CHAPTER 31

HISTORY OF OCEAN OUTLETS, LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

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INTRODUCTION

Los Angeles County has a number of watercourses which discharge into the Pacific Ocean. Three of these are of major importance in that they traverse the Coastal Plain area of the County. These three are the Los Angeles River, the San Gabriel River, and Ballona Creek. They have a combined drainage area of approximately 1,645 square miles, most of which is within Los Angeles County. Such area not only comprises over 40 percent of the land area of the County but, more important, includes within its boundaries, the great majority of the County's population.

The Coastal Plain area of Los Angeles County, prior to installation of flood control works, was probably subject to a greater potential flood hazard than any area of similar size and density of population in the United States. It has been subjected periodically to floods that, descending from the San Gabriel and Santa Monica Mountains, have rushed across the valley floor towards the Pacific Ocean altering topographic features and causing loss of life and property. As far back as 1815, floods of damaging character have been recorded. Within the last 90 years the San Gabriel and Los Angeles Rivers have changed their courses, creating new channels in materially different directions.

Prior to 1889, the floods, while causing extensive damage and inconvenience, did not create any general demand that remedial measures be adopted because channel encroachment had not yet developed to any marked degree and property values did not warrant the cost of coordinated protection from floods. However, between 1889 and 1914 a great industrial and agricultural expansion took place concurrent with a large increase in population. Property values boomed. Lands which lay adjacent to river and stream channels developed a market value, were sold and improvements constructed thereon, the purchasers in many instances not realizing that the property purchased was liable to flood damage.

Thus, the flood of 1914, while not the greatest of record, caused a property loss of over $10,000,000, made hundreds of people homeless, isolated communities and resulted in personal injury and loss of life. It was this flood which so forcibly brought to the attention of all County residents the necessity for a broad, coordinated program of flood control in Los Angeles County, a program which would, in part, insure defined and controlled waterways across the Coastal Plain to the Pacific Ocean.

Such a program has, in the intervening years, been conceived and is now in process of being carried out by the local and Federal agencies charged with this responsibility. The Los Angeles County Flood Control District, created by Act of the State Legislature in 1915, is the responsible local agency; the Federal agency is the Department of the Army which, through the Corps of Engineers, is responsible for carrying out the provisions of the Federal Flood Control Act of 1936 and later similar Acts whereby control of floods was recognized as a Federal as well as local responsibility.

It is the purpose of this discussion to briefly cover the history of each of the three major ocean outlets and the improvements which have been made thereto by the Flood Control District and the Corps of Engineers during the past 30 years of flood control activities in Los Angeles County. They will be discussed in order of geographical location from north to south.

BALLONA CREEK OUTLET

Ballona Creek discharges its waters into Santa Monica Bay at Playa del Rey about 26 statute miles by water northwesterly of the entrance to Los Angeles Harbor.

The outlet intersects a shallow lagoon approximately a mile long and 200 ft. wide lying parallel to and approximately 800 ft. inshore. Ballona Creek has its origin in the Santa Monica Mountains seven miles northeasterly from its mouth and has a tributary drainage area of approximately 129 square miles. The watershed includes the western part of the City of Los Angeles, the Baldwin Hills and the south slope of the Santa Monica Mountains to and including Sepulveda Canyon.

Early maps indicate that Ballona Creek outlet was located under the Playa del Rey bluffs at the southern edge of the tide lands into which Ballona Creek flood waters were discharged. It is quite probable that the natural outlet migrated during past times for some distance upcoast and back but no maps are available to verify this. During the period 1906 to 1908 the outlet was fixed at its location at that time, approximately one-quarter mile upcoast from the bluffs, by the construction of bulkheads, jetties and tide gates. This outlet, about 200 ft. in width and extending about 425 ft. seaward, served the dual purpose of providing not only an outlet for the Ballona Creek discharge of that period, but also tide water for the extensive system of canals, which had been constructed to the northwest in what was then the City of Venice.

With the increase in development and population in the Ballona Creek watershed, came an increasing need to improve the waterway of Ballona Creek, particularly the outlet to the ocean. This was primarily a problem of straightening and widening a not too well defined channel and of eliminating a right angle turn from the channel into the lagoon and from the lagoon into the outlet before flood waters could reach the ocean.

Following the formation of the Flood Control District, attempts were made to obtain participation of the communities interested in the channel and outlet improvement program. A partial improvement program, financed by Flood Control District funds, was carried on until 1936 when the Federal Flood Control Act was passed which provided sufficient funds for completion of the channel and construction of a new outlet. While a defined outlet for Ballona Creek was thus in existence from 1906 to 1936, in the latter part of this period, it became inadequate due to increase in discharge from the rapidly developing tributary urban area; to lack of a defined channel of sufficient capacity through the adjacent tide lands; and to the poor hydraulic conditions at the lagoon and outlet.

Under the Federal improvement program of Ballona Creek, the Corps of Engineers excavated a new outlet to the ocean early in 1937 at a location approximately 1400 ft. upcoast from the old outlet. This channel has a base width of 200 ft. and is trapezoidal in section with rock-faced levees. Parallel rock jetties, which extended seaward approximately 650 ft., were constructed by the Corps of Engineers during 1938 and later were grouted. The base width between jetties is 260 ft.

Following construction of the jetties, severe erosion occurred downcoast between the old and new outlets, since normal littoral drift in that vicinity is in a downcoast direction. This adverse beach condition continued until 1947 when the City of Los Angeles, as part of its beach improvement program, extended the jetties an additional 590 ft. and artificially replenished the beach, widening it to approximately 800 ft. with sand pumped from the site of the new Hyperion Outfall Sewer Plant.

Prior to construction of the present outlet of Ballona Creek, model studies to investigate the effect of outlet installations of various types on adjacent beaches were carried on by the California Institute of Technology in 1934 under agreement with the Flood Control District, and by the United States Waterways Experiment Station at Vicksburg, Mississippi in 1937 under Federal sponsorship. Both studies indicated that the beach between the new and old outlets would be subjected to extensive erosion when construction of jetties was completed with the Federal agency predicting that erosion would reach a maximum of 100 ft. It is of interest to note that beach erosion to approximately this extent occurred prior to the start of the beach widening program by the City of Los Angeles and that the former residence of Actress Mae Murray, located in this reach of beach, was partially undermined and had to be moved to a new site to prevent complete loss.

The construction of jetties has proven effective in maintaining satisfactory outlet conditions at the present location of Ballona Creek outlet. The elimination,

for the time being, of the normal supply of sand from upcoast together with the flushing action of the ample tidal prism resulting from channel and lagoon storage capacity will doubtless maintain this favorable condition for some time to come.

LOS ANGELES RIVER OUTLET

The Los Angeles River has its origin in the Santa Susanna and Santa Monica Mountains bordering the westerly portion of the San Fernando Valley. It flows easterly about 20 miles along the south side of the valley, cuts six miles southeasterly around the easterly terminus of the Santa Monica Mountains to Los Angeles Narrows in the vicinity of Elysian Park, and thence flows in a generally southerly direction approximately 22 miles across the Coastal Plain, entering the ocean at Long Beach. It has a watershed area of approximately 818 square miles.

Early Californians, including Pio Pico, last Spanish Governor of Alta California, have been recorded as stating that prior to 1825 the Los Angeles River discharged southwesterly through Ballona Creek into Santa Monica Bay. A severe flood that year is credited with having changed the direction of flow and the discharge of the Los Angeles River has since been in a southerly direction.

Prior to January 1868, the Los Angeles River joined the San Gabriel River about seven miles north of San Pedro Bay. A flood which occurred during that month split the waters of the San Gabriel River above what is now known as Whittier Narrows and diverted a considerable portion into a new channel which discharged into Alamitos Bay, some six miles downcoast from the old outlet into San Pedro Bay. Thereafter, the name "Los Angeles River" was gradually applied to the lower reach of the old San Gabriel River and the new San Gabriel River became known as "San Gabriel River." Thus, the Los Angeles River acquired an official outlet to the ocean at San Pedro Bay, although still receiving through the interconnecting stream, the Rio Hondo, an appreciable percentage of the discharge from the San Gabriel River watershed.

The approximate location of the outlet of the Los Angeles River during the 90 years following the flood of 1825 was in the East Basin of Los Angeles Harbor near the easterly end of Terminal Island. During this time Los Angeles Harbor assumed a constantly increasing importance in the welfare of the County. Hence, when the flood of 1914 discharged several million cubic yards of silt in the dredged areas in Los Angeles Harbor and a smaller volume in the dredged areas in Long Beach Harbor, an appeal was made to the Congress of the United States for assistance in protecting the harbors from further damage of this nature. Under the Federal Government's responsibility for harbors and navigation, Federal funds were ultimately made available by Act of Congress in 1917, for the construction of a new channel to carry the discharge of the Los Angeles River to the ocean just east of Long Beach Harbor. This improvement, completed in 1921, provided a channel, trapezoidal in section, which had a base width of 530 feet and levees faced with heavy, rock riprap. The new channel was approximately 4-1/2 miles in length and extended due south through the City of Long Beach from its intersection with the natural channel upstream.

The construction of the Los Angeles River outlet in 1921 did not provide jetties to carry flows seaward to deep water. Consequently, deposition of sand and silt occurred. A survey in 1926 showed that in the lower 6,300 ft. of channel there was an accumulation of 612,000 cubic yards of sediment and a considerable delta formation seaward from shoreline. In order to protect the Long Beach Outer Harbor from intrusion of flood-borne debris, a stone breakwater, completed in 1929, was constructed on an extension of the westerly bank of the Los Angeles River. It extended southerly 4300 ft. into the ocean and thence in a southwesterly direction towards San Pedro.

Following completion of the breakwater, the sediments in the discharge of the Los Angeles River were deflected in a southeasterly and downcoast direction. The growth of the delta from 1923 to 1935 over an area which extended from the breakwater approximately 4,000 ft. downcoast and seaward from the Long Beach "Board Walk" a like distance was about 4,500,000 cubic yards. In 1938 this accumulation was greatly increased. Flood Control District offshore surveys taken in the summers of 1935 and 1938 showed that over 2,200,000 cubic yards of sand and silt had

been deposited within a lesser area offshore during this 3-year period, the major part of which was the result of the March 1938 flood.

In 1943 and 1944 the City of Long Beach Harbor Department, as part of its harbor development program, extended the west bank of the outlet of the Los Angeles River seaward 3500 ft. to the southeast in a long-radius curve from shore by construction of a dike faced with rock riprap. The area westerly to the previously constructed breakwater was filled with material dredged, under supervision of the Corps of Engineers, from the delta at the mouth of the river. Additional material dredged from this area between 1943 and 1946 was distributed along the beach downcoast approximately four miles in a beach-widening program of the City of Long Beach. Over 6,000,000 cubic yards of sand and silt were dredged during this period to final depths varying from 25 to 45 ft. below mean lower low water. In 1946 the dike was extended another 700 ft.

Further improvement of harbor facilities was undertaken by the Long Beach Harbor Department in 1949 by extension of the rock dike 975 ft. farther seaward to a total length of approximately a mile and the filling of the reclaimed area to the west with material dredged from the Los Angeles River outlet. Approximately 8,200,000 cubic yards were removed to a depth of 70 ft. below mean lower low water during the dredging operations which were only recently completed.

In addition to these outlet improvements, a short length of jetty has been constructed along the extension of the east bank of the Los Angeles River by the Long Beach Harbor Department to protect the downcoast beach from flood damage.

The present conditions at the outlet are considered satisfactory and the dredged area should provide ample storage capacity for flood-borne sands and silt. The construction of Hansen, Sepulveda and Whittier Narrows Flood Control Basins within the tributary watershed and the improvement of the channels downstream therefrom should reduce materially the volume of silt and sands which will reach the ocean in the future, thus reducing outlet maintenance costs.

This reduction will, of course, be considerably less than would otherwise result should some of the sediments deposited in the flood control basins be sluiced to the ocean.

SAN GABRIEL RIVER OUTLET

The San Gabriel River, which drains the eastern part of Los Angeles County and a small part of Orange County has its headwaters in the San Gabriel Mountains which rise to an elevation of over 10,000 ft. above sea level. It flows southwesterly 14 miles across San Gabriel Valley to Whittier Narrows, thence southward 20 miles to enter the ocean at Alamitos Bay near the eastern boundary of Long Beach and within the City of Seal Beach in Orange County. It has a tributary drainage area of approximately 698 square miles. The low, marshy tide lands adjacent to the San Gabriel River outlet are susceptible to inundation during floods unless the runoff is carried to the ocean by an adequate channel.

During the period from 1868, when the San Gabriel River cut a new channel to the ocean, to 1931, the outlet migrated downcoast about 2800 ft. At the end of this period the outlet had reached the low bluff on which the Los Angeles Gas and Electric Corporation, in 1925, constructed a steam electric generating plant, which later became the property of the City of Los Angeles Department of Water and Power.

During the late twenties, the Flood Control District had improved the lower reach of the San Gabriel River by straightening and widening the channel terminating the improvement at the intersection with the natural channel of the river approximately 4,000 ft. northerly from the ocean. The natural course of the river below this point was tortuous and discharged into the easterly end of Alamitos Bay some distance westerly of the outlet to the ocean.

By 1930 a number of oil wells as well as other improvements had been located in the area adjacent to Alamitos Bay, which were subject to damage in case of inundation from flood waters of the San Gabriel River. It was, therefore, believed desirable that a new channel be constructed to provide a more direct and controlled outlet for San Gabriel River discharge.

The proposed project called for the construction of a channel having a base width of 260 ft. with rock-faced levees, extending from the terminus of the improved section upstream southerly to the confluence with Alamitos Bay, widening to a base width of 300 ft., thence to the ocean. The project also included construction of two parallel jetties 320 ft. apart and extending approximately 500 ft. seaward from Ocean Avenue, the shoreline drive between Seal Beach and Long Beach.

The original plans provided that the jetties be extended in units of 500 ft. each to a total length of 1500 ft. with the ends of each unit opposite each other in practically equal depths of water. This was to provide for the building of a symmetrical delta which, under favorable wave action, it was believed, would permit distribution of the delta deposits to both Los Angeles and Orange County beaches. Due to the location of the outlet, it was necessary that the several political subdivisions concerned approve the plans. In order to obtain the approval of the City of Seal Beach, it was necessary to revise the plans for jetties and construct the easterly jetty approximately 350 ft. longer than the westerly jetty, or to a length of 725 ft. The jetties were completed in 1933 and the channel excavation in 1935. The westerly jetty was extended in 1940 from an approximate length of 375 ft. to the same distance seaward as the easterly jetty. No extensions have been made to these jetties since then.

One of the important considerations in design of the outlet was that of safeguarding the supply of cooling water which was required to cool the condensers of the steam power plant of the Los Angeles Gas and Electric Company. The ebb and flood of tide water in Alamitos Bay had, at time of construction of the power plant, scoured a channel adjacent to the bluff on which the steam plant was located, and a satisfactory supply of cooling water had thus been available and was probably one of the major reasons for its location at that site. It was also necessary to provide a warm water by-pass in the east jetty to permit the water used for cooling purposes to be returned to the outlet.

In order to determine the most effective solution to the problems incident to the design of the outlet, model studies were undertaken by the California Institute of Technology in 1933 and 1934, financed jointly by the Los Angeles Gas and Electric Corporation and the Flood Control District. Based on recommendations resulting from the model tests, current deflector vanes were constructed on the downstream side of each of the 12 piers of the Second Street bridge across the newly-constructed section of the San Gabriel River. The levee on the west side of the channel was extended only a short distance south of Second Street, the first street upstream from Ocean Avenue, leaving an unrestricted opening into the channel from Alamitos Bay. The tests indicated that the flood flows would be directed, by the deflectors, toward the cold water intake of the steam plant which, in conjunction with the ebb and flood of the tidal prism in Alamitos Bay, would maintain satisfactory intake conditions at the steam plant.

By 1937, an extensive sand bar had formed on the west side of the channel, immediately upstream from Ocean Avenue, which thereby constricted the opening from the bay into the channel and, extending easterly into the channel, had also formed a constriction adjacent to the cold water intake. However, the depth of water adjacent to the intake was still comparable to that prior to construction of the new outlet. The flood of March 1938 scoured out a portion of the sand bar and reduced the constriction, thus permitting a less constricted flow from Alamitos Bay. By 1941, however, shoaling of the channel, resulting from tide-borne material, had become so serious that the Flood Control District constructed a 200-ft. groin of Wakefield sheet piling at the south side of the confluence of the bay and channel to deflect the tidal flow from the bay into a more restricted section hoping to thus maintain sufficient depth of water at the cold water intake. Conditions in the channel failed to improve and dredging of a training channel was undertaken during several periods in 1941 and 1942 to direct the discharge of the outlet along the easterly side of the channel adjacent to the steam plant. These measures were of only temporary benefit. In 1944 a separate entrance to Alamitos Bay was constructed under joint cooperation by the State of California, County of Los Angeles, City of Long Beach, Los Angeles Department of Water and Power, and the Flood Control District. Included as parts of the project were the separation of the San Gabriel River Outlet from Alamitos Bay by construction, by the Flood Control Dis-

trict, of a rock-faced levee on the west side of the channel, and the construction by the Los Angeles Department of Water and Power of a cold water intake on the bay side of the new levee and a connecting conduit under the river channel to the steam plant. This installation has provided a satisfactory supply of cooling water for the power plant since that date.

The new entrance to Alamitos Bay included construction of a stone jetty approximately 800 ft. long on the upcoast side, and the dredging of a channel varying from 80 ft. to 200 ft. in width which extended from the seaward end of the west jetty through the entrance and westerly into Alamitos Bay. Sand dredged at this time and during 1945 and 1946, amounting to approximately 800,000 cubic yards, was distributed in a beach-widening program upcoast from the west jetty of the bay entrance.

The shoaling of the outlet of the San Gabriel River has, during the past six years of deficient rainfall, and separation from Alamitos Bay, become more and more pronounced. The downcoast littoral drift has carried a large portion of the beach sand from upcoast of the bay entrance to the vicinity of the river outlet where it has been carried up-channel by flood tide. Ebb tide has failed to carry it back to the ocean. This has resulted in the formation of an extensive sand bar on the west side of the channel between Ocean Avenue and Second Street, and a still larger bar on the east side of the outlet seaward from the warm water by-pass to the extent of almost overtopping the east jetty.

Experience during past minor river discharges indicates that these sand bars will erode readily during floods. Ultimately, however, it may be necessary to dredge a basin seaward of the outlet or extend the jetties to deeper water. This eventuality may be delayed considerably, however, due to the dredging which the City of Long Beach has just undertaken at the entrance to Alamitos Bay. The basin to be dredged seaward of the entrance as well as the entrance channel itself will require the removal of approximately 450,000 cubic yards of sand which is to be distributed along the beach upcoast. This improvement not only will remove a part of the delta formed at the entrance to the bay, thus removing one of the immediate sources of supply to the sand bars in the river outlet, but it will entrap sand which will be moved downcoast by future littoral drift, thereby further delaying more serious shoaling of San Gabriel River outlet from tidal action.

CONCLUSIONS

In conclusion, and as of this date, the three ocean outlets, covered in this discussion, appear to be in a favorable condition in providing safe waterways to the ocean for flood waters. Beach damage resulting from installation of outlet jetties has become a negligible factor either by reason of the natural forces in play or because of artificial beach replenishment. The future requirements in maintenance of the individual outlets will, of course, depend upon future floods, the operation of upstream flood control works, and shore and offshore installations. By and large, the maintenance of adequate outlets should become less instead of more of a problem in the years ahead.