondo in the valley are 41 and 27 feet per mile, respectively.

8. Soils of the drainage area are primarily residual, derived from metamorphic and igneous rocks. The mountain soil is coarse, porous, rocky, and generally shallow, with large areas of bare rock outcrop. The hill soils are shallow, but generally less pervious than mountain soil. The valley soil, classified as recent alluvium and older alluvium, varies from coarse sand and gravel in the stream channels and at the canyon mouths to silty clay and clay loam in the lower (southern) part of the valley, and clay on the east and west sides. Long the summits and in the higher ravines of the mountains there is a fairly well-developed growth of ponderosa pine, incense cedar, juniper, and oak. Cottonwoods, box elders, sycamores,

oaks, willows, and alders are found along the watercourses at lower elevations. In general, the remainder of the mountains is covered with brush, varying in density from scattered bushes to nearly impenetrable thickets. These consist of California lilac, scrub oak, mountain mahogany, sumac, laurel, sage, and manzanita. The dense chaparral growth and long, dry summers render the region extremely susceptible to fires which are difficult to control, frequently resulting in complete denudation of extensive areas. The hills are without trees except for a few, such as oaks, sycamores, and cottonwoods along the stream channels. Grasses are the principal natural vegetation on the hills. On much of the hill land and nearly all the valley land the natural vegetation has been replaced by cultivated field, orchard, and truck crops, and, especially in the valley west of the Rio Hondo, by urban and suburban development. As a result of the urban development, much of the valley has become all-impervious to rainfall infiltration and storm-runoff percolation. The percentage of all-impervious area is increasing rapidly with continuing development.

9. Downstream development.--The overflow area downstream from Whittier Narrows flood-control basin prior to construction of the dam comprised about 60,000 acres of highly developed industrial, residential, and agricultural property in the south eastern part of Los Angeles County. This area has an estimated value of about $300,000,000 and is occupied by about 1,000,000 persons. Included in the overflow area are parts of the cities of Long Beach, Artesia, Compton, Downey, Lakewood, Lynwood, Montebello, South Gate, and numerous other communities. Facilities vital to defense mobilization and national economy are subject to serious damage or disruption by floods. These facilities include major aircraft plants, including North American and Douglas plants; oil refineries, including those of Richfield, Union, Shell, General Petroleum, Texas, Tidewater Associated, and Standard Oil Companies; automobile factories and assembly plants, including those of Ford, General Motors, and Studebaker Companies; important harbor facilities and shipyards; main transcontinental railroads and highways; United States Naval installation, including the Los Alamitos Air Station and Ammunition and Net Storage Depot near Seal Beach; and many other smaller but important facilities.

10. Hydrometeorological characteristics.--The climate in the drainage area is subtropical and semiarid in the valleys and hills and is temperate and humid in the mountains. Most precipitation in the drainage area is associated with general winter storms that result from extratropical cyclones of north Pacific origin. During the months of November through April, these storms move south over the Pacific Ocean to the latitudes of southern California and thence inland and result in precipitation over large areas. Major storms consist of one or more cyclonic disturbances and occasionally last 4 days or more. Thunderstorms, which may result in intense precipitation over small areas during short periods, occasionally occur

either in association with general winter storms or independently. Summer thunderstorms are infrequent. The greatest floods from the entire drainage area above Whittier Narrows floods-control basin result from general winter storms, but the greatest floods from a small sub-basin result from thunderstorms. The mean seasonal precipitation in the drainage area ranges from 16 inches at the dam to more than 45 inches at the crest along the northern boundary of the area (pl. A-3). Most of the precipitation falls during the months of November to April, inclusive. Rainless periods of several months during the summer are common. The monthly distribution of precipitation and other meteorological elements for Los Angeles and Mount Wilson, considered representative of the valley and mountainous areas, are shown in tables A-1 and A-2. The location of these stations are shown on plate A-1.

11. Snow falls frequently during the winter at elevations above 5,000 feet but melts rapidly except on the protected northern slopes and on the higher peaks. Snow rarely falls in the valley. Generally, the effects of snow upon flood runoff is considered slight. However, appreciable effect is possible and current information is obtained during storms for optimum operation of the reservoir. The maximum snow cover in the mountains above Whittier Narrows Dam, based on a record extending back 23 years, occurred in March 1944. The snowline at that time was at an elevation of 4,000 feet. Above this elevation, the average snow depth was 61.3 inches over an area of 75,360 acres. The average water content of snow over the area was 18.4 inches using a snow density of 30 percent. Monthly snow data for Mount Wilson considered representative of the mountain area, are shown in table A-2.

12. Runoff from the drainage area is characterized by unusually high flood peaks of short duration. The physiographic features of the region serve to intensify rainfall rates. High rainfall intensities, combined with effect of shallow surface soils underlain by impervious bedrock, fanshaped collecting systems, occasional denudation by fire, and steepness of gradients, produce floods heavily laden with debris below the canyon mouths. Most streams in the drainage area are intermittent. During normal dry weather the discharge of many streams in increased by regulated outflow from dams in the mountains. Hydrographs of the Rio Hondo above Mission Bridge (1 mile above the dam) for the years 1938 through 1952, and for the San Gabriel River at Beverly Boulevard (1-1/4 miles below the dam) for the years 1937 through 1951 are shown on plates A-4 and A-5, respectively.

13. Floods of record.--During the period for which daily hydrologic data are available (1880-1955), medium to large floods occurred at Whittier Narrows in 1884, 1886, 1889, 1890, 1891, 1905, 1906, 1910, 1911, 1914, 1916, 1921, 1926, 1927, 1934, 1938, and 1943. Hydrographs for the more recent of these floods are shown on plate A-6. Hyetographs for corresponding storms are shown on plate A-7. The floods

of 1884, 1889, March 1938, and January 1943 were outstanding, and the flood of 1934 was large on some of the tributary streams. The flood of January 1952, although small at Whittier Narrows, was the second largest flood of record on the lower reaches of the Los Angeles River.

14. The greatest flood of record at Whittier Narrows was caused by the storm of 27 February - 3 March 1938. This flood resulted from intense rainfall on 2 March, preceded by continuous moderate rainfall that commenced on 27 February. Average rainfall depth over the drainage area was 17.3 inches for the storm. Low rainfall-loss rates and the unusually large rainfall of the storm caused high rates of runoff, especially in the mountains. Past peak discharges were exceeded at all existing stream-gaging stations, with the exception of a few valley stations. Many stream-gaging stations were destroyed as a result of the high discharges of this flood. Estimated peak discharge at Whittier Narrows was 47,000 cubic feet per second. The estimated flood hydrograph and other pertinent hydrologic data area shown on plate A-6. This flood caused damages estimated at more than $2,000,000 downstream from Whittier Narrows Dam. The damages that would be caused under present conditions of development by a flood which would inundate areas similar to those flooded in 1938 are estimated at over $11,000,000.

15. The storm of 21-24 January 1943 was in many respects the most severe of record for the San Gabriel River Basin. In the mountains the recorded intensities for durations greater than 12 hours exceeded all previous recorded intensities in the area. At Hoegee's Camp, the maximum 24-hour precipitation was 25.83 inches. Average rainfall depth over the drainage area above Whittier Narrows was 18.3 inches for the storm. Peak discharge at Whittier Narrows was estimated at 26,200 cubic feet per second. The estimated flood hydrograph and other pertinent hydrologic data are shown on plate A-6.

16. Upstream regulation.--There area numerous reservoirs and diversion structures in the drainage area tributary to Whittier Narrows Reservoir. The only structure operated solely for flood control is Santa Fe flood-control reservoir. This structure, completed in 1949, is under the jurisdiction of the U.S. Army Corps of Engineers. It has a capacity of 34,300 acre-feet at spillway crest. The 16-gated outlets, which discharge into San Gabriel River, have a combined capacity of 41,000 cubic feet per second with reservoir water surface at spillway crest. At present Santa Fe Reservoir is operated on an interim operation schedule designed to minimize damage along the unimproved downstream channel. For further information concerning the operation of this reservoir, reference is made to Appendix III of the Master Reservoir Regulation Manual.

17. Four other large reservoirs are in the drainage area above Whittier Narrows. They are Morris, San Gabriel, and Cogswell Reservoirs on San Gabriel River, and Puddingstone Reservoir on upper Walnut Creek. Morris Reservoir is operated by the Metropolitan

Water District for water supply and is normally full to spillway crest. The Los Angeles County Flood Control District operates the San Gabriel, Cogswell, and Puddingstone Reservoirs. San Gabriel and Cogswell Reservoirs are flood-control and conservation reservoirs. Current operation plans for the San Gabriel and Cogswell Reservoirs will make 33,000 and 9,600 acre-feet, respectively, available for flood control at the beginning of floods. Puddingstone Reservoir is also operated for flood control and conservation. An allotment of 5,000 acre-feet of storage will be available for flood control at the beginning of floods.

18. Eight small combination flood-control and water-conservation reservoirs are in operation in the drainage area and numerous debris basins have been constructed. Several diversions are made upstream from Whittier Narrows for irrigation, spreading, water supply, and production of power. However, major floodflows are not appreciably affected by the operation of these structures. Pertinent data on existing reservoirs in the drainage area are given in table A-3, and their locations are shown on plate A-1.

19. Hydrologic basis of design.--Selection of the reservoir capacity for Whittier Narrows Reservoir was based primarily on controlling the greatest flood (standard project) that may reasonably be expected to occur to nondamaging flows below the dam. The method of developing the standard project flood is outlined in the report titled "Hydrology, San Gabriel River and the Rio Hondo above Whittier Narrows Flood-Control Basin with Addendum on the Hydrologic Effect of Diverting Outflow from Whittier Narrows Flood-Control Basin to Los Angeles River via the Rio Hondo," dated 20 December 1944 and revised 10 July 1946. It is based on the assumed occurrence of a storm equivalent to the storm of January 1943 at a time when the ground conditions would be reasonably conducive to runoff. In developing the flood, all upstream reservoirs except San Gabriel and Santa Fe were assumed full to spillway crest at the beginning of the storm. San Gabriel Reservoir was assumed to have 12,500 acre-feet of water in storage at the beginning of the storm, and the outflow was assumed to be controlled to 4,000 cubic feet per second until there was 22,000 acre-feet of water in storage. At this point, the outflow was increased by increments of 1,000 cubic feet per second until it reached 10,000 cubic feet per second. This maximum outflow was assumed constant until the amount of water in storage decreased to 12,500 acre-feet. Santa Fe flood-control basin was assumed empty at the beginning of the flood and the outlets were assumed completely open during the flood. The regulating effect of the outlet conduits at all other existing upstream reservoirs was assumed negligible during the flood. The resulting flood with a peak of 70,000 cubic feet per second and a 4-day volume of 250,000 acre-feet was routed through the reservoir assuming the following conditions: (a) the outlet gates fully open until the outflow reached 40,000 cubic feet per second and then throttled to maintain that outflow, and (b) the spillway gates closed. This resulted in a

maximum water-surface elevation of 228.5 feet and a corresponding storage of about 33,000 acre-feet. The top of the spillway gates was thus set at elevation 229 feet. No allowance was made for sedimentation in the reservoir capacity. The rate of debris inflow is expected to be small because debris flows from the mountain and foothill areas are largely controlled by Santa Fe flood-control reservoir and numerous other flood-control reservoirs and debris basin. Only 178 square miles of low sediment-producing valley area will be contributing sediment to Whittier Narrows Reservoir. The regulated outflow of 40,000 cubic feet per second was selected after extensive economic studies were made of the cost of the project with various combinations of outflow and height of dam.

20. The development of the maximum probable flood was similar to the development of the standard project flood. The maximum probable flood is defined as the flood that would result if the maximum possible storm rainfall for the drainage area were to occur at a time when ground conditions in the area were conducive to maximum runoff. The maximum possible storm was based on information given in the report title "Revised Report on Maximum Possible Precipitation, Los Angeles Area, Calfornia," dated 29 December 1945 and prepared by the Hydrometeorological Section of the Untied States Weather Bureau. The rainfall pattern was based on the 1943 storm. In developing the flood, all upstream reservoirs were assumed full to spillway crest at the start of the storm. The resulting flood with a peak of 305,000 cubic feet per second and a 4-day volume of 690,000 acre-feet was routed through Whittier Narrows Reservoir under the following conditions: (a) the regulated outflow through the outlets would be 40,000 cubic feet, (b) the reservoir water surface would be at elevation 228.5 feet above mean sea level at the start of the flood, and (c) the spillway gates would operate automatically on a predetermined schedule. The outlet gates were assumed operative due to the remote possibility that one or more of the large radial gates would become partially blocked or stuck. The routing resulted in a reservoir water-surface elevation of 234 feet. With a 5-foot freeboard, the top of the dam was set at elevation 239 feet.

21. Description of the project.--The project includes: (a) a dam and outlet works on the San Gabriel River and the Rio Hondo at Whittier Narrows, (b) Rio Hondo channel improvements above the dam from Rush Avenue to Rubio Wash with a capacity of 51,000 cubic feet per second, (c) San Gabriel River channel improvement from about 1 mile above the dam to the San Jose Creek diversion channel with a capacity of 99,000 cubic feet per second, (d) a floodflow channel in the reservoir to divert flows from the San Gabriel River to Rio Hondo with a capacity of 30,000 cubic feet per second when the Rio Hondo pool is below elevation 197.5 feet, (e) a diversion channel for diverting San Jose Creek flows into the reservoir with a capacity of 38,000 cubic feet per second, (f) Rio Hondo channel improvement below the dam to the Los Angels River with a capacity ranging from

40,000 to 42,500 cubic feet per second, and (g) the relocation of streets and utilities within the project area. The general plan of the project is shown on plate A-8. Pertinent data are tabulated in table A-4.

22. The reservoir is formed by an earth (rolled fill) dam having a crest length of 16,960 feet at elevation 239.0 (top of dam), and a maximum height above the Rio Hondo streambed of 56 feet (pl. A-9). The area and capacity of the reservoir at elevation 229.0 (top of spillway gates when closed) are 2,470 acres and 36,160 acre-feet, respectively; at the top of the dam, the area is 3,630 acres and the capacity is 67,060 acre-feet. (Area and capacity values are based on survey ending in March 1957.) Rosemead Boulevard passes over the dam and across the reservoir. The roadway is elevated within the reservoir area with a minimum elevation of 211.0. Below this elevation, the Mission Creek pool and the Rio Hondo pool are divided by Rosemead Boulevard with only the floodflow channel (invert elev. 197.5) connecting the two pools. The Rio Hondo pool at stages below elevation 188 is divided into two pools by a diversion dike in the Rio Hondo channel just above the dam. San Gabriel River channel is separated from the Mission Creek pool below elevation 208 (invert of floodflow channel at San Gabriel River).

23. Seventy-three productive oil wells are located below elevation 230 within Whittier Narrows Reservoir. Approximate elevations of these wells are tabulated in table A-5. The Los Angeles District Office of the U.S. Army Corps of Engineers is negotiating contracts with owners of the oil wells to compensate them for possible damages caused by the construction and operation of Whittier Narrows Dam.

24. The outlet works are located near the right abutment of the dam so that discharges are directed into the Rio Hondo (pl. A-10). Four radial gates, 30 feet wide by 20 feet high, when closed, seal gate openings 30 feet wide by 19 feet high. The gates are numbered from left to right looking downstream. Gate sills are at elevation 184. Regulated outflow (40,000 cubic feet per second) is reached at elevation 208.4. Maximum discharge capacity (reservoir elevation 229.0) is 74,700 cubic feet per second. Trash racks are not provided because the outlets are sufficiently large to pass the anticipated maximum size of debris. The piers between the gates are designed to withstand unequal water pressures caused by any gate being closed while the adjoining gate is open. Each gate is equipped with a single $7^{1}/_{2}$-horsepower motor. Reduction units provided give a hoisting speed of approximately 1 foot per minute. Although provision is made for control of the consists by push-button stations at the motors, they will generally be operated from a control board located in the control house. Automatic electrical operation of gate No. 1 is provided to open the gate when the water surface reaches elevation 189 and close the gate when the water surface falls below elevation187. In addition, an automatic device

is installed that will ring an alarm in the dam tender's residence and will stop a clock and flash a light in the district office when the reservoir water surface reaches an elevation of approximately 187 feet.

25. The spillway structure, consisting of nine 50- by 29-foot radial gates, separated by six 8-foot wide and two 16-foot wide piers, is located so as to discharge into San Gabriel River (pl. A-11). Gates are numbered from left to right looking downstream. The gate sills are at elevation 200 feet. The gates are automatically operated by floats and counterweights above water-surface elevation 228.5 where they commence opening and continue until fully open at water-surface elevation 233.5. At reservoir water-surface elevation 234, the design discharge is 251,000 cubic feet per second, and at elevation 239, the discharge is 308,000 cubic feet per second. In addition to the automatic control system, the spillway gates are equipped with mechanical hoists for use in routine maintenance and in emergencies if the automatic control system should fail. Each gate is hoisted by a unit containing a 3-horsepower motor and gear reductions designed to lift the gate at a speed of approximately 1 foot per minute. The motor is connected to the hoist mechanism through a clutch designed to disengage when the automatic float system is in operation. Controls for the mechanical hoists are located on the bridge adjacent to each motor.

26. Commercial electrical power is available for lights, the automatic operation of outlet gate No. 1, and minor power devices. A 30-kW generator provides standby power in the event of commercial power failure. Electrical power for gate hoists and other heavy power units is obtained from a diesel-driven, 75-kW-a generator, with a 75-kW-a standby unit.

27. A 30-inch reinforced concrete pipe is provided to pass Mission Creek flows through the dam. The main flow in mission Creek originates from rising ground water within the reservoir area. Flow of the creek is continuous and normally less than 5 cubic feet per second. Mission Creek flow constitutes a part of the water reaching the Arroyo Ditch and Water Company's intake downstream from the dam. The Mission Creek conduit is located in the central embankment of the dam, just east of Rosemead Boulevard. The intake structure contains trash rack, a sand trap, and a manually operated 36-inch slide gate. Top of the intake structure and operating mechanism is at elevation 202.5, which will permit operation of the gate during all but major floods. A 30-inch, low-pressure gate valve is provided near the downstream end of the conduit for regulating the outflow during times that the 36-inch gate is flooded. The conduit was designed to pass 30 cubic feet per second when reservoir water surface reaches about elevation 191. Invert of the intake structure is at elevation 187.5.

28. Hydrologic facilities.--Facilities for obtaining hydrologic data required in the operation of Whittier Narrows Dam include: (a) a glass-tube rain gage and a recording rain gage located at the dam; (b) rain gages, from which radio reports are received, located in or near the drainage area at Chilao, Crystal lake, Big Pines, Mt. Baldy, San Dimas, Sierra Madre, and Santa Fe Dam; (c) rain gages, operated by the Los Angeles County Flood Control District, located at Sierra Madre Dam, Sawpit Dam, Cogswell Dam, San Gabriel Dam, Morris Dam, Opid's Camp, and Colby's Ranch; (d) reservoir water-surface recorders located in the outlet control house, the spillway control house, and in the floodflow channel at Rosemead Boulevard; (e) reservoir staff gages; (f) outlet gate position recorders and indicators in the outlet control house and spillway gate position recorders in the spillway piers and indicators in the spillway control house; (g) inflow gaging stations located on Alhambra Wash near Klingerman Street (Los Angeles County Flood Control District station), on the Rio Hondo below Garvey Avenue, and on the San Gabriel River at Parkway Bridge; and (h) outflow gaging stations located on the Rio Hondo below the dam, on San Gabriel River at Beverly Boulevard (Los Angeles County Flood Control District station), and on Mission Creek below the dam. The locations of the above facilities are shown on plate A-1.

29. The outflow gaging station on the Rio Hondo is equipped with telemetering equipment to transmit gage heights to the outlet control house. The inflow gaging stations on the Rio Hondo below Garvey Avenue and on Alhambra Wash near Klingerman Street are being equipped with Telemarks connected to a commercial telephone system. It is planned to install the same type equipment at the inflow gaging station on the San Gabriel River at Parkway Bridge. No Telemark installation is contemplated for the Mission Creek gaging station.

30. Communication facilities.--The following communication facilities have been installed at Whittier Narrows Dam for reporting hydraulic data: (a) commercial telephone service in the outlet control house, (b) a telephone system between the outlet control house, the spillway control house and the individual spillway gate controls, (c) a telephone system, owned by the Los Angeles County Flood Control District, between their spreading grounds in the Rio Hondo, the outlet control house, and the spillway control house, (d) a sound-powered telephone system between the outlet control house and the gaging station on the Rio Hondo below the dam, and (e) a two-way radio in the outlet control house, and a remote-control radio unit in the spillway control house for communicating with the district office.

31. Sedimentation measurements.--An initial survey to be used as the basis for future determinations of sedimentation was completed in March 1957. The contours for this survey are at 2-foot intervals. In order to obtain information on the depth of sediment in the

reservoir to determine whether anew survey is required, two permanent monumented ranges were established as shown on plate A-8. Future surveys will be made after each major flood or at intervals of not over 10 years.

32. Diversion structures.--Several water-conservation facilities in the vicinity of Whittier Narrows Dam, but not part of that project, were affected by the construction and operation of the dam. Downstream from the dam on the Rio Hondo, the Los Angeles County Flood Control District operates a spreading ground of 443 acres located on the east side of the Rio Hondo channel between the Union Pacific Railroad and Slauson Avenue (pl. A-12). The sustained percolation capacity of these grounds is approximately 600 cubic feet per second. In order to facilitate operation of the spreading grounds, a permanent headworks consisting of 3 power-operated Tainter gates, 12 feet high, has been constructed in the channel. Included in the diversion headworks are four 5- by 4-foot vertical slide gates (capacity 750 cubic feet per second) in the left bank which control flows into the spreading grounds, and two 4- by 4-foot vertical slide gates (capacity 150 cubic feet per second) in the right bank which control flows into the natural channel percolation area along the west bank of the concrete channel.

33. Water rights to the rising water flow in the Rio Hondo are satisfied by a diversion conduit in the left abutment of the outlet works. This conduit discharges low flows to the unimproved ditch behind the left levee of the downstream channel. Invert of the conduit is at elevation 184.0. It is 3 feet in diameter, and is controlled by a manually operated slide gate. Two trash racks are provided for the conduit intake. Operation of the gate is from a stand near the top of the dam. The Los Angeles County Flood Control District will operate the gate for diverting and spreading water. Construction of a low grouted-cobblestone dike to divert low flows to the diversion conduit was completed about November 1956. The dike has a top elevation of 188.0, and extends 2,000 feet upstream from the left pier of the outlet works to the right bank of the Rio Hondo.

34. Local interests are using the natural bed of the Rio Hondo between Beverly Boulevard and Anaheim-Telegraph Road for percolation purposes. In order to continue the use of the abandoned streambed west of the channel improvement for this purpose, a 54-inch gated siphon was constructed under the channel a short distance downstream from Beverly Boulevard to divert up to 150 cubic feet per second to this area.

35. The Arroyo Ditch and Water Company has developed facilities in the left levee of the original Rio Hondo channel just downstream from Beverly Boulevard for diverting approximately 25 cubic feet per second to its ditch system (pl. A-12). Water for these facilities

will be supplied through the diversion conduit in the left abutment of the outlet works. The right of other water users to low flows is subject to the prior right of the Arroyo Ditch and Water Company.

36. The Los Angeles County Flood Control District operates spreading grounds on the west side of San Gabriel River between Whittier Boulevard and Washington Boulevard. This spreading grounds has a gross area of 111 acres, an intake capacity of 200 cubic feet per second, and a percolation capacity of approximately 85 cubic feet per second.

37. The San Jose Creek diversion channel which diverts flows from San Jose Creek into San Gabriel River above Whittier Narrows Dam was constructed as a part of the Whittier Narrows project. The capacity of this diversion channel is 38,000 cubic feet per second.

38. The floodflow channel is trapezoidal in section with a base width of 400 feet and side slopes of 1 on 2.5. The invert elevation of the floodflow channel at the San Gabriel River is 208.0 feet. Invert elevation at the Rosemead Boulevard Bridge is 199.0 feet with a low-flow channel 40 feet wide having an invert elevation of 197.5 feet.

39. Downstream channels.--The Rio Hondo channel improvement from Whittier Narrows Dam to the Los Angeles River has been completed, and capacities range from 40,000 to 42,500 cubic feet per second. The Los Angeles River channel improvement from the confluence with the Rio Hondo to the Pacific Ocean is scheduled for completion by December 1957. At that time, the channel capacity will vary from 140,000 to 146,000 cubic feet per second. The capacity of the San Gabriel River channel from Whittier Narrows Dam to the Pacific Ocean is estimated at 10,000 cubic feet per second for a sustained flow. However, it is believed that some maintenance would be required. Current plans call for the expenditure of about $10,000,000 to improve the San Gabriel River channel. When improvements are completed, the channel will have a capacity of 15,000 cubic feet per second from the dam to the confluence with Coyote Creek and a capacity of 30,000 cubic feet per second from Coyote Creek to the ocean.

40. Changes to authorized plan.--The final project plan differs from the plan prepared in 1940 due primarily to (a) the changed location of the dam to meet objection raised mostly by local interests in El Monte, adjacent to the upper reservoir area, (b) changes made necessary by building construction and highway improvements which took place in the reservoir area, and (c) design modifications. In 1946 the dam was redesigned to provide outlet works which would discharge into the Rio Hondo rather than into the San Gabriel River. The controlled outflow was increased, a gated spillway was provided, and the alignment was revised slightly. In 1948, the dam site was moved downstream a distance of one-half mile in order to avoid the flooding of 300 private homes and property and adjacent to the city of El Monte in the upstream reservoir area.

41. Construction history.--Construction of the dam began on 23 March 1950 and closure was made on 15 November 1955. Construction of the project is scheduled for completion in 1957. The total Federal cost for the project is expected to be $32,300,000.

42. Development of reservoir area.--Extensive development of the reservoir area for recreation is planned. The Los Angeles County Parks and Recreation Department will develop most of the area. Facilities planned by this organization include picnic areas, golf course, amusement area, equestrian trials, and facilities for athletic events. A fishing lake has already been established. The National Audubon Society operates a wildlife sanctuary and nature center, and the Los Angeles Rifle and Revolver Club and the City of Alhambra Pistol Club operate ranges in the reservoir area.

Table A-1

Summary of climatological data at Los Angeles, California*

Month	Temperature			Precipitation			Snow		
	Mean monthly	Record highest	Record lowest	Mean monthly	Maximum monthly	Minimum monthly	Mean monthly	Maximum monthly	Minimum monthly
	Degrees Fahrenheit	Degrees Fahrenheit	Degrees Fahrenheit	Inches	Inches	Inches	Inches	Inches	Inches
Jan.	55.0	90	28	2.38	13.30	T	T	2.0	0
Feb.	56.4	92	28	3.37	13.37	0	T	T	0
Mar.	58.9	99	31	2.36	12.36	T	T	T	0
Apr.	61.5	100	36	1.17	7.53	T	0	0	0
May	64.8	103	40	.26	3.57	0	0	0	0
Jun.	67.8	105	46	.07	1.39	0	0	0	0
Jul.	72.5	109	49	T	.27	0	0	0	0
Aug.	72.9	106	49	.02	.61	0	0	0	0
Sep.	71.0	108	44	.27	5.67	0	0	0	0
Oct.	66.6	104	40	.50	6.96	0	0	0	0
Nov.	62.1	96	34	1.03	6.53	0	T	T	0
Dec.	57.3	92	30	3.11	15.80	0	T	T	0
Period of record	63.9	109	28	**14.54	15.80	0	**T	2.0	0

* Latitude 34° 03' N; longitude 118° 14' W.; elevation 312 feet above mean sea level.
** Mean seasonal.

NOTE: Period of record for mean values 30 years (1921-1950). Period of record for maximum and minimum values 77 years (1877-1954). "T" refers to trace.

Table A-2

Summary of climatological data at Mount Wilson, California*

Month	Temperature			Precipitation			Snow		
	Mean monthly	Record highest	Record lowest	Mean monthly	Maximum monthly	Minimum monthly	Mean monthly	Maximum monthly	Minimum monthly
	Degrees Fahrenheit	Degrees Fahrenheit	Degrees Fahrenheit	Inches	Inches	Inches	Inches	Inches	Inches
Jan.	42.1	75	7	5.54	28.59	0.03	13.0	82.0	0
Feb.	42.3	73	14	7.76	24.61	0	10.8	71.7	0
Mar.	45.2	80	14	5.58	22.80	.02	6.5	54.0	0
Apr.	50.9	85	14	2.86	17.55	0	2.9	13.0	0
May	56.8	91	21	.81	11.04	0	.9	11.0	0
June	65.2	98	29	.13	1.39	0	T	T	0
July	73.1	99	42	.02	.40	0	0	0	0
Aug.	72.3	101	38	.11	1.24	0	0	0	0
Sept.	67.2	98	34	.64	11.78	0	0	0	0
Oct.	57.8	91	21	1.57	6.97	0	.5	5.5	0
Nov.	51.0	80	15	2.52	11.31	0	1.9	10.0	0
Dec.	44.7	75	13	6.33	29.40	0	7.2	28.0	0
Period of record	55.7	101	7	**33.87	29.40	0	**42.7	82.0	0

* Latitude 34° 14' N.; longitude 118° 04' W.; elevation 5,707 feet above mean sea level.
** Mean seasonal.

NOTE: Period of record for mean values 34 years (1916-1950). Period of record for maximum and minimum values 50 years (1904-1954). "T" refers to trace.

Table A-3

Pertinent data for existing dams in drainage area above Whittier Narrows flood-control reservoir

Dam*	Purpose	Year completed	Drainage area**	Storage capacity		Maximum outflow	
				Spillway crest	Top of dam	Outlets***	Spillway#
ON SAN GABRIEL RIVER			Square miles	Acre-feet	Acre-feet	Cubic feet per second	Cubic feet per second
Cogswell Dam	Flood Control and Water Conservation	1934	39.2	10,600	13,800	11,800	57,300
San Gabriel Dam	...do	1939	202.7	43,900	60,600	12,600	297,000
Morris Dam	Water supply	1934	211.3	28,600	37,200	5,800	77,600
Santa Fe Dam	Flood control	1949	236	34,300	55,000	41,000	331,400
ON OTHER STREAMS							
Big Dalton Dam	Flood Control and Water Conservation	1929	4.5	950	##1,150	1,500	##5,310
Big Santa Anita Dam	...do	1927	10.6	580	##760	550	##5,550
Eaton Wash Dam	Flood Control and Debris Control	1937	9.5	700	1,410	5,040	58,800
Live Oak Dam	Flood Control and Water Conservation	1922	2.3	220	##310	370	##6,730
Puddingstone Diversion Dam	Diversion	1928	2.6	140	340	3,500	27,700
Puddingstone Dams 1,2, and 3	Flood Control and Water Conservation	1926	32.1	17,200	23,700	810	28,500
San Dimas Dam	...do	1922	16.2	1,040	##1,440	2,160	##3,260
Sawpit Dam	...do	1927	3.3	310	##490	220	##2,070
Thompson Creek Dam	...do	1928	3.5	570	1,060	390	6,200
Sierra Madre Dam	Flood Control and Debris Control	1928	2.4	42	##54	200	##3,840

* All structures are operated by the Los Angeles County Flood Control District, except Santa Fe flood-control basin, which is operated by the Corps of Engineers and Morris Dam which is operated by the Metropolitan Water District. Data for all structures except Santa Fe flood-control basin furnished by Los Angeles County Flood Control District.

** Each drainage area includes all upstream drainage area.

*** Water surface elevation at spillway crest.

\# Water surface elevation at top of dam.

Water surface elevation at top of parapet.

Table A-4

Pertinent data, Whittier Narrows flood-control reservoir

Item	Quantity
Drainage area	554 sq. mi.
Reservoir:	
Elevation -	
Rio Hondo Streambed at centerline of dam	183.0 ft. m.s.l.
San Gabriel River at centerline of dam	200.0 ft. m.s.l.
Crest of Rosemead Blvd. fill	210.0 ft. m.s.l.
Spillway design surcharge level	234.0 ft. m.s.l.
Area -	
At elevation 229.0	2,470 ac.
At spillway design surcharge level	3,120 ac.
At top of dam	3,630 ac.
Capacity -	
At elevation 229.0	36,160 ac.-ft. 36660
At spillway design surcharge level (elev. 234)	50,150 ac.-ft. 50065
At top of dam (elev. 239)	67,060 ac.-ft. 66973
Dam:	
Type	Earth
Height above streambed (Rio Hondo)	56.0 ft.
Top length	16,960 ft.
Top elevation	239.0 ft. m.s.l.
Outlets:	
Type of gates	Tainter
Number of gates	4
Size of gates	30 x 20 ft.
Size of outlets	30 x 19 ft.
Gate sill elevation	184.0 ft. m.s.l.
Gate headwall, bottom elevation	203.0 ft. m.s.l.
Regulated outflow (elevation 208.4 to 239.0)	40,000 c.f.s.
Maximum capacity (elevation 229.0)	74,700 c.f.s.
Spillway:	
Type	Gated
Type of gates	Tainter
Number of gates	9
Size of gates	50 x 29 ft.
Gate sill elevation	200.0 ft. m.s.l.
Top of gates (gates closed) elevation	229 ft. m.s.l.
Discharge at design surcharge (elevation 234.0)	251,000 c.f.s.
Maximum discharge capacity (elevation 239.0)	307,900 c.f.s.

Table A-4--Continued

Pertinent data, Whittier Narrows flood-control reservoir

Item	Quantity
Flood-flow channel:	
Elevation -	
Sill at San Gabriel River channel	208.0 ft. m.s.l.
Invert of low flow channel at Rosemead Blvd. Bridge.	197.5 ft. m.s.l.
Regulation (Reservoir design flood):	
Length of storm	2.5 days
Total storm inflow	256,000 ac.-ft.
Inflow peak	70,000 c.f.s.
Outflow peak	40,300 c.f.s.
Maximum pool elevation	228.5 ft. m.s.l.

Table A-5

Oil well elevations within Whittier Narrows Reservoir

Elevation	Number of wells below given elevation		Elevation	Number of wells below given elevation	
	Rio Hondo side*	San Gabriel River side**		Rio Hondo side*	San Gabriel River side**
Feet above mean sea level			Feet above mean sea level		
193.0	0	0	212.0	52	12
193.5	1	0	212.5	52	12
194.0	2	0	213.0	53	12
194.5	3	0	213.5	54	12
195.0	3	0	214.0	54	12
195.5	5	0	214.5	54	12
196.0	9	0	215.0	54	12
196.5	9	0	215.5	54	12
197.0	11	0	216.0	54	12
197.5	15	0	216.5	54	12
198.0	19	0	217.0	54	12
198.5	21	0	217.5	54	12
199.0	22	0	218.0	54	12
199.5	22	0	218.5	54	12
200.0	23	0	219.0	54	12
200.5	28	0	219.5	54	12
201.0	29	0	220.0	54	12
201.5	30	0	220.5	54	12
202.0	31	0	221.0	54	12
202.5	32	0	221.5	54	12
203.0	32	0	222.0	56	12
203.5	32	0	222.5	57	12
204.0	34	0	223.0	57	12
204.5	42	0	223.5	57	12
205.0	44	1	224.0	58	12
205.5	45	1	224.5	58	12
206.0	46	3	225.0	59	12
206.5	48	4	225.5	59	12
207.0	49	4	226.0	60	12
207.5	49	5	226.5	60	12
208.0	49	5	227.0	60	12
208.5	49	6	227.5	60	12
209.0	49	6	228.0	60	12
209.5	49	8	228.5	60	12
210.0	50	9	229.0	60	12
210.5	51	12	229.5	60	12
211.0	52	12	230.0	61	12
211.5	52	12			

* Area west of Rosemead Boulevard.

** Area east of Rosemead Boulevard.