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DISTRICT LOS ANGELES CA 1977

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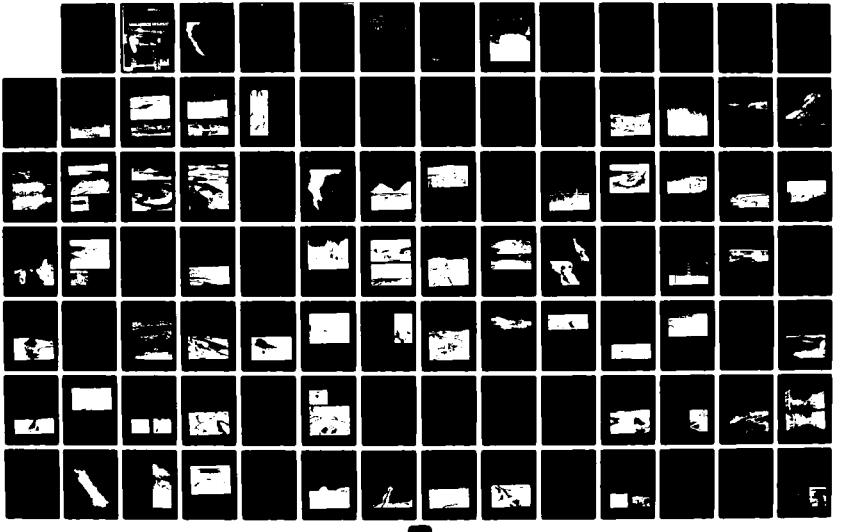
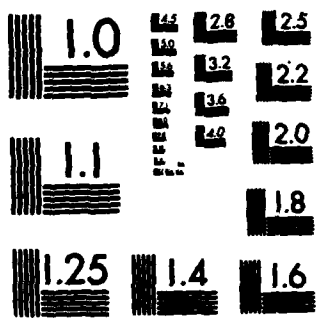
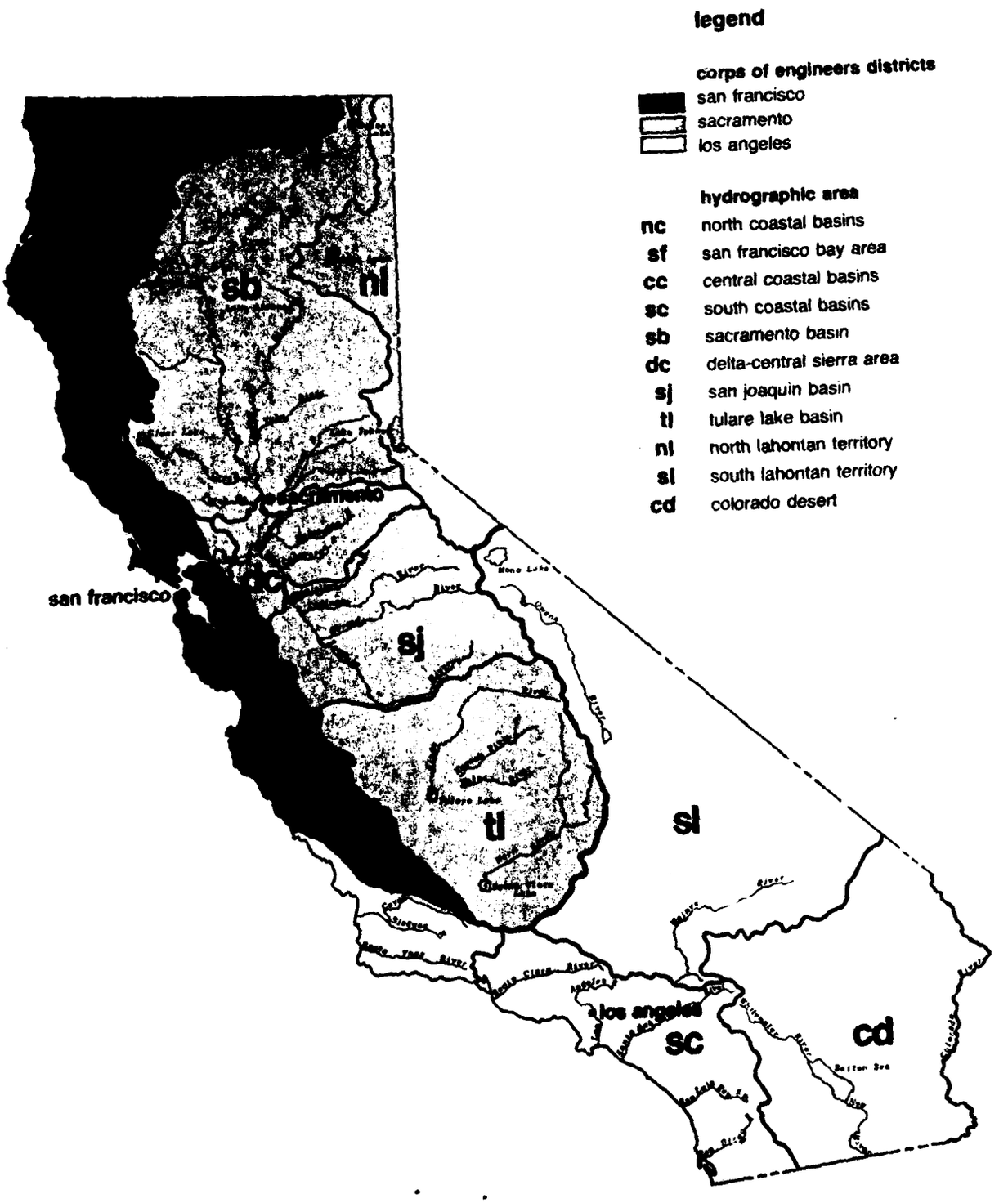




CALIFORNIA

WATER RESOURCES DEVELOPMENT

california waterways, hydrographic areas and corps of engineers districts



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Provide information on accomplishments of the Corps of Engineers and on the scope and progress of current programs. It contains information on the role of the Corps in planning, constructing and operating water resources development projects; on general investigation studies; on projects that are completed, under construction or in the planning stage; and on Corps of Engineers authorities for participating in water resources development. Data on investigations and projects are grouped by hydrographic areas of

California, which have been selected on the basis of major drainage patterns.

water resources development

u.s. army corps of engineers

in california

1977

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u.s. army corps of engineers

TO OUR READERS:

Throughout history, water has played a dominant role in shaping the destinies of nations and entire civilizations. The early settlement and development of our country occurred along our coasts and water courses. The management of our land and water resources was the catalyst which enabled us to progress from a basically rural and agrarian economy to the urban and industrialized nation we are today.

Since the General Survey Act of 1824, the US Army Corps of Engineers has played a vital role in the development and management of our national water resources. At the direction of Presidents and with Congressional authorization and funding, the Corps of Engineers has planned and executed major national programs for navigation, flood control, water supply, hydroelectric power, recreation and water conservation which have been responsive to the changing needs and demands of the American people for 152 years. These programs have contributed significantly to the economic growth of our country and to the well-being of the American people.

Today, the activities of the Corps of Engineers in water resources management, under the direction of the Executive and Legislative branches of the Federal government, continue to support national goals and objectives. These include conservation of our water resources, protection of our wetlands, non-structural solutions to flood-damage control problems, total water management in metropolitan areas, flood plain management, and the preservation and enhancement of the quality of our environment for future generations.

This booklet describes the past, current, and proposed activities of the Corps of Engineers in your state. I trust that you will find it informative, interesting, and useful.

J. W. MORRIS
Lieutenant General, USA
Chief of Engineers

BUILDING TOMORROW TODAY

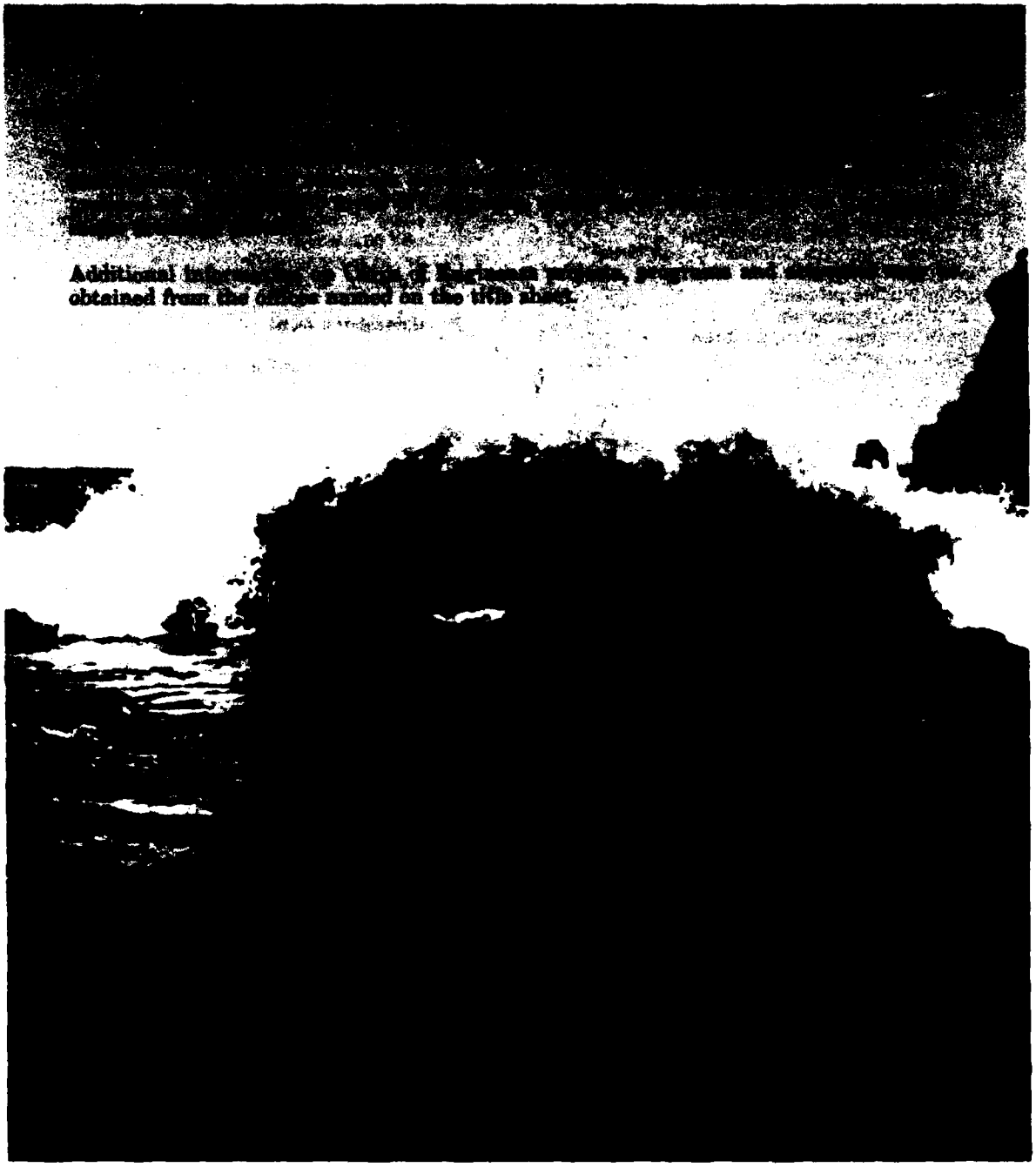


table of contents

table of contents

table of contents

1 water resources development by the corps of engineers in california

introduction

California, the Golden State, comprises a land area of about 158,000 square miles and a water area of about 2,000 square miles. The state has more than 1,200 miles of scenic coastline. Its topography is more varied than any other part of the United States except Alaska. Elevations range from 282 feet below sea level in Death Valley to 14,495 feet above sea level at the top of Mount Whitney, the highest and lowest points in the conterminous United States. In total, the state consists of eleven geomorphic provinces, each of which is distinctive from its neighbors. The dominant provinces are the Coast Ranges, the Central Valley and the Sierra Nevada.

The Coast Ranges extend for nearly 600 miles just inland from the ocean. Their numerous, often indistinct, ridges rise from 2,000 to 7,000 feet and are separated by the valleys of numerous major rivers and other smaller streams.

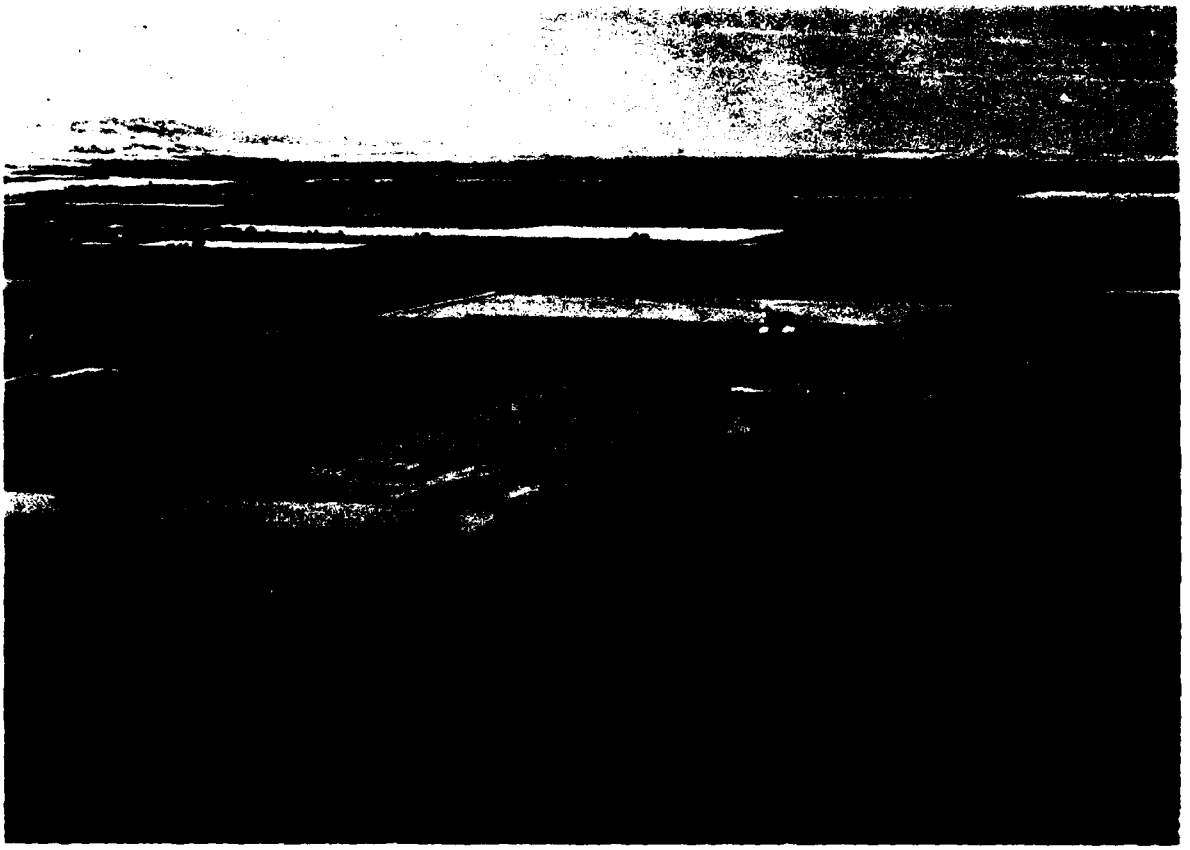
The Central Valley lies east of the Coast Ranges and west of the Sierra Nevada. It is a vast alluvial plain 400 miles long by 50 miles wide. The southward flowing Sacramento River drains the northern portion of the valley and the northward flowing San Joaquin River drains the southern portion, except for a closed area of about 17,000 square miles at the southern end of the valley.

In the Sierra Nevada, a great westward dipping fault block 385 miles long and 85 miles wide, lofty mountain peaks tower above precipitous gorges and canyons. About a dozen major streams traverse the western slope of the range and flow into the Sacramento and San Joaquin Rivers. Many of these streams occupy valleys as deep as one-half mile. By far the most spectacular of these is Yosemite, which was carved by glaciers many thousands of years ago. In the northern part of the Sierra Nevada, the highest peaks reach to about 8,500 feet. Mountain top elevations increase toward the south to culminate in Mount Whitney. Precipitous drops in elevation characterize most of the east side of the Sierra Nevada. Near Mount Whitney, this drop is almost 2 miles in a horizontal distance of 6 miles.

Other geomorphic provinces of the State are studies in contrasts. They range from the rugged, densely timbered Klamath Mountains and great redwood forests in the northwest sector of the State to high and low desert areas in the southwest sector along its eastern border, and to the volcanic cone studded Modoc Plateau in the northeast sector. The Transverse Ranges, of which the Channel Islands represent a seaward extension, break the typical southeastward grain of California topography and instead trend eastward as a group of linear ranges. The peaks in one of these ranges, the San Gabriel Mountains just north of Los Angeles, reach almost 10,000 feet. The Los Angeles-Long Beach metropolitan complex — the sixth largest in the world in population — lies on a broad coastal plain not much above sea level. The extreme variation in the physiography of California is illustrated in the following photographs.[1]

the california coast near monterey.

[1]Photographs courtesy of the U.S. Bureau of Reclamation, Mid Pacific Region.



▲ *lower cache creek area east of winters.*

▼ *dunes on the east side of imperial valley.*

water resources development by the corps of engineers in california

▲ *mt. shasta, an extinct volcano, in northern sacramento basin.*

▼ *donner lake in the sierra nevada.*

The climate of California is as varied as its physiography, but is generally considered to be mild. Instead of the usual four seasons, most of California has two — a cool, wet winter season and a warm, dry summer season. Coastal areas have a marine or mediterranean type climate with warm winters, cool summers, little daily and seasonal range in temperature and high relative humidity. Inland from the coast, as the marine influence lessens, the climate becomes more continental with warmer summers, colder winters, greater range in daily and seasonal temperatures and lower humidity. The change from mediterranean to continental climates results from topography, which also controls the amount and distribution of precipitation. In large portions of windward slopes of the northern Coast Ranges and the northern mountain region, annual precipitation is 50 inches or more. Annual precipitation decreases to about 20 inches in valley floor areas of the northern Central Valley, less than 10 inches in valley floor areas of the southern Central Valley and less than 5 inches in the southeastern desert areas. Mean annual precipitation ranges from 120 inches in parts of the northern Coast Ranges to less than 2 inches in parts of Death Valley. Most of the annual precipitation occurs in the winter season, which extends from November through March in the southern part of the State and from October through April in the northern part.

Snow occurs at elevations as low as 2,000 feet in the Sierra Nevada foothills, but does not remain on the ground below 4,000 feet. The zone of heavy snowfall is from 7,000 to 8,000 feet. Melting of the normally deep snowpack in these and higher elevations results in the continuous flow of most Sierra Nevada streams during the summer.

Temperatures ranging from 134° to −45° have been recorded in California. On the basis of continued periods of high temperatures, Death Valley is the hottest place in the world. Along the coast, the range in temperature from day to night and from winter to summer is very small, and daily and seasonal ranges in temperature increase with distance from the coast. In periods of extreme summer heat, the temperature in Death Valley can be twice that recorded along the north coast.

Thunderstorms occur in the summer in the interior, high mountain and desert areas. Where precipitation is very light, lightning can cause forest fires. Tornadoes occur some place in California on the average of about

◀ *redwoods*

once a year. Although flooding can occur at any time of the year, the worst floods usually occur in winter as a result of prolonged, widespread rainstorms accompanied by above normal temperatures that melt the snowpack. Small drainages are also subject to flooding from localized storms. Occasionally, persistent dry weather or droughts occur during the winter season.

California has abundant water, metal, nonmetallic minerals, fuel and forestry resources. Most crops grown anywhere in the United States can be grown in California. Further, because of an unusually long frost-free period, many crops grown in California cannot be grown commercially elsewhere, and agriculture based on irrigation is the predominant factor of the economy of the State. In total, however, the economy of the State is highly diversified with about 9.5 million people gainfully employed. Distribution of employment shows about 3 million persons employed in basic industries such as agriculture, forestry, mining, manufacturing and fishing; and about 6.5 million employed in service industries. The 1976 population of California, 21.6 million, is expected to increase to about 34 million by the year 2000.

California has extensive development for municipal, industrial and irrigation water supplies and sufficient water is developed by completed water projects, or will be developed by those under or nearing construction, to meet most urban and irrigation needs foreseen for the near future. However, additional conveyance facilities are needed to deliver developed supplies to certain service areas. While additional major storage projects may not be needed immediately for water conservation, they may be warranted for flood control because flood problems are increasing. Indeed, intensification of land use resulting from increasing population will require a vigorous flood control program for many years to come. Local agencies should carefully consider flood plain management in addition to construction of flood control facilities.

The increasing demand for water-associated recreation will require the development of additional water surface and shoreline, particularly near major urban centers. More than four-fifths of the additional electrical energy needed by about the year 2000 is expected to be derived from fossil or nuclear fueled steam plants, which require large amounts of cooling water. If half of the projected increase in generating capacity is from inland sites, due to limited acceptability of coastal sites, the demand for cooling water could comprise one of the largest increases in future water demand.

California has a highly developed system of modern, well maintained State and interstate freeways and highways, and a variety of commercial and recreational navigation facilities exist along its 1,200 mile coast, within its natural bays and estuaries, and on the Sacramento and San Joaquin Rivers. Major commercial navigation developments exist in the San Francisco and Los Angeles areas. However, present trends in ship design — for example, 50-foot draft tankers and 70-foot draft super tankers — and advanced cargo handling techniques indicate that major improvements are required if existing ports and waterways are to operate efficiently in the future. Future commercial navigation needs also include construction of coastal harbors for light draft commercial vessels, extension and enlargement of inland waterways and harbors and extension of offshore petroleum terminals to deeper water. A chain of harbors of refuge is needed for intracoastal cruising by recreational vessels.

hydrographic areas of california

To present information on Corps of Engineers projects and activities in a region with such wide variations in physiography and climate as California, the State has been divided into the following eleven areas:

North Coastal Basins
San Francisco Bay Area
Central Coastal Basins
South Coastal Basins
Sacramento Basin
Delta-Central Sierra Area
San Joaquin Basin
Tulare Lake Basin
North Lahontan Territory
South Lahontan Territory
Colorado Desert

A chapter is devoted to each area, the boundaries of which coincide generally with major hydrographic (drainage) areas that have been used in various State-wide studies. Each area represents relatively homogeneous characteristics of streamflow, existing and potential water resources development and topographic and economic independence.

Several of the areas have similar or closely related economic or hydrologic characteristics (the North and South Lahontan Territories and the four areas of the Central Valley — Sacramento Basin, Delta-Central Sierra Area, San Joaquin Basin and Tulare Lake Basin), but have been subdivided on the basis of their size and shape.

A map showing the 11 areas used in this booklet appears inside the front cover.

corps of engineers activities in california

The water resources development program of the Corps of Engineers in California began in 1852 when Congress appropriated $30,000 for levee construction and fencing at the mouth of the San Diego River, thus originating facilities that would ultimately evolve into today's important San Diego Harbor. Other early navigation work included San Francisco Harbor, 1868; Oakland Harbor, 1874; and San Joaquin River, 1876. Several other navigation projects were authorized prior to the turn of the century.

On the basis of a report prepared by the California Debris Commission in 1907, the first flood control work by the Corps of Engineers in California was authorized by the River and Harbor Act of 1910. The authorized work consisted of increasing the flood carrying capacity of the Sacramento River downstream from the mouth of Cache Slough. The existing Sacramento River Flood Control Project, substantially as conceived by the Debris Commission as a result of studies directed by Congress in 1910, was authorized in 1917 in the first major flood control legislation in the history of our country. Subsequent to these early beginnings, Corps of Engineers activities in California have expanded into almost all of the facets of the civil works program and into water resources projects constructed or under construction.

The National Environmental Policy Act of 1969 has served to increase the Corps of Engineers awareness of the interrelation between water resources development projects and all aspects of the environment. Current actions of the Corps, which may have a significant impact on the environment, whether beneficial or adverse, must be described in detail in an environmental impact statement. This statement, or EIS, is reviewed by Federal, State and local agencies and individuals, and a public hearing is conducted.

Many of the projects and investigations described in this booklet have been covered by EIS's. When construction of a project was authorized prior to the effective date of the Act, in most cases no EIS was prepared. But if any project requires operation or maintenance activities, then an EIS has probably been prepared to disclose any potential environmental impacts of those activities.

For current investigations, and for projects in the planning stages, EIS's are prepared at appropriate times to include consideration of environmental factors in the evaluation of projects and alternatives to projects. Projects are often planned to minimize adverse environmental effects and to create environmental benefits where such opportunities exist. Information about environmental studies and EIS's on individual projects and investigations may be obtained by contacting the appropriate District Office of the Corps of Engineers.

The Corps of Engineers participates in water resources development at the direction of Congress. Over the years, a large body of legislation that forms the basic authorities for civil works has been developed. Chapter 13 contains a detailed discussion of the principal authorities, along with a description of the Corps relationship to the Secretary of the Army; the method by which Corps of Engineers projects are initiated, authorized and completed; and how projects are funded.

navigation program

The navigation program of the Corps of Engineers in California includes improvement and maintenance of all major coastal harbors in the State, development of deep draft and shallow draft inland waterways and maintenance of navigable streams. The purpose of the program is to assist in the development and conduct of waterborne commerce and small boat recreation.

The control of hydraulic mining debris in the Central Valley is also a part of the navigation program.

urban studies program

This new program for the Corps of Engineers began in 1972 in response to changing developmental priorities and a high degree of Federal attention to the interrelated problems of growing concentrations of population, industry and commerce. The major objective of the program is to use the Corps, working in partnership with local and state governments, to develop realistic plans which can help solve water and land related problems for about the next 50 years in selected urban regions.

The specific functional areas in which the Corps will be involved are flood control and flood plain management, municipal and industrial water supply, wastewater management, bank and channel stabilization, lake, ocean and estuarine restoration and protection, water oriented recreational development in conjunction with other project purposes and development of regional harbors and waterways. The solutions to problems in these areas are interrelated and may impact directly upon other urban problems, such as housing and open space needs. These interrelationships and impacts necessitate complete and timely interchange of plan-

ning information. It is desirable for urban planning alternatives to be developed in concert with programs of other Federal, State and local agencies. Urban studies are conducted so as to provide appropriate input into the local urban area comprehensive planning and to avoid duplication of effort among participating Federal agencies.

flood control program

The flood control program of the Corps of Engineers in California functions to protect urban, suburban and agricultural areas.

An estimated $3.8 billion in flood damages has been prevented throughout the State by completed Corps of Engineers projects. These include many units of levee projects and a large number of flood control storage projects.

Although the flood control program provides effective protection to project areas, many streams still remain uncontrolled and many areas of the State remain entirely unprotected.

While urban centers generally have better protection than rural areas, they are still potentially liable to serious damages from large floods. Comprehensive planning and construction programs must be continued in order to check periodic floods which cause destruction and damage, and waste to the ocean vast amounts of water that could be conserved for the benefit of the people, agriculture and industry of California.

beach erosion control program

The beach erosion control program of the Corps of Engineers in California includes studies of erosion problems and construction of shore protection projects for publicly owned or publicly used beaches, shoreline parks and conservation areas along the California coast.

status of projects

For convenience in designating the status of Corps of Engineers projects in California, they have been classified as completed, under construction or authorized but not started.

A summary of projects according to these classifications is shown below. Their locations are indicated on special project maps included in appropriate chapters and on a map at the end of this booklet. Brief descriptions of individual projects are presented in subsequent chapters. Information on projects may also be found in the Chief of Engineers' annual report on civil works activities.

type of project	status			total
	completed	under construction	authorized not started	
Navigation	37	9	2	48
Small Navigation	5	0	0	5
Debris Control	3	0	0	3
Beach Erosion Control and Shore Protection	7	4	1	12
Small Beach Erosion Control and Shore Protection	1	0	1	2
Multipurpose	28	7	10	45
Flood Control	31	12	18	61
Small Flood-Control	17	1	0	18
Total	129	33	32	194

regulatory functions

Under long-standing procedures evolving from the River and Harbor Act of 1899, and in addition to other regulatory functions, the Corps of Engineers has administered a permit program for structures and operations in navigable waters.

Regulatory functions include:

Approval of sites and plans for dams and dikes.

Permits for structures or operations in navigable waters.

Removal of sunken vessels or other obstructions endangering navigation.

Establishment of danger zones, dumping grounds, restricted areas, fishing areas and harbor lines.

Many hundreds of permits for construction and activities in and along navigable streams have been issued by the Corps. It has also been necessary to disapprove many applications for permits.

recreation facilities at corps of engineers projects

Under its water resources development program in California, the Corps of Engineers has provided basic public-use facilities at the majority of its storage projects. Local agencies and private interests have provided additional facilities and services to supplement these facilities.

A summary of 1976 public-use data for available recreation facilities at Corps of Engineers storage projects in California is tabulated below:

name of project and stream	1976 attendance		surface acres normal pool	shoreline miles, normal pool	water access areas	launching lanes	picnic areas	swimming beaches	tent & trailer spaces	organized camps	rental boats in project area
	annual	peak day									
Black Butte Lake, Stony Creek	243,240	1,400	2,845	25	6	7	2	1	99	0	0
Brea Dam, Brea Creek	356,900	2,015	(a)	(a)	(b)	(b)	1	(b)	(b)	(b)	(b)
Carbon Canyon Dam	182,500	1,250	*3	*0.5	*1	(b)	1	(b)	(b)	(b)	(b)
Englebright Lake, Yuba River	143,050	530	750	10	6	4	2	0	65	0	4
Fullerton Dam	71,700	525	*4	*0.5	(b)	(b)	1	(b)	(b)	(b)	(b)
Hansen Dam, Tujunga Wash	1,488,800	9,990	125	3	1	2	3	1	(b)	(b)	0
Isabella Lake, Kern River	849,351	18,960	6,520	30	30	17	1	1	522	3	160
Lake Kaweah, Kaweah River	417,300	5,700	570	8	5	6	3	0	78	0	9
Lake Mendocino, Russian River	1,500,000	21,130	1,700	14	7	12	5	2	320	2	15
Martis Creek Lake, Martis Creek	24,000	300	71	2	1	0	1	0	25	0	0
Mojave River Dam	46,900	670	(a)	(a)	(b)	(b)	1	(b)	50	(b)	(b)
New Hogan Lake, Calaveras River	194,180	3,770	2,650	42	3	11	1	2	121	0	20
North Fork Lake, N. Fk. American River	27,000	600	280	15	1	1	2	2	0	0	0
Pine Flat Lake, Kings River	694,190	13,550	3,450	53	5	8	11	1	121	0	30
Prado Dam, Santa Ana River	304,000	2,460	*15	*1	*1	(b)	3	(b)	(b)	1	(b)
Sepulveda Dam, Los Angeles River	1,457,500	9,500	(a)	(a)	(b)	(b)	2	(b)	(b)	(b)	(b)
Success Lake, Tule River	724,440	11,990	600	7	6	7	3	0	104	0	20
Whittier Narrows Dam, Rio Hondo and San Gabriel River	2,418,400	21,450	*76	*4	*1	(b)	3	(b)	(b)	(b)	32

*Recreation Lake
(a) No permanent pool.
(b) Not applicable.

water pollution and water quality control

Water quality and pollution control are given full consideration in the planning and construction of Federal water resources development projects.

In 1972 the Corps' regulatory responsibilities were increased with the passage of the Federal Water Pollution Control Act Amendments (FWPCA) and the Marine Protection, Research and Sanctuaries Act

(MPRSA). Section 404 (FWPCA) authorizes the Secretary of the Army, acting through the Chief of Engineers, to issue permits for the discharge of dredged or fill material into the waters of the United States at specified disposal sites. Section 103 (MPRSA) authorizes the Secretary of the Army to issue permits for the transportation of dredged material for the purpose of dumping it in ocean waters.

flood plain management services program

A long-range Statewide flood plain information study program is underway in California. To date, 99 studies have been completed; 5 more are scheduled for completion.

The Corps of Engineers also undertakes flood insurance rate studies at the request of the Federal Insurance Administration, Department of Housing and Urban Development.

investigations and reports program

Detailed investigations of potential water resources development projects are essential prior to their authorization for construction. Congress has directed that the Corps of Engineers make investigations and prepare reports on numerous proposed improvements in California. Many of these investigations and reports have been completed and submitted to Congress; others are in progress; and the remainder will be completed as funds are made available and submitted to Congress for its decision on authorization.

A summary of preauthorization investigations and reports in California is listed below.

Preauthorization studies and detailed planning of water resources development projects require extensive coordination between the numerous agencies concerned. Coordination procedures are prescribed in the regulations covering Corps of Engineers activities. The Pacific Southwest Inter-Agency Committee on Water Resources, which is composed of representatives from six Federal agencies and nine Pacific-Southwestern states, coordinates water resources development activities on a regional basis. At meetings held about once every four months, each member state and agency presents a brief on what it has done and what it proposes to do.

The Corps of Engineers conducts a program of research and development for solving new problems that arise in project design, operation, maintenance and evaluation, and for progressive improvement of engineering techniques and procedures. Research and development studies that have been conducted in California have involved experimental equipment for measuring stream flow velocity; utilization of laser beams in measuring movement of large concrete structures; use of epoxy compounds to prevent erosion of certain internal surfaces of flood control outlet struc-

status of reports	navigation	beach erosion	urban study	flood control	special	total
Completed[1]	2	0	0	0	2	4
In progress	10	2	2	19	4	37
Suspended or not started[2]	7	4	0	3	1	15
Total	19	6	2	22	7	56

[1]Approved by the Board of Engineers for Rivers and Harbors but not yet acted upon by Congress.

[2]Studies classified as active which have either been temporarily suspended or not started. Does not include studies which have been classified as inactive or deferred.

tures and utilizing automatic data processing to improve procedures for collecting and analyzing recreation use data.

The need to accelerate improvement of hydrologic engineering techniques, to train engineers in applying these techniques and to take advantage of computers in water phenomena research led to the establishment of a Corps of Engineers Hydrologic Engineering Center in 1964. The Center is located in Davis, California, and provides Corps-wide technological services, trains personnel and systematizes procedures in hydrologic engineering. It also maintains close liaison with the academic community, engages in research and coordinates a flow of technological data to sharpen the Corps capability in planning, designing, constructing and operating water resources facilities. In carrying out its mission, the Center obtains computer services through contracts that provide access to the Government owned CDC 6600 and 7600 computers at Lawrence Laboratory in Berkeley and to a commercially owned UNIVAC 1108 computer in Santa Clara. Communication with the computers is provided through a terminal and leased telephone lines.

The Center has been intensively investigating methods for conduct of comprehensive planning as part of a Corps pilot community assistance effort. Procedures for acquiring, encoding, storage and retrieval of land use and general resource information were developed and applied in the Oconee Expanded Flood Plain Information Study, Georgia. The computer-stored information is interfaced with existing operational computer analysis models to quickly determine effects of proposed land use changes on hydrology, hydraulics and flood damage potential.

In 1972 and 1974, the Center conducted four-week international workshops that covered computer applications in hydrologic analyses. Thirty engineers representing 22 countries participated in the 1972 workshop and 24 engineers from 17 countries attended in 1974. A well-equipped classroom capable of accommodating 35 students is located at the Center.

more than 400 Corps engineers, and nearly 100 from other agencies participated in Hydrologic Engineering Center training courses in 1976.

water resources development by the corps of engineers in california

As part of the International Hydrological Decade (a world-wide effort sponsored by UNESCO to advance the science of water during the period 1964-1974), the Center prepared and published a 12 volume report systematically outlining methods that can be used in planning and designing water resources projects in areas where little hydrologic data are available.

emergency work

California has had a long history of floods and its inhabitants have repeatedly suffered severe flood losses. Floodfighting and recovery from floods have imposed staggering financial burdens at all levels of government.

Floods, of course, occurred prior to the recorded history of California, but the earliest known flood occurred on *El Rio de la Porciuncula* (now the Los Angeles River) in early January 1770. In crossing that stream on 7 January, Father Juan Crespi recorded in his diary that "a few days previously there had been a great flood which had caused it to leave its bed." From 1770 to 1972, 34 major rain or snowmelt floods occurred in the State. These floods claimed more than 350 lives and resulted in well over a billion dollars in flood damage. Some of these floods inundated vast areas. For example, floods in the Central Valley in 1805 inundated the entire valley floor. In 1861-62, a great flood often referred to as the "Noachian Flood of California" turned the Central Valley into an inland sea, covered much of

the flood of 1884 washed out streets and tracks, leaving this horse drawn trolley car on the edge of the los angeles river.

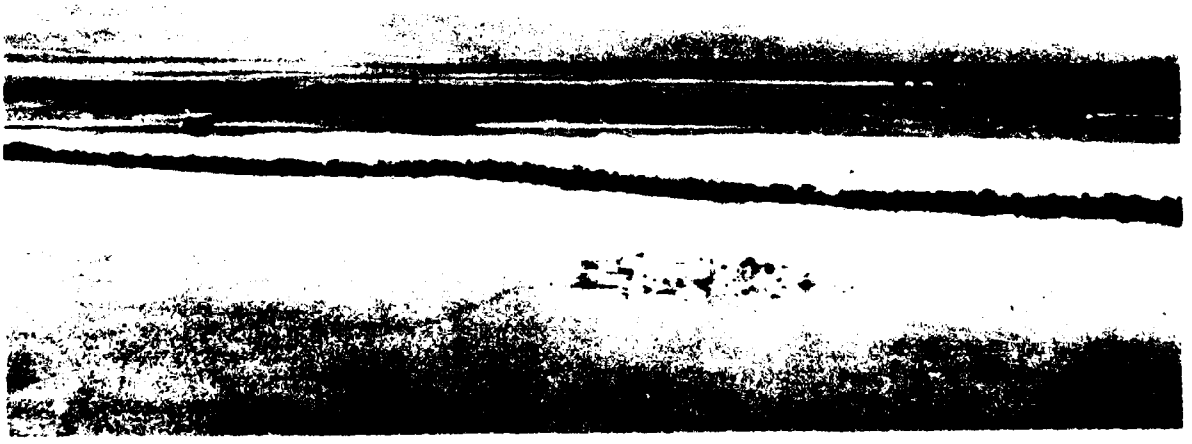
the 1938 flood ripped out many bridges, including the pacific electric and southern pacific railroad bridge spanning the santa ana river.

the Los Angeles River Basin and inundated extensive areas in other localities. Great floods also occurred in 1867, 1907, 1909, 1955, 1964, 1966-67 and 1969.

Existing flood control facilities in California have been very effective, but flooding and flood damages continue to occur in some areas that do not have protective works; where it is economically infeasible to provide flood protection against extremely rare floods; and because nonstructural measures to reduce flood damage have not been extensively implemented. Consequently, the continuing authorities for the Corps of Engineers to participate in emergency repair and restoration of facilities damaged during floods (or during other natural disasters) have been extensively used over the years.

▲ *the december 1950 flood severed this southern pacific line west of manteca in san joaquin county.*

in december 1955 the pajaro river flooded nearly 8,000 acres
▼ *near gilroy in santa clara county.*



◀ *in december 1955 the feather river levee failed, flooding yuba city. forty lives were lost during the flood.*

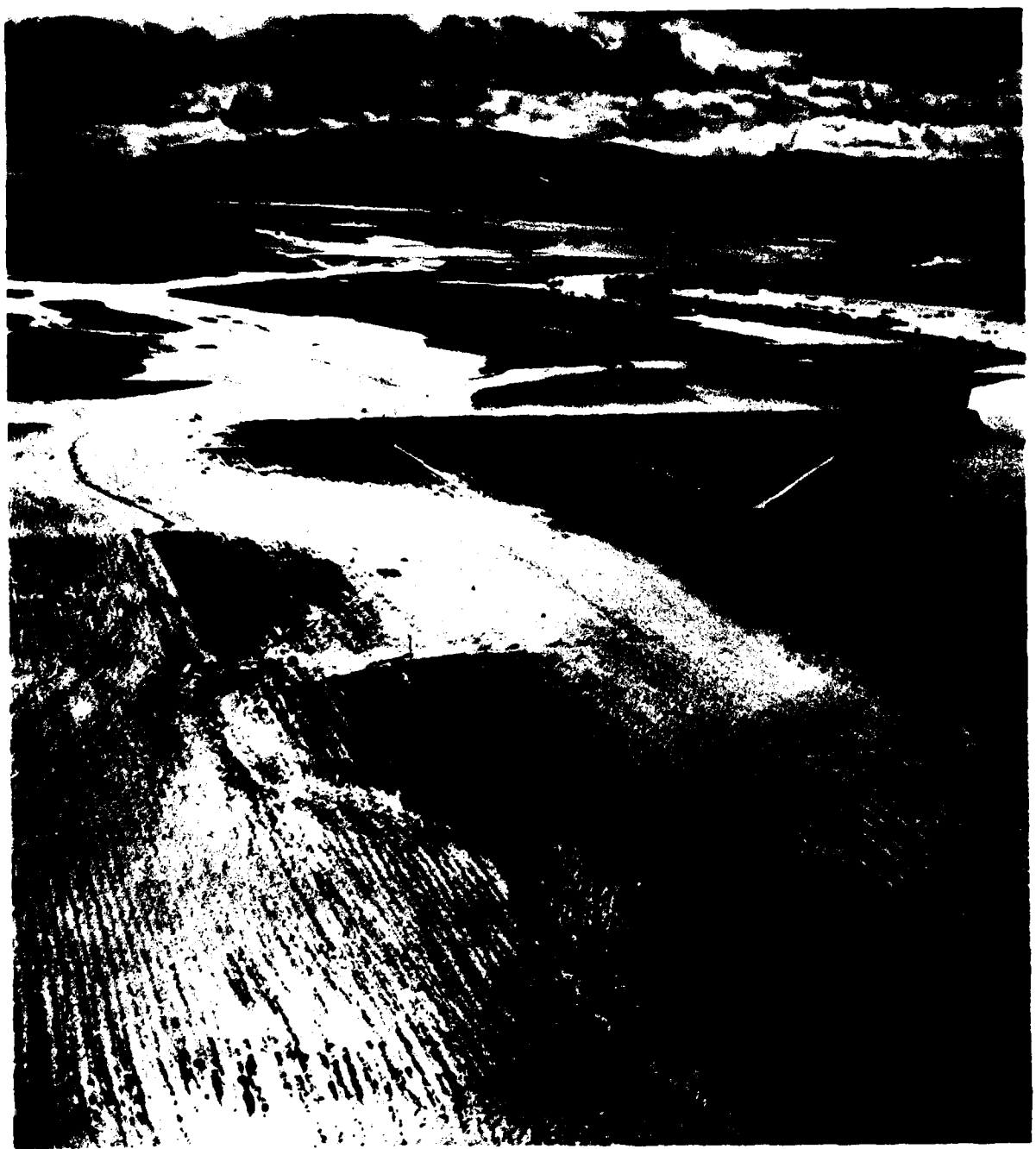
the eel river floated these logs off flat cars during its december 1964 rampage. this scene is along highway 101 ▼ *near rohnerville, humboldt county.*

▲ *the december 1964 floods carried this section of northwestern pacific railway bridge down the eel river near the town of south fork.*

◀ *rain and snowmelt floodwaters filled tulare lake in early 1969 giving it the appearance of an inland sea. (photo courtesy of the corcoran journal)*

▲ *floods in january 1969 caused the levee protecting sherman island to fail.*

the stanislaus river levee gave way to the january 1969 ▼ *floods, inundating extensive farmlands.*



floodwaters of the salinas river stream across farmland.

Emergency work in the interest of navigation has been less extensive than that in the interest of flood control. The principal types of work accomplished on emergency bases comprise floodfighting and rescue operations; repairing or restoring levees; protecting streambanks and levees subject to erosion; and restoring, clearing and snagging stream channels. Costs of emergency work in California under Public Law 84-99 (see Chapter 13, page 226); other continuing authorities and special Congressional authorizations are summarized by area as follows:

Hydrographic Area	Cost
North Coastal Basins	$ 7,480,000
San Francisco Bay Area	3,600,000
Central Coastal Basins	8,800,000
South Coastal Basins	9,430,000
Sacramento Basin	17,700,000
Delta-Central Sierra Area	4,500,000
San Joaquin Basin	5,020,000
Tulare Lake Basin	5,410,000
North Lahontan Territory	105,000
South Lahontan Territory	815,000
Colorado Desert	346,000

The most extensive application of continuing emergency work authorities in California followed the floods of December 1955-January 1956, December 1964-January 1965 and January-February 1969.

A special application of Public Law 84-99 occurred during the snowmelt flood season of 1969. Early that year California was one of 26 states where near-record snowmelt flooding was expected. In a letter dated 1 March 1969, the Director of the Office of Emergency Preparedness (OEP) notified the Secretary of the Army that "the President has directed that all feasible steps within the authorities of the Federal agencies be taken to prepare for floods which threaten to occur in various parts of the country because of the unusual snowpack conditions which now exist." Special reference was made to the continuing authorities of the Corps of Engineers under Public Law 84-99, which previously had been utilized primarily during and after flood emergencies. The President urged "aggressive use of these authorities under present conditions." Work under the program, which the OEP named Operation Foresight, was undertaken in the Central Valley, in Owens Valley and on the north slope of the San Bernardino Mountains.

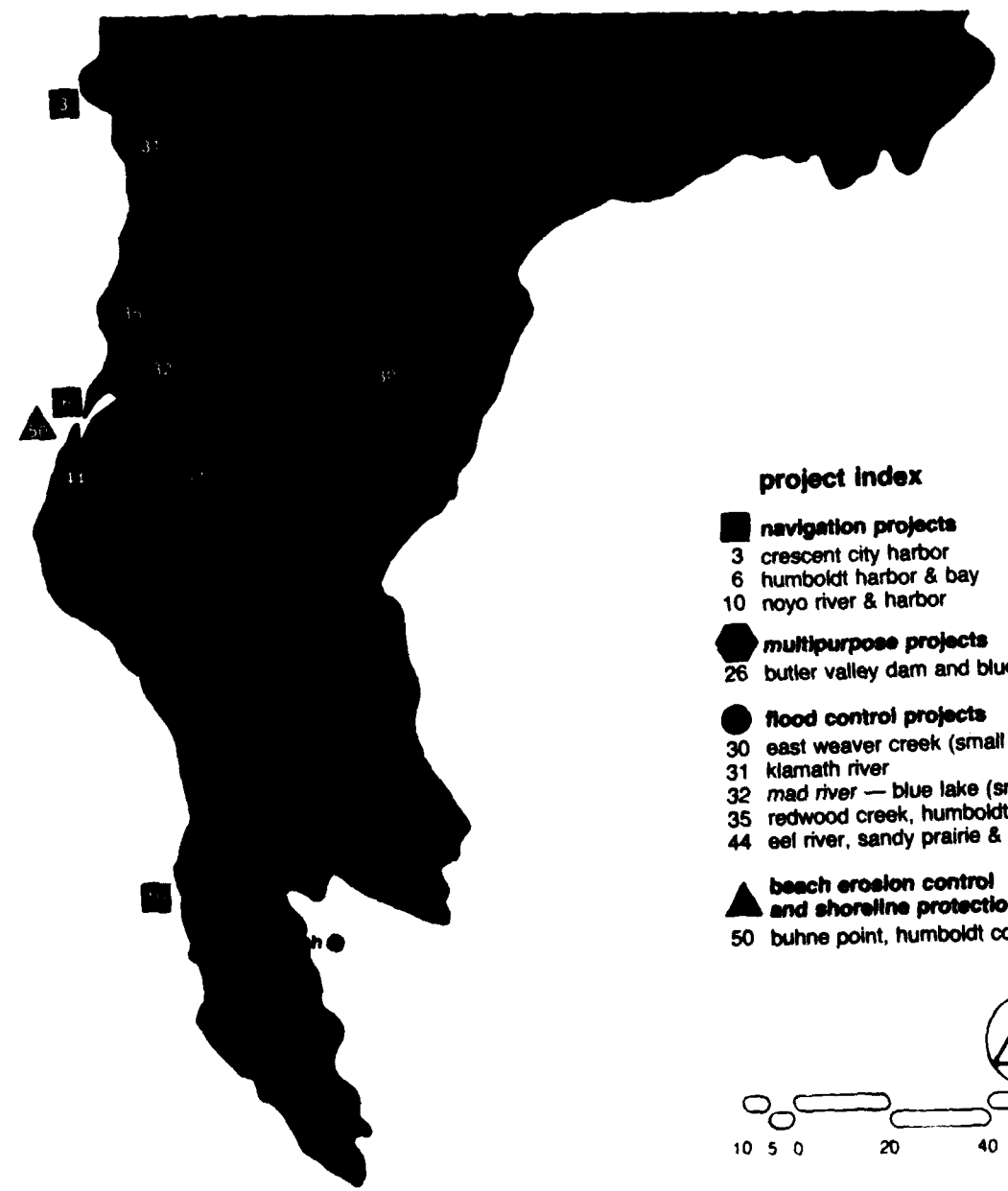
Operation Foresight work consisted mainly of channel rectification; raising, strengthening, repairing and protecting levees; and constructing new levees. Other work included construction of a temporary 63,000 acre-foot floodwater detention basin, construction of about 800 acres of temporary percolation ponds and emplacing temporary sack concrete barriers in the spillways of two flood control storage projects. It is estimated that advance preparation under Operation Foresight reduced potential snowmelt flood damage by $12 million. Cost of the work was more than $4 million, of which 80 percent was borne by the Federal government.

An example of an application of Public Law 84-99 followed the Andrus Island levee failure in the Sacramento-San Joaquin Delta on 21 June 1972. The levee on the San Joaquin River side of the island failed from unknown causes in the middle of the night permitting river water to inundate both Andrus and Brannan Islands. Damage totaled an estimated $28 million. Emergency work consisted of an abortive attempt to protect the Andrus Island community of Isleton.

Under national disaster recovery authorities (see "Emergency Work under Public Law 93-288," page 226), the Corps of Engineers performs varied repair and restoration work at the request of the specified coordinating Federal agency. The costs of such work following major disasters in California are summarized as follows:

Disaster	Cost
December 1955-January 1956 Floods	$ 2,520,000
Failure of Baldwin Hills Dam, December 1963	1,251,000
December 1964-January 1965 Floods	24,280,000
November-December 1965 Floods	240,000
December 1966 Floods	3,469,000
January-February 1969 Floods	27,173,000
January 1970 Floods	3,393,000
September-November 1970 Wildfires	5,750,000
San Fernando-Sylmar Earthquake February 1971	28,000,000
Andrus Island Levee Failure	2,560,000

2 north coastal basins



project index

navigation projects
3 crescent city harbor
6 humboldt harbor & bay
10 noyo river & harbor

multipurpose projects
26 butler valley dam and blue lake

flood control projects
30 east weaver creek (small project)
31 klamath river
32 *mad river* — blue lake (small project)
35 redwood creek, humboldt county
44 eel river, sandy prairie & delta area

beach erosion control and shoreline protection projects
50 buhne point, humboldt county

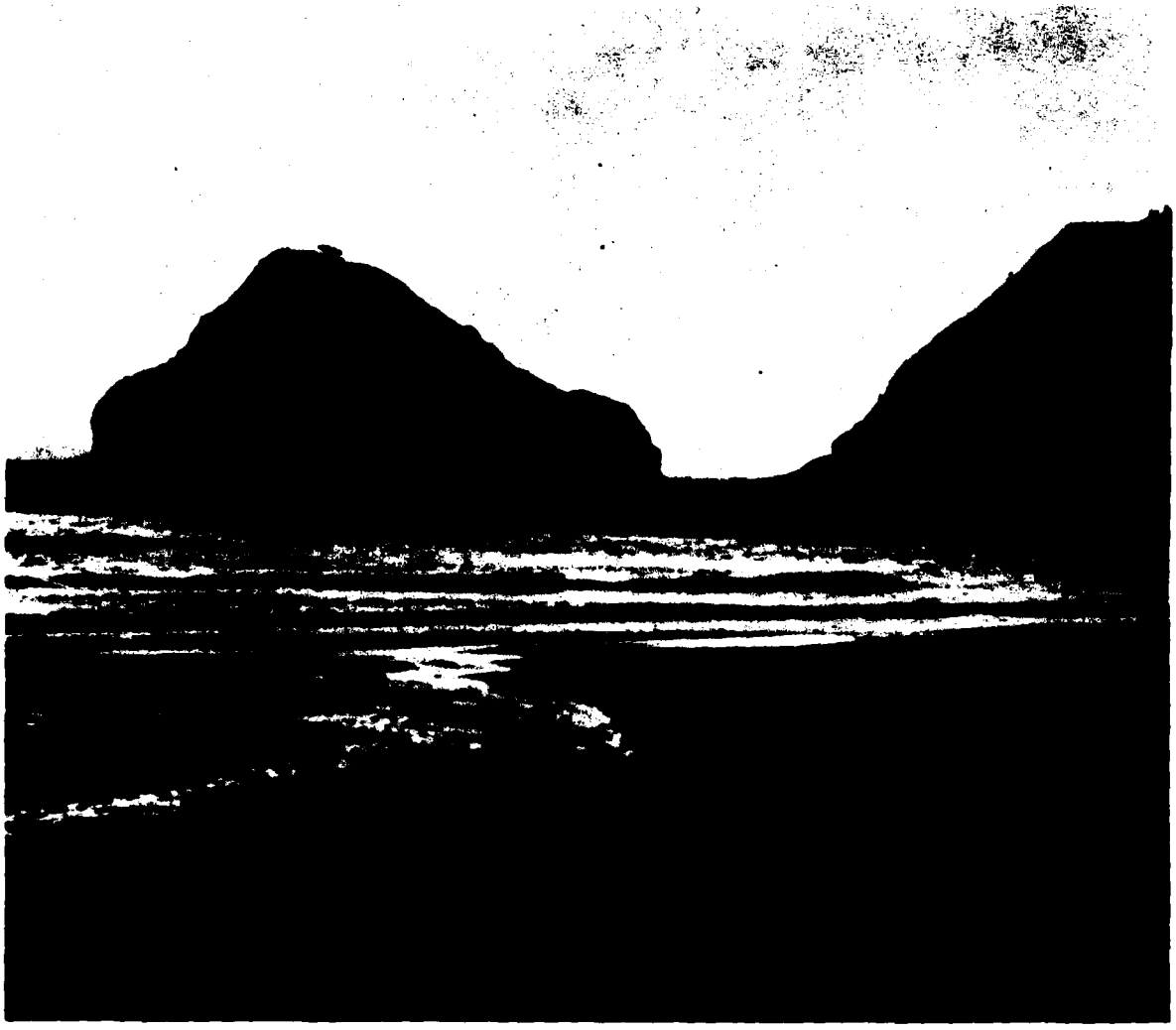
[1]Project numbers relate to Location and Status of Projects Map inside back cover.

description

The North Coastal Basins extend along the Pacific Ocean from the mouth of the Russian River in Sonoma County to just north of the California-Oregon border. Within the State of California, the basins include all of Del Norte, Humboldt and Trinity Counties, and parts of Mendocino, Siskiyou, Sonoma, Lake, Glenn and Modoc Counties.

Throughout most of the area, mountains and rolling hills extend to the ocean creating some of the most impressive coastal scenery in the State. The major mountain ranges are the Klamath Mountains and the Coast Ranges, which are the sources of the largest streams in the basins: the Klamath, Eel, Mad, Smith and Mattole Rivers and Redwood Creek. The Klamath is the largest stream in the basin, draining 15,500 square miles or about two-thirds of the entire area.

(photo courtesy of vtn.)



north coastal basins

the crescent city harbor provides sheltered moorings for the fishing fleet.

The present population of the North Coastal Basins, 240,000, is projected to increase to over 300,000 by the year 2000. Eureka, Crescent City, Yreka, Weaverville and Fort Bragg are the principal urban centers.

Since nearly half of California's commercial forest land is located in the area, lumbering and processing of forest products are major industries. Sport and commercial fishing, general recreation and agricultural activities, particularly dairying, also contribute significantly to the economic base.

King and silver salmon and steelhead trout abound in the north coastal streams. Approximately 30 percent of the king salmon and virtually all of the silver salmon in California are found here. Mule deer of various species are the dominant big game in the area. Black bear and the remnants of a once large population of Roosevelt elk inhabit the redwood forests. Pronghorn antelope are also native to the area.

Flood control facilities in the North Coastal Basins are very limited. Past floods, particularly those occurring along major rivers, have resulted in serious damages to urban and rural property. Due to steep gradients in the areas drained, floods are characterized by rapid rises and recessions. Most floods are of such short duration that streams seldom top their banks for more than a day or two. Flood peaks generally result from intense short-duration rainfall preceded by prolonged moderate to heavy rain. Snowmelt is rarely a contributing factor. The floods of 1955 and 1964-65 were the most severe known in the basins.

Facilities for commercial navigation include Humboldt Harbor (deep draft) and Crescent City Harbor (shallow draft). Waterborne commerce consists principally of lumber and petroleum; however, this is changing as the economy of the area diversifies.

The precipitous cliffs and jutting promontories of the shoreline are frequently beset by severe storms, strong winds and squalls. Heavy waves generated by storms in the North Pacific buffet the coast during summer as well as winter. Damage from great sea waves (tsunamis) occurs in the Crescent City area where seven tsunamis have been recorded since 1964.

navigation projects

Prefatory Note[1]

In their search for the mythical Straits of Anian, believed to be a sea passage through the North American continent, such well-known Spanish explorers as Juan Rodrigues Cabrillo, Bartolome Ferrelo, Sebastian Cermeño and Sebastian Vizcaino sailed the waters of the north coast, each seeking fame and fortune and each sighting landfalls to the north and south of Humboldt Bay, but never discovering the bay itself.

For two hundred years, Spanish galleons engaged in the Philippine trade rode the trade winds east to the Alta California coast. The westerly winds carried the galleons usually no farther north than Cape Mendocino, but in 1595 Cermeño, a merchant-adventurer, and his crew of 70 men were carried as far north as the 43rd parallel in sight of land, but held far out to sea away from the treacherous surf. Cermeño, hampered by a half-starving crew suffering with scurvy, feared that if he ordered the anchor dropped on these remote shores, his crew would be too weak to lift it again. Cermeño and his crew continued to sail south past Humboldt Bay to arrive 3 days later at Drake's Bay where the *San Augustin* was shipwrecked. Cermeño and most of his crew survived and continued their journey south in an open boat. Cermeño is credited with acquiring a surprisingly accurate knowledge of the coast of California from just north of Humboldt Bay to Baja California, but no mention of sighting Humboldt Bay was made in his journals or on his maps.

In 1603, Vizcaino sailed from Acapulco to north of Cape Mendocino, possibly as far as the mouth of the Rogue River in Oregon, and sighted snow capped mountains. Because of the rough seas off the north coast, Vizcaino was forced to retreat to calmer waters south of San Francisco, which he explored extensively before returning to Acapulco.

In 1775, two Spanish mariners, Lieutenant Cuadra y Bodega and Captain Bruno Heceta, made landfall 20 miles north of Humboldt Bay and entered a small bay near Trinidad Head which they named "Trinity Bay" in honor of the day, Trinity Sunday, June 9.

For the next 150 years the Spanish Manila trade continued to sail tiny galleons along the northern California coast, anchoring to take on water and food supplies and to barter with the Indians, but no significant explorations of north coastal waters occurred.

[1]Principal source: Hoover, Rensch, and Rensch, *Historic Spots in California*, Third Edition.

In March 1806, Count Nikolai Rezanov sailed the *Juno* south from Sitka through "hostile Spanish waters" to seek relief for his starving crew. He also sailed past Humboldt Bay without discovering it, and continued south to San Francisco Bay. Later that same year, an American sea captain, Jonathan Winship, made the first recorded discovery of Humboldt Bay. Employed by the Russian-American Fur Company to find seals and sea otter, he sailed the *O'Cain* and a fleet of 40 small boats manned by Aleut Indians through the long-obscured entrance to Humboldt Bay, anchoring opposite the present site of Eureka. Winship named the harbor "Bay of Indians" because of the numerous Indian villages found along its shore. He named the entrance to the bay "Rezanov" after the Russian count.

In the 1800s, development of fur trade; lumbering and mining gave impetus to the establishment of a direct sea route from San Francisco Bay to Humboldt Bay and the north coast. In 1849, Dr. Josiah Gregg, employed by the United States government to find the mouths of the wild rivers, traced the Trinity River to its mouth and rediscovered Humboldt Bay, which lies south of the river's mouth, and named it Trinity Bay. One year later, Lieutenant Douglass Ottinger, in command of the *Laura Virginia*, sailed from San Francisco to drop anchor in the bay which he renamed Humboldt Bay after the German scientist and traveler, Baron Alexander von Humboldt.

With the discovery of gold in the 1850s along the Trinity, Klamath, Mad and Eel Rivers, sea travel was preferred to the slower overland methods by miners who were anxious to get to their claims and ship their gold to San Francisco. Other newcomers to the north coast made their fortunes harvesting virgin stands of redwood. Mill towns sprang up along the coast in Del Norte, Humboldt, Mendocino and Sonoma Counties at inlets, coves and bays where deep water permitted shipping.

On the shores of Humboldt Bay, several towns sprang up hoping to become the trading center for the developing lumber and fishing industries. The last of these towns, Eureka, was established on Humboldt Bay in May 1850, and later became the natural shipping center and the county seat.

The Corps of Engineers began initial work at Humboldt Bay after funds were appropriated by Congress in March 1881. The harbor entrance was improved and the inner basin dredged to promote safer passage. The project proved to be of vital importance to regional navigation, with early records showing that more than 1,000 vessels entered Humboldt Bay in 1899. Hum-

boldt Harbor continues to be of significance to navigation in northern California.

Crescent City Harbor (San Francisco District)
Crescent City Harbor is located 17 miles south of the California-Oregon state line, midway between San Francisco Bay and the mouth of the Columbia River. Improvement of the harbor was first authorized in 1918, with additional work taking place in subsequent years up to 1957.

The project consists of a 4,700 foot outer breakwater, a 1,200 foot inner breakwater, a 2,400 foot sand barrier and harbor and boat basins. Construction of the seaward end of the outer breakwater included the use of tetrapods, manufactured on a royalty-free basis under a license agreement granted by Etablissments Neyrpic, Grenoble, France. The project is being maintained by the Corps of Engineers.

Modifications of the project were authorized in 1965 to include a 400 foot extension of the inner breakwater and a tee-shaped inner harbor basin. Construction of the inner breakwater was completed in 1973, but work on the inner harbor basin has been deferred indefinitely. Major rehabilitation work was performed in 1964 and again in 1974 using dolosse armor units.

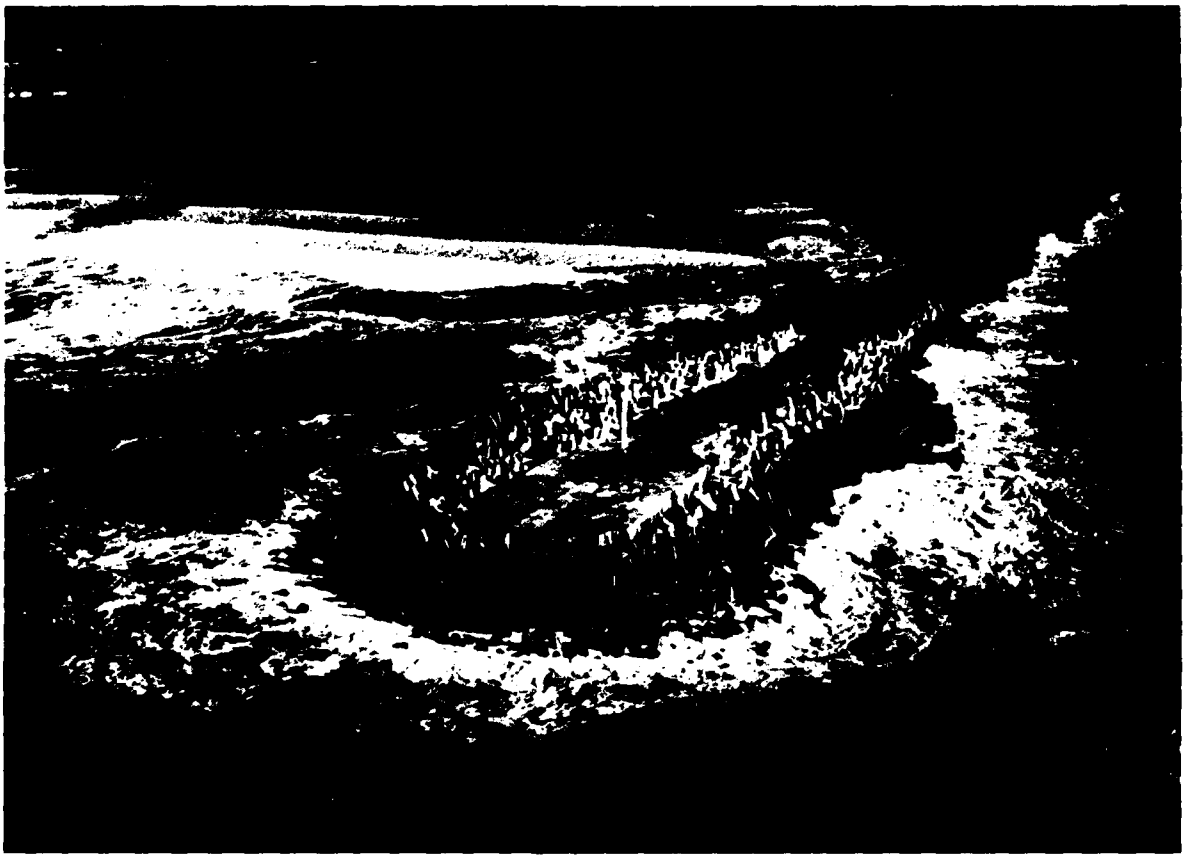
The Federal costs for completed work and work in progress totals $7.8 million. Local interests contributed $300,000 to the project.

Crescent City Harbor serves an area of about 13,000 square miles in northern California and southern Oregon. Waterborne commerce in the harbor was 229,000 tons in 1975 and averaged 318,000 tons annually during 1966-1975. Principal commodities shipped were petroleum, lumber, fish products, sand and gravel, and crushed rock.

Humboldt Harbor and Bay (San Francisco District)
Humboldt Harbor is on a landlocked bay at Eureka about 225 miles north of San Francisco Bay and 87 miles south of the California-Oregon state line. The area tributary to Humboldt Bay contains about 80 percent of the world supply of redwood timber, as well as large stands of Douglas fir. Humboldt Bay is the site of the State's largest centers for oyster cultivation and for exportation of lumber products, including pulp.

Improvement of the harbor was first authorized in 1881, with the latest improvements completed in 1955. The

loading timber for export in humboldt harbor.



about 2,500 dolosse armor units, each weighing 42 tons, protect the humboldt harbor jetties from waves up to 40 feet high.

project consists of nearly two miles of jetty, about eleven miles of channels and a turning basin. Harbor depths range from 26 to 40 feet. Modifications to the project, authorized in 1968, include deepening the North Bay, Samoa and Outer Eureka Channels, widening portions of the channel and bends, and dredging a turning basin at the head of Samoa Channel. Dredging an anchorage area in North Bay has been eliminated from the project.

The Federal cost of completed work was $3 million, supplemented by a local contribution of $1 million. The estimated cost of project modifications is $5.9 million, 80 percent of which will be borne by the Federal government.

The jetties, completed in 1927, are subject to recurring storm damages and have been repaired periodically. In 1957, severe winter storms substantially increased the scope of required repairs. Protective armor stone was dislodged, concrete side slopes were undermined and portions of the concrete cap and underlying core were lost. The north and south jetties were repaired in 1961 and 1964. Concrete armor units were placed in 1972.

Harbor commerce consists of varied petroleum products, lumber and related products, and salt water fish. Waterborne commerce in 1975 totaled 1.4 million tons including foreign traffic. Average tonnage for the 1966-1975 period was 1.3 million tons.

A special investigation of economic, environmental and social uses of the Humboldt Harbor and Bay region was initiated in 1976 and is discussed later in this section.

part of the commercial fishing fleet in the older portion of noyo harbor.

Noyo River and Harbor (San Francisco District) The Noyo River and Harbor Project is located about 135 miles northwest of San Francisco. It is the only improved harbor between Bodega Bay, 87 miles to the south, and Humboldt Bay, 87 miles to the north. Improvement of the harbor was first authorized in 1922 and most completed improvements are being maintained by the Corps of Engineers.

The project consists of a wall, two jetties and 3,200 feet of channel. A mooring basin and a 400 foot channel extension were constructed by the Noyo Harbor District with funds provided by a grant from the Economic Development Administration and a loan from the State of California. The mooring basin is maintained by local interests; the channel extension is maintained by the Corps of Engineers.

Federal cost of the project was $200,000. Local costs totaled $1 million.

During storm periods, the harbor entrance is extremely hazardous; nine lives have been lost in the vicinity of the harbor since 1943. The fishing industry is vital to the economy of the community of Noyo. The commercial fish catch in 1975 amounted to about 5,600 tons. Two hundred fishing boats are permanently berthed at Noyo Harbor and about 500 use the harbor during the salmon trolling season.

The Water Resources Development Act of 1976 (PL 94-587) modified the authorized Noyo Harbor project to allow construction of such breakwaters (limited to not more than two) and channel improvements as may be needed to provide protection deemed necessary to meet applicable economic and environmental criteria.

navigation study

Coast of Northern California, Harbors For Light Draft Vessels (San Francisco District)
The coastline of northern California is frequently beset by dense fog, ground swells from distant storms and sudden intense local storms. These conditions are hazardous to small boat navigation and are particularly threatening to the fishing industry which is vital to the economy of coastal communities. The lack of harbors of refuge compounds the dangerous conditions.

A study of a chain of small craft harbors along the coast of Northern California was authorized by the 1945 and 1946 Rivers and Harbors Acts. A system analysis which treats the entire coast of Northern California as a unit was completed in October 1971, and the output will be used as a basis for project formulation. The study completion date is indefinite. See pages 52 and 78 for information on this study as it pertains to the San Francisco Bay Area and the Central Coastal Basins.

multipurpose project

Butler Valley Dam and Blue Lake Project (San Francisco District)
The Butler Valley Dam and Blue Lake Project consists of a rockfill dam 350 feet high and 1,850 feet long on the Mad River east of Eureka. The project would have a storage capacity of 460,000 acre-feet. By controlling the runoff from about 70 percent of the drainage basin upstream from the dam, the project would provide a high degree of flood protection in the Mad River Delta. In addition to flood control, the project would provide about 160,000 acre-feet of water for municipal and industrial uses in the Mad River water service area, and extensive opportunities for water-oriented recreational activities.

Authorized by the 1958 Flood Control Act, Butler Valley Dam has been recommended for reclassification to "inactive" due to lack of support by local interests.

flood control projects

Eel River, Sandy Prairie and Delta Area (San Francisco District)
The Delta area near the mouth of the Eel River is subject to recurring flood damages due to the instability and limited discharge capacity of the constantly shifting channel.

Levees in the Sandy Prairie area, on the east bank of the river near the City of Fortuna, were constructed during the period between the two major floods of 1955 and 1964. The project, completed in 1959, consists of about 4 miles of levee on the west bank of the Eel River. About 1 mile of this levee, which has an average height of 25 feet, was riprapped for slope protection. To date, the completed improvements have prevented flood damages of more than $490,000. The project was modified in 1965 to provide for the construction of new levees and the modification of existing levees in the

flood damage by the eel river at rio dell, december 1964.

delta area on the Eel River and on the Salt River, and for the construction of a boat launching ramp and associated recreation facilities. Preconstruction planning for the 1965 modification has been suspended, and the levee additions were placed in an inactive category in 1972.

The Federal first cost of the completed work was $680,000, and the non-Federal cost was $300,000. Local interests maintain the completed improvements. Before classification of the levees as inactive, the Federal cost of the work authorized in 1965 was estimated at $26.1 million, and the cost to local interests was estimated at $7.1 million.

Klamath River at and in the Vicinity of Klamath (San Francisco District)
This flood control project is located at the mouth of the Klamath River, some 35 miles south of the Oregon border. Cities in the flood plain of the Klamath near the ocean have suffered severe flood and erosion damages from winter storms. These cities include Klamath, Klamath Glen, Camp Klamath and Requa. The devastating flood of December 1955 caused damages in the project area estimated at nearly $2 million. The December 1964 flood inundated the town of Klamath to depths of up to 18 feet and almost completely devastated the project area. Damages were estimated at $8 million.

the december 1964 floods on the klamath river severed u.s. highway 101 at the town of klamath.

Authorized in 1966, the project provides for the construction of a levee at Klamath and the construction of a new flood-free townsite at Klamath. The new townsite is protected by the filling of a 50 acre area behind a new freeway to the level of the freeway embankment. Local interests are responsible for controlling development in the remaining flood plain, which has a land area of 2,200 acres.

In 1972 bank protection was completed along two miles of the north bank of the lower Klamath River.

The Federal cost of the work authorized in 1966 was $3 million, and costs for the later work totaled $4.8 million. Local interests contributed a total of $745,000.

The project prevents destructive flooding in the towns of Klamath and Klamath Glen and results in annual benefits estimated at $860,000. The project also provides immediate and long-range benefits to the economy of the river basin due to increased employment opportunities and greater utilization of lands protected from flooding. The lower Klamath River is internationally known for its salmon and steelhead fishing, and the economy of the area is largely dependent on these activities. Due to the natural attractions of the area, it is expected that annual recreation usage will increase to about 1.4 million visitor-days by the year 2000, and that the population of the flood plain will triple during the same period.

highway 101 bridge at klamath, december 1964

north coastal basins

▲ *completed bank protection work along the klamath river.*

◀ *the klamath river is internationally known for its salmon and steelhead fishing.*

Redwood Creek, Humboldt County (San Francisco District)
Redwood Creek drains an area of about 280 square miles and empties into the Pacific Ocean about 50 miles south of the Oregon border. The project, completed in 1968, consists of 3.4 miles of channel straightening and 6.3 miles of levees along the creek. It provides flood protection along the lower 4-mile reach of the creek, adjacent to and including the town of Orick.

The Federal cost of the project was $4.5 million. Local interests contributed $570,000 and provide the maintenance of the project. Remedial work to the interior drainage system was completed in 1976.

The estimated value of lands and improvements in the area protected by the project is $16.6 million. Floods in 1953, 1955 and 1964 caused damages of $2.9 million. If the project had been completed, virtually all of these damages could have been prevented.

flood control study

Northern California Streams (San Francisco and Sacramento Districts)
Authorized by Flood Control Act of 1962, this study includes all streams in Northern California flowing into the Pacific Ocean, including the Sacramento River and its tributaries. Work on the study has been divided between the San Francisco and Sacramento Districts. The San Francisco District will study and report on the coastal streams, and the Sacramento District will study and report on the interior streams. A number of separately authorized studies are to be completed within the framework of the study.

In late December 1964 and early January 1965, all of the counties in the North Coastal Basins were declared disaster areas as a result of unprecedented flooding. The floods resulted in the loss of at least 24 lives, evacuation of entire communities, destruction of bridges, highways and utilities and widespread property damage. An evaluation of the amount of destruction by the flood showed damages amounted to approximately $240 million. By comparison, the record-breaking flood of 1955-1956 caused damages estimated at $44 million. These flood events demonstrated the need for flood control measures, and the growing water supply requirements in the study area showed the need for water conservation and related improvements.

Initial study effort has been concentrated on small coastal streams not covered by separate authorizations. Progress reports on the Mattole, Garcia, Noyo and Gualala River Basins have been completed in conjunction with a report now under preparation for the Navarro River Basin. Separately authorized studies to be accomplished within the framework of the study consist of those on the Mad River Basin in the North Coastal Basins area, and the Russian River Basin in the San Francisco Bay Area. The Sacramento District portion of this study is discussed on page 162.

mad river basin
The 100 mile long Mad River drains an area of nearly 500 square miles in Trinity and Humboldt Counties. The lower delta and valley, which comprise the principal flood areas, are devoted primarily to agriculture and lumbering. Combined damages of over $7 million were sustained in the floods of December 1955 and December 1964-January 1965. A basinwide study of flood control and related problems authorized in 1956 is in an indefinite status.

russian river basin
The study of the Russian River Basin is discussed on page 63.

small flood-control projects

East Weaver Creek, Trinity County (San Francisco District)
Construction of channel improvements and levees to provide flood protection to the town of Weaverville was completed in 1963. The project consists of about 2,200 feet of trapezoidal-section earth channel with riprap protection and about 3,000 feet of levees.

The Federal cost of the project was $200,000, while local costs totaled $100,000. The improvements are maintained by local interests.

Since its completion, the project has prevented damages estimated at $250,000.

Mad River at Blue Lake (San Francisco District)
A small flood-control project on the north fork of the Mad River near the community of Blue Lake was completed in 1955 and transferred to Humboldt County for operation and maintenance. This project, consisting of channel clearing and construction of about 3,000 feet of levee, provides flood protection to adjacent agricultural and industrial lands.

To prevent deterioration of existing levees and to provide additional protection to the community of Blue Lake, construction of about 2,000 feet of new levee and raising and riprapping of about 7,000 feet of existing levees was completed in 1963.

The Federal government bore $390,000 of the project costs, while local interests contributed $60,000 and provide maintenance of the project.

The project has prevented damages of more than $2.2 million, including $800,000 in the 1964 floods.

beach erosion control and shore protection project

Buhne Point, Humboldt Bay (San Francisco District)
Humboldt Bay is a landlocked body of water situated 250 miles northwest of San Francisco Harbor at Eureka. Buhne Point, a prominent bluff located on the bayshore almost directly opposite the jettied entrance to the bay, and Buhne Spit, which adjoins Buhne Point on the south, are subject to severe erosion from wave action. Buhne Point has been protected from further erosion by the construction of a privately owned rubblemound seawall. In order to stabilize and protect critical areas along Buhne Spit, the Corps of Engineers plans to construct 800 feet of rubblemound seawall and 790 feet of stone groin. This project has been recommended for reclassification as "inactive" due to lack of local support.

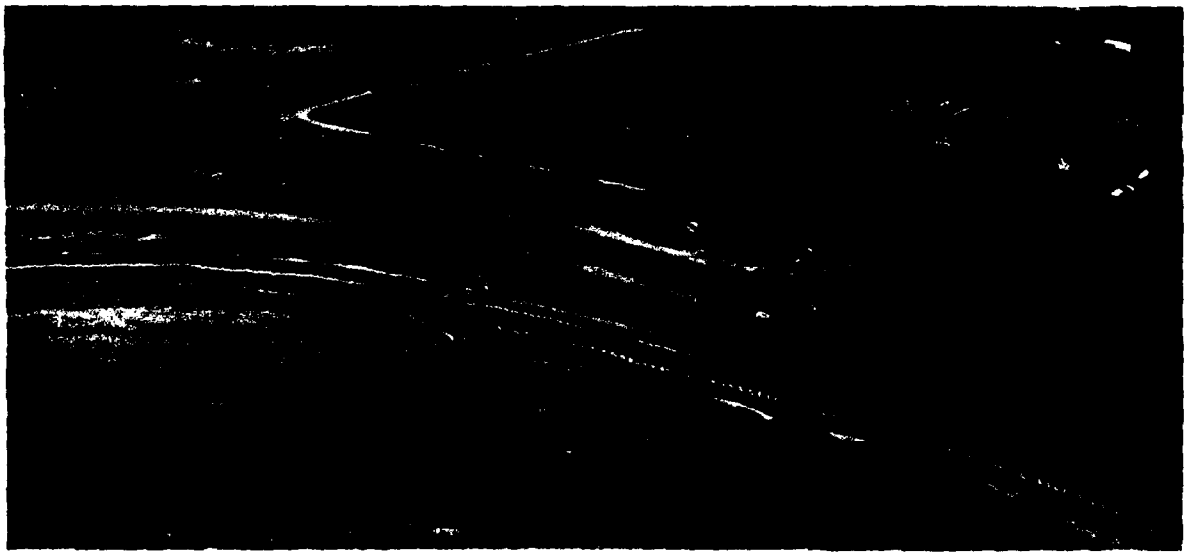
special investigations

Coast of California, Protection Against Storm and Tidal Waves (San Francisco and Los Angeles Districts)
A special investigation of storm and tidal waves along the Pacific Coast was authorized by the 1965 Flood Control Act. The study area covers the entire coast from Canada to Mexico, which is subject to destructive wind and wave action during the storm season (November through April), and periodically subject to tidal waves (tsunamis) that cause extensive property damage and sometimes loss of life.

The study will include analyses of feasible protective measures and consider the advisability of restrictive zoning and installation of warning systems. Several individual reports are envisioned.

Eel River Investigation (San Francisco District)
A study of the Eel River Basin and adjacent areas was initiated in 1976. Its purpose is to determine whether previous recommendations for development of water resources in the basin should be modified. Through the physical, environmental, social and economic structure, the study will examine the needs of the basin and adjoining areas and the future well-being of the people.

bank stabilization along the mad river at the blue lake sewage treatment plant, october 1974.



In general, the study will consider the development, management, conservation and environmental enhancement of the water and land resources of the basin. Among other things, it will specifically consider flood control; streamflow augmentation; water quality and water supply for municipal and industrial uses; interbasin water exchange; sedimentation problems; streambank and shoreline erosion; recreation and protection of unique natural and historical areas; forest, mineral and agricultural production; and watershed protection and management.

It is expected that various local, State and Federal agencies will participate in the investigation.

Humboldt Harbor and Bay (San Francisco District) Humboldt Bay is the only major landlocked anchorage north of San Francisco Bay. Although physically smaller than San Francisco Bay, Humboldt Bay offers comparative environmental and economic opportunities.

An investigation of the Humboldt Bay region was initiated in 1976 to determine optimum economic, environmental and social uses of the bay and its environs. The investigation will include, but not be limited to inventorying present use patterns in the region; determining the extent of various governmental jurisdictions and the impact of such jurisdictions on land use; examining the suitability of land resources for single and multiple purposes; and developing other data needed to provide the bases for sound and integrated planning at local, regional, State and Federal levels.

A completion date for the investigation has not been established.

emergency work

Emergency work performed by the Corps of Engineers in the North Coastal Basins has consisted primarily of floodfighting, flood suppression activities and debris removal. The Corps has also participated in restoration operations following tsunamis that have occurred in the Crescent City area. To date, under Congressional authorities, the Corps has spent in excess of $7 million for emergency work in the North Coastal Basins.

The most severe floods known in the North Coastal Basins occurred in December 1955 and in December 1964-January 1965. The 1964-1965 floods were of unprecedented intensity for so vast an area. They resulted from an extremely unfavorable combination of storm patterns, above freezing temperatures at high elevations in the watersheds and intense prior precipitation.

In the Eel River Basin, 24 lives were lost. Entire communities were demolished and hundreds of miles of roads and highways were severely damaged. In Mendocino and Humboldt Counties alone, 70 road and highway bridges were destroyed or damaged. An estimated 100 miles of track and uncounted rolling stock of the only railroad serving the area were damaged or destroyed. Entire herds of valuable dairy stock were drowned, as were large numbers of other livestock. The lumbering industry suffered enormous losses. Hundreds of millions of board feet of trees, logs and lumber were washed away and damages to mill facilities were extensive. In total, about 223,000 acres were inundated and damages amounted to $184 million.

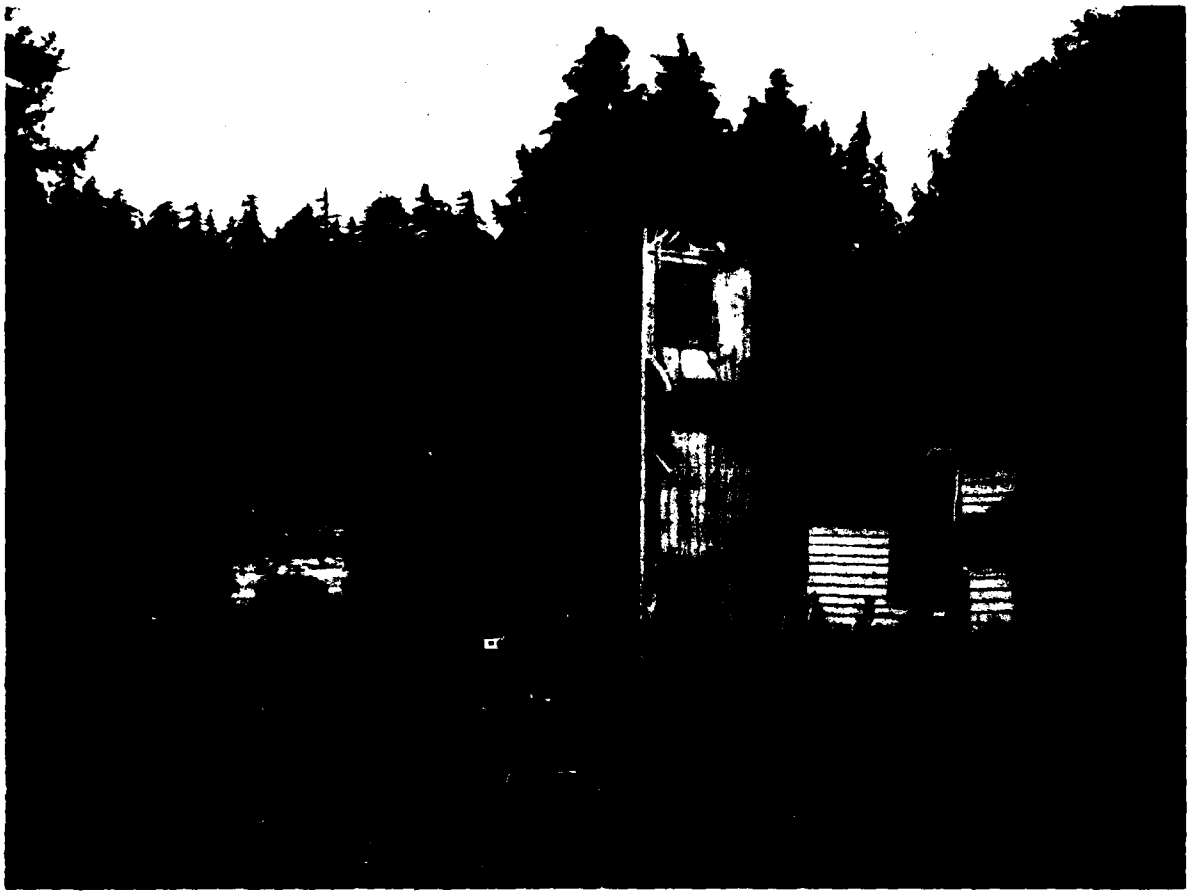
During the floods, about 10,000 persons received assistance from disaster relief agencies or military personnel. The aircraft carrier "Bennington" was dispatched from Southern California to provide helicopters, medical supplies and emergency rations. Extensive aerial rescue and relief operations were carried out under extremely hazardous flying conditions. The San Francisco District mobilized for emergency operations and activated a flood emergency center in Eureka with field offices in Yreka and Crescent City.

Following the 1964 floods, the Corps of Engineers performed $5.4 million in floodfighting and cleanup activities under Public Law 84-99. Work consisted of levee repairs and bank protection, snagging and clearing and rescue operations.

During the period of January 1972 to June 1973, the OEP requested the Corps to participate in flood suppression and floodfighting activities in Humboldt and Del Norte Counties. During this time, flood damages resulting from heavy rains caused estimated losses of $5.4 million. The Corps spent about $296,000 in emergency work. From January to October 1974, the Corps of Engineers spent in excess of $470,000 preparing for anticipated rainfloods, fighting floods on the Mad River, placing emergency bank protection and rehabilitating flood control works in Humboldt and Del Norte Counties.

At the request of the Federal Disaster Assistance Administration (FDAA), the San Francisco District also assisted in inspections of applications received from public entities for reimbursement of prior flood losses. The Corps recommended that $410,000 be reimbursed, which was approved by the FDAA.

Other emergency work performed by the San Francisco District Office was conducted as a result of

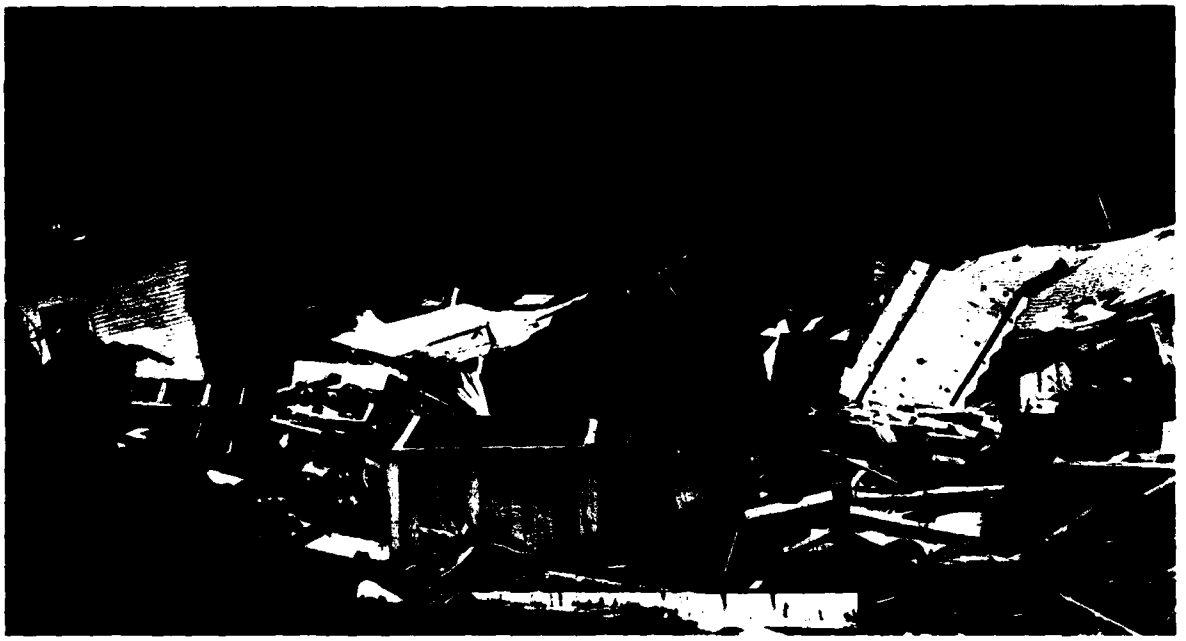


wreckage left by the december 1964 flood in pepperwood along the eel river before disaster recovery assistance by the corps of engineers.

tsunamis which occur in the Crescent City area. Seven tsunamis (great sea waves generated by earthquakes) have been recorded at Crescent City Harbor since 1964. The most devastating tsunami to occur resulted from an earthquake in Alaska on 28 March 1964. The tsunami was of such magnitude that a wall of water rushed inland from the sea, gathered the ebbing water in the shallow draft harbor before it and submerged the central portion of Crescent City. It destroyed public, private and commercial property. Damages were estimated at $11 million.

Immediately following the tsunami, Corps of Engineers personnel arrived in Crescent City to begin emergency operations. The OEP relied upon the Corps to furnish estimates of damages to public property including clean up of streets, roads and highways; restoration of storm sewers and repair of Citizen's Dock.

Local Congressmen called upon the Corps to survey Crescent City and Crescent City Harbor, which were declared a joint disaster area on 3 April. A Corps of Engineers project office was immediately established to begin contracting for debris cleanup which began on 6 April. More than 35 contracts were let with a value in excess of $250,000. Emergency work performed under the direction of the Corps of Engineers was completed in early July.



a mass of wrecked stafford area homes, top photo, lie in the wake of the eel river's december 1964 rampage. the lower photo shows the same location at stafford following debris removal by the corps of engineers.

north coastal basins

flood plain management services program

The following flood plain information studies for streams in the North Coastal Basins have been completed:

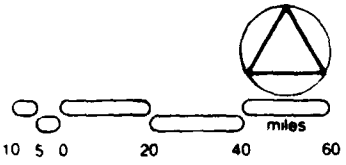
Eel River, Stafford to Holmes
South Fork Eel River, Weott to Meyers Flat
South Fork Eel River, Phillipsville to Garberville
Van Duzen River, Poverty Flats Area
Lake Earl, Lake Talawa and Lower Smith River
Trinity River, Lewiston Lake to Junction City
Freshwater Creek, Eureka Area.

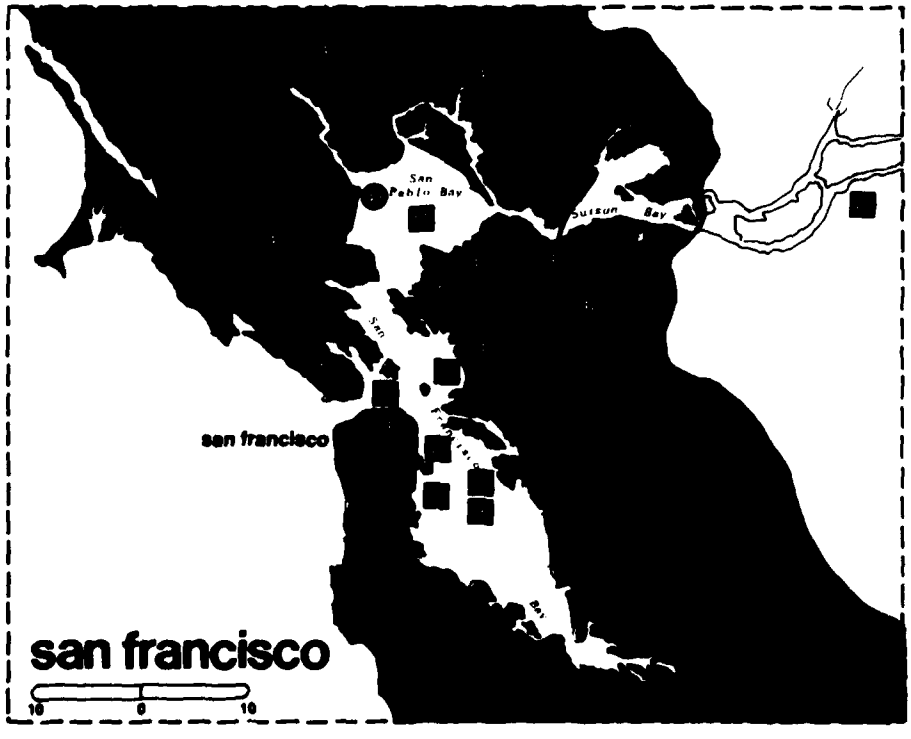
No future sites for flood plain management services have been selected at this time.

debris left at crescent city by the december 1964 floods.

the 1964 tsunami lifted and then dropped this pier in crescent city harbor, damaging it as shown in the top photo. the bottom photo shows the pier following restoration.

3 san francisco bay area





project index

navigation projects

1 berkeley harbor (small project)
2 bodega harbor
4 gas house cove (east harbor facility, san francisco marina) (small project)
5 half moon bay harbor
9 napa river
11 oakland harbor
12 petaluma river
13 redwood city harbor
14 richmond harbor
15 san francisco harbor
16 san leandro marina (breakwater, small project)
17 san pablo bay & mare island strait
18 san rafael creek
20 islais creek (small project)
21 san francisco bay to stockton (john f. baldwin & stockton ship channels)
22 san francisco harbor & bay, collection & removal of drift
23 san leandro marina (maintenance)
59 suisun bay channel
60 suisun channel
61 suisun point channel (small project)

multipurpose projects

24 lake mendocino
25 dry creek (warm springs) lake and channel
27 knights valley lake

flood control projects

28 alameda creek
29 coyote creek (small project)
34 pinole creek (small project)
36 rheem creek (small project)
37 rodeo creek (small project)
38 san leandro creek (small project)
39 san lorenzo creek, alameda county
41 corte madera creek
42 walnut creek
43 alhambra creek
45 napa river basin
47 sonoma creek basin
48 wildcat-san pablo creeks
95 green valley creek (small project)
109 fairfield vicinity streams

san francisco bay area

description

The San Francisco Bay Area includes the Russian River Basin and all other stream basins draining directly into the Pacific Ocean between the Russian River in Sonoma County and the San Lorenzo River in Santa Cruz County. Also included are all stream basins draining into San Francisco Bay west of the junction of the Sacramento and San Joaquin Rivers.

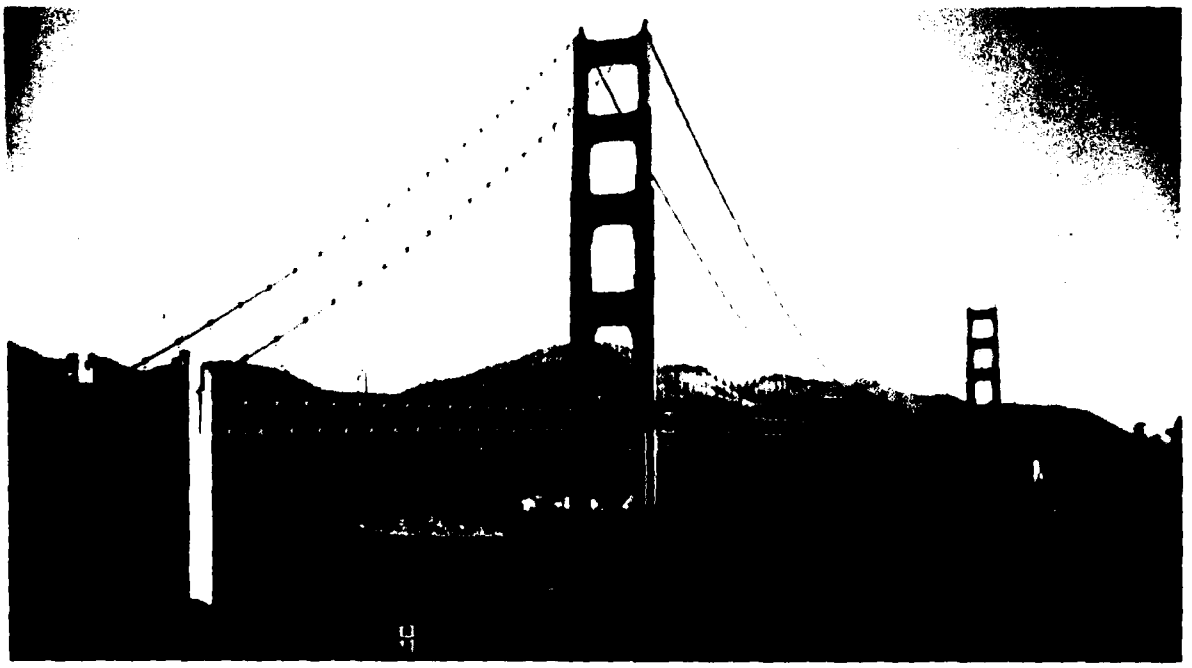
San Francisco Bay consists of four separate bays: Suisun, San Pablo, Lower San Francisco and San Francisco Bay proper. The San Francisco Bay area encompasses about 6,100 square miles, 280 miles of bayshore and 150 miles of scenic coastline. The area's most outstanding physiographic feature is the bay, a vast landlocked estuarine complex through which runoff from the entire Central Valley drains to the Pacific Ocean.

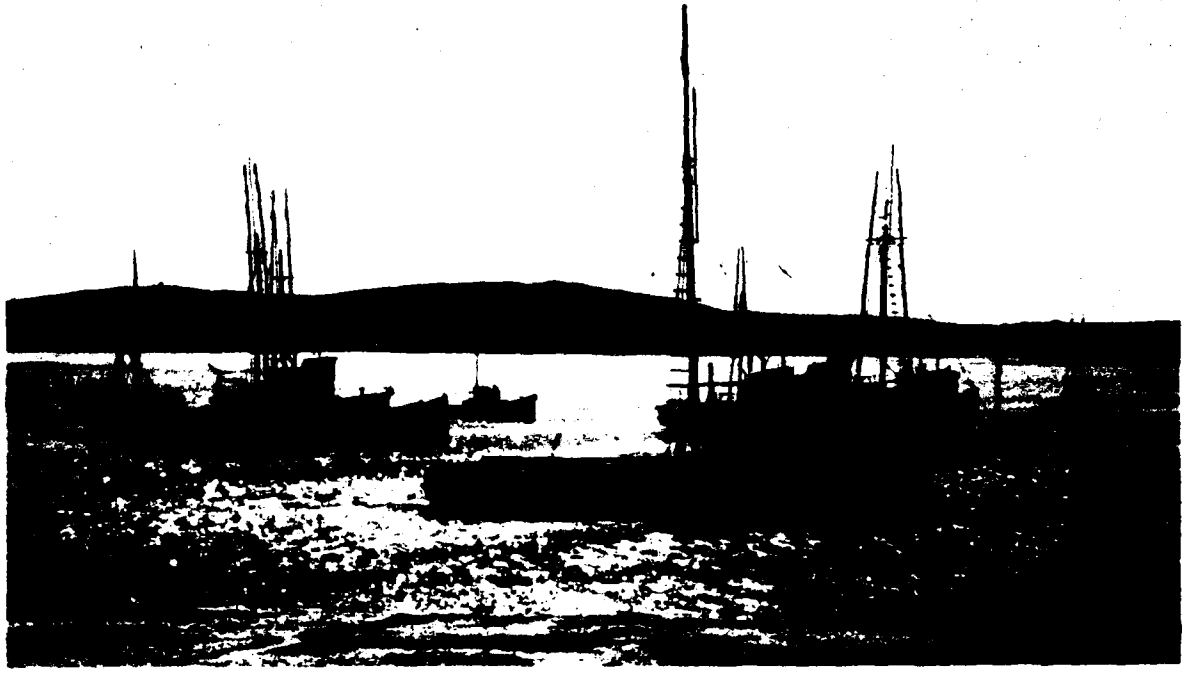
The area is characterized by varied topography that includes rugged mountains, rolling hills, numerous small stream valleys, large fertile valleys, extensive tidelands and marshlands and some of the most spectacular coastline in the United States. The climate of the area is characterized by warm, dry summers and mild, wet winters, and is marked by wide contrasts within short distances. For example, during the summer coastal areas are cool with frequent morning and evening fog, while the inland valleys a few miles to the east are quite warm. Average annual precipitation is about 32 inches per year consisting almost entirely of rain. Snowfall is a rare occurrence.

Streams in the area are subject to large variations in flow with most of them becoming dry in the summer. Major streams are the Russian, Napa and Guadalupe Rivers and Alameda and Coyote Creeks. The San Francisco Bay Area is water deficient, depending upon importation of municipal and industrial supplies from the Sierra Nevada.

Coastal streams serve as spawning and nursery grounds for numerous anadromous fish. About one-half million anadromous fish annually pass through San Francisco Bay to reach spawning areas in the Sacramento and San Joaquin Basins. The bay is also highly important to shrimp, clams, oysters and to many lesser-known yet vital links in the food chain. Although the area around San Francisco Bay is highly ur-

(photo courtesy of vtn.)





banized, the hills, agricultural areas and mountains provide habitat for a variety of wildlife. Two varieties of blacktail deer are common in the area and pheasant, quail and dove inhabit grass and woodland areas. A portion of the area is on the Pacific Flyway and large numbers of migrating waterfowl use its water areas and marshlands for feeding and resting.

San Francisco Bay, one of the major natural bays of the North American Continent, and one of the most important port complexes on the Pacific Coast, is considered as the "Gateway to the Orient." The bay, about 42 miles long and from 5 to 13 miles wide is connected to the Pacific Ocean by a narrow water passage known as the "Golden Gate."

The San Francisco Bay Area ranks second in population in California with its 1970 population of 4.6 million expected to increase to about 6.4 million by the year 2000. The economy of the area is dominated by highly diversified industrial, manufacturing and commercial activities. The key to the Bay Area's industrial development and high level of economic activity has been its geographical setting coupled with excellent air, surface and water transportation facilities.

Waterborne commerce of the area accounts for about 46 percent of the total waterborne commerce of California. The principal commercial ports are San Francisco Harbor, Oakland Harbor, Richmond Harbor, Redwood City Harbor and terminal and harbor facilities in San Pablo Bay, Mare Island Strait, Carquinez Strait and Suisun Bay.

Floods in the area result from intense rainstorms, generally preceded by prolonged rainfall that has saturated the ground. Peak flows are usually of short duration. Historically, major flood problems have occurred in urban areas located in the relatively flat, wide valleys near the mouths of rivers. However, the frequency of flooding on the Russian River, particularly near Guerneville, is among the highest in the State. The most severe floods known in the area were those that occurred in December 1955 and December 1964. Four people lost their lives during these floods. About 90,000 acres were inundated during the 1955 flood and damages totaled nearly $23 million. The Russian River Basin sustained unprecedented damage during the 1964 flood, which accounted for virtually all of the reported damage in the San Francisco Bay Area for that year (about $17 million).

san francisco bay area

About 130 miles of shoreline are actively eroding. This condition is presently so severe along 12 miles of coastline in San Francisco and northern San Mateo County that urban areas are threatened.

Other water-related problems in the area are associated with San Francisco Bay itself and the surrounding metropolitan complex. These principally comprise pollution, waste disposal and silting. The waste disposal problem is complex and will become more so as population and industrial development increase and existing treatment facilities become overburdened. The bay has been neglected as a recreational resource; only a few miles of its shoreline are included in waterside parks.

navigation projects

Prefatory Note[1]

San Francisco Bay, the heart of the San Francisco Bay Area and one of the great natural harbors of the world, was discovered not from the sea, but from the land. Juan Rodriguez Cabrillo and Bartolome Ferrelo had sailed along the entire California Coast in two tiny ships in 1542-43, but missed the entrance to San Francisco Bay. They visited (probably discovered) the Farallon Islands. In 1579, Sir Francis Drake landed on the Farallons for a supply of seal meat, birds and eggs, and anchored to recondition his ship in a "convenient and fit harborough" on the mainland on 28 June. He remained at this anchorage until 3 August, but no conclusive evidence shows whether he was in Drakes Bay, Bodega Bay or San Francisco Bay. Drake explored inland from his anchorage, but nothing recorded shows he saw the bay, possibly because

> "we [were] continually visited with like nipping colds as we had felt before; . . . neither could we at any time in whole fourteene dayes together, find the aire so cleare as to be able to take the height of sunne or starre."[2]

In 1595, Sebastian Rodriguez Cermeño landed at Drakes Bay and named it *Bahia de San Francisco*, which caused much confusion among historians for many years.

In 1602-03, Sebastian Vizcaino retraced the route of Cabrillo's voyage of 60 years earlier. He entered nearly all the sheltered anchorages along the coast, including Monterey Bay, but for some unknown reason missed the entrance to San Francisco Bay. About 160 years later, the Spanish became seriously concerned with possible English penetration to the Pacific and Russian progress south from Alaska. Four Spanish colonizing expeditions, two by land and two by sea, were sent to Alta California under the overall command of Don Gaspar de Portola. Proceeding from a settlement at San Diego and searching for Monterey Bay, Portola's element of the colonizing expeditions reached the vicinity of Point San Pedro. It had reached Monterey Bay on 7 October 1769, but Portola did not believe it to be the anchorage seen by Vizcaino in 1602 and so continued to the north. At a camp in Pedro Valley, Portola commissioned Sgt. Jose de Ortega, expedition scout and pathfinder, to explore north as far as Point Reyes, which, with the Farallon Islands and the white cliffs of the bay they knew as the *Puerto de San Francisco*, had been seen from the summit of the Montara Mountains. On 1 November, Ortega reached the channel of the Golden Gate. It barred the way to his objective and he turned to the east along the south shore of the channel. The party climbed *La Loma Alta* (Telegraph Hill) and from that point saw the whole expanse of the bay, its islands and the *Contra Costa* hills beyond. Ortega returned to Portola's camp and reported his observations. Neither recognized the significance of the discovery and the expedition, now considered to be a failure, began its return to San Diego on 11 November. The Spanish called the entrance to the newly discovered bay *La Boca del Puerto de San Francisco*, but an American, John Charles Fremont, gave it its present name.

Juan Manuel de Ayala, commander of the ship *San Carlos*, and Jose Canizares, his subordinate, were the first to enter San Francisco Bay. The *San Carlos* had sailed with a fleet sent from Mexico in 1775 to explore the bay. Ayala's mission was to find whether the entrance was navigable, and whether the bay contained suitable anchorages. He was also to explore in the interest of Spain the estuaries of the bay and determine whether a strait connected Drakes Bay and San Francisco Bay. On 4 August, the entrance to the bay was reached and Canizares was sent ahead to find anchorage. However, the currents and tides of *La Boca Del Puerto de San Francisco* were too strong for the launch in which he was reconnoitering. Therefore, on the evening tide of 5 August, Ayala cautiously moved the *San Carlos* into the unknown strait. Taking frequent soundings, he proceeded to an anchorage off present-day Sausalito. Ayala moved from his original anchorage to a cove on *Isla de Nuestra Senora de los Angeles* (Angel Island) and ultimately remained in the bay for 44 days. He explored every arm and inlet (going as far east as the mouth of the San Joaquin River), made frequent soundings and prepared a map.

The signficance of San Francisco Bay in the economic development of the area, the State of California and the

[1]Principal source: Hoover, Rensch, and Rensch, *Historic Spots in California*, Third Edition.
[2]Op. cit., p. 174.

nation is now a matter of history and need not be reiterated here. However, it should be noted that San Francisco Harbor has been a major contributor to that development, and that its improvement by the Corps of Engineers began with a project adopted by Congress in 1868 for removal of Blossom Rock as an obstruction to navigation. Blossom Rock was 5 feet underwater about ¾ mile offshore and midway between Alcatraz and Yerba Buena Islands. It was "in the track of vessels approaching the city from the ocean, or in going to sea, and is directly in the way of vessels running to and from the Sacramento and San Joaquin Rivers."[1] Removal of the rock to a depth of 24 feet below low water was completed in 1870 at a cost of about $75,000. The work marked the beginning of Corps of Engineers civil works activities in Northern California.

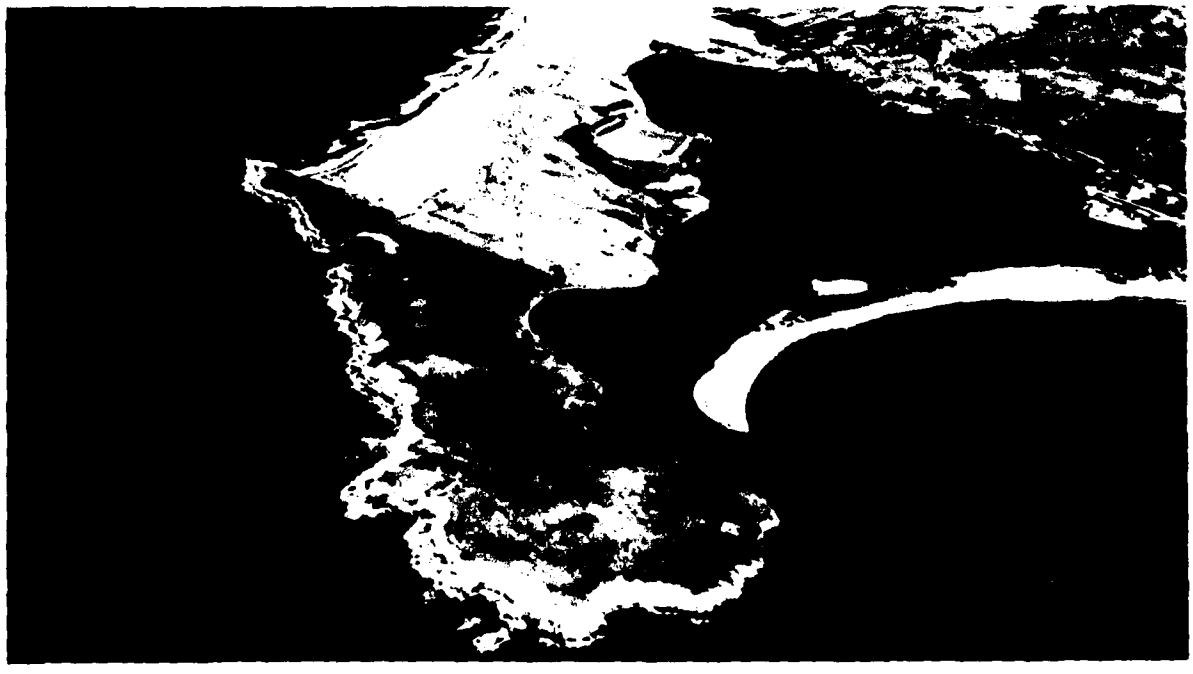
Bodega Harbor (San Francisco District)
Bodega Harbor is a triangular shaped coastal lagoon situated at the northern end of Bodega Bay, about 55 miles north of San Francisco. The harbor consists of a bulkhead to retain a sand spit, two jetties, entrance and navigation channels and 3 turning basins. Controlling depth of the harbor is 12 feet. Construction of a 4,500 foot earth mole and the Doran Beach Channel have been authorized but not yet built.

The total Federal cost of completed work was $1 million. Estimated Federal cost of the earth mole and Doran Beach Channel, authorized in 1965, is $2.2 million. The cost of meeting requirements of local cooperation for completed work amounted to $52,000. Local interests also contributed $2,000 toward rehabilitation, completed in 1961. The estimated cost of local cooperation for the authorized future modifications is $1.4 million.

Bodega Harbor is the only improved harbor in the 140-mile reach between San Francisco Bay and Noyo Harbor, and serves as an important harbor of refuge and as the home port for a small commercial fishing fleet. Commerce in the harbor in 1975 amounted to about 2,700 tons of fresh fish and shellfish.

Half Moon Bay Harbor (San Francisco District)
Half Moon Bay is located on the coast about 15 miles south of San Francisco. The project consists of two breakwaters that form a protected harbor for commercial fishing vessels and recreational craft. It was authorized by the 1948 River and Harbor Act and completed in 1961. As a remedial measure to alleviate surge, construction of a 1,050 foot extension of the west breakwater was completed in 1967. The minimum

bodega harbor provides a refuge for small craft north of san francisco.



[1]Report of the Chief of Engineers, 25 October 1869, p. 487.

depth of the 245 acre harbor is 6 feet.

Total Federal cost of the project was $6.7 million for new work and maintenance. The cost of meeting requirements for local cooperation was about $1 million.

The waterborne commerce of Half Moon Bay Harbor, which amounted to about 355 tons in 1975, consists entirely of fresh fish and shellfish. The town of Princeton at the northern end of the bay is the center of commercial fishing and the fish processing industry. The project has expanded harbor usage by commercial and recreation craft and stimulated industrial and recreational activities in the tributary area. It provides a needed harbor of refuge during storm periods.

Napa River (San Francisco District)
The Napa River rises on the southern slope of Mount St. Helena in Napa County and flows into Mare Island Strait in the vicinity of Vallejo. The first improvement of the navigable reach of the river, below the town of Napa, was authorized by the 1888 River and Harbor Act. Subsequent authorizations provided for further improvements. The project includes the 69,000 foot Mare Island Strait, the 17,000 foot Asylum Slough and a turning basin. The controlling depth of the project is 15 feet.

The project was completed in 1950 and is being maintained by the Corps of Engineers. Total Federal cost for the project was $1 million. Local interests provided lands, rights-of-way, easements, disposal areas and impounding and drainage work for channel maintenance. Construction of authorized dikes and revetments has been placed in an inactive status. Estimated cost of the uncompleted work is $146,000.

Commerce on the Napa River consists principally of sand, gravel, crushed rock, silt and fabricated metal products. This commerce amounted to about 230,000 tons in 1975 and averaged about 187,000 tons annually during the 1966-1975 period.

Oakland Harbor (San Francisco District)
Oakland Harbor is a major port located on the east side of the San Francisco Bay opposite the Golden Gate. It consists of the Outer Harbor and the Inner Harbor. The Outer Harbor has a 9,000 foot main entrance channel and an 8,000 foot channel and turning basin. Controlling depths are 35 feet. The Inner Harbor, with the main commercial waterfront, consists of a 37,000 foot entrance channel and turning basin, inner channels, a tidal canal and two jetties. Controlling depths vary from 18 to 30 feet.

All completed navigation improvements are being maintained by the Corps of Engineers. The 1962 River and Harbor Act authorized deepening the 30-foot inner harbor channel to 35 feet and deepening the lower 1,300 feet of the north channel in Brooklyn Basin from 25 to 35 feet. Channel deepening, including Fortman Basin, was completed in 1975. Deepening the tidal canal above Park Street has been recommended for deauthorization.

The Federal cost of the project was $5.5 million. Expenditures of local interests in meeting requirements for cooperation are in excess of $11 million. The total estimated Federal cost of the 1962 modification is $7 million, with additional requirements of local cooperation estimated to be $1.8 million.

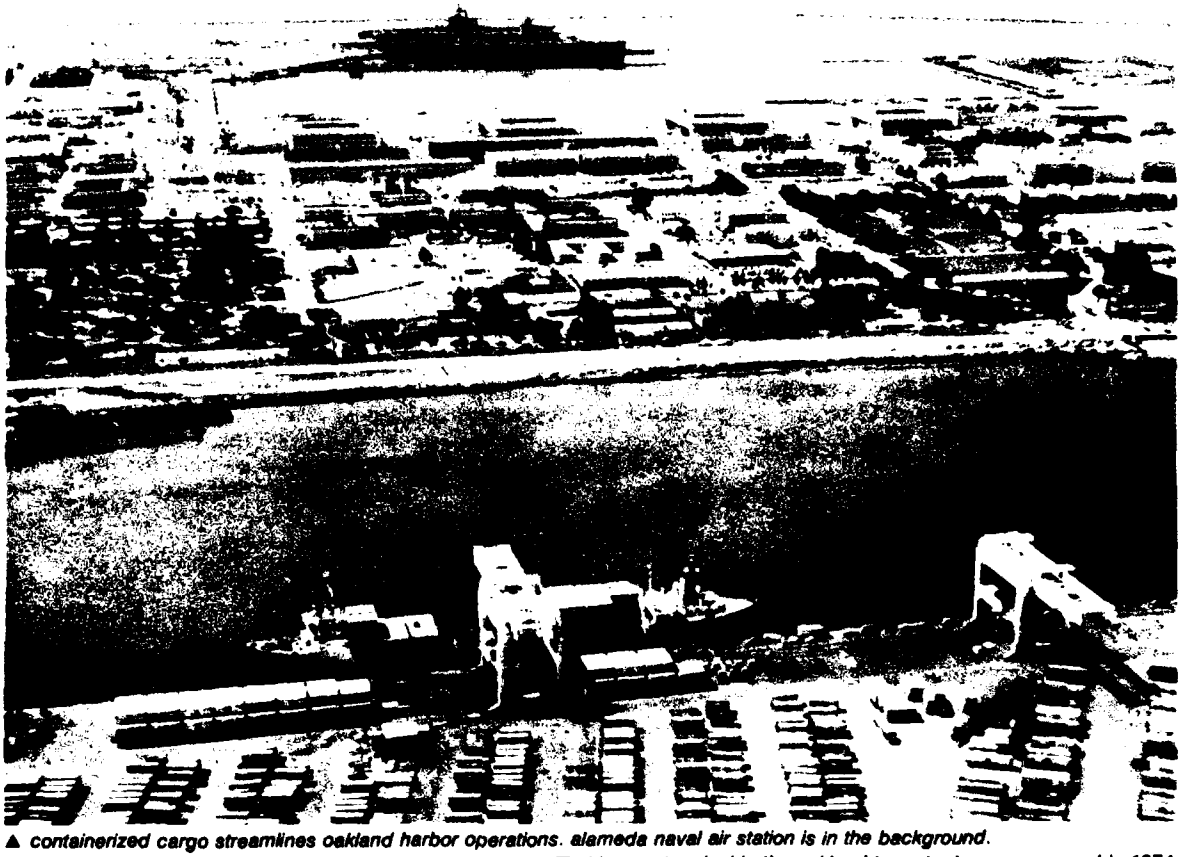
The improvement of Oakland Harbor by the Corps of Engineers has contributed to the growth of the harbor and its use for commercial shipping, military purposes and recreational boating. Several thousand acres of submerged and marsh lands were reclaimed for military and industrial use by the disposal of dredged material. Waterborne commerce in Oakland Harbor, exclusive of cargo carried in military vessels, amounted to about 6.2 million tons in 1975 and averaged about 5.8 million tons annually for the period of 1966-1975.

The 1962 River and Harbor Act authorized reconstruction of the existing Fruitvale Avenue bridge across the tidal canal. The project would provide a two-lane movable bridge adequate for the authorized 25-foot navigation project.

Subsequent inspections revealed that the rehabilitation of the existing bridge was not feasible. The bridge was redesigned and construction of a four lane bridge was authorized as an item of maintenance at an estimated cost of $4.3 million. Work was completed in 1973. Reconstruction of the old bridge has been recommended for inactive classification.

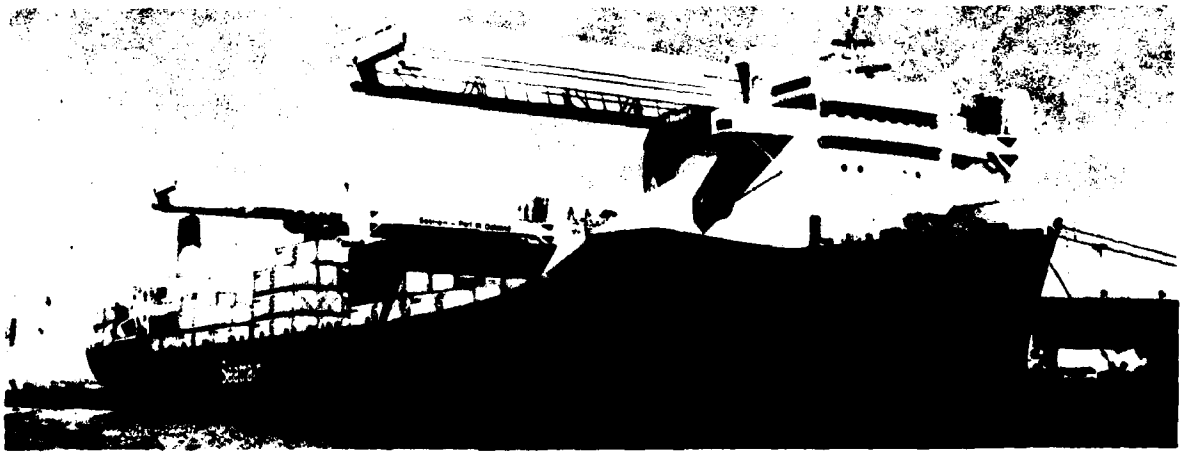
A 1972 Congressional resolution authorized a study of the Oakland Outer Harbor. The resolution requested recommendations for the most effective, efficient and economic means of developing the Oakland Outer Harbor to serve deep draft shipping needs, with identification of the depth and extent of dredging required, and the extent of Federal interest.

Public meetings were held in 1975 and 1976 with various alternatives being presented to the public. A feasibility report was prepared in 1976 recommending deepening the existing channel to a depth of 43 feet. The total first cost is estimated to be $25.8 million. This



▲ *containerized cargo streamlines oakland harbor operations. alameda naval air station is in the background.*

▼ *this new terminal in the oakland inner harbor was opened in 1974.*



san francisco bay area

study has been combined with investigations of Redwood City and Richmond Harbors under the special in-depth study of the San Francisco Bay Area.

Petaluma River (San Francisco District)
Petaluma River flows through the City of Petaluma and empties into San Pablo Bay, an arm of San Francisco Bay, about 20 miles north of the Golden Gate. The tributary area is famous for its poultry and egg production.

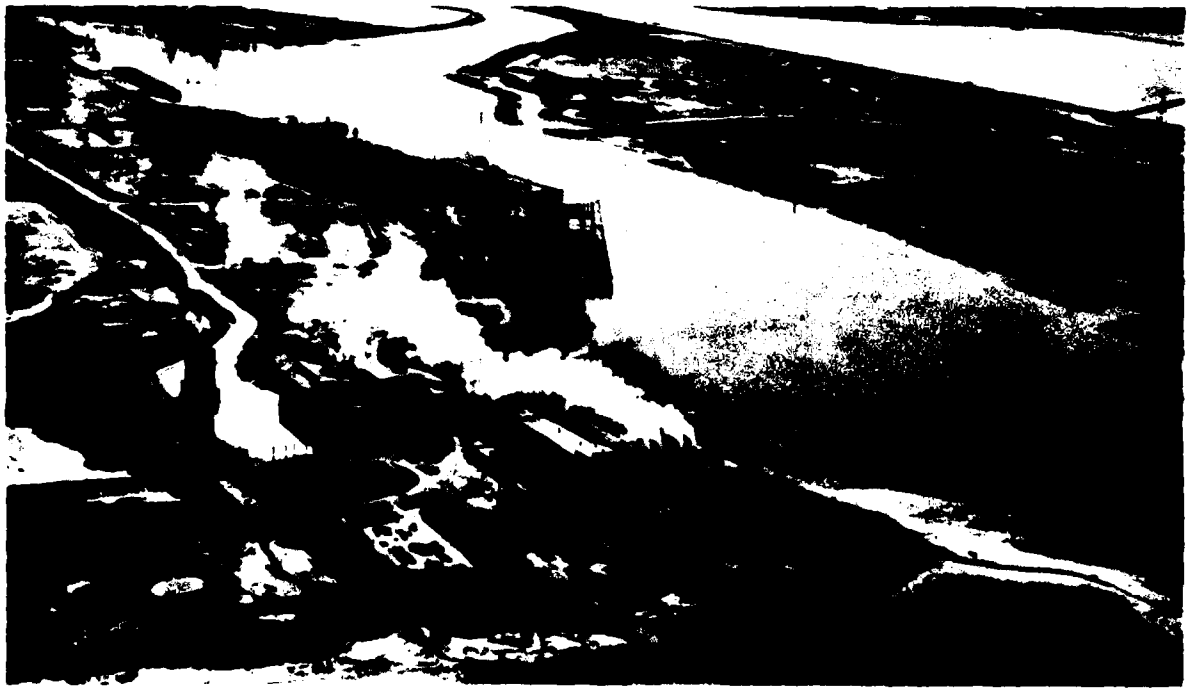
Improvement of Petaluma River by the Corps of Engineers was first authorized by the 1880 River and Harbor Act. Subsequent improvements were authorized by the River and Harbor Acts of 1892, 1918, 1925 and 1930. The project consists of a 4.7 mile channel *across flats in San Pablo Bay, a turning* basin and 2 river channels totaling about 15 miles in length. Controlling depths range from 4 feet to 8 feet.

The project was completed in 1933 and is being maintained by the Corps of Engineers. Total Federal cost was $300,000. The cost of meeting requirements of local cooperation for construction of the project amounted to $200,000.

Commerce on the waterway consists of sand, gravel, crushed aggregate, oyster shells and miscellaneous non-metallic mineral products. Cargo handled in 1975 amounted to about 9000 tons and averaged about 186,000 tons annually during the period 1966-1975.

Redwood City Harbor (San Francisco District)
Redwood City Harbor is located about 20 miles south of San Francisco on Redwood Creek, a tributary to San Francisco Bay. Corps of Engineers work in this harbor provided for improvements on Redwood Creek that consist of an entrance channel, 2 turning basins, a connecting channel, inner channel and the San Bruno Shoal Channel. Controlling depth of the harbor is 30 feet. The project was completed in 1965 and is being maintained by the Corps of Engineers.

redwood city harbor handles cargoes of lumber, salt and petroleum products.



Total Federal cost of the project was $1.7 million. The cost of meeting requirements for local cooperation of the project amounted to $200,000. At the time of project completion, the Port of Redwood City had spent more than $1.2 million for additions and improvements to the existing municipally owned and operated shore facilities. In 1951, the Leslie Salt Company opened a multi-million dollar salt production, storage and bulk shiploading facility at the upper limit of Turning Basin No. 2. The bulk loading facilities are available for public use through contractual arrangements with the Port of Redwood City.

Commerce in the harbor amounted to about 429,000 tons in 1975 and averaged 1.2 million tons annually during the period 1966-1975. Major items handled are salt, building cement, petroleum products and limestone.

An investigation of the project was authorized by Congressional resolution in 1965. Its purpose is to study any increased harbor usage and resulting environmental effects that would result from deepening the present channel to 37 feet in order to allow fully loaded modern cargo vessels to enter the harbor at all tidal stages. This study is described under the San Francisco Bay Area (In Depth) Study (see page 65).

Richmond Harbor (San Francisco District)
Richmond Harbor is located on the east side of San Francisco Bay about 10 miles northwest of Oakland. The Department of the Navy maintains a fuel depot at Point Molate. There are also extensive petroleum handling facilities in the area that are commercially owned.

The existing project provides a 4,000 foot channel adjacent to South Hampton Shoal from deep water in San Francisco Bay to the outer harbor; an inner harbor entrance channel and turning basin at Point Richmond; a channel and turning basin at Point Potrero; the Santa Fe Channel and turning basin; the San Pablo Channel; and a 10,000 foot training wall. Controlling depths of the harbor vary from 20 feet to 35 feet. Deepening of the maneuvering area at Richmond Long Wharf to a maximum of 45 feet and dredging the West Richmond Channel to 45 feet for about 2.5 miles through the west navigation opening of the Richmond-San Rafael Bridge are authorized.

richmond-san rafael bridge connects the richmond harbor area with marin county. (photo courtesy of vtn)

san francisco bay area

facilities for handling petroleum products are dominant in richmond harbor.

The project was completed by the Corps of Engineers in 1957 with the exception of the authorized harbor and channel deepening, which is currently unscheduled. Federal cost of the project was $3 million. Local costs for completed work amounted to $4 million. Rehabilitation of the Richmond Harbor Training Wall was accomplished in 1966 at a total Federal cost of $165,000. The estimated Federal cost for the West Richmond Channel and maneuvering area is $11.5 million.

Waterborne commerce in Richmond Harbor consists primarily of petroleum products, limestone, quarry products, aluminum ores and oil seeds. Commodities totaled 18.3 million tons in 1975 and averaged 15.5 million tons per year during the 1966-1975 period.

A study of the Richmond Harbor has been included under the special in-depth study of the San Francisco Bay Area (see page 65).

San Francisco Bay to Stockton (John F. Baldwin and Stockton Ship Channels) (San Francisco and Sacramento Districts)
The 1965 River and Harbor Act authorized improvement of navigation channels extending from the San Francisco Bay entrance to the Port of Stockton through San Francisco, Marin, Contra Costa, Solano, Sacramento and San Joaquin Counties. The project, consisting of improving navigation channels, constructing certain new navigation facilities and constructing associated recreational facilities, provides for the modification of 5 completed navigation projects. The authorized improvements in the San Francisco Bay Area are:

a. Modification of the existing San Francisco Harbor Project by increasing the depth of the main ship channel across San Francisco Bar from 50 feet to 55 feet.

b. Modifying the existing Richmond Harbor Project by deepening the West Richmond Channel through the west navigation opening of the Richmond-San Rafael Bridge from 35 feet to 45 feet, and by enlarging and deepening the present approach area to Richmond Long Wharf to provide a maneuvering area 45 feet deep, 600 to 2,800 feet wide and 8,400 feet long.

c. Modifying the existing San Pablo Bay and Mare Island Strait Project by deepening and lengthening Pinole Shoal Channel to 45 feet deep and about 11 miles long, and by dredging a 45 foot maneuvering area adjacent to Oleum Pier.

d. Modifying the existing Suisun Bay Channel Project by deepening and widening existing project channels to depths and widths presently under study, and possibly providing new facilities such as maneuvering areas and turning basins in the existing project reach of Suisun Bay.

The fifth project affected is located in the Delta-Central Sierra Area and is discussed on page 173.

Total first cost of the project is estimated at $139.0 million of which $108.0 million would be the Federal cost of new work (including $830,000 for navigation aids to be provided by the U.S. Coast Guard) and $31.0 million would be the non-Federal cost of meeting the requirements of local cooperation for construction of the project. In addition, local interests must provide,

the corps' hopper dredge "biddle" steams back towards the golden gate after disposing of dredge spoil at sea.

operate and maintain adequate terminal facilities and operate and maintain the public recreation areas.

Primary benefits resulting from the authorized improvements would be savings in transportation costs, increased safety and increased commerce.

Dredging of the main ship channel across San Francisco Bar started in June 1971 and was completed in February 1974. Bank protection work between Venice Island and Stockton was initiated in December 1971 and completed in June 1972. Further construction was deferred as a result of the passage of the National Environmental Policy Act and the need for a complete reassessment of the environmental impact of the project.

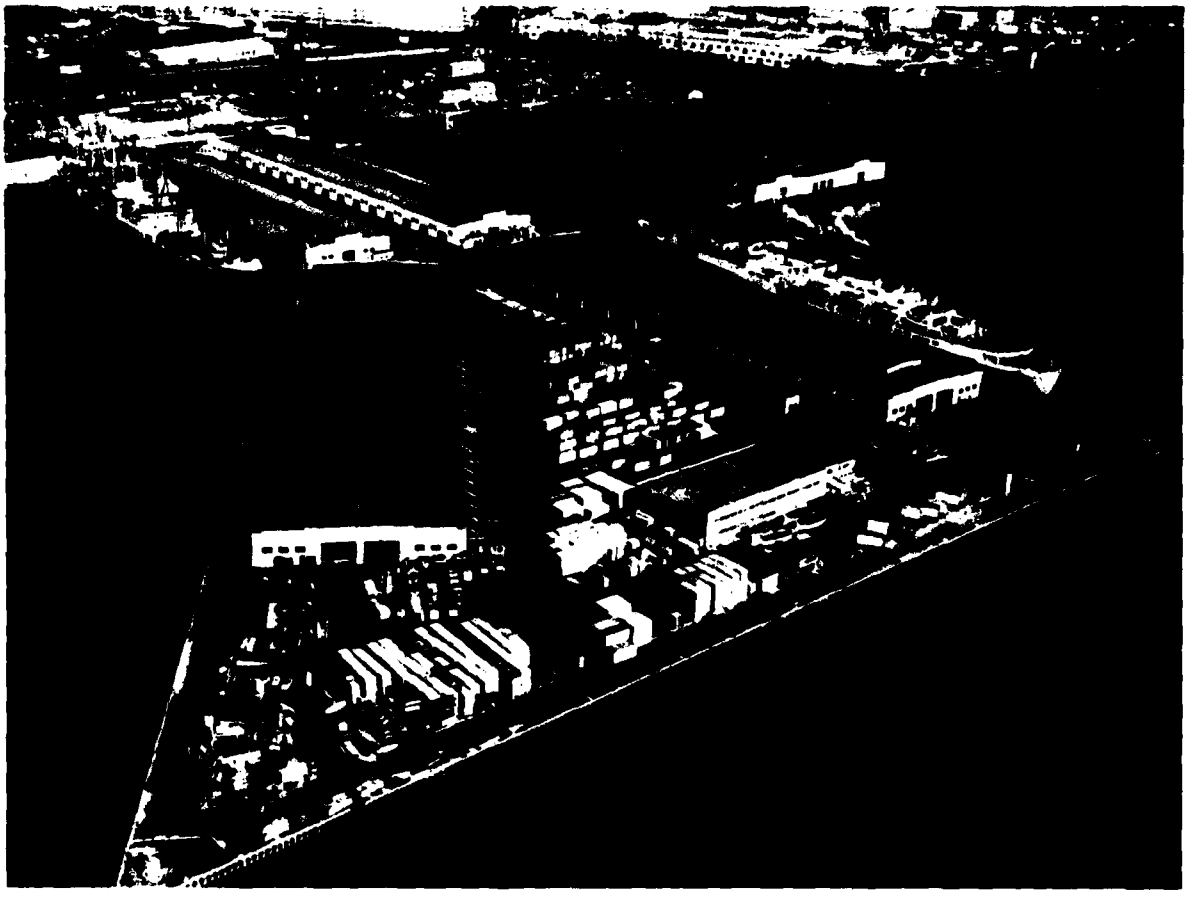
san francisco bay area

San Francisco Harbor (San Francisco District)
The San Francisco Harbor Project extends from the Pacific Ocean offshore approach channel (through San Francisco Bar) to the San Francisco Airport, south of San Francisco. Improvement of this harbor has been an almost continuous operation since 1869 when work authorized by the 1868 River and Harbor Act was begun.

The existing harbor was developed by the Corps of Engineers. The 16,000 foot San Francisco Bar Channel was dredged; Presidio, Black Point, Point Knox and Alcatraz Shoals were removed to depths of 35 to 40 feet; large rocks in navigation routes were removed; and channels, approaches and turning basins were developed. This work was completed in 1959. Controlling depths of the harbor range from 35 feet to 50 feet. The San Francisco Bar Channel has been deepened to 55 feet.

The total Federal cost of the project was $2.7 million. Local interests complied with all requirements for local cooperation, including a cash contribution of $135,000. The San Francisco Bar Project is being maintained by the Corps of Engineers. The action of waves, tidal currents and littoral sand movement offshore from the Golden Gate continually build up the San Francisco Bar, and dredging the channel across the bar is a con-

some of the extensive pier facilities at san francisco harbor.



the corps of engineers designed and operates the "coyote" to remove floating debris in san francisco bay.

tinuing maintenance operation performed with a hopper dredge. The estimated Federal cost of deepening San Francisco Bar Channel to 55 feet was $2 million.

In addition to the primary military and commercial use of the harbor, heavy recreational use is increasing. The accelerated interest in boating is reflected locally by the construction of new small boat facilities on tributary streams as well as in communities adjacent to the bay proper.

Waterborne commerce through San Francisco Harbor totaled 2.5 million tons in 1975, exclusive of military cargo. Average annual tonnage for 1966-1975 was 3.7 million tons, not including passenger or car ferries. In 1975, 55.5 million tons of waterborne commerce passed through the Golden Gate entrance to San Francisco Bay.

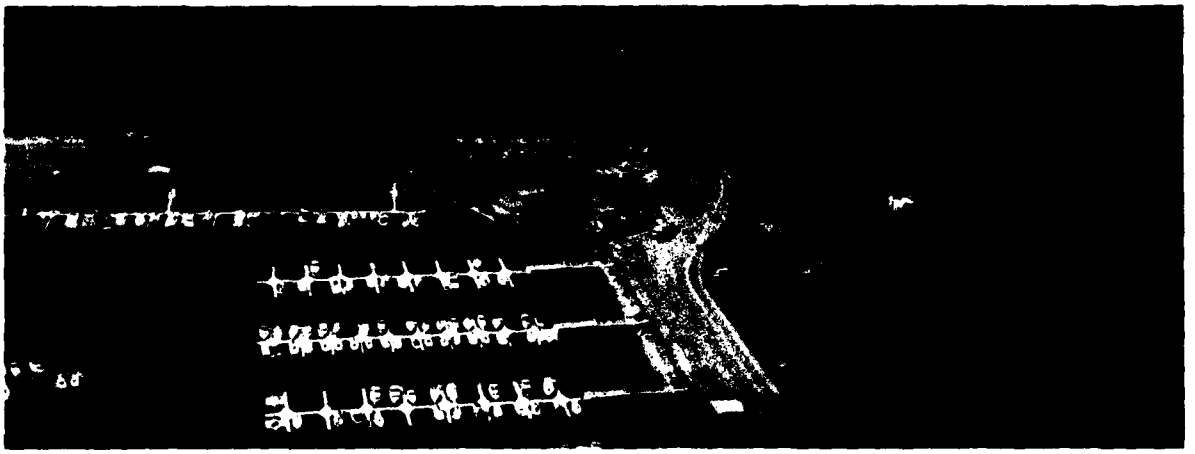
San Francisco Harbor and Bay, Collection and Removal of Drift (San Francisco District)
The 1950 River and Harbor Act authorized a project for the collection and removal of drift from San Francisco Harbor and Bay to reduce hazards to navigation and seaplane operations. Collection and removal of drift has been accomplished since 1950 as maintenance work under the San Francisco Harbor Project. No funds have been provided for the authorized project for construction of plant and equipment, and the project is currently classified as inactive.

The Corps of Engineers is presently using a tugboat and two U.S. Navy YSDs (with bows modified to contain collecting nets) to remove floating debris from San Francisco Bay and tributary waters. Disposal of debris is by land fill method.

The Corps also inspects all known dumping grounds and waterfront construction areas and investigates all reports of illegal disposal of materials to reduce the amount of floating debris. Backed by Federal law against polluting navigable waters, legal action has been brought against offenders. Recent urbanization of shoreline areas and abandonment of antiquated facilities have resulted in increased quantities of drift and debris entering the harbors and waterways of San Francisco Bay and its tributaries. These conditions have created a situation that detracts from the harbor environment and endangers the life, health and property of all waterway users as well as interfering with navigation.

A study of this project was authorized by Congressional resolution in 1971 and initiated in 1976. Its purpose is to evaluate methods of reducing maintenance activities, which have risen from an average of $230,000 annually for the 20-year period 1950-1969 to $740,000 during the last five years. A completion date for this study has not been established.

san francisco bay area



dredging operations at san leandro marina.

San Leandro Marina (Maintenance) (San Francisco District)
San Leandro Marina, a recreational complex, is located on the east side of San Francisco Bay immediately south of Oakland International Airport. Built in 1962 and presently maintained by the City of San Leandro, the marina consists of a small boat launching ramp, turning basin, breakwater entrance channel, berthing facilities and parking areas. Controlling depth is 8 feet.

This authorized project will consist of maintaining the main access channel and interior access channels of San Leandro Marina. Annual Federal maintenance cost is estimated at $76,000.

No Federal funds have yet been allocated to begin initial maintenance operations.

San Leandro Marina (Breakwater) (San Francisco District)
The mud island breakwater which provides protection to the marina (see above) is subject to constant erosion and in 1974 was overtopped by waves causing damage to boats and piers. Construction of a permanent breakwater 700 feet long and 12 feet high to protect the marina was completed in 1976.

San Pablo Bay and Mare Island Strait (San Francisco District)
San Pablo Bay is the main body of water forming the northerly arm of San Francisco Bay. Mare Island Strait, the estuary of the Napa River, provides access to Mare Island Naval Shipyard and commercial and recreational docking facilities in the City of Vallejo.

Dredging in San Pablo by the Corps of Engineers was first authorized by the 1902 River and Harbor Act. Further improvements were completed in 1943 at a Federal cost of $1.4 million. Due to the nature of the project, no local cooperation was required. The project consists of the 40,000 foot Pinole Shoal Channel, the 17,000 foot Mare Island Strait Channel and turning basin and a maneuvering area at Oleum Pier. Controlling depths range from 30 to 45 feet.

Enlargement of the Pinole Shoal Channel and deepening of the maneuvering area has been authorized as part of the San Francisco Bay to Stockton Project.

The channel in San Pablo Bay carries commerce en route to Mare Island Strait, Napa River, Carquinez Strait, Suisun Bay and ports on Sacramento and San Joaquin Rivers. In addition to its uses for commercial and military purposes, the waterway also is used extensively by recreational craft. Total commerce on this waterway in 1975, exclusive of cargo carried in military vessels, amounted to 28.6 million tons of which 4.3 million tons was destined for, or originated from, ports in San Pablo Bay and Mare Island Strait. The remainder was through traffic. Commerce carried on the waterway averaged 24.5 million tons annually for the period 1966-1975.

San Rafael Creek (San Francisco District)
San Rafael Creek is a small tidal stream that empties into the northwestern part of San Francisco Bay about 14 miles north of the Golden Gate. It is one of the most popular recreational craft harbors in the San Francisco Bay area, serving as home port for about 1,000 small vessels.

Improvement of San Rafael Creek, authorized by the 1919 River and Harbor Act, was completed in 1928. The project, maintained by the Corps of Engineers, consists of a 10,000 foot entrance channel, a 9,000 foot river channel and a turning basin. Controlling navigation depths are 6 and 8 feet. Total Federal cost was $30,000. Local cooperation for construction required an additional $40,000.

Suisun Bay Channel (San Francisco District)
Suisun Bay Channel is situated in Suisun Bay between Martinez and Pittsburg. The project was completed in 1934 at a Federal cost of $140,000. The project consists of a 13 mile main channel leading to the mouth of New York Slough and a 2 mile auxiliary channel. Controlling depths of the two channels are 30 feet and 20 feet, respectively. Maximum channel width is 300 feet.

Suisun Bay Channel is the interconnecting link between San Francisco Bay and the navigation channels of the Sacramento and San Joaquin Rivers. It permits transit of nearly all types of vessels, including most oceangoing ships. Biennial dredging is required to maintain project depths and widths. Commerce on this waterway was about 8.7 million tons in 1975.

This project will be modified by the San Francisco Bay to Stockton Project (see page 48). That project provides for modifying existing facilities by deepening and widening project channels, and possibly by providing new facilities such as maneuvering areas and turning basins in the project reach of Suisun Bay.

Suisun Channel (San Francisco District)
A navigation project for the improvement of Suisun Slough, a tidal inlet connecting the town of Suisun with Suisun Bay, was completed in 1947. The project consists of a turning basin at the town of Suisun and a dredge channel about 13 miles long, 125 to 200 feet wide and 8 feet deep. Federal construction cost was $200,000. Commerce handled on this waterway in 1975 was 19,350 tons and consisted entirely of petroleum products.

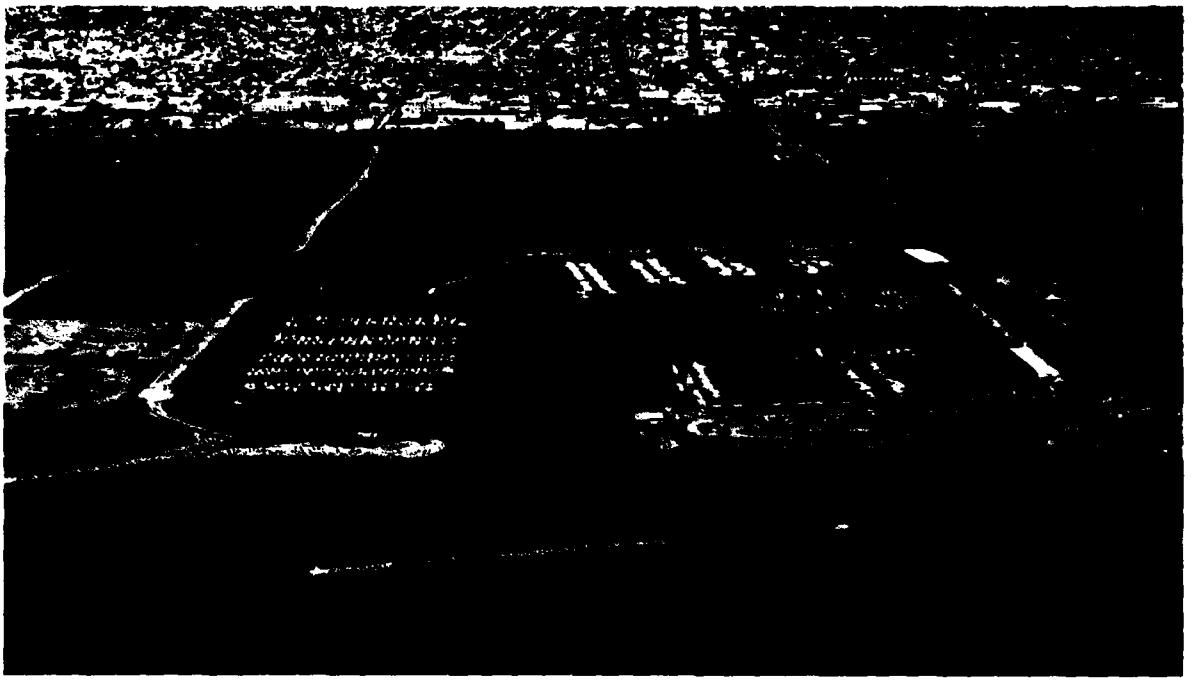
navigation studies

Coast of Northern California, Harbors for Light Draft Vessels (San Francisco District)
The authorized study of a chain of small harbors of refuge along the coast of Northern California (see page 26) includes the coastal areas of the San Francisco Bay Area. Study effort has been limited to preliminary environmental research.

Fisherman's Wharf (San Francisco District)
Fisherman's Wharf, in San Francisco Bay near the Golden Gate, contains an intensively used commercial and recreational fishing boat facility with one of the highest vessel densities for its size in the State.

fisherman's wharf

san francisco bay area



berkeley marina, with the city of berkeley in the background.

Fisherman's Wharf is a major tourist attraction with numerous restaurants and shops.

The existing berthing area is vulnerable to northern storms. Repeated wave and surge damage has been suffered by the fishing and pleasure craft docked there.

As authorized by House resolution, 15 May 1966, the study is considering varying methods to reduce the adverse effect of surge on the 150 boats presently using the area and to provide safe berthing for an additional 300 craft. The study was completed in 1976.

San Francisco Bay and Tributaries, Deep Water Ports (Dredging) (San Francisco District)
Disposal of dredged material is a major problem in San Francisco Bay and its tributaries. The California Regional Water Quality Control Board, San Francisco Bay Region, and the Environmental Protection Agency are developing requirements and criteria for disposal of dredged materials. It is anticipated that they either will require revision of present disposal methods (resulting in increased haul distances and additional hopper dredge time) or will require hopper dredges to have pumpout capabilities for landfill disposal.

The option for land disposal is rapidly becoming limited on lands immediately adjacent to San Francisco Bay owing to landfill restrictions. Consideration of long distance disposal measures has become necessary, which would significantly increase costs to Federal and local interests. The disposal problem is accentuated because it is usually a requirement that local interests furnish, free of cost to the United States, all lands, easements and rights-of-way for construction and subsequent maintenance of projects.

This study, authorized by Congress in 1970, but not started, will develop recommendations for the most effective, efficient and economic means of maintaining authorized navigation channels from the standpoint of environmental and ecological factors, completion of authorized projects, future requirements and current technological developments.

small navigation projects

Berkeley Harbor (San Francisco District)
This small navigation project, completed in 1965, consisted of Federal participation in improvement of the existing harbor by construction of a detached rubble-mound breakwater to protect the entrance channel.

Federal cost of the project was about $160,000, including aids to navigation provided by the U.S. Coast Guard. The cost of meeting requirements of local cooperation for construction was also $160,000.

Gas House Cove (East Harbor Facility, San Francisco Marina) (San Francisco District)
Gas House Cove is a small craft harbor located at the east end of San Francisco Marina on the northern waterfront of the City of San Francisco. Wind, waves and surge have created intolerable conditions for moored boats in the harbor area.

The wave problems at the East Harbor location were solved by a 117 foot concrete sheet pile breakwater connecting the two existing breakwaters. Construction was completed in 1975.

Suisun Point Channel (San Francisco District)
A small navigation project in Upper Carquinez Strait and Lower Suisun Bay was completed in 1964 by the Corps of Engineers to alleviate serious collision and grounding hazards to deep draft navigation. The project consisted of widening and deepening the existing Suisun Point and Bulls Head Channels in the vicinity of the Martinez-Benicia Bridges, a reach of about 2 miles, to provide adequate maneuvering room for deep draft vessels and to create a settling basin to reduce shoal intrusion into the main navigation channel.

Federal cost of the project was about $190,000. Local interests furnished lands, easements and rights-of-way necessary for the project and provided dredger spoil retention works.

Islais Creek (San Francisco District)
Islais Creek, a small tidal stream, enters San Francisco Bay from the west at the southern extremity of the Port of San Francisco. Islais Creek channel enters into the main South Bay Ship Channel. The existing navigation channel is inadequate based on current demands created by new facilities and usage. At the present time, the annual commerce in this channel is 720,000 tons with an anticipated increase to 1.3 million tons due to the operation of new terminal facilities.

This small navigation project will deepen the Islais Creek channel from 35 to 40 feet and extend the entrance channel and approach area to the new Army Street Terminal. Construction is under way.

multipurpose projects

Dry Creek (Warm Springs) Lake and Channel (San Francisco District)
A multipurpose project on Dry Creek was authorized by the 1962 Flood Control Act as the second phase of a basin plan of development. Dry Creek drains a rugged area of about 220 square miles in the southwestern portion of the Russian River Basin. The project will consist of a dam and lake on Dry Creek just below the mouth of Warm Springs Creek and downstream channel improvements. The lake will have a gross storage capacity of about 381,000 acre-feet for flood control, water supply and recreation.

Preconstruction planning, land acquisition, road relocations and rock embankment fill are in progress. The relocation of Unit No. 1 of the Stewart Point-Skaggs Springs Road and construction of an overlook road and parking area were completed in 1968. Cemetery relocations were completed the following year. The center span for the Warm Springs Bridge was placed on 8 September 1972. This 470 foot section of deck truss span, which totals 1,600 feet in length, was raised in a single lift of 900 tons.

The Federal first cost of the project is estimated at $206 million. Local interests will provide lands required for the downstream channel improvement works at an estimated cost of $75,000 and will maintain the channel improvements after completion. Under provisions of the 1958 Water Supply Act, the Sonoma County Water Agency signed a contract in December 1964 obtaining perpetual rights to 132,000 acre-feet of water supply storage space in the lake. This was the first contract of its kind to be negotiated with the Corps of Engineers in California. Local interests are required to reimburse the Federal government for costs allocated to water supply storage, to be paid over a period not to exceed 50 years after use of this storage is initiated. This reimbursement is estimated at $56.7 million, exclusive of interest.

Along the lower reaches of the river, the project will provide flood protection to about 20,500 acres of land used for agricultural and recreational purposes, including some 15 resort communities and numerous summer and permanent homes. Total average annual benefits are estimated at $9.1 million. If the project had been completed and in operation during the December 1964 flood, it would have prevented flood damages estimated at $3.6 million.

san francisco bay area

Knights Valley Lake (San Francisco District)
Knights Valley Lake in the Franz-Maacama Creek drainage area was authorized by the 1966 Flood Control Act as the third phase of a basin plan of development. The project, located in Sonoma County about 20 miles north of the City of Santa Rosa, was authorized to provide for three-stage construction of a multipurpose lake for flood control, water supply, recreation and water conveyance facilities.

Due to lack of local support, the project was recommended for de-authorization in 1976.

Lake Mendocino (Coyote Valley Dam) and Russian River Channel (San Francisco District)
The Russian River rises in the Coast Ranges in northwestern California and empties into the Pacific Ocean at Jenner, about 60 miles northwest of San Francisco. The river system drains an area of about 1,485 square miles in Sonoma, Mendocino and Lake Counties. The principal tributaries are East Fork Russian River and Dry, Maacama, Mark West and Santa Rosa Creeks.

Major flood damages have been sustained in the Russian River Basin on the average of every two years. A comprehensive flood control plan for the basin was prepared in 1948. To date, development of the Russian River Basin has been authorized in three phases comprising the following multipurpose storage projects and channel work:

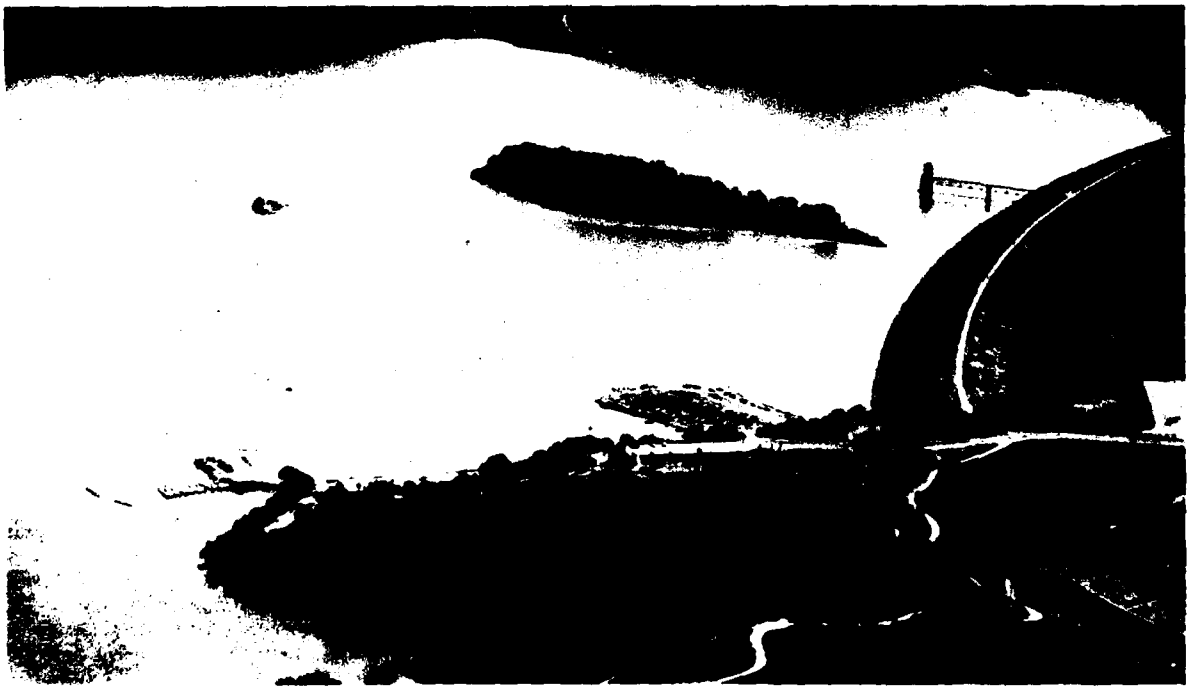
a. Lake Mendocino (Coyote Valley Dam) on the East Fork of the Russian River and bank stabilization work along the Russian River and its principal tributaries.

b. Dry Creek (Warm Springs) Lake and Channel.

c. Knights Valley Lake was recommended for deauthorization in 1976.

Coyote Valley Dam was completed in 1959. It is an earthfill structure with a crest length of 3,560 feet and a height of 160 feet. The total capacity of Lake Mendocino is 122,500 acre-feet. The dam and lake are operated and maintained by the Corps of Engineers.

coyote valley dam and lake mendocino



Bank stabilization works have been constructed in critical reaches along the Russian River in Mendocino and Sonoma Counties.

Total Federal cost for Coyote Valley Dam, bank stabilization works and recreational facilities was $15.4 million. The cost of meeting requirements of local cooperation amounted to $5.8 million. The bank stabilization works are being maintained by local interests. In addition, local interests have spent about $11 million for water distribution facilities and flood control improvements.

Lake Mendocino was opened for public recreational use in June 1959. The Corps of Engineers provided a boat launching ramp and parking area in the vicinity of the outlet works and a fire protection and access road in the northeast area. Local interests constructed a water supply system and additional recreational facilities. The Corps of Engineers administers the project area for public use and recreational development. The moderate climate of the region assures year-around recreational use of the reservoir area by both local and out-of-state visitors. Public use of the reservoir area has been extensive. Lake Mendocino was visited by more than 1.5 million people in 1975.

The project provides a high degree of flood protection in Ukiah and Hopland Valleys and a lesser degree of protection in the areas farther downstream. Since its completion in 1959, the project has prevented flood damages estimated at $9 million of which about $3 million in damages were prevented during the December 1964 flood and $1.7 million in fiscal year 1970.

The project also provides an urgently needed supplemental water supply for irrigation and for a rapidly growing urban and suburban area. Planned releases from the lake are made to augment streamflow during the dry summer months and to permit continuing use of downstream recreational facilities. Releases for water conservation purposes are determined by the Sonoma County Flood Control and Water Conservation District.

For several years an experimental nursery at the lake has produced native trees and shrubs cultivated as

lake mendocino offers good sailing.

san francisco bay area

channelization of alameda creek by the corps protects a rapidly growing area in alameda county.

seedlings and planted around the picnic areas and campsites to enhance the natural beauty and recreational pleasure of the site.

flood control projects

Alameda Creek (San Francisco District)
Alameda Creek, which drains an area of 695 square miles, rises in the Diablo Range in Santa Clara County, flows northerly and westerly for about 40 miles and empties into the southern end of San Francisco Bay near the town of Alvarado. Low-lying areas in the basin are subject to recurring flood damages of major proportions. The floods of 1955 and 1958 caused direct flood damages estimated at $5.3 million.

The project for flood control on Alameda Creek consists of landscaped channel improvements, a recreational trail system along Alameda Creek below the town of Niles and a multipurpose reservoir for flood control, water supply and recreation on Arroyo del Valle, a tributary stream. The reservoir has a total storage capacity of about 77,000 acre-feet. The Federal government is constructing the channel improvements and the State of California has constructed the reservoir as a part of the California Water Plan. The Federal government made a cash contribution of $5.1 million toward the first cost and maintenance and operations cost of the reservoir. The amount was based on the flood control benefits to be afforded by the reservoir and a monetary limitation imposed by the authorizing act.

The estimated Federal first cost of the channel improvement is $26.7 million. The estimated cost of meeting requirements of local cooperation for construction of channel improvements is $33.5 million.

Construction of the dam by the State of California was completed in 1968. Relocation of the Southern Pacific Railroad bridge and riprapped channel improvements from San Francisco Bay to Niles Canyon have also been completed. Seven additional erosion control structures upstream of Decoto Road and dredging in the vicinity of Newark Boulevard; construction of three control structures; the recreational trail system and landscaping were completed in 1976. The project is complete except for two year plant maintenance and the marsh development in the lower reaches of the project. Portions of the project were turned over to local interests for maintenance in 1976.

During the past decade, Alameda Creek Basin has experienced a population increase of about 150 percent. Land use in the flood plain is rapidly changing from agricultural to urban, and additional water supply is urgently needed. Pumping from the underground basin has exceeded the natural recharge rate for the past 30 years and has resulted in a lowering of the water table, posing a serious threat of saltwater intrusion. The multipurpose reservoir will provide flood control and water supply storage and will reduce peak flows through Livermore Valley, Niles Canyon and the coastal plain. The average annual flood control benefits to be derived from the project are estimated at $2.5 million. Flood damages prevented to date amount to about $1.9 million.

Alhambra Creek (San Francisco District)
Alhambra Creek drains a portion of Contra Costa County into Carquinez Strait at the City of Martinez about 25 miles northeast of San Francisco. The basin is subject to intensive winter storms and recurring flood damages, particularly in Martinez.

The authorized project consists of about 4 miles of continuous channel improvements and diversion works on Alhambra and Franklin Creeks in Martinez. The Federal first cost of the project is estimated at $17.0 million and the first cost for requirements of local cooperation is estimated at $1.9 million.

Based on anticipated increases in population and economic development, the project is designed to provide a high degree of flood protection to about 660 acres in Martinez. The maximum flood of record, which occurred in April 1958, inundated about 420 acres of residential and commercial property and caused flood damages estimated at $416,000.

The project has been recommended for reclassification as inactive due to lack of local support.

Corte Madera Creek (San Francisco District)
Corte Madera Creek drains an area of about 28 square miles in Marin County on the western side of San Francisco Bay. The creek basin is essentially a residential area (suburban to San Francisco). Two separate areas in the basin are subject to extensive flooding; the larger area extends through Ross Valley into the tidal marshlands and includes the communities of San Anselmo, Ross, Kentfield, Larkspur, Corte Madera and Greenbrae. The other area is within the City of Fairfax. Flooding has caused substantial annual property damages in the basin.

The project consists of channel improvements from San Francisco Bay to Sir Francis Drake Boulevard. Improvements and landscaping have been completed on Corte Madera Creek from Lagunitas Road to Sir Francis Drake Boulevard and on Tamalpais Creek. Completion of the final reach has been delayed to 1980 to study additional alternatives.

a portion of tamalpais creek before completion of the corte madera creek flood control project.

the same view after construction shows how esthetics were preserved by sculptured concrete lining, redwood fencing and retention of oak trees.

Federal first cost of the project is estimated at $15.5 million. The estimated cost to local interests of meeting requirements of local cooperation is $6.8 million. The project will be maintained by local interests and will provide a high degree of flood protection to residential, commercial and public property along Corte Madera Creek. Flood damages prevented to date amount to $325,000.

Fairfield Vicinity Streams (Sacramento District)
A flood control project for streams in the vicinity of Fairfield was authorized in 1970. Preconstruction planning was initiated in 1973 and is scheduled for completion in 1977.

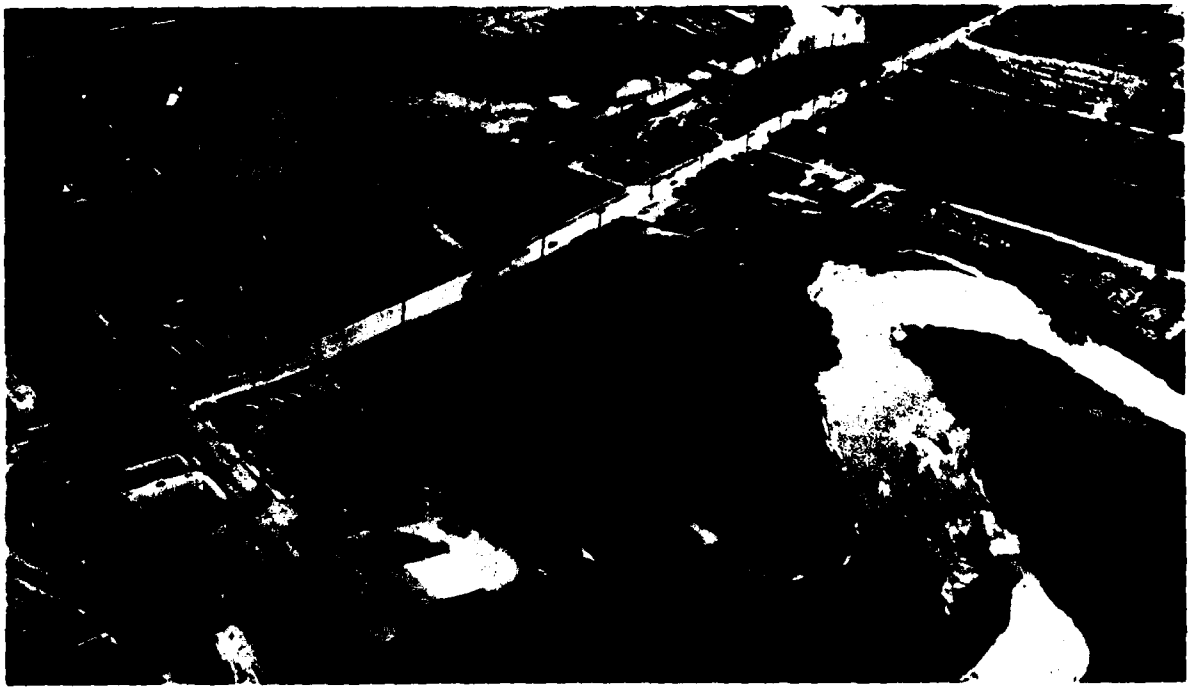
The plan provides for 8.7 miles of stream channel improvements including eight drop structures to reduce stream velocities on Ledgewood, Laurel and McCoy Creeks; construction of 3 miles of diversion channels (Pennsylvania Avenue Creek to Ledgewood Creek, Union Avenue Creek to Laurel Creek and Laurel Creek to McCoy Creek); new bridges and culverts; modification of an existing detention basin and development of project related recreation facilities, which will include access roads, parking areas, restroom facilities, hiking, and bicycle trails.

Trees, grass and shrubs will be planted to replace foliage removed during construction of the project. The project will provide a high degree of protection to about 3,900 acres of land in and adjacent to the City of Fairfield.

Costs for the project are to be shared by the Federal government and local interests according to a cost sharing plan evolving from the 1936 Flood Control Act. According to the plan, Federal first cost would be $9.1 million and non-Federal cost would be $6.5 million. Local interests must also reimburse the Federal government an estimated $200,000 for part of the project costs chargeable to recreation. Operation and maintenance of the completed works will be the responsibility of local interests.

Initiation of construction is subject to receipt of assurances of local cooperation in accordance with Section

the authorized napa river project would eliminate this oxbow, greatly improving the river's ability to convey floodwaters.



221, Flood Control Act of 1970 (Public Law 91-611).

Napa River Basin (San Francisco District)
Napa River rises in Napa County on the southern slope of Mount St. Helena. It flows southerly about 50 miles to discharge into Mare Island Strait in the vicinity of Vallejo. The drainage basin comprises 426 square miles and ranges from tidal marshes to mountainous terrain. Severe winter storms and flooding occur frequently. In the lower part of the river, flood conditions are aggravated by high tides and local runoff.

The authorized flood control project provides for channel enlargement and realignment, construction of levees, floodwalls and public boat launching facilities in an 11-mile reach downstream from Trancas Road in the City of Napa. The Federal first cost of the project is estimated at $38.6 million. The estimated cost to local interests of meeting requirements of local cooperation is $15.5 million.

The project will provide a high degree of flood protection to urbanized areas, particularly the City of Napa. Floods in 1955 (the largest known), 1963 and 1965 caused damages estimated at $1.2 million. Almost all these damages would have been prevented by the project. Under present conditions of development, floods of these magnitudes would cause damages in excess of $4.5 million.

The project was placed on the ballot by the Napa County Board of Supervisors. It was defeated by a narrow margin in the November 1976 elections. The City of Napa is presently examining the possibility of taking over as the project sponsor.

San Lorenzo Creek, Alameda County (San Francisco District)
San Lorenzo Creek flows through a highly developed residential area on the eastern side of San Francisco Bay about 15 miles southeast of San Francisco. The project consists of 1.4 miles of levees and a 3.9 mile rectangular concrete channel, which provide flood protection to the communities of San Lorenzo Village and Hayward.

Total Federal cost of the project was $5.2 million. The cost of meeting requirements of local cooperation amounted to $1 million. Local interests are maintaining the levees. Other levees constructed by local interests in the lower reach of the creek have been incorporated into the project on the basis of a cash equivalent value of $200,000, in lieu of providing a required cash contribution. Since its completion in 1962, the project has prevented flood damages estimated at over $6 million.

Sonoma Creek Basin (San Francisco District)
Sonoma Creek and its tributaries drain an area of about 154 square miles in Sonoma County and flow into San Pablo Bay, an arm of San Francisco Bay. The authorized project consists of channel improvements and appurtenant works on the lower 15 miles of the creek. The Federal first cost of the project is estimated at $18.6 million, and the local interest cost is estimated at $1.2 million.

Although the Sonoma Creek Basin is subject to recurring major flood damages, land use in the area is changing rapidly from agricultural to residential and industrial. Population of the basin has increased about 50 percent in the past decade and is expected to total about 155,000 by the year 2000.

The project is designed to provide a high degree of flood protection to 10,700 acres of urbanizing land. The maximum flood of record in December 1955 inundated about 6,300 acres of residential and agricultural land and caused damages in the project area of about $370,000.

Due to lack of local support, this project has been reclassified inactive.

Walnut Creek (San Francisco District)
The Walnut Creek Project provides for enlargement and straightening of the channels of Walnut Creek and lower San Ramon Creek, including levees and channel stabilization structures where required, levees and incidental work on Grayson and Pacheco Creeks and channel improvement work on Pine and Galindo Creeks.

Total cost of the project is estimated at $62.3 million, of which $46.2 million is to be Federal cost and $16.1 million local interest cost. Local interests will operate and maintain the project after its completion.

Construction was started in 1964 and is scheduled for completion in 1982. Work remaining includes two reaches on the main stem and on San Ramon Creek. Channel improvements on the remaining reaches are being studied. A by-pass plan, which would permit existing creeks to be left in their natural state is being investigated. Construction on Upper Pine and Lower Pine and Galindo Creeks must await the completion and approval of detailed design studies.

The project will provide a high degree of flood protection to about 6,670 acres in the flood plain at and below the City of Walnut Creek. If the project had been completed and in operation during the 1955-1956 and 1958

san francisco bay area

◀ *construction along walnut creek, september 1970.*

▼ *a completed section of the walnut creek project.*

floods, it would have prevented flood damages estimated at $4.5 million.

A study of the Walnut Creek Basin was authorized by Congressional resolution in 1963. Its general purpose is to determine whether the authorized project should be extended to provide flood control on tributary waterways. Such an extension might incorporate works already existing and proposed by the Soil Conservation Service, and existing and potential improvements on major and minor tributaries to Walnut Creek. As a result of urbanization, much of the basin is experiencing flood and drainage problems. Existing waterways are inadequate to carry floodflows. The Soil Conservation Service and the local flood control district have jointly provided a flood detention basin on Pine Creek along with general channel improvements, realignment and enlargement and bank revetment on other tributary streams.

The basin study was started in 1965. Evaluation of the study areas has been completed, with the exception of the Diablo area. No feasible projects have been identified to date.

Wildcat and San Pablo Creeks (San Francisco District)
Wildcat and San Pablo Creeks flow into San Pablo Bay, an arm of San Francisco Bay, at a point in Contra Costa County about 20 miles northeast of San Francisco.

Wildcat Creek drains approximately 11 square miles in the Berkeley Hills. San Pablo Creek originates near Orinda and drains approximately 42 square miles. The areas adjacent to both creeks have been subject to recurring inundation and erosion from floods, with the February 1968 flood causing damages estimated at $450,000. During the 1958 flood, 600 homes were damaged and 35 persons evacuated. Past floods have infiltrated the sewage system causing local pollution and danger to public health. The channels of the creeks are inadequate to pass floods of even relatively minor magnitude. Studies show that overbank flows occur an average of once every three years, especially along Wildcat Creek.

Light industry, nurseries and other commercial enterprises are continuing to develop in parts of the flood plain, even though the threat of flooding has retarded economic growth, particularly near North Richmond. The population of the basin was approximately 60,000 in 1970 and is expected to increase by 75 percent by the year 2000, thus increasing the exposure to flood damage.

The Feasibility Report was approved by Congress in June 1976 and Advanced Engineering and Design studies initiated in October 1976. Completion of the Phase I and Phase II General Design Memorandums is expected by December 1979.

The Federal first cost of the project is estimated at $9.1 million. The estimated cost to local interests of meeting requirements of local cooperation is $7.5 million.

urban study

Alameda Creek (Upper Basin) Urban Study (San Francisco District)
The Upper Alameda Creek study area encompasses the Livermore and San Ramon Valley areas. These two areas, which contain the cities of Livermore and Pleasanton and the communities of Dublin and San Ramon, were originally a shallow lake. Over many years, the lake was reclaimed by a series of drainage ditches following the many streams crossing the lake bed. The principal streams are the Arroyo Del Valley, Arroyo Mocho, Arroyo Los Positos, Tassajara Creek, San Ramon Creek, Chabot and Alamo Canals, Arroyo de la Laguna and Alameda Creek.

Land use in the Upper Basin has changed from predominantly agricultural to rapidly growing residential and urban uses, in non-uniform distributions. Population in the Upper Basin has increased from 20,400 in 1960 to 95,000 in 1976, a gain of about 365 percent. The present population and its associated activities have exceeded the capability of existing public facilities. This problem has focused attention on environmental concerns. The local planning agencies are presently formulating social and environmental goals based on public input and knowledge of available resources and needs for environmental preservation.

Study efforts during calendar year 1977 will focus on the stormwater runoff problem. The analysis will be conducted in two phases. Phase I, expected to be completed by October 1977, will be conducted in concert with the area-wide Section 208 program. This phase will emphasize near-term controls and nonstructural solutions to abate storm runoff pollution. The second phase of this study will consider long-term control measures in greater detail. Other major components of the study are flood control, water supply and quality, water-oriented recreation, and fish and wildlife enhancement.

san francisco bay area

flood control studies

Guadalupe River and Adjacent Streams (San Francisco District)
The Guadalupe River drains an area of 800 square miles in Santa Clara and Alameda Counties and flows into lower San Francisco Bay at a point 10 miles east of Palo Alto. Inadequate and decreasing channel capacities and subsidence of the valley floor in recent years have contributed to flooding, bank erosion and, in the lower reaches of the river, tidal inundation from the bay. The floods of 1955 and 1958 resulted in agricultural, commercial and residential damages exceeding $5.4 million. Major damage to urban property during both storms occurred in the town of Alviso, which was flooded to depths of 5 feet in 1955 and was inundated for 17 days during the 1958 flood. Losses from floods may be expected to increase, since the population of the basin increased from 244,000 in 1960 to 385,000 in 1976 and is expected to gain another 75 percent by the year 2000.

This investigation is oriented toward studying flood control improvements for that portion of the Guadalupe River included in the Department of Housing and Urban Development Model Cities Program for San Jose. Improvements along Silver Creek will also be studied.

A target date of 1979 has been set for completion of the study.

San Francisco Bay Shoreline (San Francisco District)
An investigation, authorized by Section 14201, the Water Resources Development Act of 1976, to study the flood and related problems of those lands lying below the plane of Mean Higher High Water along the San Francisco Bay Shoreline of San Mateo, Santa Clara, Alameda, Napa, Sonoma and Solano Counties to the confluence of the Sacramento and San Joaquin Rivers with a view toward determining the feasibility of and the Federal interest in providing protection against tidal and fluvial flooding. The investigation will evaluate the effects of any proposed improvements on wildlife preservation, agriculture, municipal and urban interests in coordination with Federal, State, regional and local agencies with particular reference to preservation of existing marshland in the San Francisco Bay region. This investigation has not yet been initiated.

Northern California Streams (San Francisco and Sacramento Districts)
Authorized by the Flood Control Act of 1962, this study includes all California streams in the north portion of the State which flow into the Pacific Ocean, including the Sacramento River and its tributaries. Information on activities in the North Coastal Basins and in the Sacramento Basin is on pages 19 and 141 respectively.

In the San Francisco Bay Area work on the study includes a flood control study of the Russian River Basin. A 1972 Congressional resolution directs the Corps of Engineers to investigate modifications of the Russian River to provide flood control consistent with water quality and protection and enhancement of the environment. The study includes evaluations of preserving free passage at the mouth of the river, summer and recreational-type dams, operation of existing structures on the river, preservation and enhancement of the fishery, sediment influx and transport, gravel mining in the flood plain, regulation of land use in the flood plain, water quality releases from Lake Mendocino and Lake Sonoma and effects of channel improvement and stabilization.

A target date of 1979 has been set for completion of this study.

Novato Creek and Tributaries (San Francisco District)
An investigation of flood and related problems in Marin County includes the area of Novato Creek and its tributaries. Floodflows on Novato Creek inundated 4,800 acres causing damages in excess of $190,000 during the December 1955 flood. The population of the stream basin is 46,000 and is expected to increase to more than 100,000 by the year 2000.

The investigation will examine possible channel realignment and levee and channel improvements. Completion of the study is scheduled for 1977.

small flood-control projects

Coyote Creek, Marin County (San Francisco District)
Flood control improvements on Coyote Creek were completed in 1965. This small flood-control project consists of about 7,500 feet of concrete-lined channel and trapezoidal section earth channel to protect the community of Tamalpais Valley, about 8 miles north of San Francisco.

Federal cost of the project was about $700,000, which was equally matched by local interests to provide total funding. The improvements are maintained by the local interests. During the January 1967 flood, the project prevented damages estimated at $40,000.

Green Valley Creek, Solano County (Sacramento District)
The Green Valley Creek Project was authorized as a small flood-control project and completed in 1962 at a total cost of $220,000, of which $140,000 was Federal funds. The project consists primarily of channel realignment and enlargement for 1.7 miles along lower Green Valley Creek and for 2.6 miles along the lower Dan Wilson Creek. These creeks drain an area of about 26 square miles lying to the north of Suisun Bay in Solano County. They flow generally southward into Suisun Bay via Cordelia Slough, which meanders for about 6 miles through a tidal marsh.

Lands within the basin are used principally for orchards, vineyards, grain and pasture. Flood problems in the area consist generally of two types: overflow and poor drainage due to inadequate channel capacity in the upper areas and tidal flooding in the lower areas.

Since its completion, the project has prevented damages estimated at about $200,000.

Pinole Creek, Contra Costa County (San Francisco District)
Construction of a small flood-control project to provide protection to the town of Pinole, a suburban residential community of about 5,000 persons, was completed in 1966. The project consists of about 1.5 miles of trapezoidal section earth channel with riprap-lined chutes to reduce high velocity flow and rectangular concrete sections under two bridges.

Total Federal cost of the project was about $860,000. The cost of meeting requirements of local cooperation was about $120,000. The improvements are maintained by the local interests.

Rheem Creek (San Francisco District)
A small flood-control project on Rheem Creek, Contra Costa County, was completed and transferred to local interests for maintenance in 1960. The project consists of about 1.5 miles of channel, of which about one-quarter mile is rectangular section concrete-lined channel, and the remainder is trapezoidal section earth channel. The project provides flood protection for the City of San Pablo, a community of about 20,000 located on the eastern side of San Francisco Bay.

Federal cost of the project was $400,000. The cost of meeting the requirements of local cooperation was about $190,000.

Rodeo Creek, Contra Costa County (San Francisco District)
A small flood-control project to protect the community of Rodeo, which is located in a narrow valley at the mouth of Rodeo Creek, was completed in 1966 and transferred to local interests for maintenance and operation. The project consists of about 1.1 miles of channel improvement, of which about 4,450 feet is trapezoidal section earth channel, riprapped as required, and about 1,450 feet is rectangular section concrete-lined channel.

Total Federal cost of the project was $990,000. The cost of meeting requirements of local cooperation was about $330,000

During the January 1967 flood, the project prevented damages estimated at $30,000.

San Leandro Creek (San Francisco District)
Construction of channel improvements in the lower reach of San Leandro Creek was completed in 1973. The creek forms part of the boundary between the cities of Oakland and San Leandro and drains a 48-square mile area into San Leandro Bay, an arm of San Francisco Bay. The project is located in the lower two miles of the creek and consists of improvements of about 1.3 miles of trapezoidal channel section and 0.5 miles of rectangular concrete section.

The Federal first cost of the project was $1 million and the non-Federal first cost $285,000. Local interests maintain the project.

The protected area includes residential, light industrial and agricultural land, in addition to a public school, major arterial highways, neighborhood streets and railroad spur tracks.

beach erosion control and shore protection study

Alameda Memorial State Beach (San Francisco District)
The East Bay Regional Park District has requested the investigation of beach erosion problems along Alameda Memorial State Beach. Studies will consider both the stabilization of shoreline to prevent further erosion and restoration of recreation beach areas, possibly by the extension of the existing marsh.

A detailed project report for this project is indefinite.

san francisco bay area

shore and hurricane protection

Shores of the City of Alameda (San Francisco District)
The study area fronts San Francisco Bay in the City of Alameda. It is approximately two miles in length. Part of the beach was created in 1959 with sand dredged from San Francisco Bay. Some reaches experienced severe erosion, up to 400 feet, during the period 1961 to 1967. The average erosion on the remaining areas has been about three feet per year.

Recreational beaches are very limited in San Francisco Bay and the loss of this beach area would severely impact such recreational activity. This survey is oriented towards beach erosion control and the enhancement of wildlife and recreation

special investigations

Coast of California, Protection Against Storm and Tidal Waves (Los Angeles District)
A special investigation of storm and tidal waves authorized by the 1965 Flood Control Act includes the ocean coasts of the San Francisco Bay Area.

Work on the study along the sea coast of the San Francisco Bay Area was placed in an inactive status in 1973.

San Francisco Bay Area (In-Depth Study) (San Francisco District)
A special in-depth investigation of the San Francisco Bay Area and all tributary deep water ports was authorized by Congressional resolution adopted 19 October 1967. Its purpose is to investigate the maximum contribution that San Francisco Bay and connecting inland ports can make to waterborne commerce of the surrounding region, the Pacific Coast and Western United States, the nation as a whole and the other nations bordering the Pacific Ocean. The investigation will involve all economic factors having an effect on the present and estimated future waterborne commerce in the Bay Area and its relationship to national and international economics as well as the regional economy. The work will entail an extensive program of research and detailed studies including the following items:

a. Relationship of waterborne commerce to other modes of transportation.

b. Trends in waterborne commerce operations reflecting technological improvements.

c. Economic analysis of present and estimated future national and international cargo shipments through the harbor complex, with particular reference to the use of supersize bulk-transport vessels and tankers.

d. Present and estimated future requirements for navigation facilities in the study area, and comparison with other national and international harbor complexes.

e. Guidelines for regional development to support optimum navigational operations.

f. Effects on the regional and national economy from new and expanded heavy industry resulting from improved navigation facilities and harbor operations.

g. Adequacy of the regional shipping capacity in defense mobilization.

h. Concepts for improvement in harbor and industrial operations and development through coordination and programming.

i. Feasibility and extent of Federal participation in expansion and improvement of facilities for waterborne commerce.

The study includes evaluation of deepening the Oakland Outer Harbor and the Redwood City Harbor to accommodate fully loaded cargo vessels at all tidal stages. It also considers modifying the Richmond Harbor to add a small craft marina, extending the inner harbor channel eastward by 6,000 to 10,000 feet, deepening the inner harbor channel to 40 or 45 feet, and extending the training wall by 6,000 to 10,000 feet.

The entire in-depth study is scheduled for completion in 1979. Completion of the Oakland Harbor portion of the study is scheduled for 1977, while the Richmond Harbor portion is scheduled for 1978. The Redwood City Harbor study is presently inactive.

San Francisco Bay and Sacramento-San Joaquin Delta Water Quality and Waste Disposal (San Francisco District)
Authorized by the 1965 Flood Control Act, this investigation covers the 12-county area encompassing the San Francisco, San Pablo and Suisun Bays and the Sacramento-San Joaquin Delta estuarine system, all of which are influenced by about 50,000 square miles of tributary drainage area. The south shorelines of the bays have intensive urban development. The north shores have urban centers, agricultural developments and extensive marshlands supporting the Pacific Flyway.

The delta area, about 60 miles east of San Francisco,

consists of about 500,000 acres of highly productive farmland situated in five counties. The delta is a low-lying tidal area largely reclaimed from swamp by levees. Dredge cuts divide the area into tracts locally known as islands. The urban areas of Sacramento and Stockton are located at the northeast and southeast corners of the delta area.

The purpose of the investigation is to determine the feasibility of, and the extent of, Federal interest in measures for waste disposal, water quality control and related factors in the study area. The study will examine the environmental, social and economic impacts of water quality and waste disposal management. It will give consideration to related proposals for flood control, navigation, salinity control, water supply, tidelands reclamation, transportation, recreation and resource development in San Francisco Bay and tributaries. The investigation will be formulated to accomplish comprehensive plans for management of waterborne wastes and overall improvement of water quality throughout the area. Study evaluations will include the following:

a. The effects and potential magnitude of saline intrusion into the water and lands of the delta, including analysis of means of preventing or minimizing such intrusion.

b. The problems of bottom sediments and disposing of dredge spoil, both for new construction and for maintenance of existing channels.

c. The capacity of the bay and delta to assimilate and cleanse themselves of waterborne wastes.

d. Analysis of a complete range of alternative methods of disposing of waterborne wastes, including reclamation and reuse where appropriate.

A hydraulic model testing program has been initiated to provide data on the effects of the proposed peripheral canal and the authorized San Francisco Bay to Stockton (John F. Baldwin) Deep Water Ship Channel

a scientist takes samples of water from the san francisco bay scale model. analysis for traces of dye help to predict pollution dispersal in the bay. water levels in the "ocean" to the left of the "golden gate bridge" in the model are raised and lowered to simulate tides.

on salinity conditions and the dispersion of waste discharges. The peripheral canal is proposed by the State of California Department of Water Resources and the Bureau of Reclamation. Additional data on the Deep Water Ship Channel may be found on page 48.

A plan of study will be prepared to develop urban runoff alternatives, monitor agricultural drainage and to investigate estuarine environmental processes. Completion of the study is indefinite.

An interim report on wastewater management alternatives authorized in 1971 was completed in 1975. Under this authorization, in March 1972 the California State Water Resources Control Board, Region IX of the Environmental Protection Agency and the San Francisco District of the Corps of Engineers executed a joint agreement for interagency water quality management planning assistance. As specified by the agreement, the Corps provided planning assistance to the State of California in the preparation of comprehensive water quality control plans for basins within the San Francisco Bay and Delta Region. Specific tasks include developing alternatives for disposal of treatment system sludge by means of land application; developing alternatives for waste-water reclamation and use as related to land application procedures; and evaluating the above alternatives in terms of the objectives of national economic development, environmental quality, social well-being, and regional development. A final report on Land Application Alternatives for Wastewater Management has been completed.

San Francisco Bay and Tributaries (San Francisco District)
The 1950 River and Harbor Act authorized a special investigation of San Francisco Bay and tributaries to consider existing and potential requirements of the entire San Francisco Bay basin complex with respect to navigation, flood control, transportation, water supply, land reclamation, recreation, national defense and allied subjects. Eleven separately authorized navigation studies will be included.

The results of the investigation will be presented in two major categories. The first will include specific plans and programs for areas of Federal interest, including deep draft navigation, small boat harbors, remedial measures for reduction of annual maintenance dredging and criteria for flood control in the tidal zones. The second will provide guidelines for use by local interests in planning integrated development of the natural resources of the bay area with respect to supplemental water supply, bay crossings, shoreline reclamation, marine-connected recreation, pollution abatement, remedial works for shoaling and establishment of a regional supervisory body for ports and ground and air transportation and possibly for implementing integrated development for the natural resources.

In order to verify analytical solutions and solve problems not susceptible to analytical solution, a scale hydraulic model of San Francisco Bay was built and is in operation. The model was extended to include the Sacramento-San Joaquin Delta so the complex water resources problems of that region could be studied. The model reproduces the rise and fall of the tide, flow and currents of water, mixing of fresh and salt water and trends in deposition of sediment. Sedimentation and shoaling tests, using radioisotope tracers, have been conducted in cooperation with scientists from the University of California. The model, which is located at the Corps of Engineers Operations Base in Sausalito, is open to visitors during the hours 9:00 a.m. to 4:00 p.m. Monday through Friday, exclusive of holidays, and on selected Saturdays each month.

the bay model has 24 tide stations. corps personnel check to ensure that water levels in the model accurately reproduce levels actually measured in the bay under identical conditions.

The relative advantages and disadvantages of bay crossings by bridges and barriers have been extensively discussed by local interests. Because of the complex problems involved and changes in the regimen of the bay and the delta area that would result from adoption of proposed barrier plans, and in consideration of the related areas of local, State and Federal interests, the Corps of Engineers was directed to undertake an impartial study of all phases of the problem and make recommendations and establish criteria leading to resolution of controversial issues.

As the first phase of the investigation, studies were made to determine the feasibility of constructing barriers in the bay. Detailed studies were made on the five major barrier plans: Chipps Island, Dillon Point, Point San Pablo, Reber Plan and a South Bay barrier, and other barrier proposals were examined on the basis of information developed from these studies. Basic data for certain elements of the study were provided by cooperating agencies. An interim technical report on the barrier phase of the study was published by the Corps of Engineers in June 1963.

The investigation was completed in 1975.

West Coast Deep Water Port Facilities (North and South Pacific Divisions)
In October 1972, a Congressional resolution authorized a study to evaluate the need, location and facilities to accommodate deep draft ocean-going vessels along the West Coast in the area between Bellingham, Washington, and San Diego, California. The study has been completed but not yet submitted to Congress.

The West Coast study was conducted as a joint effort of the Corps of Engineers' North Pacific Division in Portland, Oregon, and the South Pacific Division in San Francisco, California. District offices in Seattle, Portland, San Francisco and Los Angeles cooperated in the study.

The study included evaluation of the need for deep water port facilities on the West Coast in view of future resource requirements, primarily oil, and review of the current revolution in the size of international bulk carriers, with vessels in excess of 250,000 deadweight

moss landing is one possible site for a deep water port.

san francisco bay area

▲ *firemen evacuated residents of kentfield, inundated by floodwaters of corte madera creek in 1958.*
▼ *sir francis drake boulevard, near san anselmo, during the 1958 floods along corte madera creek.*

tons now in use; and an evaluation of potential locations and types of possible facilities. A wide range of sites were analyzed, including inland, on shore, near shore and off shore facilities. Public meetings were held to elicit information and comments on the study from all interested parties.

Site analyses were performed by the San Francisco District Office for Crescent City and Humboldt Bay, Richmond Central, San Francisco Bay, Offshore Golden Gate and Offshore Moss Landing.

Similar regional deep water port facilities studies by the Corps of Engineers were conducted on the North Atlantic and Gulf Coasts.

emergency work

Emergency work performed by the Corps of Engineers in the San Francisco Bay Area under Public Law 84-99 totals about $3.2 million. Following major floods in the San Francisco Bay Area, especially those that occurred in December 1955 and December 1964, the Corps of Engineers was called upon for floodfighting and rescue operations, post-flood repair and restoration work under continuing authorities for emergency activities.

Most emergency work costs are attributable to floods that occurred in the Russian River Basin and along streams tributary to San Francisco and San Pablo Bay. As of 1972, a total of $416,000 had been spent under the authority of Public Law 55-189 for removal of obstructions and wrecked vessels from coastal and other navigable waters in the area.

Under authorities antecedent to Public Law 93-266, the Corps of Engineers has performed restoration, rehabilitation and other work costing $2 million in the San Francisco Bay Area. Of this total, $590,000 was spent primarily for channel clearing and debris removal in the San Lorenzo River Basin following the 1955 flood, and $1.4 million for similar work in the Russian River Basin subsequent to the 1964 flood.

In February 1973, South San Francisco and Marin Counties were declared disaster areas due to extremely heavy winter rains and resultant flooding. At the request of the OEP, the Corps investigated applications for reimbursement of Federal funds. In South San Francisco, damages to public and private facilities amounted to $2.2 million. In Marin County, total damages were estimated to be $3 million. Applications for reimbursement totaled $1.2 million, with Corps' recommendations for reimbursement totaling nearly $500,000.

During the period January 1972 - June 1973, the Corps of Engineers conducted floodfighting activities under Public Law 84-99 on Colma Creek in South San Francisco. Emergency repairs cost $95,000.

From January of 1974 through October 1974 the Corps of Engineers spent about $480,000 preparing for floods, fighting floods on the Russian River and rehabilitating flood control works in Mendocino and Sonoma Counties.

Miscellaneous reconnaissance and reporting on area streams and rivers have cost an estimated $18,000.

flood plain management services program

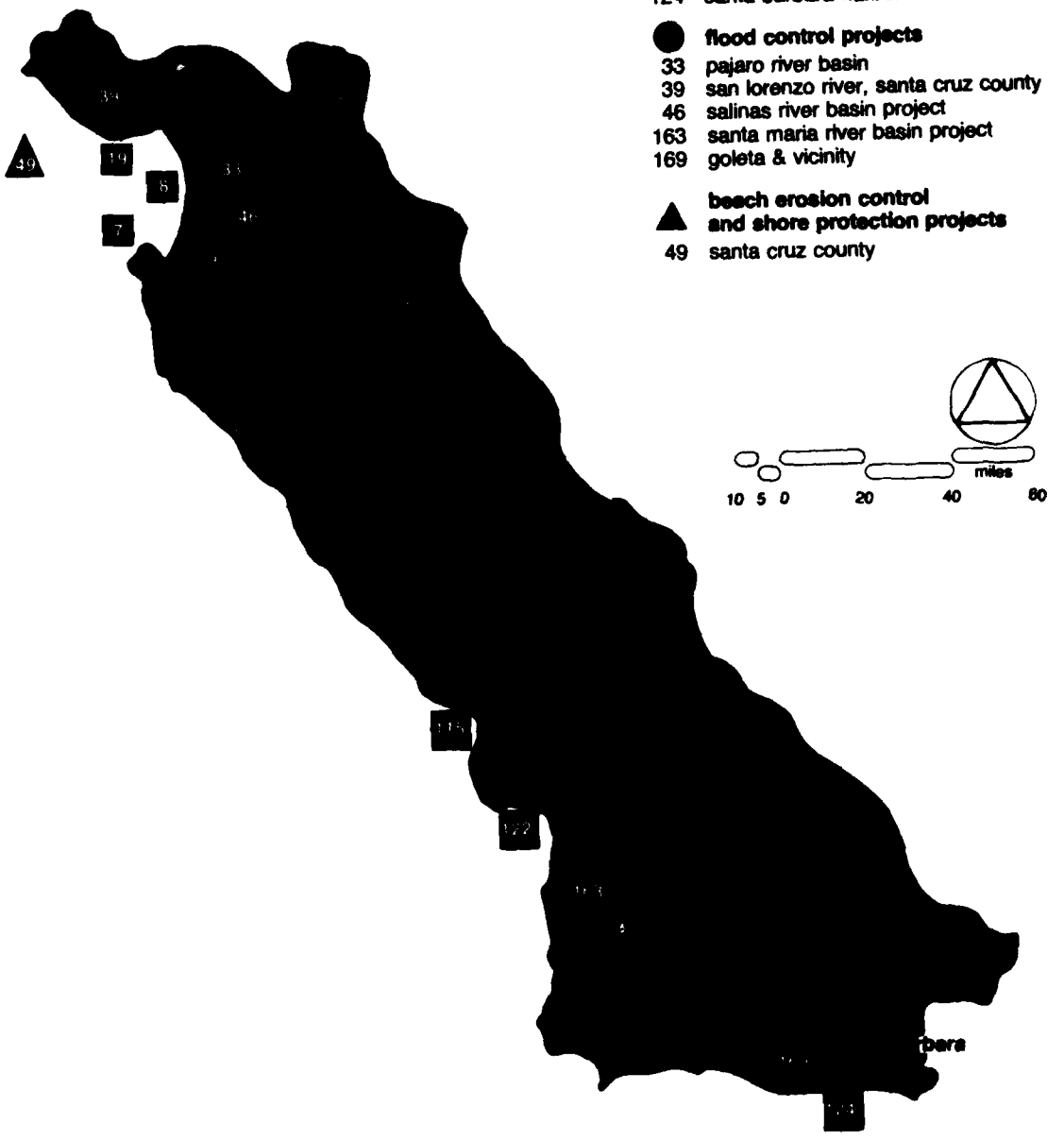
The following flood plain information studies for streams in the San Francisco Bay Area have been completed:

Coyote Creek, Santa Clara County
Green Valley, Dan Wilson and Suisun Creeks, Solano County
Guadalupe River, Santa Clara County
Fisher Creek, Santa Clara County
Alamitos-Calero Creeks, Santa Clara County
Penitencia Creek, Santa Clara County
Rush Creek, Marin County

The following study is in progress:

Sonoma Creek Basin, Sonoma County

4 central coastal basins



description

The Central Coastal Basins include the coastal counties of Santa Cruz, Monterey, San Luis Obispo and Santa Barbara and portions of Santa Clara County, San Benito County and the inland portion of Ventura County. The area extends from the San Lorenzo Drainage Basin north of Santa Cruz to just south of Santa Barbara and comprises a land and water area of about 11,450 square miles.

Except for river valleys, there is little or no coastal plain. Throughout most of the area, mountainous terrain and rolling hills extend to the shoreline thus producing a rugged coast considered to be one of the most scenic in the United States. Important mountain chains paralleling the coast are the Santa Lucia, Diablo, La Panza and Gabilan Ranges, and the Sierra Madre, San Rafael and Santa Ynez Mountains.

Important streams in the basins include the San Lorenzo, Pajaro, Salinas, Carmel, Santa Maria and Santa Ynez Rivers. The Salinas River is the largest stream, draining over 40 percent of the total area. Its major tributaries include the Nacimiento, San Antonio and Arroyo Seco Rivers, which originate west of the main stream in the Santa Lucia Range and Estrella and San Lorenzo Creeks, which originate east of the main stream in the Diablo Range. Lesser streams include the Morro-San Simeon and San Luis Obispo-Arroyo Grande Coastal Groups in San Luis Obispo County and the Santa Barbara County Group.

The Salinas River runs through the largest of the intermountain valleys of the Coast Ranges. Famous for its lettuce fields, the Salinas Valley is about ten miles wide near the coast.

Major urban centers include Salinas, Monterey, Carmel, Santa Cruz, Watsonville, San Luis Obispo, Santa Maria and Santa Barbara. In 1970 the population of the area was 810,000. It is projected to increase to about 1.6 million by the year 2000. The economy of the Central Coastal Basins is supported primarily by agriculture and related industry. Other major contributors include manufacturing, petroleum, mineral production and recreation. Santa Barbara County coast is frequently referred to as the American Riviera.

Water resources development problems include flood control, sedimentation and erosion. Because of the steep gradients involved, floodflows on streams drain-

(photo courtesy of vtn.)

central coastal basins

monterey bay. santa cruz is along the coast at left, and salinas is on the right. san luis reservoir is visible in the background.

ing the mountains of the Coast Ranges are characterized by extremely rapid rise, and almost as rapid recession, subjecting agricultural and urban areas to flood damage. The steep slopes in the upper watersheds experience severe erosion during storm runoff, depositing large amounts of sediment in the flood plains. Erosion rates are intensified following wildfires in the upper watersheds. Of the total of 356 miles of mainland shoreline, about 46 miles are considered to be noneroding or stable. The remaining 310 miles are in varying degrees of erosion with about 90 miles eroding critically, threatening highways, urban properties and recreational swimming beaches.

Future water resources development problems are expected to stem largely from economic growth and changes in the use of flood plains. Future development will require additional measures to reduce flood damage.

navigation projects

Prefatory Note[1]

Navigation in the Central Coastal Basins is primarily associated with Monterey Bay and Harbor. Monterey

[1]Principal source: Hoover, Rensch, and Rensch, *Historic Spots in California*, Third Edition.

Bay was discovered in 1602 by Sebastian Vizcaino, a Spanish merchant-contractor. He showed the bay as *Puerto de Monterrei* on his charts. Sailing under contract for Spanish Viceroy Juan de Onate, Vizcaino was searching for pearl beds and exploring the California Coast for a port of refuge for use by Manila galleons. Monterey Bay was the prize discovery of his voyage which he described in his journal as "the best port that could be desired, for besides being sheltered from all the winds, it has many pines for masts and yards, and live oaks and white oaks, and water in great quantity, all near the shore." Vizcaino described the adjoining land as being "thick with Indians and very fertile with the climate and quality of the soil resembling Castile." Being a merchant who was also active in the Spanish-Philippine trade, Vizcaino gave particular notice to the favorable latitude of Monterey Bay between 36 degrees and 37 degrees north. He wrote that the port would provide "protection and security for the ships coming from the Philippines." Vizcaino's enthusiastic description of Monterey Bay was accepted as fact about Alta California and was the chief motivating force that attracted further Spanish interest to the region.

By the late 1700s, overland expeditions from Mexico to Monterey Bay had been accomplished and Father Junipero Serra and other Franciscan monks had begun to establish a chain of missions. At Monterey Bay, Father Serra had established *Mission San Carlos Borromeo (El Carmelo)* which was simultaneously dedicated with the *Presidio of Monterey*.

Early visitors to the *Presidio* arriving by sea included George Vancouver, who arrived in 1793, and Count de la Perouse, who in 1786 claimed to have been "greeted by Castillo guns from the battery on the hill." During the Spanish and Mexican periods, Monterey was the military and social capital of Alta California. It was the port of entry where "Boston Ships" and whaling vessels came to trade.

Small coves in the vicinity of Monterey Bay became important whaling stations in the 1800s. One of the most important on the California coast was the Moss Landing Whaling Station located 15 miles north of Monterey. Whalers Cove on Point Lobos, just south of Monterey Bay, also sheltered both whaler and buccaneer. As California's Central Coast became more settled, navigation was increased to carry passengers to San Francisco and to ship lumber, flour and paper from mills situated near deep water.

Corps of Engineers activities in Monterey Bay first began in the mid-1870s when it was included in a river and harbor survey. In 1912, harbor improvements were authorized by Congress but were not implemented due to lack of local support and funds. In 1930, the existing project was authorized and constructed during the next decade. Modifications to the harbor have been authorized over the years.

Monterey Harbor (San Francisco District)
Monterey Harbor is one of the most important fishing ports on the Pacific Coast. This harbor is located at the southern end of Monterey Bay, about 90 miles south of San Francisco Bay. Improvement of the harbor was completed in 1947 at a Federal cost of $700,000, supplemented by local contributions in the amount of $80,000.

The existing project consists of three breakwaters and a harbor area adjacent to the Municipal Wharf. Controlling depth of the harbor is 8 feet.

The 1960 River and Harbor Act authorized additional breakwater construction. In 1968, the project scope was modified based on hydraulic model studies at the Waterways Experiment Station, Vicksburg, Mississippi, and the concept changed from an enlarged mooring area to a marina-type complex. The approved plan provides for construction of a detached north breakwater and an east breakwater. Planning for these improvements has been completed. Federal cost for construction of east and north breakwaters is estimated to be $11 million. Local interest cooperation in the project modification will amount to $5.4 million.

Vessel traffic in Monterey Harbor consists principally of recreational and fishing craft. Commerce in the harbor amounted to about 11,600 tons of fresh fish and shellfish in 1975.

Due to lack of local support, the project modification has been recommended for reclassification to inactive status.

Morro Bay Harbor (Los Angeles District)
Morro Bay Harbor, the only natural landlocked bay along this reach of the coast, is 110 miles south of Monterey Bay and about midway between San Francisco and Los Angeles.

Completed in 1946 and maintained by the Corps of Engineers, the project cost $2.6 million, of which all but $33,000 was Federal funds. In 1964 an additional $2.1 million was spent to rehabilitate deteriorated structures and channels. Maintenance costs to date total $3.3 million, including $300,000 spent by the Navy.

The project consists of two entrance breakwaters, a stone dike, a stone groin, an entrance channel, two harbor channels and a revetment for the entire waterfront of the City of Morro Bay. The channels, which have a design depth of 12 feet and 16 feet, join a natural channel leading to the small craft harbor at the State park near White Point. San Luis Obispo County, the City of Morro Bay, the California Wildlife Conservation Board and private local interests have provided about $3.4 million in facilities for public use of project areas.

Morro Bay serves as home port for a U.S. Coast Guard patrol boat and about 350 small recreation boats. It is used regularly by about 180 commercial and sport fishing boats. During fishing season approximately 200 vessels based at other ports land fish at Morro Bay Harbor contributing to the harbor's estimated 2,000 tons of annual waterborne commerce.

An investigation to determine the advisability of modifying the existing project is now being conducted by the Federal government. Completion date is indefinite.

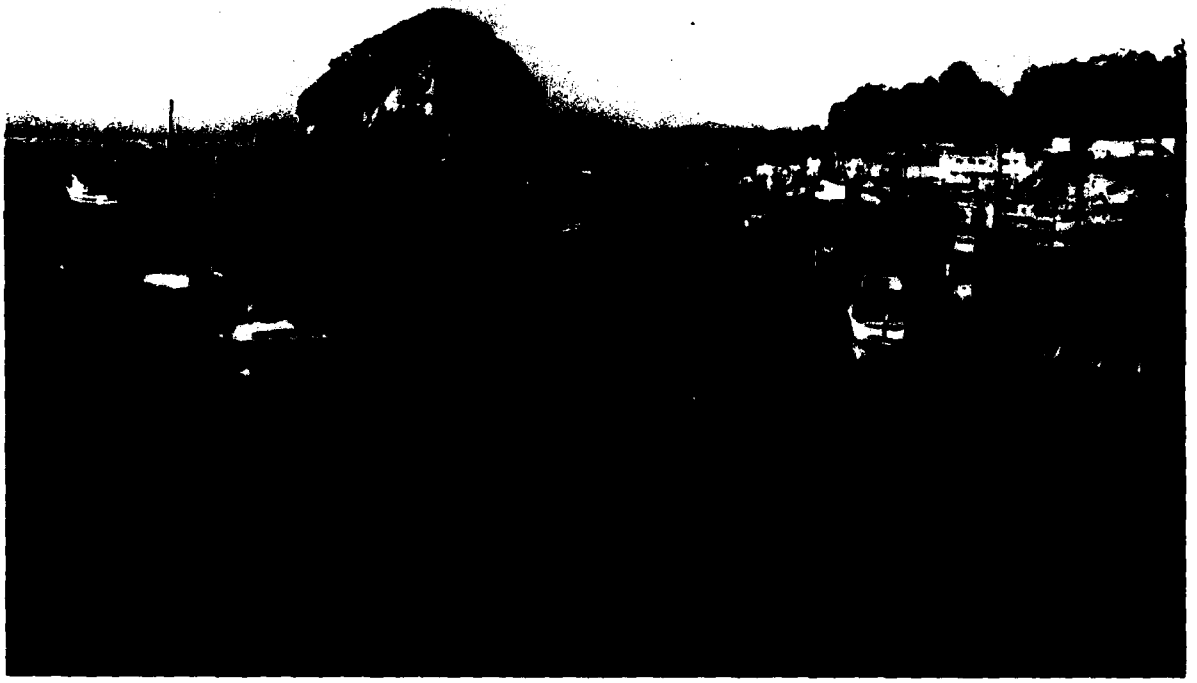
Moss Landing Harbor (San Francisco District) Moss Landing Harbor is located on Monterey Bay about midway between the cities of Santa Cruz and Monterey, about 80 miles south of San Francisco Bay. Harbor improvements were completed in 1947 and are being maintained by the Corps of Engineers. The project consists of two jetties, a 1,900 foot entrance channel, a 3,200 foot lagoon channel and a turning basin. Controlling depth is 15 feet.

The total Federal cost was about $340,000. Local interests provided rights-of-way and disposal areas.

The economy of Moss Landing is sustained by commercial fishing and by offshore handling of petroleum products by pipeline and barge. Such commerce amounted to 748,000 tons in 1975.

A Corps of Engineers study of Moss Landing Harbor has been included in a larger study, "Coast of Northern

morro bay harbor is home port for about 350 small recreational craft and about 180 commercial and sport-fishing boats.



California, Harbors for Light Draft Vessels," described elsewhere in this book.

Port San Luis (Los Angeles District)
Port San Luis (formerly San Luis Obispo Harbor) is located about 190 miles northwest of Los Angeles Harbor and 245 miles southeast of San Francisco Harbor. Historically a pirate's cove, it was known as Port Harford. During the last quarter of the nineteenth century, Congress recognized Port San Luis as being the first harbor of importance to navigation in the Central Coastal Basins and subsequently authorized harbor improvements.

Completed in 1913 at a Federal cost of $568,000, the existing project consists of a rubblemound breakwater 2,160 feet long.

About 120 commercial and recreational craft use the port facilities, which are owned by the Port San Luis District. The estimated annual commercial fish catch is $1 million. Because of the potential storm damages in the winter, recreational boating is limited to about 8 months each year. Other facilities in the bay are used for waterborne commerce, estimated at 2 million tons in 1975.

In 1976, additional harbor improvements were authorized. The improvements would include construction of a detached breakwater 3,615 feet long and a south breakwater 750 feet long; dredging a main channel and north and south entrance channels, with a total length of 5,200 feet; and removing rock pinnacles from the anchorage area and north entrance channel.

The improved harbor would accommodate 910 commercial and recreational craft, provide a harbor of refuge for transient boats, prevent storm damage to existing boats, increase commercial and sport fishing, and alleviate demand for berthings and moorings in the region. The estimated total Federal cost of the new work would be $6,065,000 ($6,040,000, Corps of Engineers; $25,000, US Coast Guard), and the estimated non-Federal cost would be $5,060,000.

port san luis, which is primarily an oil landing terminal, is used as a base by about 120 commercial and recreational craft.

central coastal basins

Santa Barbara Harbor (Los Angeles District)
Santa Barbara Harbor, located 90 miles northwest of Los Angeles Harbor and 320 miles southeast of San Francisco Harbor, was formed by a 2,800 foot rubblemound breakwater. The harbor was constructed by the City of Santa Barbara with financial assistance from a local yachtsman at a cost of $3 million.

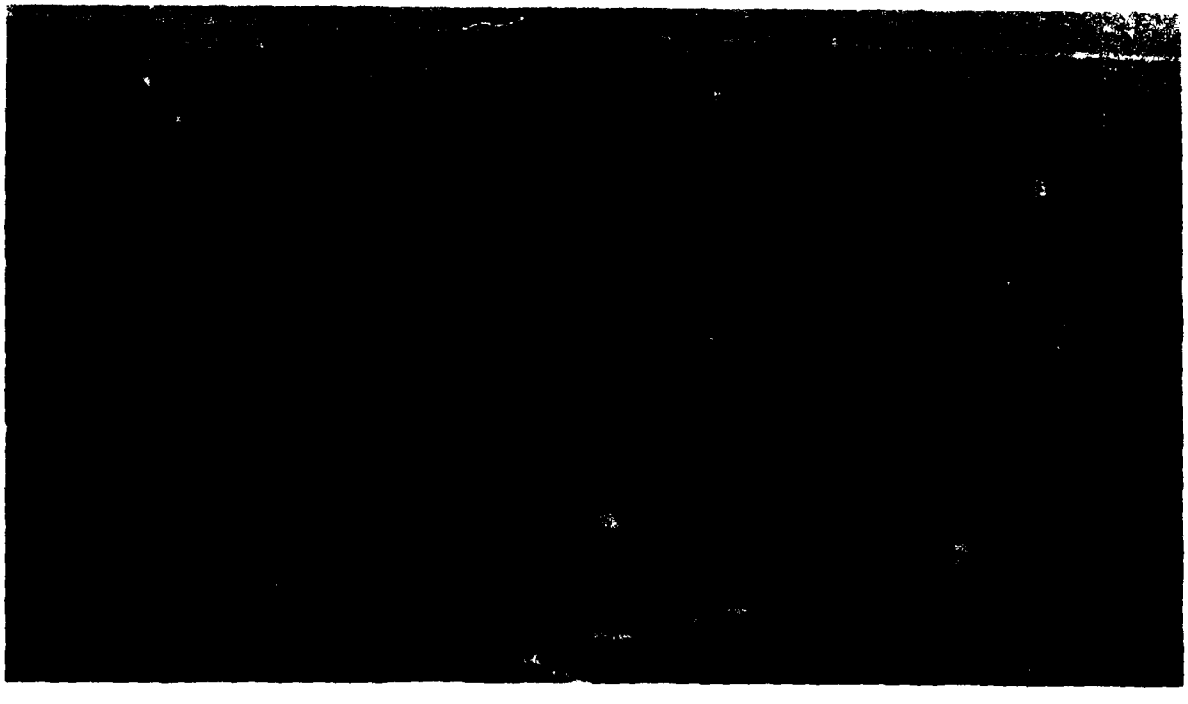
The project consists of a wharf, pier, landing float, launching ramp for small craft, and open mooring space. The wharf is used for general cargo and for servicing fishing and oil exploration boats. The pier, constructed by the U.S. Navy and operated by the City of Santa Barbara, is used for servicing pleasure and light commercial boats.

Used extensively for recreation, the small craft harbor offers refuge for vessels on coastwise trips and is home port for about 800 pleasure craft and fishing boats. Waterborne commerce in 1975 was about 3,800 tons of fish and fish products.

The Corps of Engineers has maintained the project since 1935 at a cost in excess of $2.5 million. Because of extensive shoaling in the harbor, continuous maintenance dredging is required. In 1956 the Federal Government assumed operation of a movable dredge that operates within the protected harbor area to pump surplus sand to downcoast beaches where continuous erosion threatens highly valuable shoreline property. Local interests have contributed $460,000 to this beach replenishment activity. Federal maintenance costs total $3.8 million.

Additional harbor improvements estimated at $6.8 million were authorized by the 1962 River and Harbor Act in an attempt to meet the increasing demand for mooring space. However, failure of a bond issue to provide funds for the local interests' part of the project necessitated reclassification of the project in 1969 to an inactive category. At present mooring facilities are unavailable for a waiting list of 500 boats.

santa barbara harbor is filled to capacity with about 800 craft based in the harbor. An additional 500 boats are on a waiting list for moorings.



Santa Cruz Harbor (San Francisco District)
Santa Cruz Harbor is located at the northern end of Monterey Bay, 65 miles south of San Francisco Bay. The 1958 River and Harbor Act provided for construction of a protected harbor for light draft vessels in Woods Lagoon, near the eastern limits of the City of Santa Cruz. The harbor was completed in 1963 at a total cost of $2.9 million, of which $1.8 million was Federal funds.

The project consists of east and west jetties, a 1,270 foot entrance channel, a 1,400 foot harbor channel and a turning basin. Controlling depths range from 10 feet to 20 feet.

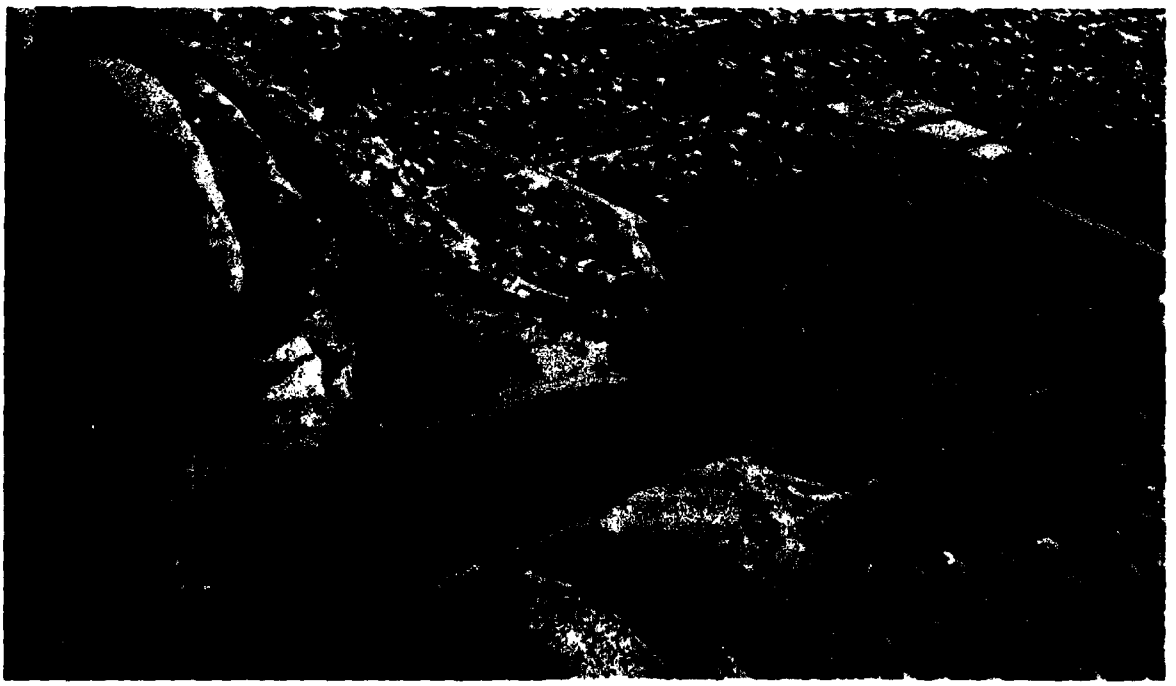
Following construction of the harbor jetties in 1963, the Corps maintained the project through annual dredging operations. A recently completed study, coordinated with the U.S. Army Waterways Experiment Station in Vicksburg, Mississippi, and the Santa Cruz Harbor District, has recommended that a jet pump be installed in Santa Cruz Harbor for sand bypassing operations. This system was installed in June 1976. Waterways Experiment Station personnel will remain, on a temporary basis, at Santa Cruz and operate the system through the 1976-1977 winter shoaling season. To date, the ability of the system to remove sand from the harbor has been demonstrated on a short-term basis. The full test of the experimental system will occur during the severe shoaling period from October 1976 to April 1977.

Facilities at Santa Cruz Harbor include a municipal pier with berthing and marine supply and repair services. Local interests were responsible for construction of the pier. The harbor has slips for 363 recreational boats.

navigation studies

Coast of Northern California, Harbors for Light Draft Vessels (San Francisco District)
A study to evaluate a possible chain of small craft harbors authorized by the River and Harbor Acts of 1945 and 1946 was completed in 1971.

santa cruz harbor provides safe moorings for 363 small craft.



central coastal basins

The study area within the Central Coastal Basins includes Santa Cruz and Monterey Counties. The study includes an evaluation of enlarging Moss Landing Harbor. Possible modifications include enlargement of the lagoon, adding a small recreational craft harbor and making deep draft navigation improvements. The study is indefinite.

flood control projects

Goleta and Vicinity (Los Angeles District)
The Goleta and Vicinity project would provide protection against floods to an overflow area of about 2,270 acres in a rapidly developing urban area. The project would be in Goleta Valley within the greater Santa Barbara area.

The drainage area of the project comprises 48 square miles in and near Goleta. The project would include 11.2 miles of channel construction on parts of Atascadero, Maria Ygnacio, San Jose, Las Vegas, San Pedro, Carneros, and Tecolotito Creeks and 1.3 miles of channel clearing on parts of Maria Ygnacio, San Jose, Las Vegas, San Pedro, and Carneros Creeks. The first cost of this work is estimated at $26.4 million in Federal cost and about $8 million in non-Federal cost.

A review of the plan, as authorized in 1970, will be conducted to determine if it satisfies the current needs of the project area or whether modifications will be required. The Corps of Engineers study will give careful consideration to function, environmental and social concerns, and aesthetics in the treatment of structures; to recreational facilities that will complement and expand existing recreational facilities; and to beautification measures that will enhance the natural environment. Protection of the ecology of the area will also be an important consideration.

No funds have been appropriated for initiation of preconstruction planning studies.

Pajaro River Basin Project (San Francisco District)
The Pajaro River flows into Monterey Bay near the City of Watsonville, about 75 miles south of San Francisco. Carnadero, Corralitos and Salispuedes Creeks are tributaries of the Pajaro River. The Pajaro River Basin Project was completed in 1949 at a Federal cost of $748,000. The project consists of river levees on both banks of the Pajaro River extending a maximum of 12 miles, and levees on each side of Corralitos Creek extending approximately 2 miles.

Local interests provided the necessary lands, easements and rights-of-way, relocated bridges and utilities and have assumed maintenance of the completed work.

The 1966 Flood Control Act authorized modification and extension of the existing levee system along the lower 12.5 miles of the Pajaro River and along about 4.5 miles of Corralitos and Salispuedes Creeks. Preconstruction planning for these improvements was placed in a deferred category in 1976. The Federal cost of the authorized modification is estimated at $28.3 million, and the first cost to local interests is estimated at $1.9 million.

Since its completion in 1949, the existing project has prevented flood damages of about $3.5 million in the Watsonville area. However, the City of Watsonville and extensive agricultural lands in the flood plain are still subject to severe damages during major floods. The modified project will provide a high degree of flood protection to this area. If a project design flood should occur, the completed modified project would prevent flood damages of about $30 million.

The Pajaro River Basin requires a supplemental water supply. In addition, the town of Gilroy is susceptible to flooding. An ongoing water resources development study, authorized by a resolution of the House Public Works Committee, is considering local flood protection works such as channel improvements and enlargements, levees on Uvas-Carnadero Creek and multipurpose reservoirs. A Citizens Advisory Committee has been formed to coordinate studies on the creek.

Salinas River Basin Project (San Francisco District)
The Salinas River basin, covering about 4,500 square miles in Monterey, San Benito and San Luis Obispo Counties, suffers recurring flood damages. Major floods in December 1966-January 1967 and January-February 1969 resulted in damages estimated at about $38.3 million.

The Salinas River Project would provide for channelization and bank protection works and other improvements on the lower 93 miles of the Salinas River from its mouth to a point between the towns of San Ardo and Bradley and on Arroyo Seco for about 1 mile above its confluence with the Salinas River. The project would stabilize the river on an improved alignment.

A reconnaissance study was conducted in 1962 to evaluate project economies and the adequacy of the plan of improvement. The report recommended retention of the project in the deferred category pending

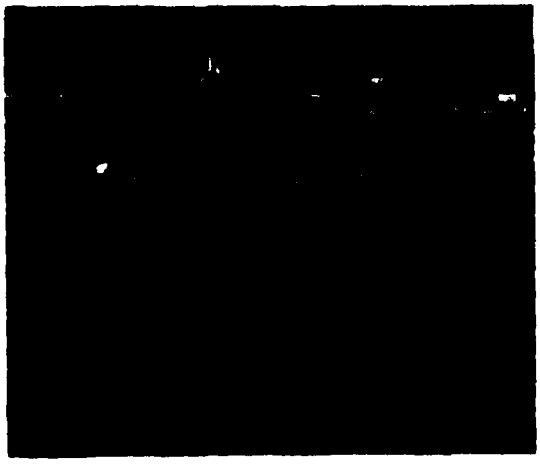
completion of additional reservoir construction proposed by local interests.

San Lorenzo River, Santa Cruz County (San Francisco District)
The San Lorenzo River flows in a general southeasterly direction from the Santa Cruz Mountains through the City of Santa Cruz where it enters Monterey Bay. Branciforte Creek, a major tributary, joins the river from the south within the City of Santa Cruz. A flood control project comprising 17,000 lineal feet of levees, a floodwall, 1.6 miles of channel work and other improvements on these streams was completed in 1959. Remedial work to the interior drainage system was completed in 1965.

Total Federal cost of the project was $4.3 million. Local contributions amounted to $2.3 million. Local interests are maintaining the project.

Santa Cruz and the adjacent region comprise one of the most popular recreational areas in Northern California. In the city, the river flows through a highly developed business, industrial and residential area that has been subject to damages from recurring floods. During the flood of December 1955, the most severe on record, damages were estimated at $7.5 million, a large part of which would have been prevented if the project had been completed and in operation at the time.

the levee along the san lorenzo river shortly after completion, and before planting.



A review survey, requested by local interests, was authorized in 1958 to provide a plan for improvement of the San Lorenzo River Basin. The survey will include consideration of levees and bank protection works in those reaches not protected by the Santa Cruz levee system and will evaluate multipurpose reservoirs for flood control, water supply and recreation. This study is being considered under the Salinas River Urban Study.

Santa Maria River Basin Project (Los Angeles District)
The Santa Maria River Basin Project consists of levee and channel improvements in Santa Maria Valley and the multipurpose Twitchell Reservoir located on the Cuyama River, a tributary of the Santa Maria River.

Twitchell Reservoir, completed in 1958 by the U.S. Bureau of Reclamation, is operated for flood control in accordance with regulations prescribed by the Secretary of the Army. The improvements in Santa Maria Valley, completed in 1963 by the Corps of Engineers, consist of 22 miles of levee and channel construction along the Santa Maria River (from Fugler Point to the Pacific Ocean) and a 2 mile leveed channel along Bradley Canyon to divert floodflows into the Santa Maria River. That part of the project along the Santa Maria River is designed to carry floodflows ranging from 150,000 to 160,000 cubic feet per second; and along Bradley Canyon, floodflows of 9,000 cubic feet per second.

the same location several years later, following cooperative landscaping under the model cities program of the department of housing and urban development.

The combined project provides a high degree of flood protection to the City of Santa Maria and about 20,000 acres of intensively developed agricultural land in the Santa Maria Valley. Since its completion the project has prevented flood damages estimated at $2.4 million. During the 1969 floods, the levees successfully withstood high velocity floodflows to prevent an estimated $2.2 million damages. However, there were project damages caused by meandering flows that undermined the stone toe protection at isolated points and by cross stream flows that eroded parts of the levees. The project is being restudied to determine the best method of remedying these problems.

The cost of the flood control levee and channel improvements, including remedial work on the damaged levees, is estimated at about $10.4 million, including $9.1 million in Federal costs. The cost of the remedial work is estimated at $3.6 million (all Federal).

urban study

Salinas River, including part of Salinas-Monterey Metropolitan Area (San Francisco District)
The Plan of Study for the Salinas-Monterey Bay area Urban Study was approved in 1976. It was amended following the establishment of Section 208 Planning Areas by the State of California. A formal agreement was negotiated between the Corps of Engineers and the Association of Monterey Bay Area Governments (AMBAG) to preclude any duplication of study efforts.

Priority planning issues include consideration of water supply, flood control, water quality and disposal of wastewater, supplementing the State Water Quality Plan for the basin. Major investigations will be undertaken to study groundwater conditions (the principal source of water supply in the area) and regional water resources management feasibility options. The study will address these problems in coordination with local, State and other Federal agencies. The study will proceed with a view to developing comprehensive water resources plans consistent with local land use planning and will act as a catalyst toward solving other urban problems. An acceptable, certifiable and implementable wastewater plan to satisfy the intent of Public Law 92-500 relative to wastewater management will be developed.

Study efforts in 1975 and 1976 concentrated on the development of a groundwater model for the Salinas Basin and land application alternatives for treated wastewater. Work on the groundwater model will continue in 1977 and the urban study is scheduled for completion in 1979.

flood control studies

Carmel River and Tributaries (San Francisco District)
An investigation of the Carmel River and its tributaries was authorized by the 1941 Flood Control Act and was initiated in 1971. The Carmel River flows from the Coastal Range mountains through western Monterey County and empties into the Pacific Ocean about 80 miles south of San Francisco. The Carmel River Basin is in an environmentally sensitive area and the economy depends largely on tourism. Permanent population was 19,000 in 1972 and is expected to increase 70 percent by the year 2000.

Recurring flood damage to agricultural lands and residential property results from heavy spring rains. Major floods in 1958 and 1969 caused damages estimated at about $1.2 million. Local interests have indicated that an immediate need exists for a supplemental water supply of 40,000 acre-feet per year to meet the demand of their service area. The study will consider provision of a multipurpose reservoir for flood control, water supply, recreation and related purposes. The study is currently scheduled for completion in 1978.

San Luis Obispo County (Los Angeles District)
The area, because of its proximity to the coast and its favorable climate, is rapidly becoming a haven for people seeking relief from urban sprawl and congestion. The study area has had a rapid rate of development in the past 15 years, and growth is expected to continue. The growth trend is increasing the need for flood control improvements or a flood plain management program.

Severe floods occurred within the study area in January and February 1969 and in January 1973 resulting in Presidential declarations of disaster in both years. The 1969 floods caused damages of $4.15 million and $850,000, respectively, with over 30 streams contributing to these damages. Areas along San Luis Obispo Creek and its tributaries sustained a total of about $1.6 million for the two floods. The January 1973 flood was mostly concentrated along San Luis Obispo Creek and its tributaries and caused damages estimated at about $4.4 million.

In 1974, an investigation of San Luis Obispo County streams within the Los Angeles District was authorized. The investigation, which was initiated in February 1976, will evaluate the flood problems and related water resources problems and needs for the area. Consideration will be given to various plans for control of floods along all streams. Reservoir storage, levee and channel construction, flood plain management

techniques, and appropriate combinations of structural and non-structural measures will be considered where appropriate. The investigation is scheduled for completion in 1981.

beach erosion control and shore protection project

Santa Cruz County (San Francisco District)
Santa Cruz County extends about 40 miles along the California coast with its northern boundary about 50 miles south of San Francisco. The beach erosion control and shore protection project, authorized by the 1958 River and Harbor Act, provides for Federal reimbursement of a portion of the cost of shore protection to be constructed by local interests at West Cliff Drive, Cliff Drive and Twin Lakes Beach at and in the vicinity of the City of Santa Cruz.

About 5,200 feet of seawalls have been completed and additions are being considered. A jetty constructed by the Corps of Engineers at the entrance to Woods Lagoon serves as a groin at the northern limit of Twin Lakes Beach.

The total cost of the project is estimated at $3.1 million, of which Federal participation is estimated at $1.5 million. This project has been recommended for reclassification to inactive status due to lack of local support.

special investigation

Coast of California, Protection Against Storm and Tidal Waves (Los Angeles and San Francisco Districts)
A special investigation of the effects of storm and tidal waves authorized by the 1965 Flood Control Act includes the coastline of the Central Coastal Basins. See page 31 for additional information on the study.

emergency work

Emergency work performed by the Corps of Engineers in the Central Coastal Basins has exceeded $7 million. Emergency services have been rendered in the form of floodfighting and rescue operations, flood suppression activities, protection and repair of banks and levees, clearance work and flood damage surveys.

In January and February 1969 the most disastrous floods known in the Central Coastal Basins occurred. Damages in excess of $25 million resulted when rain-swollen streams and creeks overflowed their banks and levees to inundate vast areas of land. Four persons lost their lives and a dozen cities and towns suffered major flood problems. Floodflows damaged streets, roads and bridges; destroyed farm equipment; damaged croplands by erosion and deposition of layers of silt and sand; disrupted and destroyed public utilities; and inundated residences, commercial establishments and U.S. Forest Service campgrounds and facilities.

As a result of the 1969 floods, the Corps of Engineers spent $3.3 million for emergency floodfighting and repair and restoration activities under Public Law 84-99. Costs to date for work under this law total $6.4 million, including $1 million spent by the Los Angeles District.

Under special Congressional authorization (Public Law 88-635), emergency flood control work was undertaken by the Corps in the Central Coastal Basins in 1964. This work was done in anticipation of a potential flood hazard resulting from disastrous fires in Santa Barbara County. In September and October, fires that raged for 10 days burned 67,000 acres of the valuable land along a 10-mile front in and adjoining the City of Santa Barbara and the communities of Montecito, Summerland, Goleta and Carpenteria. With the beginning of winter rains, these communities faced the threat of flood and debris flows that would run unchecked from the exposed hillsides.

Flood suppression measures taken by the Corps to prevent the impending disaster included rectification of 15 miles of channels and construction of 6 debris basins. Cost of the work was approximately $1 million.

Similar action was taken by the Corps in 1971 after fires denuded 16,000 acres along the coastal slopes of the Santa Ynez Mountains, once again threatening the towns of Montecito and Carpenteria. Vegetation through the area was powder dry after 8 months without rain. Fires raced through riparian woodlands and brush-covered hillsides, mostly untouched by fire since 1917, producing what firefighters call a "clean burn." That is, the area was denuded of vegetation and steep canyons with high potential for rock slides and debris production were exposed. In essence, the fires armed a time bomb that would be triggered by winter rains, which reached flood-producing magnitudes at the end of December.

In Public Law 92-184, Congress authorized the Corps to conduct flood suppression activities in the devastated areas. The work included construction of 9 debris barriers, 8 grade stabilizers, clearing and shaping of existing channels and removing fire debris from the

central coastal basins

City of Carpenteria, Carpenteria State Park and Sandyland Slough. The cost of this work was $1.3 million.

During and following the floods that occurred in the burned areas in December, an additional $100,000 was spent under the authority of Public Law 84-99 for floodfighting and debris clearing.

In total, $7.5 million was spent by the Corps of Engineers at the request of the OEP for repair and restoration of flood damage under the provisions of Public Law 93-288 and antecedent authorities. Of this, $6.6 million was spent for repair and restoration work. A summary of these costs by major streams and stream groups follows:

Morro-San Simeon Coastal Streams	$ 764,000
San Luis Obispo-Arroyo Grande Coastal Streams	1,066,000
Santa Maria River Basin	82,000
Santa Ynez River Basin	1,813,000
Santa Barbara County Streams	2,844,000
Total	$6,569,000

Major items of work included restoration of levees, restoration of stream channels, bank revetments, repair and restoration of water supply and sanitary systems, clearing landslides and removing debris.

the january 1969 floods inundated farmland in the vicinity of chualar in monterey county.

another view of the 1969 floods near chualar, showing the sewage treatment plant (foreground) nearly destroyed.

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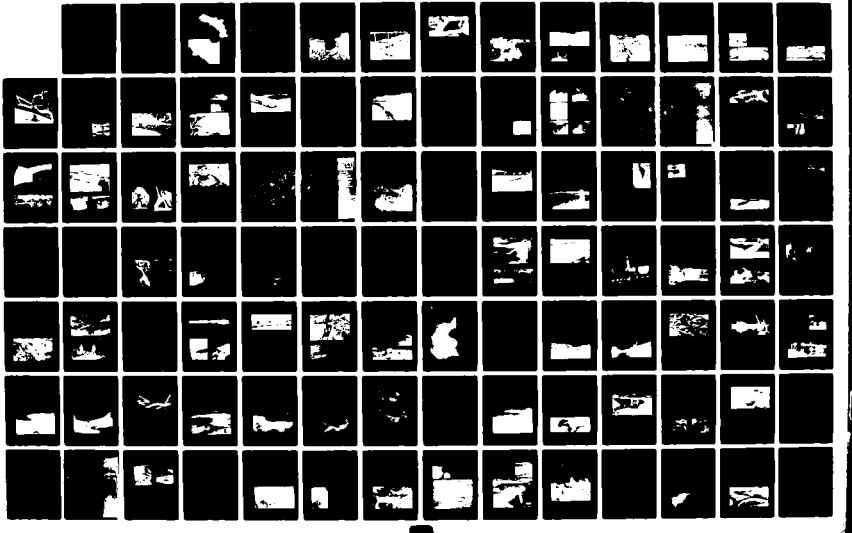
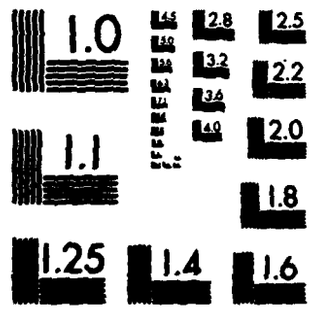




Other major expenditures for work requested by the OEP comprised $490,000 for repair and restoration activities in the Salinas River Basin following the December 1965 flood, and $465,000 for clearing debris from stream channels following the December 1971 floods in the area devastated by fire in Santa Barbara County in October.

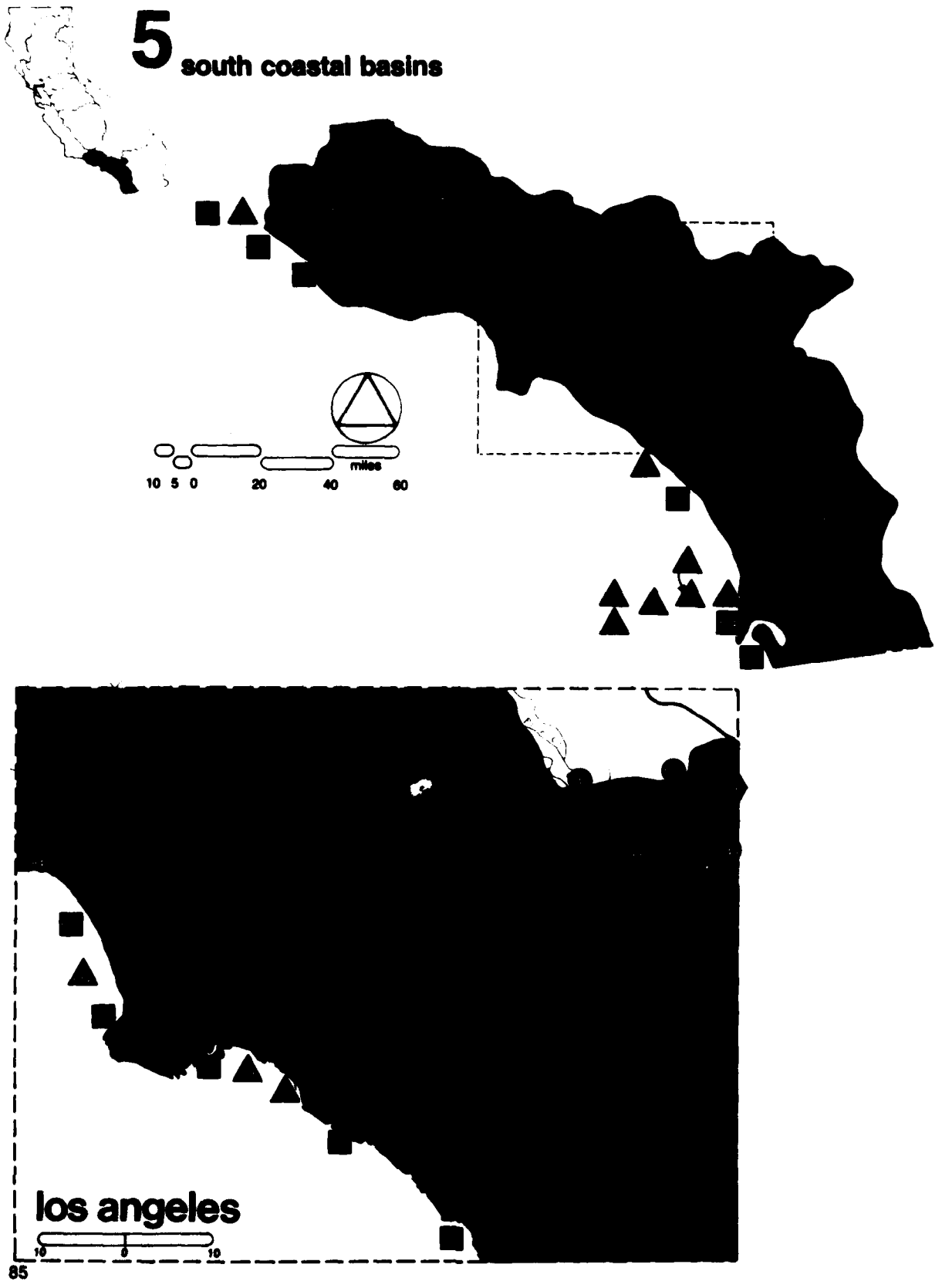
Other emergency work included expenditures of $159,000 under Public Law 55-189 to remove obstructions to navigation and wrecked vessels from coastal waters.

flood plain management services program

The following flood plain information studies for streams in the Central Coastal Basins have been completed:

Aptos Creek, Santa Cruz County
Carmel River, Monterey County
San Felipe Lake and Pacheco Creek (Unit I), San Benito County
San Lorenzo River-Boulder and Bear Creeks, Santa Cruz County
Santa Ynez River, Cachuma Dam to Buellton
Santa Ynez River, Lompoc to the Ocean
Soquel Creek, Santa Cruz County
Uvas-Carnadero Creek, Santa Clara County
City of Santa Barbara Streams
Corralitos Creek, Santa Cruz County
Llagas Creek (Unit I), Santa Clara County
Montecito Streams
San Benito River, San Benito County
San Felipe Lake (Unit II), San Benito County
San Luis Obispo Creek and tributaries

No future studies are scheduled at this time.


5
south coastal basins
miles
10 5 0 20 40 60
los angeles
10 0 10

project index

navigation projects

111 channel islands harbor
112 dana point harbor
113 marina del rey
114 san diego river and mission bay harbor
116 redondo beach king harbor
117 ventura marina
118 los angeles & long beach harbors
119 newport bay harbor
120 oceanside harbor
121 port hueneme harbor
123 san diego harbor

multipurpose projects

125 hansen dam
126 lopez dam
127 santa fe dam
128 sepulveda dam
129 whittier narrows dam
131 los angeles county drainage area project
132 hodges dam
134 brea dam
135 carbon canyon dam & channel
136 fullerton dam
138 prado dam

flood control projects

133 sweetwater river project
137 cucamonga creek & tributaries
139 mentone dam
140 santiago creek channel
141 santa ana river channel
142 devil, east twin & warm creeks channel improvements, & lytle creek levee
143 lytle & cajon creeks channel improvements
144 lytle & warm creeks project
145 riverside levees
146 san antonio & chino creeks channels
147 san antonio dam
148 san jacinto river levee & bautista creek channel
149 mill creek levees
150 aliso creek, san juan, trabuco & villa park dams
151 oak st. drain
152 university wash & spring brook project
155 city creek levee (small project)
156 kenter canyon conduit & channel
160 rose creek channel (small project)
161 san diego river levee & channel improvements
162 santa clara river levee
164 stewart canyon debris basin & channel
166 ventura river levee
167 santa paula creek channel & debris basins
168 calleguas creek, simi valley to moorpark
170 san diego river (mission valley) project
171 san luis rey river project
173 tijuana river international flood control project

beach erosion control and shoreline protection projects

174 anaheim bay harbor
175 bird rock area of la jolla (small project)
176 doheny state beach
177 ocean beach
178 oceanside
179 point mugu to san pedro breakwater
180 imperial beach
181 san buenaventura state beach
182 san diego (sunset cliffs)
183 san gabriel river to newport bay
184 las tunas beach park

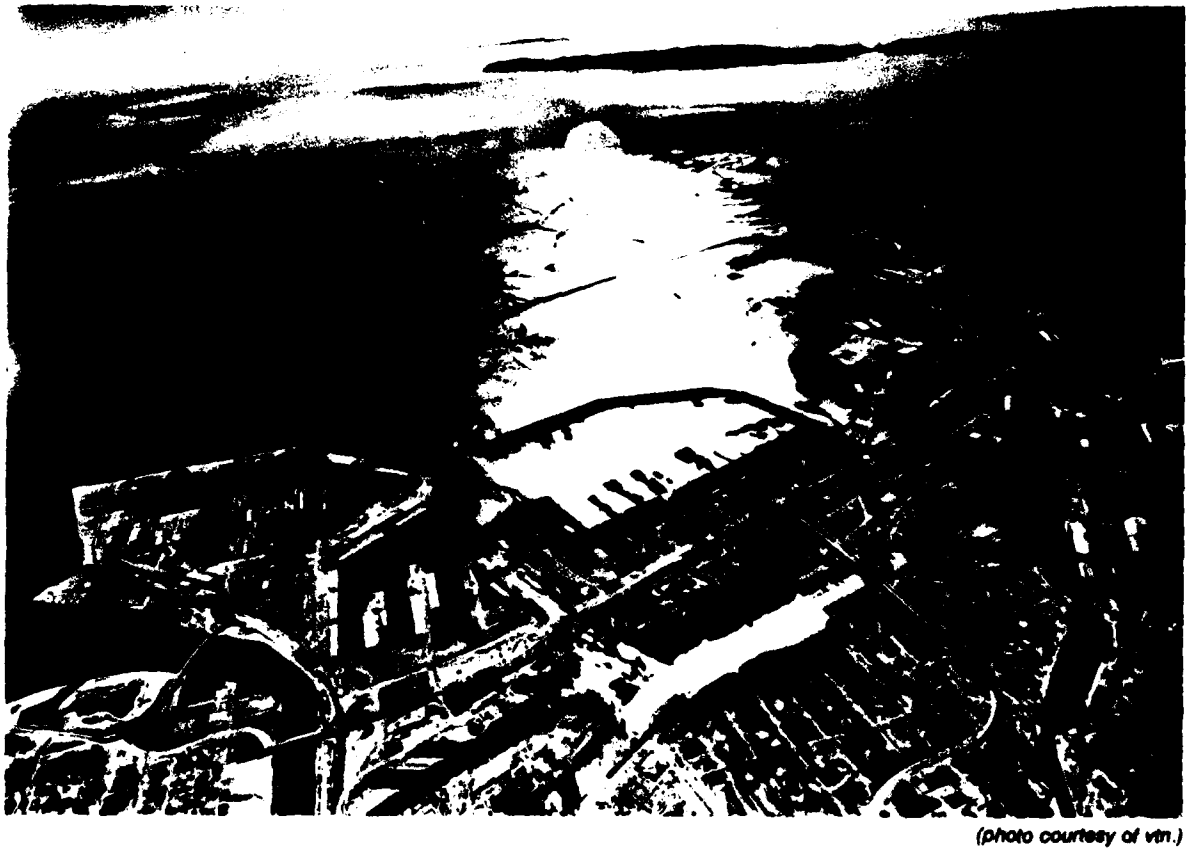
south coastal basins

description

The South Coastal Basins extend along the Pacific Ocean from just south of Santa Barbara to the Mexican border. They have a scenic coastline of 233 miles and cover about 11,000 square miles, including a water area of about 60 square miles. The topography is varied, including gently sloping coastal plains, fertile valleys, rolling foothills and rugged mountains. The basins extend eastward from the ocean a maximum of 75 miles to the peaks and ridges of the Tehachapi, San Gabriel, San Bernardino and San Jacinto Mountains and the coastal ranges of San Diego County. The coastal plain comprises about one-third of the area. White sandy ocean beaches, steep cliffs rising from the sea, snow-covered mountains, irrigated farmlands and sprawling metropolitan areas make it a land of great contrasts and great natural beauty.

The coastal climate is characterized by light precipitation and mild temperatures that have small daily and annual ranges. Inland temperature variations are greater and precipitation is heavier. In general, the climate is extremely varied and ranges from desert to subtropical conditions. Annual precipitation ranges from about 10 inches along the coast to more than 40 inches in some of the higher mountain areas.

The principal streams are the Santa Clara, Los Angeles, San Gabriel, Santa Ana, Santa Margarita, San Luis Rey, San Dieguito, San Diego and Tijuana Rivers. In the coastal plain, contiguous drainage areas are separated by low, poorly defined divides. The South Coastal Basins area is water-deficient, depending upon importation for about one-half of its municipal and industrial supplies. Average annual runoff is 1.2 million acre-feet.



(photo courtesy of vtn.)

The South Coastal Basins are densely populated with over one-half the population of California (11 to 12 million) in less than 7 percent of the entire area of the State. Principal population centers are the Los Angeles-Long Beach, Ventura-Oxnard and San Diego metropolitan complexes, all of which have evidenced phenomenal growth rates.

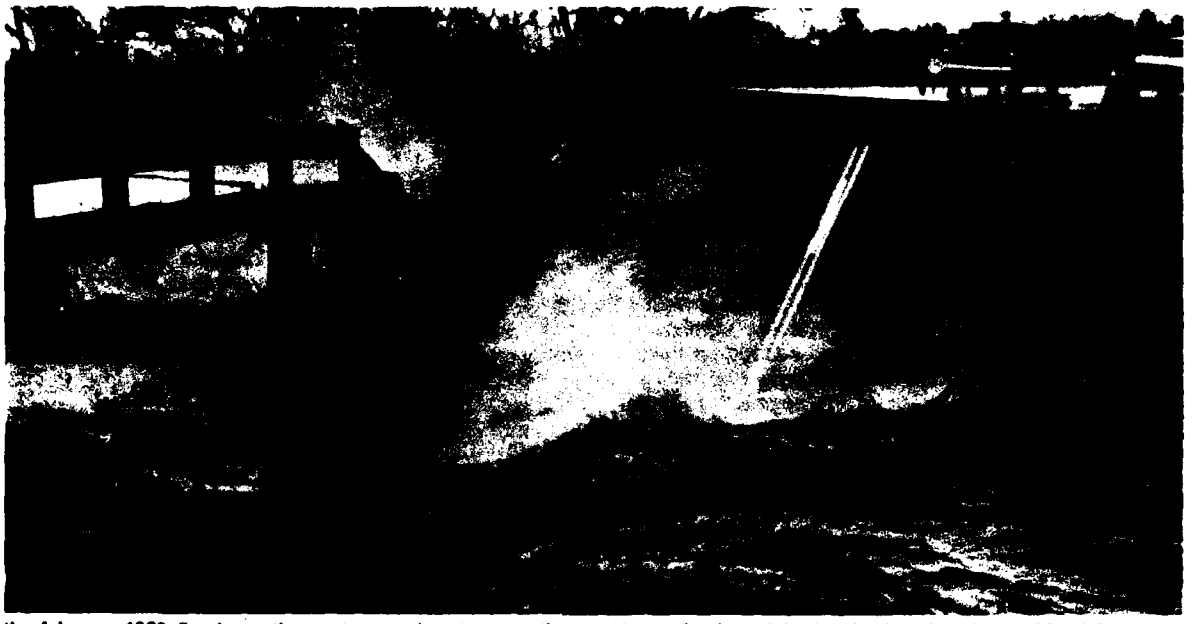
The area has a varied economic base that includes (among many other important activities) automobile assembly; television and motion picture production; petroleum production and processing; aircraft production; and the manufacture of tires, furniture and wearing apparel. Agricultural activities are also significant and include production of citrus and subtropical fruits and numerous truck crops. A large number of military establishments form a significant segment of the economic base of the area.

Transportation facilities in the South Coastal Basins are highly developed and include an extensive freeway-highway complex; transcontinental and local rail service; international and domestic air service from several airports; and deep draft harbors for foreign and coastal trade.

Much of the burgeoning urban development in Southern California has taken place on the flood plains needed for the passage of floodflows. As a result, floods in areas without adequate flood control improvements have taken heavy tolls of life and property. Most floods are produced by general winter storms that usually occur from December through March. Eight great floods have occurred in the recorded history of the basins. Of these, the floods that occurred in 1969 were the most damaging known in Ventura, Orange, San Bernardino and Riverside Counties. Although

(photo courtesy of vtn.)

south coastal basins



the february 1969 floods on the santa ana river tore out the van buren boulevard bridge in the city of riverside. (photo courtesy of riverside flood control and water conservation district.)

substantial flood damage occurred in Los Angeles County in 1969, the Los Angeles County Drainage Area Project protected the Los Angeles metropolitan area from what otherwise would have been unprecedented damage. Most of the Southern California counties were declared a national disaster area in 1969. San Diego County, which was on the southern fringes of the storms that caused the 1969 floods, and Imperial County were the only Southern California counties not included.

Other great floods of the past may have equaled or surpassed the 1969 floods in magnitude of flow, but the 1969 floods were the most damaging floods of record, largely because the other floods occurred when Southern California was not so intensively developed. More than 100 persons lost their lives in the 1969 floods. Although many flood control projects have been constructed in densely developed areas, particularly in the Los Angeles metropolitan complex, intensive development in other urban areas adjacent to unimproved or partly improved stream channels has greatly increased the flood damage potential in most areas on the coastal plain. This trend is continuing, with more agricultural and undeveloped land being developed for urban use, thereby magnifying potential flood problems.

Commercial and recreational navigation facilities have been constructed by the Corps of Engineers along the coastline. The Los Angeles-Long Beach Harbors, the largest man-made port complex in the world, were constructed to serve the Los Angeles area, which has become the commercial center of Southern California. More than 30 percent of the waterborne commerce of California passes through the harbors.

Because the ocean waters are warm enough for water-contact sports throughout the year, ocean-oriented sports are a way of life for a large part of the population. Swimming, sunbathing, surfing, fishing, water skiing and boating are year-round activities. Recreational boating has been rapidly growing since 1886 when the San Diego Yacht Club was formed. As a result, most small craft harbors are now fully developed and cannot provide additional berthing or mooring facilities. Although the Corps of Engineers has constructed eight small craft harbors, some reaches of coast between all-weather harbors exceed 35 miles — the spacing considered desirable for small craft harbors of refuge.

Erosion along the coast is a continuing problem. Of the area's 233 miles of shoreline, only about 27 miles are considered to be stable. The remaining shoreline is

being eroded at varying rates, with critical erosion taking place along 163 miles of shoreline. Erosion threatens highways, homes, business property and recreational beaches.

navigation projects

Prefatory Note
Fifty years after Columbus arrived in the New World, Juan Rodriguez Cabrillo discovered the coast of Southern California. On 28 September 1542, he sailed into San Diego Bay, which he named *Bahia de San Miguel* (Bay of St. Michael). Eight days later, he made a landfall at San Pedro Bay, which he named *Bahia de los Fumos y Fuegos* (Bay of Smokes and Fires) — probably as a result of grass fires set by the Indians to round up game. Sebastian Vizcaino, who explored the coast of California in 1602-03, bestowed the present names on these bays. He named San Diego Bay *Bahia de San Diego de Alcala de Henares* (Bay of St. James of Alcala of the Hayfields), which would later be shortened to San Diego Bay. San Pedro Bay *(Bahia de San Pedro)* was named in honor of St. Peter, the patron saint of the day Vizcaino made his landfall.

For the next 100 years, the only known visitors to San Pedro Bay were Aleuts attracted by sea otters found in the kelp beds offshore. With the coming of American trading ships carrying cloth and rum from New England to be bartered for sea otter skins, cow hides and tallow (and with the increase in coastal trade as a result of the gold rush of 1849), Southern California began to realize the importance of its great natural harbors. The need to improve and maintain these harbors were recognized by Congress in 1852 when funds were appropriated to divert the silt-carrying San Diego River back into its original course to False Bay (now Mission Bay). This marked the start of Corps of Engineers work in California.

Channel Islands Harbor (Los Angeles District)
Channel Islands Harbor, completed in 1961, is a combination small craft harbor and shore protection project. It is situated at the southern end of the Santa Barbara

channel islands harbor provides recreation for youngsters of every age — from 7 to 70 years.

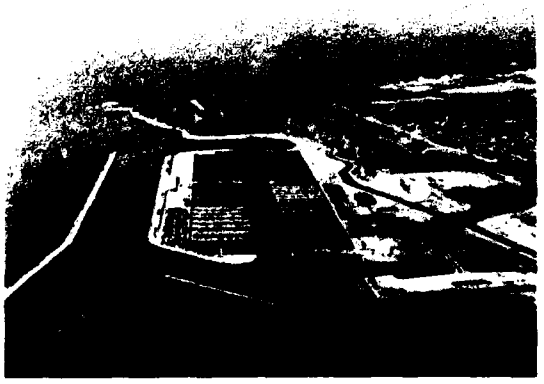
Channel one mile northwest of Port Hueneme Harbor and about 65 miles northwest of Los Angeles Harbor. The Federal share of the $7.3 million project was $6.5 million, with local interests providing the remaining $800,000. Federal maintenance costs to 30 June 1976 total $10 million.

Channel Islands Harbor was constructed by the Corps of Engineers as a by-product in developing a solution to sand problems created by Port Hueneme. A sand trap was constructed to pass more than 1 million cubic yards of sand annually around Port Hueneme to downcoast beaches. The harbor was formed by constructing two jetties and a 2,300-foot long offshore breakwater, incorporating a harbor entrance into the sand-trap structures, and excavating a harbor for small craft; about 6.2 million cubic yards of dredged materials were deposited on the downcoast shoreline. The completed harbor includes an entrance channel, entrance basin, and inner and side basins. Controlling depths of the harbor range from 10 to 20 feet.

Approximately 1,000 small craft are berthed in the harbor. Private interests have spent about $10 million to construct motels, restaurants and other harbor facilities. Biennial restoration and maintenance of the downcoast shoreline provides protection to public beaches and to residential, agricultural, commercial and industrial property in and near the City of Port Hueneme.

Dana Point Harbor (Los Angeles District)
Dana Point Harbor, completed in 1970, consists of breakwaters, entrance and interior channels, an an-

▲ *this scale model of dana point harbor was constructed at the corps of engineers waterways experiment station in vicksburg, mississippi. it was used to design the harbor to protect boats from waves and surge.*



◀ *dana point harbor, completed in 1970, won the chief of engineers 1972 distinguished design award for civil works.*

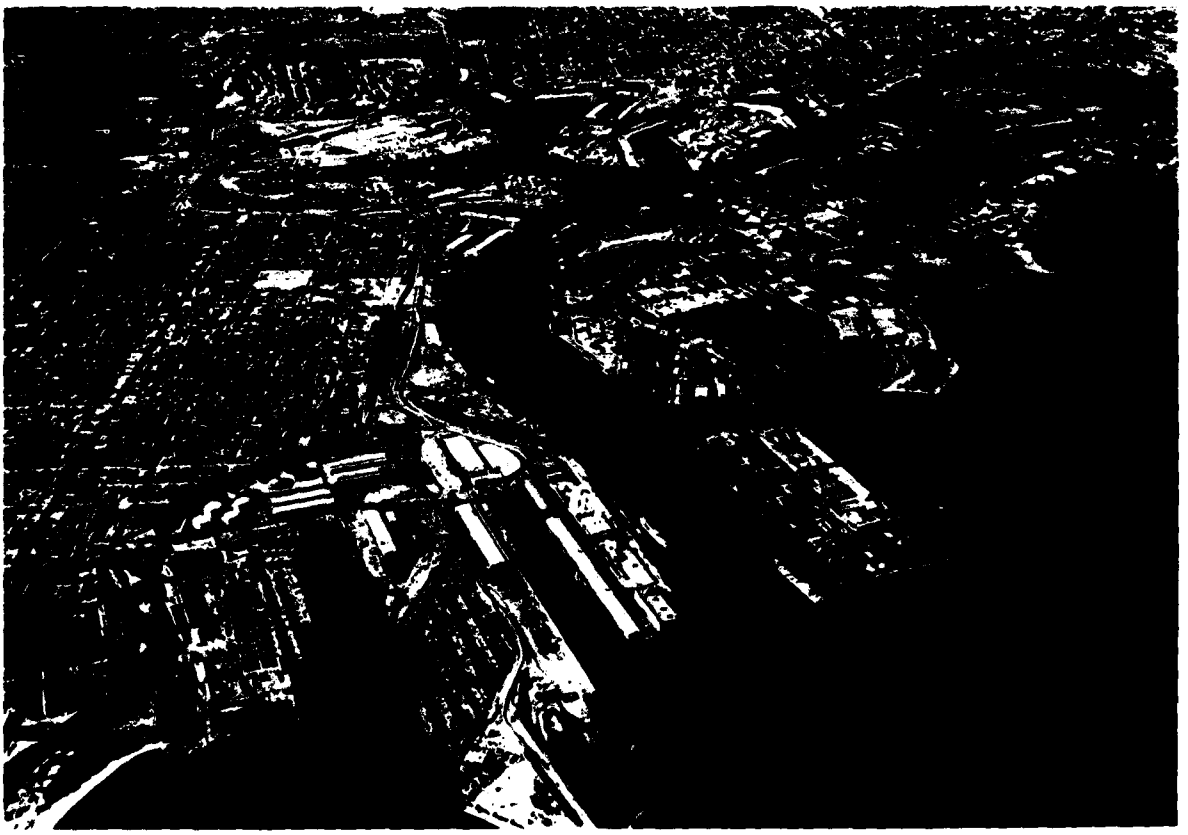
chorage area and a turning basin. Controlling depths range from 10 to 20 feet. Cost of the harbor was about $9.5 million, which was shared about equally by Federal and non-Federal interests. The Orange County Harbors, Beaches and Parks District has spent another $10 million for harbor improvements, and other local interests have provided support facilities costing about $5 million.

Dana Point Harbor was planned with special environmental awareness and was coordinated with redevelopment of Doheny State Beach. A marine life refuge will be established adjacent to the harbor, and a site within the harbor is devoted to a marine studies institute. Marine life in the harbor has rapidly multiplied due to environmental changes resulting from construction of the breakwaters and an internal seawall.

Dana Point Harbor provides an important link in the chain of harbors of refuge for light draft vessels along the Pacific Coast. At present 1,565 small boats are berthed in the harbor. By 1977, mooring spaces for about 2,200 boats will be available.

The project has an unusual construction history in that the entire harbor design was the first to be model-tested at the Corps of Engineers Waterways Experiment Station in Vicksburg, Mississippi, and it was the first project to have a laser beam used in the alignment of breakwaters. The harbor received the 1972 Chief of Engineers Distinguished Design Award for Civil Works.

the port of los angeles covers more than 7,000 acres of land and water. the port of long beach begins at the extreme upper right in this photo.



south coastal basins

Los Angeles and Long Beach Harbors (Los Angeles District)
Only bold initiative and creative engineering vision could have effected the transformation of the open roadstead at San Pedro into the two magnificent harbors that exist today. Although the enterprising inhabitants of the Los Angeles area had pushed for a deep water habor throughout the late 1800s and the 1871 River and Harbor Act authorized construction of the now existing breakwater at Wilmington, it was not until the Los Angeles District of the Corps of Engineers was established in 1898 that such a harbor began to become a reality.

Los Angeles and Long Beach Harbors now comprise one of the most extensive man-made harbor improvements in the world, with more than 18 square miles of water area leeward of stone breakwaters. The $36.3 million harbor complex includes two separate outer harbors, with anchorage areas protected by more than 8 miles of stone breakwaters, and two separate inner harbors connected by a navigable waterway. The inner harbor channel is 40 feet deep and 1,000 feet wide. The Los Angeles Harbor entrance channel was dredged to a depth of 52 feet to the supertanker wharf by the City of Los Angeles. The Long Beach Harbor entrance channel was dredged to a depth of 62 feet by the Port of Long Beach. The extensive interior system of turning basins and connecting channels in both harbors accommodates most oceangoing vessels.

In 1958, the old West Basin bridge, which had caused more than 200 marine accidents and interfered with the free movement of 60 million tons of cargo since 1931, was removed. The Federal share of the bridge removal project was $120,000.

night view of los angeles harbor

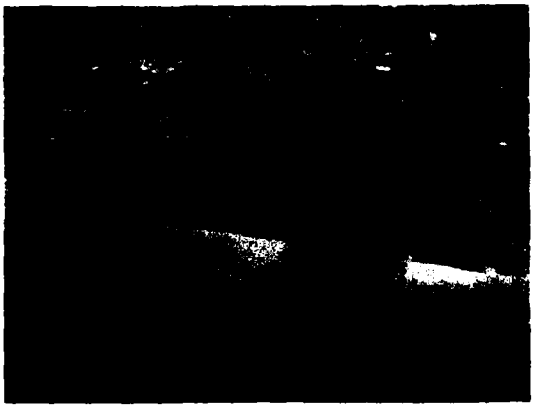
In 1976, dredging to a depth of 45 feet to accommodate deep draft vessels was authorized. The dredging would be done in the Los Angeles Harbor main channel, the turning basin, and the East and West Basins. Dredged material would provide 187 acres of additional land between Terminal Island and the U.S. Naval Station. The material would be placed behind rockfaced dikes built by the Port of Los Angeles.

To date, the Federal first cost of work completed totals $34.6 million, and the non-Federal first cost $1.7 million. Federal maintenance costs to date total $3 million. The Federal cost of the additional dredging is estimated at $16 million.

Traffic through the Los Angeles and Long Beach Harbors includes almost every classification of commerce. In 1975, the total commerce handled at these harbors amounted to more than 57 million tons. About 3,000 small recreational craft are berthed in Los Angeles Harbor, and about 1,700 in Long Beach Harbor.

An investigation of Los Angeles and Long Beach Harbors was authorized by Congress and began in 1965. Its purpose is to determine the advisability of modifying the existing harbors to accommodate deeper draft vessels, especially the supertankers. Consideration is being given to deepening the outer harbors and providing additional shallow draft recreational boating facilities. The final report, which will make recommendations on optimum development of both harbors, is scheduled for completion in 1979.

In 1970 the population of the area tributary to the harbors was 19 million. It is expected to increase to 26 million by the year 2000. Waterborne commerce



◀ *marina del rey is one of the largest small craft harbors in the world. (photo courtesy of los angeles county flood control district.)*

extensive development has been attracted by the facilities at marina del rey. restaurants, hotels and condominiums now ▼ *surround the harbor.*

through the harbors was 57 million tons (including military cargo and ship fuel) in 1975. By the year 2000, commerce is expected to increase to about 180 million tons. Projections indicate that about 6,000 deep draft vessels will arrive or depart at the harbors annually. At present, there are only three ports in the United States (Los Angeles, Long Beach and Seattle) where a vessel in the 100,000 ton dead weight load range can be fully loaded at berth.

Marina del Rey (Los Angeles District)
Marina del Rey, one of the largest small craft harbors in the world, is located about 20 miles upcoast from the Los Angeles Harbor. Authorized in 1954 and completed in 1965, the $27.5 million marina was developed as a joint project by the Corps of Engineers and Los Angeles County. Federal costs were approximately $4.3 million. The project consists of an offshore breakwater, entrance jetties, dredging the entrance and main channels and revetment of the banks adjoining the upper part of the entrance channel. The local share of the project, amounting to $23.2 million, included contributing 50 percent of the cost of the Federal work and dredging the eight side basins in the marina. Controlling depths range from 10 to 20 feet. Federal maintenance costs to date total $329,000.

Efforts to develop Marina del Rey began in 1886 when the Santa Fe Railroad attempted to convert the estuary of Ballona Creek into a major world port. The plan failed, as did others as recently as 1930. However, by the 1940s the expanding fleet of small boats in Los Angeles County and the growing interest in recreational boating pointed up the need for a harbor to be home port for many small craft and a harbor of refuge.

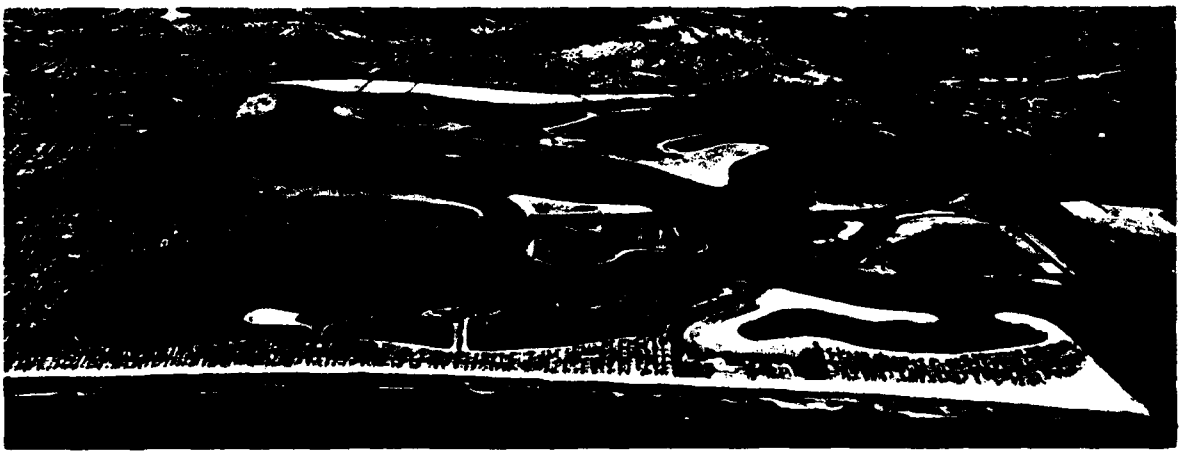
Approximately 5,800 small boats are berthed at Marina del Rey, which is used entirely for recreational and sport fishing. Private interests have spent about $153 million to provide motels, restaurants, condominiums, luxury apartment complexes and other facilities.

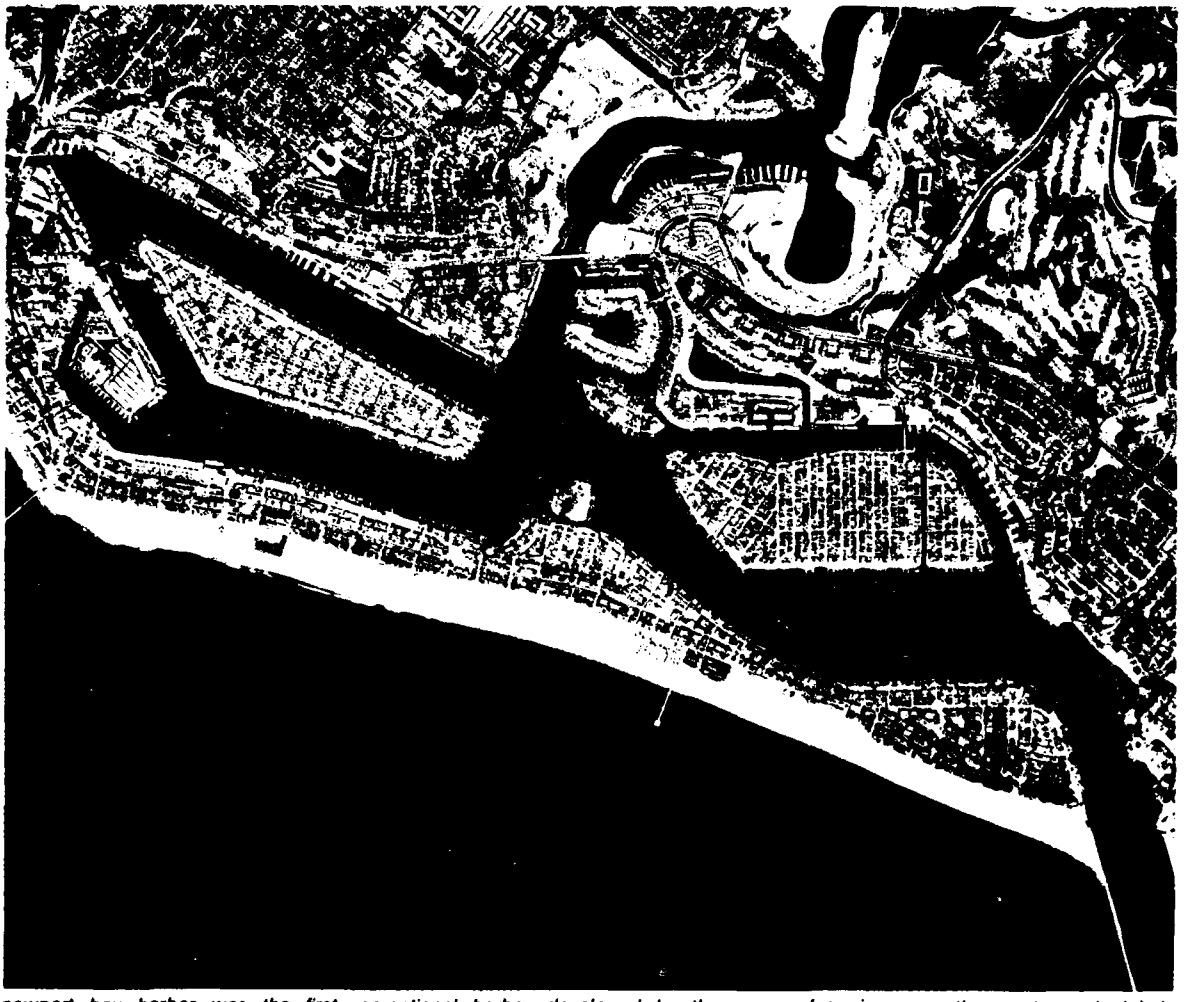
San Diego River and Mission Bay Harbor (Los Angeles District)
Mission Bay Harbor, one of the most scenic water-oriented recreational areas in the world, is located about 10 miles north of the entrance to San Diego Bay. Thousands of recreational and sport fishing craft move across the harbor's sheltered waters and thousands of vacationing tourists enjoy the hotels and restaurants built along the shoreline. Other attractions at Mission Bay Harbor include Sea World Park, swimming beaches, water skiing areas and a golf course.

Maintained by the Corps of Engineers, Mission Bay Harbor is part of a dual-purpose project designed for flood control on the San Diego River and for navigation of shallow draft vessels in Mission Bay.

Harbor features include stone revetments for the entrance channel, the main channel and the turning basin. Controlling depths of the harbor range from 15 to 25 feet. The entrance jetties function to stabilize both the navigation entrance channel and the mouth of the San Diego River floodway. The middle jetty, which separates the navigation channel from the floodway, is

view of mission bay harbor. the san diego river flood control improvements are on the right. (photo courtesy of the san diego union.)





newport bay harbor was the first recreational harbor developed by the corps of engineers on the west coast. (photo courtesy of vtn)

a feature of both the navigation and flood control improvements. These facilities are maintained by the Corps of Engineers.

More than 2,000 small recreational and sport fishing boats are berthed in Mission Bay Harbor. The harbor area, not yet fully developed, will consist of about 2,000 acres of navigable water and an equal area of land. The harbor will eventually berth about 3,000 boats. A new marina for an additional 500 small craft is scheduled for development. When completed, the first cost of the project is estimated at $32.4 million ($14.9 million in Federal costs and $17.5 million in non-Federal costs).

Newport Bay Harbor (Los Angeles District)
Newport Bay Harbor, located about 24 miles southeast of the Los Angeles-Long Beach Harbors, is one of the showplaces of Southern California. Luxury homes line

the shore and fill the islands in the bay. The harbor is a popular year-round resort for vacationers and pleasure boat enthusiasts, many of whom live in the immediate area. About 8,000 small craft are berthed in the harbor.

Beginning in 1933 the Corps of Engineers began to work in conjunction with local interests to build the $1.6 million harbor. It consists of rubblemound entrance jetties, entrance and inner channels, a turning basin and anchorage facilities. Project costs were shared equally between the Federal government and local interests. Since 1916, Orange County and the City of Newport Beach have spent about $4 million for dredging and jetty work that supplements the Federal project.

The initial phase of the project, amounting to 76 percent, has been completed and is under Federal maintenance. Work not yet completed consists of widening the main channel to a general width of 350 feet, deepening Newport channel (one of the inner channels) to 15 feet and dredging the north and south anchorages to a depth of 20 feet. At present, the uncompleted part of the project is in an inactive category.

Oceanside Harbor (Los Angeles District)
Oceanside Harbor, once a beach fronting the City of Oceanside, is located about 30 miles north of the City of San Diego. Completed in 1963 by the Corps of Engineers, the project includes an approach channel, entrance and inner channels, a jetty, a turning basin and the Del Mar Boat Basin. The Del Mar Boat Basin was built in 1943 by the U.S. Marine Corps and is used exclusively as the harbor for Camp Pendleton. Controlling depths of the harbor range from 10 to 20 feet.

Authorized by Congress in 1958, the small craft harbor was developed concurrently with dredging operations and restoration of the beach as a beach erosion control and shore protection project. Presently about 700 small craft are berthed in the harbor and 12 commercial and sport fishing boats use the harbor. Thirty-five mooring spaces are maintained to accommodate visiting small craft. Permanent mooring facilities are provided for a U.S. Coast Guard cutter. The harbor's waterborne commerce consists mostly of fish and fish products. Since 1965 the Corps of Engineers has maintained the general navigation features of Del Mar Boat Basin and Oceanside Harbor. Federal maintenance costs to June 30, 1976, total $4.6 million. Del Mar Boat Basin is used exclusively by the U.S. Marine Corps.

An investigation to determine the feasibility of modifying the existing Oceanside Harbor Project has been authorized by Congress. The investigation, which began in 1968, is being made to determine the need of modifying the existing project to accommodate present and future mooring facilities in the harbor and to reduce the problems resulting from shoaling in the navigation channel. At present, the berthing deficit in the area tributary to the harbor is about 700. The deficit will continue to grow as the population increases.

The rapid rate of shoaling taking place in the entrance to Oceanside Harbor is impeding navigation in and out of the small craft harbor and is also hindering vessel movement in the adjacent Del Mar Boat Basin. A companion beach erosion control study is currently underway and is being closely coordinated with this investigation. It is currently scheduled for completion in mid-1978.

A possible solution to the problem at Oceanside Harbor is to extend the south jetty of the entrance to the harbor and to construct a south breakwater beginning at the mouth of the San Luis Rey River. The investigation is currently scheduled for completion in 1978.

oceanside harbor provides berthing facilities for about 700 small craft.

Port Hueneme Harbor (Los Angeles District)
Port Hueneme Harbor, known as Central California's gateway to world trade, is located in Ventura County. The harbor is the only port for deep draft (35 feet or more) shipping between the Los Angeles-Long Beach Harbors 65 miles to the south and the San Francisco-Oakland Harbors more than 400 miles to the north.

Port Hueneme, which is presently used by deep draft commercial vessels and the U.S. Navy, consists of jetties, approach and entrance channels, an interior channel and a central basin. Controlling depths range from 32 to 40 feet.

The harbor is a man-made improvement constructed by local interests, represented by the Oxnard Harbor District. In planning for the harbor, the harbor district capitalized on a unique and advantageous natural undersea phenomenon, the deep Hueneme Chasm, which leads to Hueneme Lagoon. Completed in 1940, the harbor operated commercially until it was taken over by the Navy in 1942 at the beginning of World War II. The Navy enlarged and improved the harbor to its present capacity. The wisdom of the Navy in enlarging the port is evidenced by the fact that more dry cargo (such as steel, lumber and Seabees equipment) for the Navy was shipped from Port Hueneme during World War II than from any other port in the United States. The same was true during the Korean hostilities and again during the operations in South Viet Nam. At present, the Navy has berthing areas and terminal facilities around the perimeter of the central basin, along the sides of a 600 by 800 foot slip off the central basin and along one side of the interior channel. Since 1961, when the Navy sold the area to the Oxnard Harbor District, local interests have had berthing areas and terminal facilities along the other side of the channel.

The 1968 River and Harbor Act authorized adoption of the existing harbor as a Federal project to provide for maintenance of the existing east and west jetties and approach and entrance channels, and for improvement

port hueneme is the only port for deep draft vessels between the los angeles-long beach port complex and the san francisco-oakland port complex.

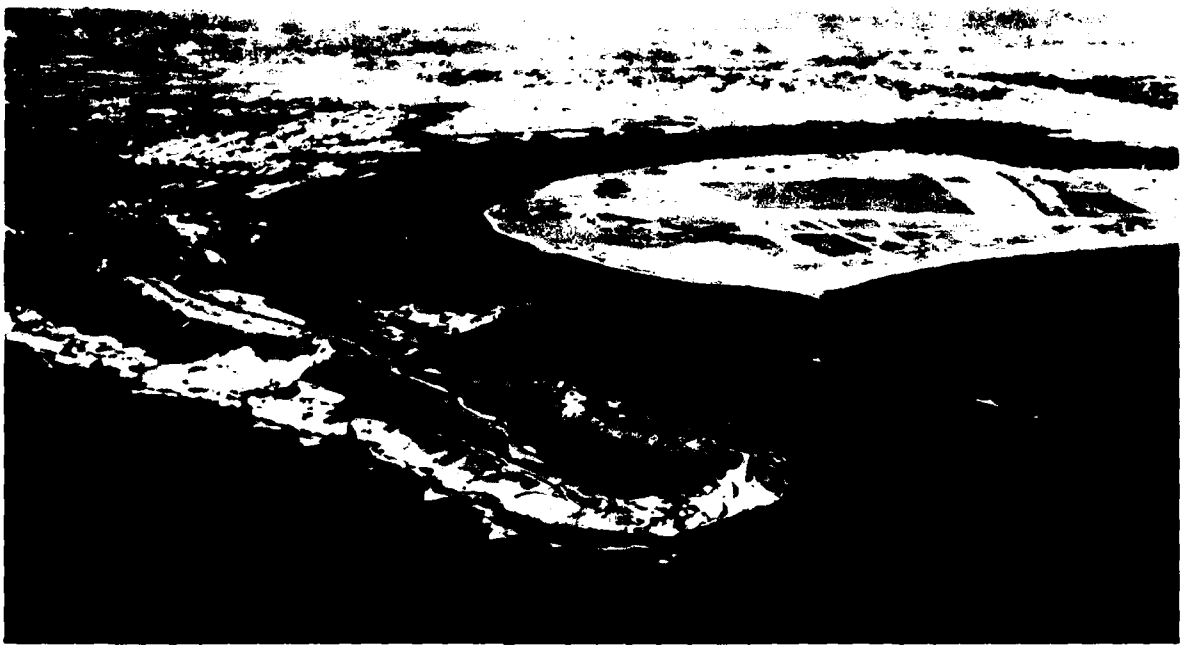
of the central basin and the interior channel (Channel A). Local interests have completed some of the authorized work by lengthening and widening Channel A. They will be reimbursed by the Federal government for this work. The estimated first cost (1974) of this work is $2.3 million ($1,720,000 in Federal cost and $614,000 in non-Federal cost).

Shipping tonnages should be substantial for the improved Port Hueneme Harbor because of its proximity to rapidly expanding major distribution centers in the southern San Joaquin Valley and in Santa Barbara and Ventura Counties. In 1975 the total commerce handled at Port Hueneme amounted to more than 1 million tons. By the year 2000 estimates indicate that more than 2 million tons will be handled annually.

Redondo Beach King Harbor (Los Angeles District) Redondo Beach King Harbor, in Santa Monica Bay

storm waves in 1944 attack the eroded beach, destroying buildings. ▶

this view of redondo beach king harbor shows the protection provided by the corps-built breakwaters. ▼



the 18 square miles of water area in san diego harbor are used extensively by the u.s. navy, commercial vessels, fishing boats and recreational craft.

about 10 miles south of Marina del Rey, was completed in 1958. It is named for Congressman Cecil King, who played a major part in obtaining Congressional appropriation of funds. The project consists of two breakwaters, an entrance channel and three basins. Controlling depths of the harbor range from 8 to 30 feet. About 1,500 small craft use the harbor which also functions to provide shore protection to a rapidly eroding section of the beach fronting the City of Redondo Beach.

After the project was completed, it became apparent that wave energy during storms activated seiche and surge conditions that caused damage to boats and structures in the harbor. Remedial measures were adopted after the completion of highly sophisticated research investigations that combined on-site study with several large-scale model tests to obtain designs that would resolve some of the problems plaguing the project. The most important finding of the investigation was that a breakwater must be relatively impermeable to waves. To achieve this and correct the problems, the Corps performed remedial construction on 2,050 feet of the existing north breakwater. This work, which was completed in 1964, consisted of raising the crown elevation to 22 feet above low water and raising the core to 9 feet above low water to decrease the wave energy inside the harbor.

In 1976, the Corps constructed three concrete baffles to prevent surge in the boat basins. The concrete baffles replaced timber baffles damaged by marine organisms.

Redondo Beach King Harbor is a project in which the City of Redondo Beach takes great pride, particularly because the harbor is an integral part of the city's successful urban redevelopment program. Expensive condominiums and apartment buildings have replaced old and rundown structures, and a quiet old town is being transformed into a popular resort area.

Federal costs of the project, including modifications and remedial work, total $5.1 million.

San Diego Harbor (Los Angeles District)
The Corps of Engineers has been working on San Diego Harbor, a landlocked crescent-shaped bay, since Congress passed the 1852 River and Harbor Act. San Diego Harbor is located in the extreme portion of Southern California just north of the Mexican border.

Original work consisted of a makeshift levee that diverted the San Diego River into an old channel discharging into False Bay (now known as Mission Bay). Within two years, however, the levee disappeared under the impact of floodflows because there had been no money to install protective stone revetment.

In 1875 Congress appropriated sufficient funds to build a substantial levee that would hold the San Diego River to its original course and prevent destruction of the harbor. From that time on, numerous improvements were authorized by subsequent River and Harbor Acts to meet the demands of expanding commerce. The project consists of a rubblemound jetty, entrance and interior channels, anchorage areas, turning basins and a seaplane basin. Controlling harbor depths range from 20 to 42 feet. Total Federal costs are about $10 million. The improvements authorized prior to 1968 are complete except those deleted by the 1968 River and Harbor Act. Maintenance costs by the Corps total $1 million.

The 1968 River and Harbor Act authorized modifications to provide for deepening and extending the existing navigation channels and extending authorized maintenance to include channel dredging or deepening by the U.S. Navy or local interests. The estimated Federal cost for these improvements is $20,834,000 ($19,300,000 Corps of Engineers, $1,529,000 US Navy, and $5,000 U.S. Coast Guard), and the estimated non-Federal first cost is $4,030,000. The improvements are scheduled for completion by late 1977.

San Diego Harbor's water area of about 18 square miles serves as home port for a large portion of the U.S. Navy as well as for commercial vessels, fishing boats and recreational craft. The harbor contains three yacht basins, Shelter Island, Harbor Island and Glorietta Bay, that berth about 3,300 small craft.

The population of the area tributary to San Diego Harbor was 1.4 million in 1970 and is expected to increase to 2.7 million by the year 2000. Waterborne commerce amounted to about 2 million tons in 1975. General dry cargo tonnage is expected to increase to nearly 5 million tons by the year 2000.

Great efforts have been made to improve environmental and ecological aspects of all operations in San Diego Harbor and have paid off well. The water quality of the southern extremity of the bay has been improved to the point where marine plants and animals now thrive where no organic life of consequence existed 15 years ago. San Diego Harbor is now the cleanest major commercially used estuary in the United States and has become an industrial and recreational complex providing jobs and varied recreational opportunities for many thousands of people.

An investigation to determine the need for constructing an entrance to San Diego Harbor through the Silver Strand, the strip of land running parallel to San Diego Bay and dividing it from the Pacific Ocean, was authorized by Congressional resolution in 1958. The north bay is heavily congested with Navy and recreational craft from its entrance at Point Loma to the National City Marine Terminal. About 700 commercial vessels must pass through this traffic each year to reach terminals and dock facilities south of the Navy and recreational facilities. The San Diego Unified Port District has indicated its strong desire for a second harbor entrance because of the projected increase in traffic.

The scope of the study was extended to include model studies requested by the Navy in 1966. The U.S. Navy has indicated that another entrance to San Diego Bay is desirable but is not essential to the conduct of naval operations in the area.

The Port District has prepared a master plan designed to provide optimum development of the bay and, at the same time, protect all the bay's beneficial uses. The investigation will take into consideration the development proposed under the master plan and will be closely coordinated with interested Federal, State and local agencies. The completion date of the investigation is indefinite.

Ventura Marina (Los Angeles District)
Ventura Marina, a man-made harbor located 6 miles northwest of Channel Islands Harbor was completed by local interests in 1963. This $3.4 million project consists of three jetties, an offshore breakwater, a sand trap leeward of the breakwater, an entrance channel and recreational facilities. Controlling depth of the harbor is 20 feet. Project cost was shared equally by the Federal government and local interests. Maintenance costs to date total $3.24 million.

The harbor has been plagued with disasters or near disasters that have closed the facility an average of 66 days each year from 1963 to 1969. During this time, hazardous conditions were caused by breaking waves in the harbor entrance and excessive buildup of sand. As a result of a dangerous entrance condition, innumerable boating accidents occurred. In 1969, the marina was almost destroyed by Santa Clara River floodflows carrying telephone poles, raw sewage, planks and

ventura marina

other debris. Mooring facilities, ramps and 92 boats were destroyed.

Harbor improvements authorized in 1968 and completed in 1972 consisted of a new detached breakwater and dredging to form the sand trap.

Ventura Marina's proximity to the Channel Islands makes it a haven for vacationing yachtsmen and year-round boating enthusiasts. Since 1963, the Ventura Port District has spent more than $6 million for harbor facilities, and private interests have spent more than $1.5 million to provide facilities for recreation and sport-fishing craft. A privately constructed residential marina, Ventura Keys, adjoins the harbor and has access to the ocean through the Ventura Marina entrance channel. Ventura Keys now consists of more than 350 waterfront homes and 450 interior residences.

About 350 recreational boats presently based at Ventura Marina and about 80 recreational craft based at Ventura Keys use the harbor entrance. Use of Ventura Marina is expected to increase sharply now that the authorized additional navigation improvements are completed.

An investigation to review the previously constructed

harbor improvements was authorized in 1973 with particular emphasis to be placed on determining the feasibility of modifying the detached breakwater. Under certain winter sea conditions, considerable wave action has been observed at the downcoast end of the breakwater. As the entrance channel to the harbor is located immediately adjacent to that end of the breakwater, a navigation hazard in the form of high waves is encountered by boats entering and leaving the harbor when these winter sea conditions exist. In addition, Santa Clara River flood flows in 1969 created a large delta in the area, altering the bottom contours to such an extent that this alteration may intensify these adverse winter wave conditions. The investigation has not yet been initiated.

navigation studies

North Coast of Los Angeles County (Los Angeles District)
An investigation to determine the needs of existing small craft harbors and for construction of new small craft harbors along the north coast of Los Angeles County was authorized in 1945. The 25-mile section of coast from the City of Santa Monica to the Ventura County line will be evaluated.

Included are separately authorized studies of Malibu Creek, Paradise Cove, Point Dume and Santa Monica Harbor. These sites have a common tributary area comprising the western part of Los Angeles County and a small part of southwest Ventura County. The population of this tributary area was 3.2 million in 1970 and is expected to be 4 million by 1980.

At present there is a need for a centrally located harbor of refuge in the study area. The nearest harbor is Marina del Rey, which is about 4 miles southeast of the City of Santa Monica. The nearest upcoast harbor is Channel Islands Harbor, which is about 45 miles from Santa Monica. Of those sites studied, Paradise Cove, which is 20 miles north of Marina del Rey and 30 miles south of Channel Islands Harbor, fits best into the State's overall plan to provide harbors of refuge along the entire California coast no more than 35 miles apart. However, opposition to a small craft harbor at Paradise Cove has been expressed by many property owners and by the State of California Department of Fish and Game.

The annual loss of life and property as a result of boating accidents in an area without a small craft harbor shows the urgent need for such a facility.

No definite completion date is presently scheduled for the investigation.

San Pedro Ports (Los Angeles District)
In 1976, a study was authorized to determine the water and surface transportation needs resulting from the expansion and further development of the San Pedro Bay ports. The study will include consideration of the feasibility and advisability of enlarging the Dominguez channel for flood control purposes. The study will begin when funds are made available.

Sunset Harbor (Los Angeles District)
This is an investigation to determine the advisability of constructing Sunset Harbor, a small craft recreational harbor, and establishing the feasibility and desirability of recreating a tidal marsh upon State controlled lands in Bolsa Chico Bay.

Sunset Harbor, which would be located in Orange County about nine miles southeast of the City of Long Beach, would serve the Los Angeles-Long Beach and Anaheim-Santa Ana-Garden Grove metropolitan areas. The investigation will include consideration of general navigation improvements, including an entrance channel on Bolsa Bay in conjunction with Marina developments proposed by local interests, and reestablishment of a salt marsh for restoration and preservation of wildlife habitat in the Bolsa Chico area. The latter will include evaluation and investigation of levees, channels and other works needed to provide and maintain tidal waters within the proposed marsh.

The population of the tributary area was about 3½ million in 1976 and is expected to increase to about 5½ million by the year 2000. The need for small craft facilities is expected to keep pace with the increase in population. At present there is a deficit of about 4,700 berthing spaces in the immediate area.

The investigation was initiated in 1965 and is scheduled for completion in 1982.

West Newport Marina (Los Angeles District)
An investigation was authorized in 1975 to determine the advisability of constructing a small craft recreational harbor along the east bank of the Santa Ana River in the West Newport area.

The 1,019-acre study area extends from the Santa Ana River on the west to the Costa Mesa-Newport bluffs on the east, and from Pacific Coast Highway on the south to Banning Place on the north.

A private engineering study indicates a small craft harbor, to accommodate 3,000 boats, is feasible. The need exists; the demand for mooring facilities grows each year. The investigation will begin when funds are made available.

multipurpose projects

Los Angeles County Drainage Area Project (Los Angeles District)
The Los Angeles County drainage area project is one of the most comprehensive projects ever built to provide protection against floods to a metropolitan area. The project, which was built by the Corps of Engineers (in cooperation with the Los Angeles County Flood Control District) includes 5 dams, 22 debris basins, and almost 300 miles of channel improvements. Project facilities are along the main stems and tributaries of the Los Angeles and San Gabriel Rivers, the Rio Hondo, and Ballona Creek. All dams are maintained by the Corps, which also maintains the Haines Canyon debris basin and channels authorized before 1941. The rest of the project is maintained by the Flood Control District.

The project protects about 325,000 acres in Los Angeles County from the hazards of periodic flooding. The flood plain includes areas in the Cities of Los Angeles, Pasadena, Glendale, Burbank, and Long Beach; many other cities in this densely populated Southern California region; and thousands of acres of valuable agricultural land.

The project, which is 99.9 percent complete, is operated in conjunction with supplemental flood control improvements built by the Flood Control District. Excluding expenditures of the Flood Control District for existing and planned future supplemental flood control improvements ($1.37 billion and $1.4 million, respectively), the cost of the project was about $433.3 million, ($354.6 million in Federal cost, including Whittier Narrows Dam, and $78.7 million in non-Federal cost). In addition, about $8.0 million in cost of recreational facilities was shared equally by the Corps and local interests. During the 1969 floods, the project prevented damages estimated at more than $1 billion. Since its construction, the project has prevented more than $1.68 billion in flood damages. The uncompleted part of the project is now in an inactive category.

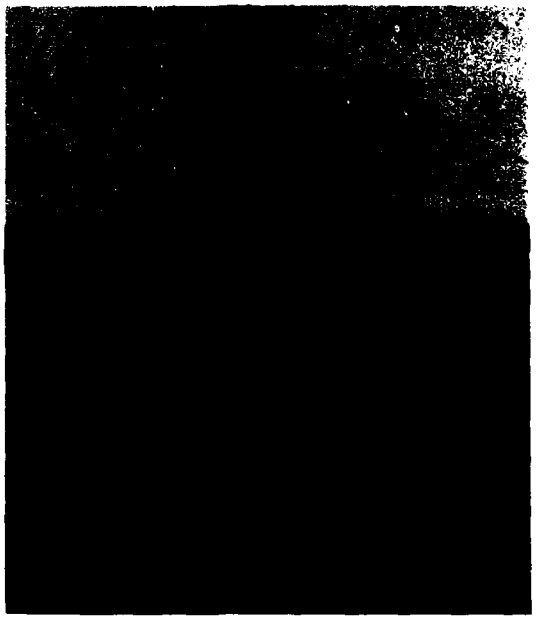
In addition to providing protection against floods, the project has made possible extensive recreational development in areas that otherwise would be completely urbanized. Much of the development has been done by the Corps in partnership with the City and County of Los Angeles. The recreational facilities afford opportunities for camping, picnicking, riding, hiking, bicycling, golf, archery, and tennis, as well as for water-oriented activities such as fishing, swimming, boating, and water skiing.

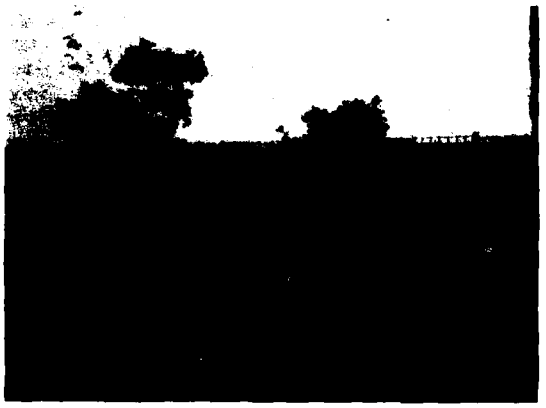
The project also contributes to groundwater recharge through a system of spreading grounds that are fed water retained in debris basins and flood control reservoirs after storms. The water percolates through sand and gravel into the groundwater system. The Flood Control District has installed special inflatable dams in soft-bottom sections of the San Gabriel River to trap end-flow from storms, thus allowing additional runoff to percolate to the groundwater system. Each year, more than 330,000 acre-feet of water is added to the underground system by the Los Angeles County drainage area project. On the basis of a per capita daily use of 150 gallons, the water added to the underground system serves almost 2 million people each year.

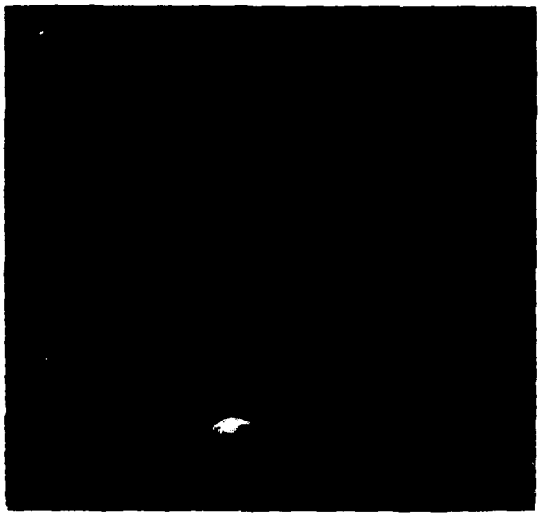
Although the Los Angeles County drainage area project prevented more than $1 billion in flood damages during the 1969 floods, about $10 million in damages occurred — mostly from mudflows in rapidly developing foothill and canyon areas not protected by flood control improvements. In addition, about $2 million in damages from landslides occurred in the Pacific Palisades area.

Studies of the Los Angeles County drainage area and the San Gabriel River Basin were authorized in 1969.

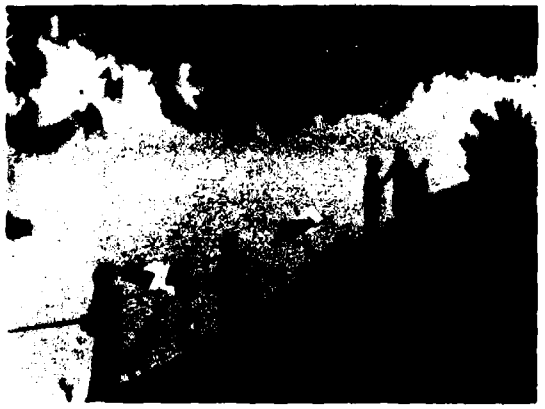
roofs of homes barely protrude over channel banks in this view of the los angeles river channel (part of lacda project) carrying a new record peak flow during the January 1969 flood (102,000 cubic feet per second at Long Beach)

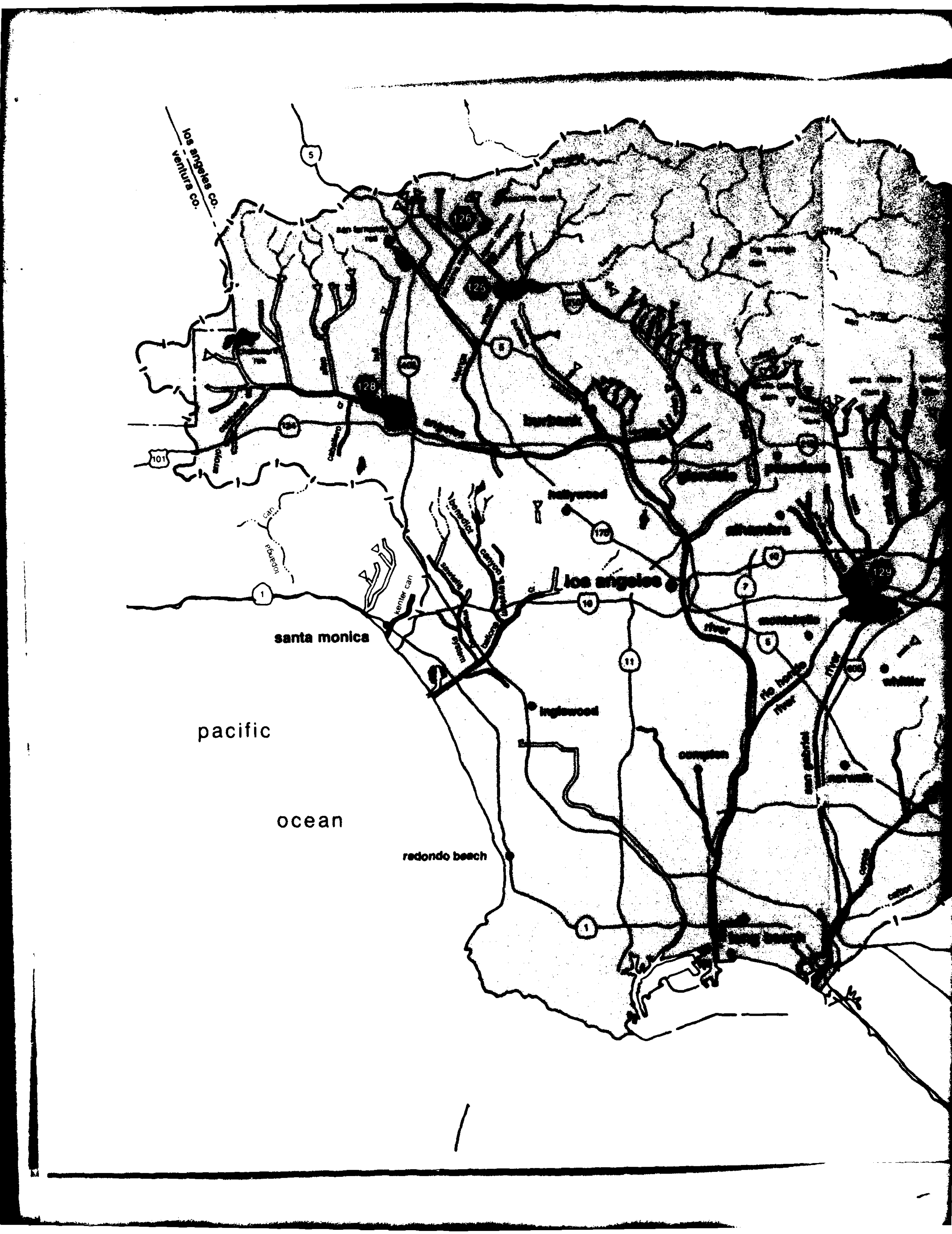






hansen dam recreational area offers something for everyone: picnic area and baseball field, solitude for the loner, companions for the gregarious, panoramic views for the horseman, and ever-popular fishing.

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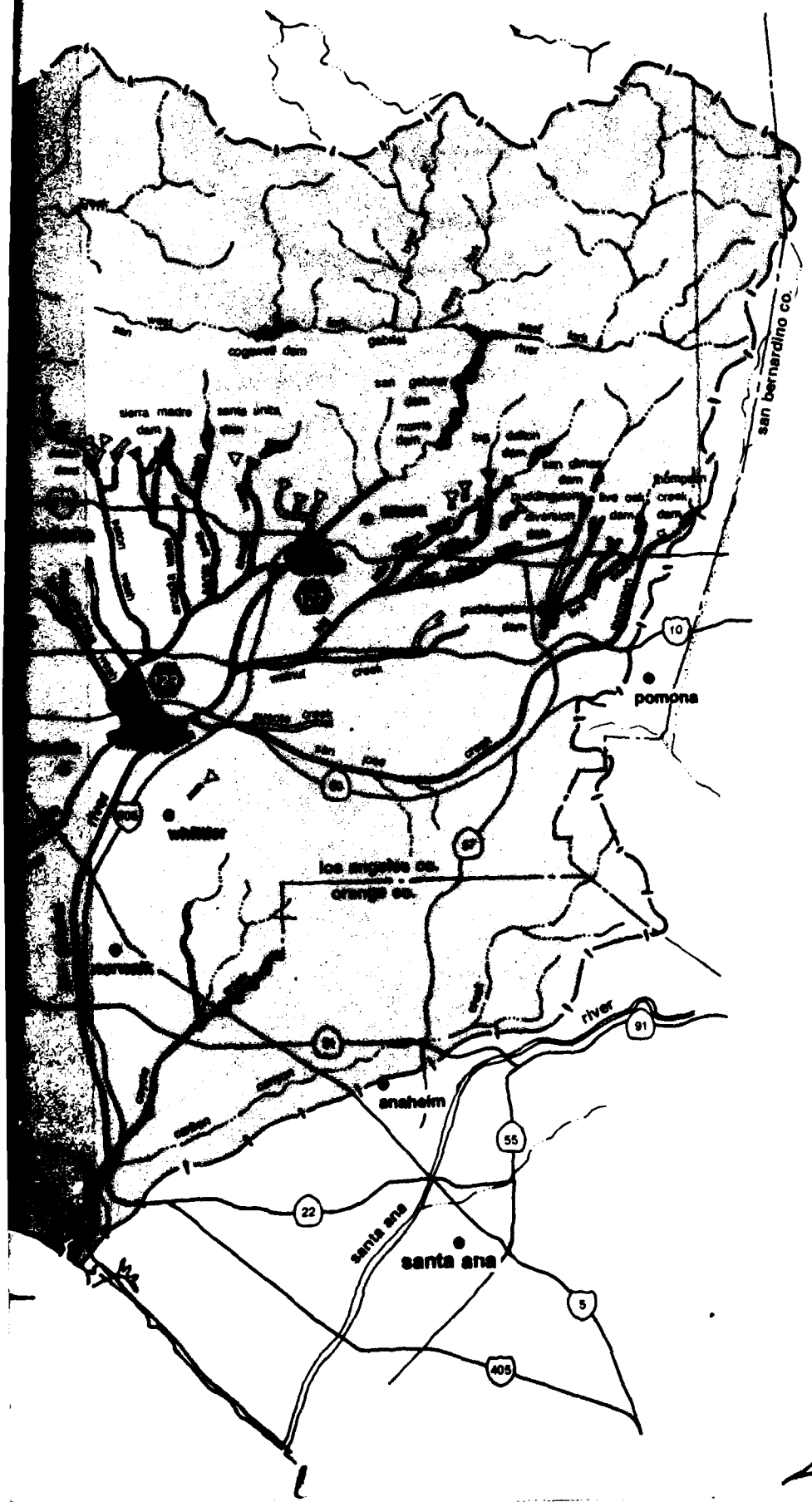
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2

view of hansen dam during february 1969. constructed at a cost of about $431 million, the los angeles county drainage area project prevented damages estimated at more than $1 billion during the 1969 floods alone.

The studies will include consideration of the adequacy of seven existing improved channels, with a total length of 34 miles, mostly constructed by local interests; the need for improving about 65 miles of channels along 44 unimproved streams; review of 4 existing Corps reservoirs to determine the desirability of incorporating additional water conservation and recreational features; and review of 22 existing debris basins and 295 miles of existing channel improvements to determine the feasibility of adding landscaping, environmental, and recreational features. The report on the study is scheduled for completion in 1983. An interim report on the Ballona Creek drainage area is scheduled for completion in 1980.

Pertinent information on the dams in the project is given in the following paragraphs.

hansen dam
Hansen Dam is an earthfill structure 97 feet high and 10,475 feet long on Tujunga Wash about 9½ miles upstream from its confluence with the Los Angeles River. The dam and reservoir (capacity 29,700 acre-feet) were completed in 1940 at a Federal cost of $11.3 million (not including $344,000 for recreational facilities). The project unit provides extensive recreational opportunities in addition to its flood control functions. Recreational facilities, which have been developed in the reservoir area by the City of Los Angeles, consist of a 125-acre lake with boat launching ramps and a swimming beach, picnic areas, riding and hiking trails, a golf course, and baseball fields. About 1,286,500 people visited the area in 1975. Existing recreational developments have cost about $4 million, and the city plans to spend about $3.9 million for additional improvements.

lopez dam
Lopez Dam is an earthfill structure 50 feet high and 1,300 feet long. The dam and reservoir (capacity 230 acre-feet) are on Pacoima Wash about 6 miles upstream from its confluence with Tujunga Wash, a tributary of the Los Angeles River.

The project unit was completed in 1954 at a Federal cost of $729,000. Recreational development proposed by the Corps and Los Angeles County includes a group camping area, restrooms, and a parking area.

santa fe dam
Santa Fe Dam is an earthfill structure 92 feet high and 23,800 feet long. The dam and reservoir (capacity 32,600 acre-feet) are on the San Gabriel River about 29 miles upstream from its mouth.

The project unit was completed in 1949 at a Federal cost of $12.6 million. In addition, Federal costs for recreational facilities total $450,000. The project area is being developed as a recreational area by Los Angeles County and the Corps of Engineers. Planned facilities include a 70-acre lake, a swimming beach, an access road, picnic facilities, and equestrian trails.

sepulveda dam
Sepulveda Dam is an earthfill structure 57 feet high and 15,444 feet long. The dam and reservoir (capacity 17,300 acre-feet) are on the upper Los Angeles River about 43 miles upstream from its mouth. The project unit was completed in 1941 at a Federal cost of $6.7 million. In addition, Federal costs for recreational facilities total $205,000.

The area behind Sepulveda Dam has been developed

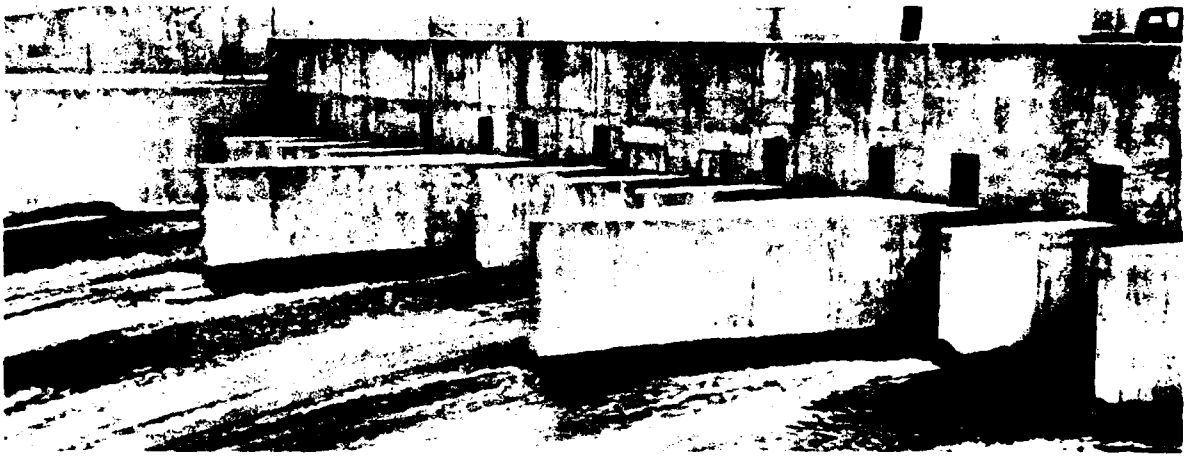
by the City of Los Angeles into one of the city's most popular recreational areas with a broad variety of facilities available. Included are golf courses, riding and hiking trails, model-plane landing fields, competition areas, archery ranges, tennis and basketball courts, a bicycle race track, a baseball park, and picnic areas.

A few acres in the project area are leased to local agencies that sponsor youth activities. However, most of the available area in the reservoir is being developed as a recreational area by the City of Los Angeles. About 1,575,800 people visited the area in 1975. Planned future development by the city includes two 18-hole golf courses, clubhouses, a tennis center, an aquatic center, and a community recreational building with an auditorium. To date, the city has spent $4.6 million on recreational facilities and plans to spend an additional $13 million in the future.

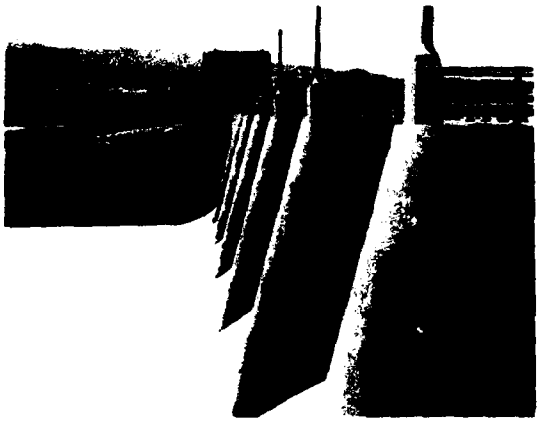
whittier narrows dam

Whittier Narrows Dam is on the main channels of the Rio Hondo and the San Gabriel River about 10 miles east of the City of Los Angeles. The dam is an earthfill structure 56 feet high and 16,960 feet long. The dam and reservoir (capacity 36,100 acre-feet) were completed in 1957 at a Federal cost of $32.3 million.

In 1975, more than 2 million people visited the area. The Los Angeles County Department of Parks and Recreation, under license from the Federal government, is developing an 1,160-acre regional park. Modern picnic facilities are enjoyed by thousands of families each



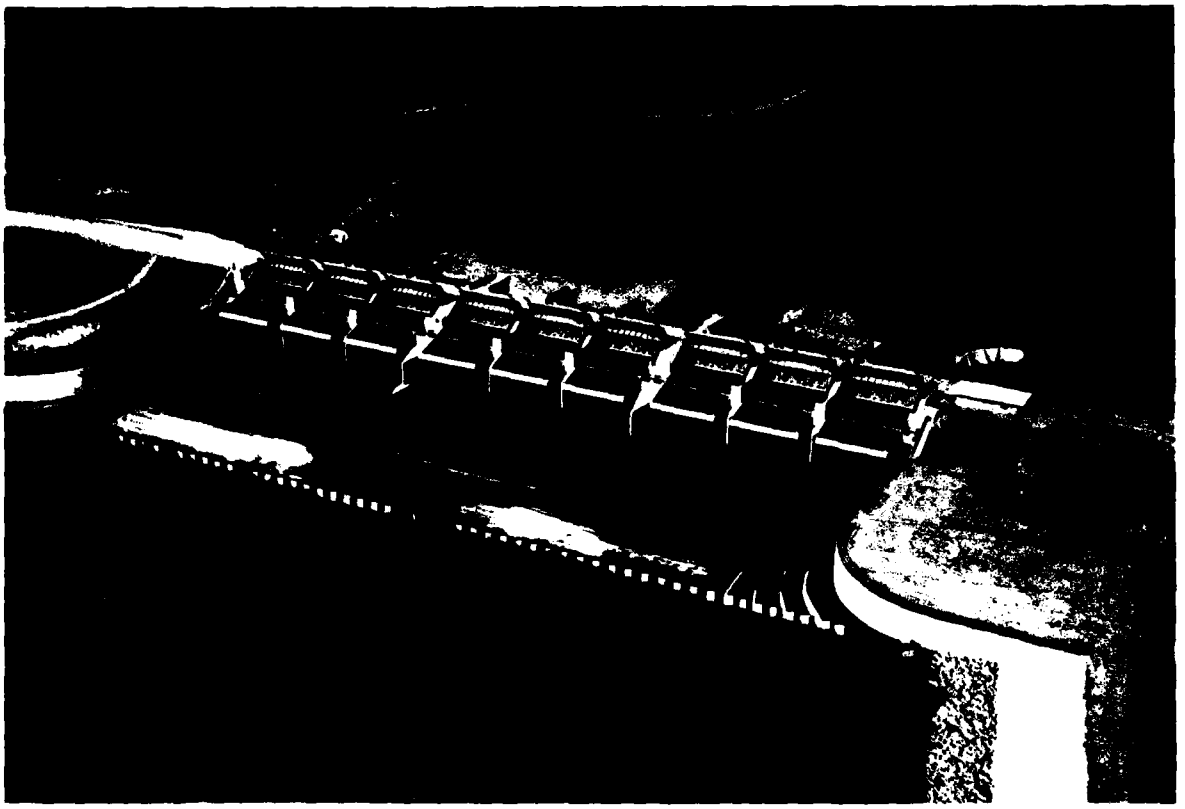
▲ *floodwaters pouring through the outlet works at santa fe dam.*



◀ *part of the outlet works of sepulveda dam.*

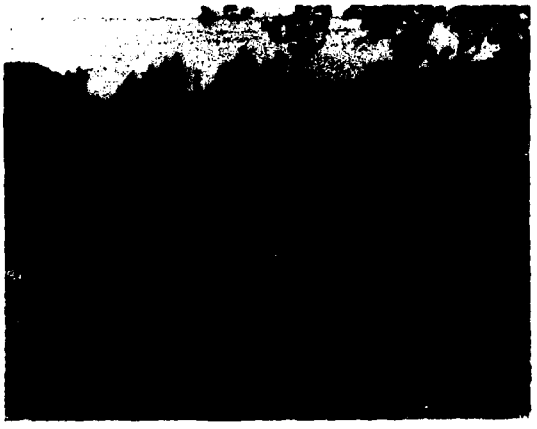
an intrepid bike rider tries his luck on the spillway at sepul- ▲
veda dam

▼ bike trails provide safe riding at whittier narrows

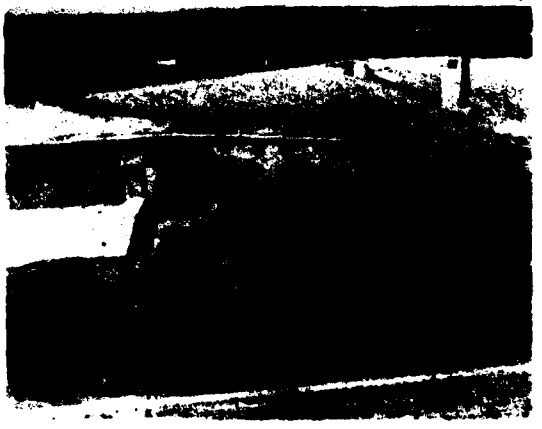


▲ *over 1.5 million persons visit the whittier narrows recreational area each year. this view shows the spillway with the san gabriel river flowing towards the foreground.*

the lakes at whittier narrows provide opportunities for ▼ *varied water-oriented recreation.*



this view of brea dam shows the spillway, left center, with the control house and outlet works at upper right. ▼



year, and a 77-acre lake with 32 rental boats attracts fishermen of all types. Recreational facilities include a trap and skeet shooting area, a baseball diamond, a 40-acre wildlife preserve operated by the National Audubon Society, and two golf courses. A few acres at the project site are leased to local agencies sponsoring youth activities and facilities for wildlife study.

Planned future development by the County includes additional picnic and parking areas, an equestrian area, a swimming lake, and a visitors center. Planned future development by the City of Pico Rivera includes expansion of the golf course and the equestrian area. The cost of existing recreational facilities built by local interests totals $5.25 million. Los Angeles County plans to spend an additional $200,000 and the City of Pico Rivera plans to spend $1.8 million for future recreational facilities.

In addition, the Corps of Engineers in partnership with Los Angeles County has built extensive recreational facilities, including picnic areas, bicycle and hiking trails, a wildlife lake, multipurpose courts, and water supply systems. Each agency has spent about $3 million on the work.

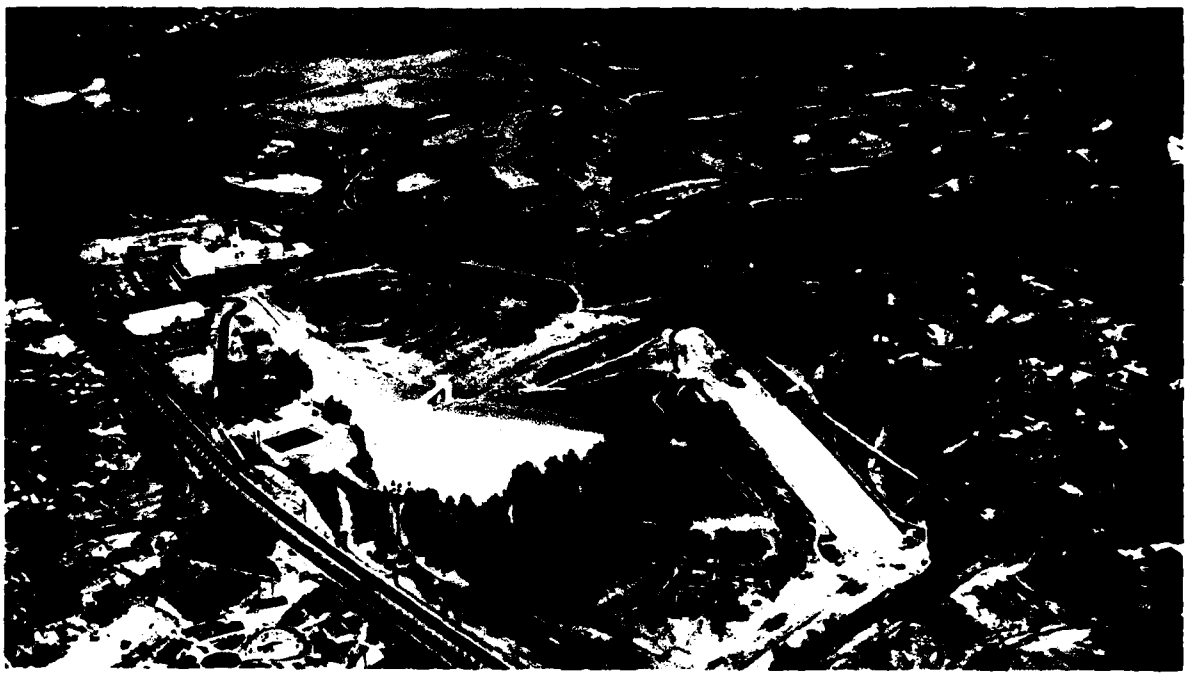
Multipurpose Projects in Santa Ana River Basin and Orange County (Los Angeles District)
Multipurpose projects either constructed or authorized for construction in the Santa Ana River Basin and Orange County are described in the following paragraphs.

brea dam
Brea Dam, an earthfill structure 87 feet high and 1,765 feet long, is on Brea Creek about 8 miles upstream from the junction of Brea and Coyote Creeks. The dam

small fry at whittier narrows recreational area are intrigued by . . .

a popeyed octopus ▼

a lofty dinosaur ▼



brea dam and reservoir on brea creek. the golf course, upper left, is part of the recreational facilities in the reservoir area.

is within the city limits of Fullerton. The capacity of the reservoir is about 4,000 acre-feet. Completed in 1942 at a Federal cost of $1.2 million, the project is operated and maintained by the Corps of Engineers.

The reservoir area is being developed as a recreational area by the City of Fullerton under license by the Federal government. The city has completed golf courses, a YMCA day camp, campgrounds for Girl Scouts and a minibike park. About 353,000 people visited the area in 1975. Planned future development by the city includes picnic and camping sites, a visitor center, an arboretum, and tennis courts. The city has spent $1.8 million on recreational facilities and plans to spend an additional $1.2 million.

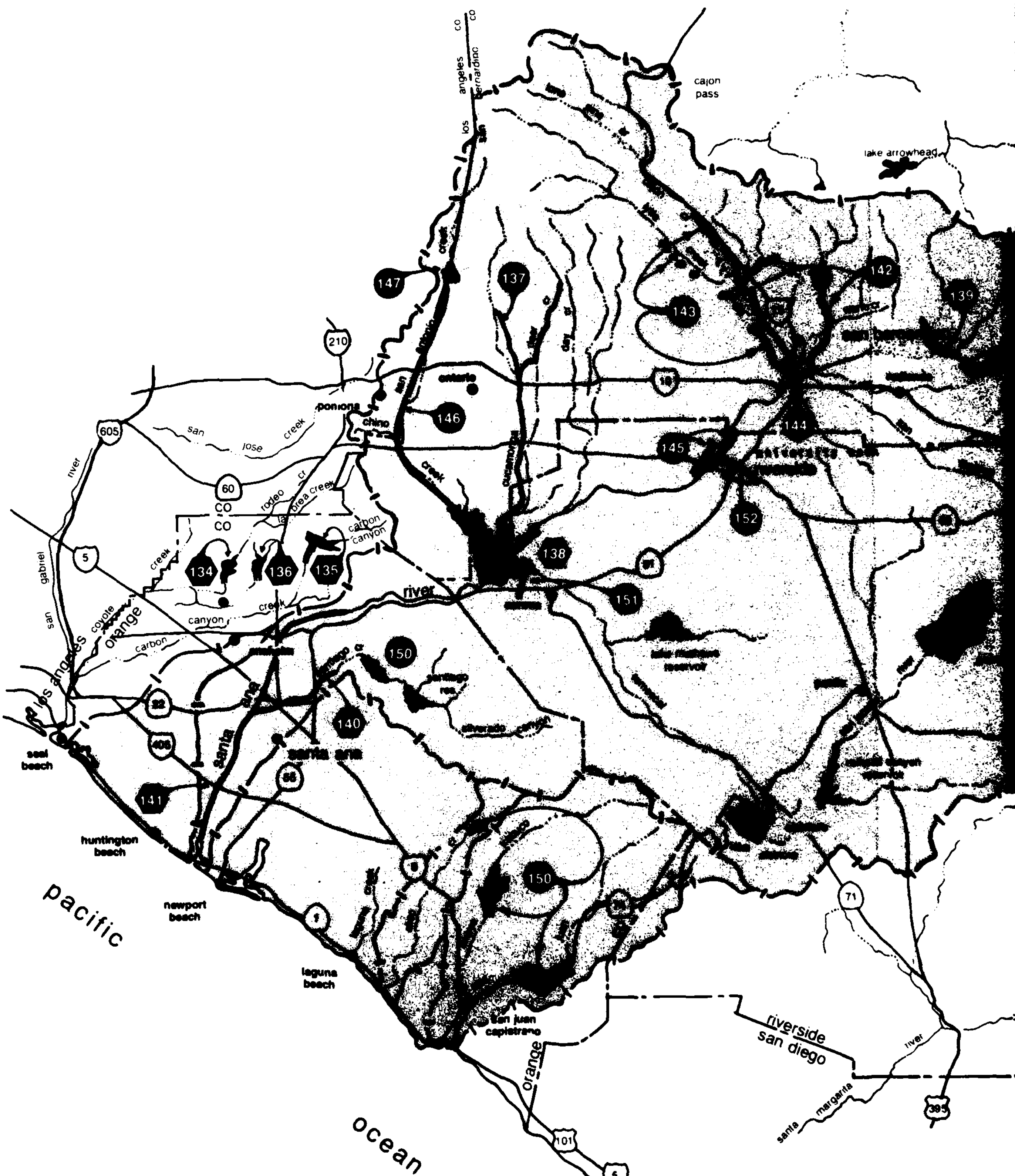
During the 1969 floods, Brea Dam prevented damages estimated at $460,000. Since its completion, the dam has prevented flood damages of $3.3 million.

carbon canyon dam and channel

Carbon Canyon Dam and channel are on Carbon Canyon Creek near the mouth of the canyon and about 16 miles northeast of Santa Ana and 4 miles east of Brea. The dam is an earthfill structure 99 feet high and 2,610 feet long, forming a reservoir with a capacity of 6,600 acre-feet. Completed in 1961 at a Federal cost of $5.3 million, the project is operated and maintained by the Corps of Engineers.

The reservoir is being developed as a recreational area by the Corps of Engineers and Orange County. Completed are picnic facilities, tennis courts, a lake, a model airplane field, multiple-purpose playing fields, and parking areas. Planned future facilities include group picnic areas, hiking and equestrian trails, restrooms, additional tennis courts, and an archery range. The cost of completed recreational facilities is about $2 million, shared equally by the Corps and Orange County.

Carbon Canyon Dam protects about 8,000 acres of highly developed metropolitan and rural areas, including large parts of the City of Anaheim, most of the City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seal beach
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huntington beach
newport beach
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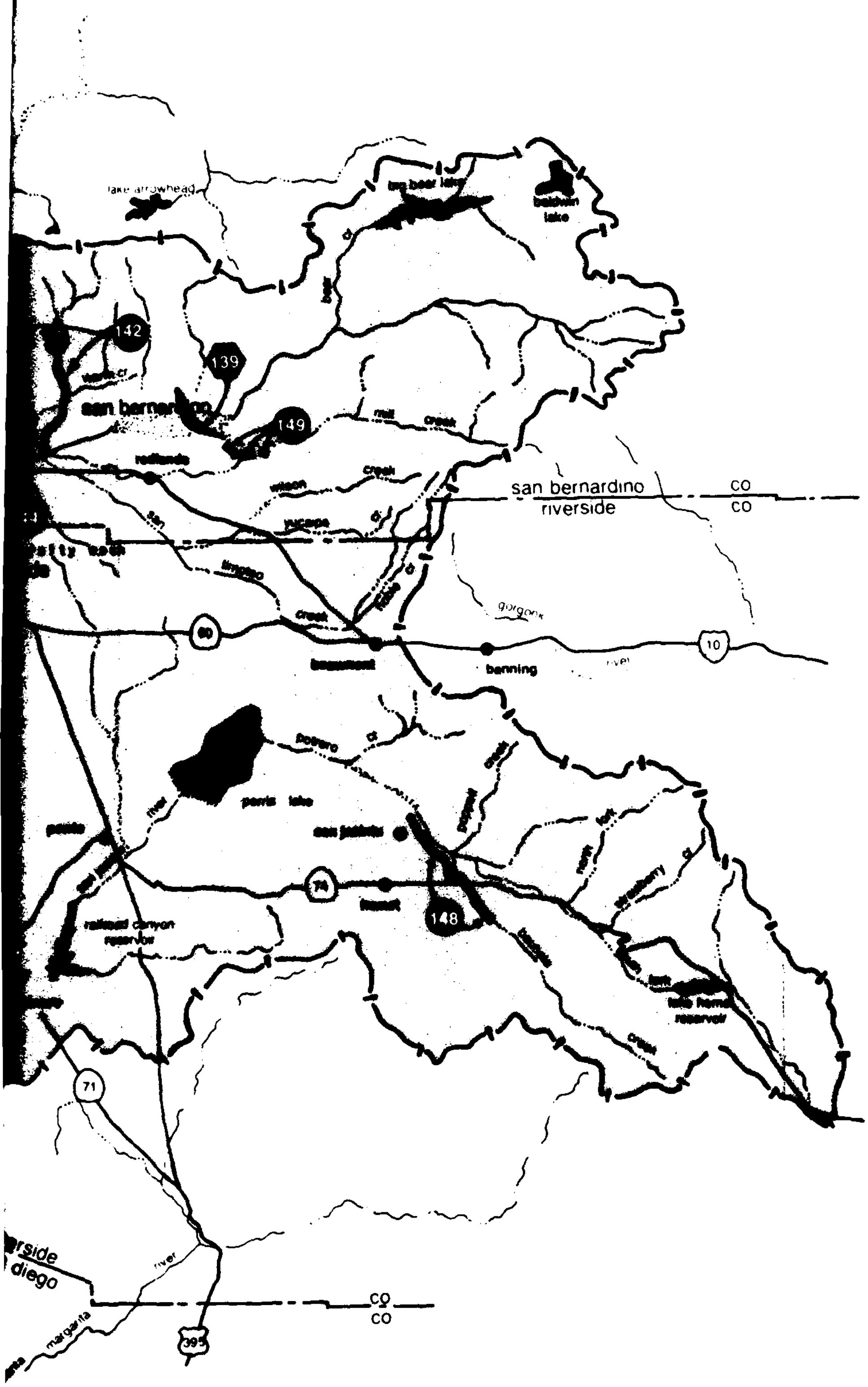
lake arrowhead
big bear lake
baldwin lake
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san bernardino
mill creek
san bernardino co
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perris lake
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railroad canyon reservoir
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of Los Alamitos, and the nearby Naval Air Station. Incidental water conservation benefits accrue from the project unit as a result of regulating floodflows to the capacity of the downstream spreading grounds.

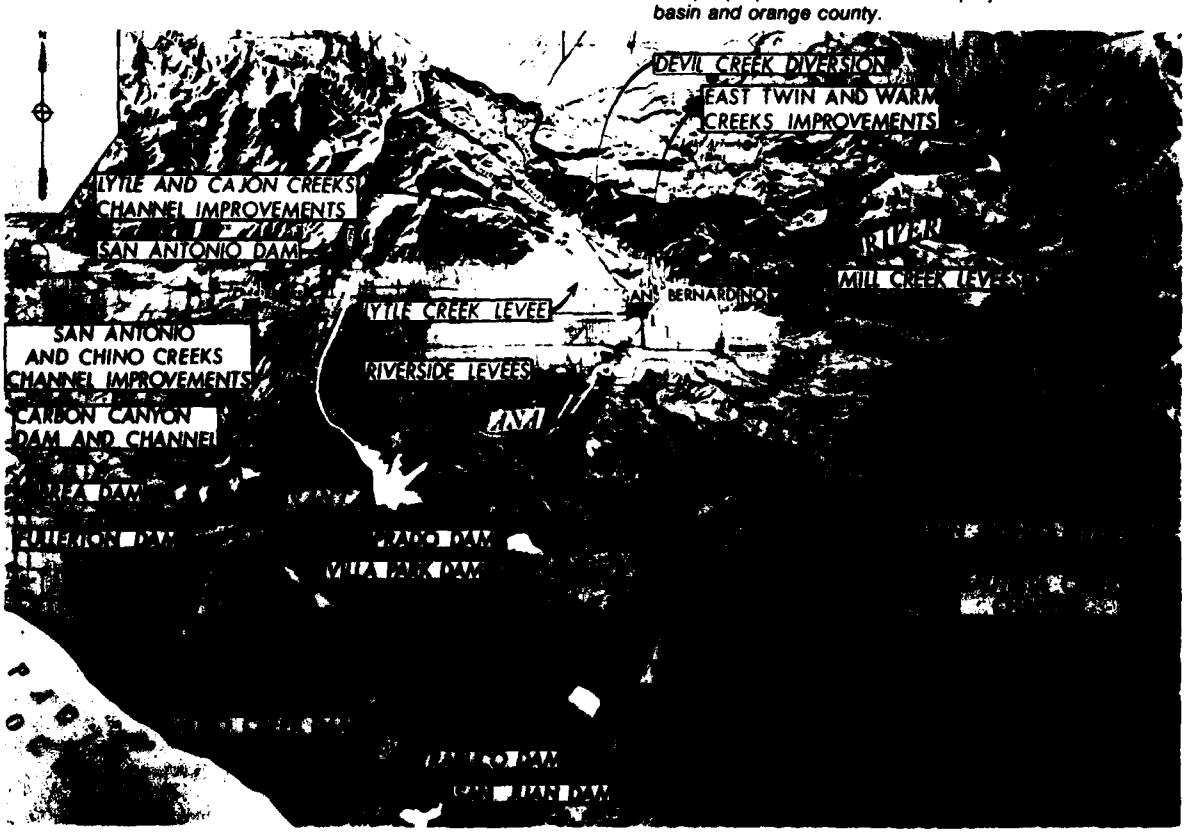
The project prevented damages estimated at $192,000 during the 1969 floods.

Cucamonga Creek and Tributaries Project (Los Angeles District)
Construction is under way on the Cucamonga Creek and tributaries project. The project consists of 10 debris basins, about 9,000 feet of diversion, collection and separation levees, and 26 miles of rectangular and trapezoidal concrete channel. The project would provide protection against floods to a 19,000-acre overflow area that includes commercial, industrial, and residential property in Upland, Ontario, Alta Loma, Cucamonga, and San Antonio Heights. It would also protect the Ontario International Airport, the San Antonio Community Hospital, the Colorado River aqueduct, and major interstate highways and railroads.

Recreational facilities planned as part of the project include hiking, bicycling, and equestrian trails along channel service roads; and rest stops, staging areas, and picnic facilities along the trail system. A beautification program to improve the project site is also part of the project concept.

The Federal cost of the project is estimated at $76.7 million, and the non-Federal cost is estimated at $16.5 million. More than 95 percent of the damage ($12.8 million) that occurred in the project area during the

multiple purpose and flood control projects in santa ana river basin and orange county.



1969 floods would have been prevented if the project had been completed at the time of the floods. The project is scheduled for completion by 1981.

fullerton dam
Fullerton Dam, 2 miles northeast of the City of Fullerton, is on East Fullerton Creek 4 miles upstream from its confluence with Brea Creek. It is an earthfill structure 47 feet high and 575 feet long, forming a reservoir with a capacity of 800 acre-feet. Completed in 1941 at a Federal cost of $411,000, the project is operated and maintained by the Corps of Engineers.

The reservoir has been developed for outdoor recreation by the Corps and Orange County. Recreational facilities include bicycle, hiking, and equestrian trails; multipurpose activity fields and courts; a picnic area; and water supply and sewage disposal systems. The work was done at a cost of $1.2 million, shared equally by the Corps and Orange County. Planned future facilities include picnic area improvements, baseball fields, an overlook area, and multipurpose courts.

Fullerton Dam prevented flood damages estimated at $66,000 during the 1969 floods. Since its completion, the dam has prevented $1.6 million in flood damages.

***Santa Ana River main stem* including Santiago Creek and Oak Street drain** (Los Angeles District)
Recognizing the catastrophic threat posed by floodflows on the Santa Ana River, Congress in 1976 authorized preconstruction planning studies of the Santa Ana River from the San Bernardino Mountains to the ocean. The authorization was based on the recommendations of the Division Engineer on an interim investigation completed in 1976, after 10 years of effort and $3 million in cost. The flood threat along the Santa Ana River is described by the Resources Agency of the State of California as the greatest flood threat in the State — and one of the two greatest engineering problems in the State. (The other is the possibility of earthquake along the San Andreas fault.) If the standard project flood occurred along the Santa Ana River, it would cause more than $3 billion in damage, probable loss of life, and vast social disruption. The plan recommended in the interim investigation provides for improvements to control the standard project flood and thus prevent massive flood damages.

The recommended plan provides for construction of a flood control dam at the Mentone site, a few miles upstream from San Bernardino; flood plain management along the 35-mile reach of the Santa Ana River from Mentone Dam downstream to Prado Reservoir; enlargement of the existing Prado Dam; minor improvements in Santa Ana Canyon (downstream from Prado Dam), which would be left in its natural state; improvement of the Santa Ana River downstream to the ocean to handle flood control releases from Prado Dam plus inflow from tributaries and local drainage; and protective works along Oak Street drain, in Corona, and Santiago Creek, in Santa Ana.

The recommended plan was developed after consideration was given to 60 possible alternative plans. The recommended plan is the only plan that meets the flood control needs, the social needs, and the environmental needs of a great metropolitan area. It was approved and accepted by the three counties (San Bernardino, Riverside, and Orange) and various cities directly affected by the flood threat and the proposed solution. The first cost (1976 prices) of the improvements proposed under the recommended plan is $805.9 million ($713 million in Federal cost and $92.9 million in non-Federal cost).

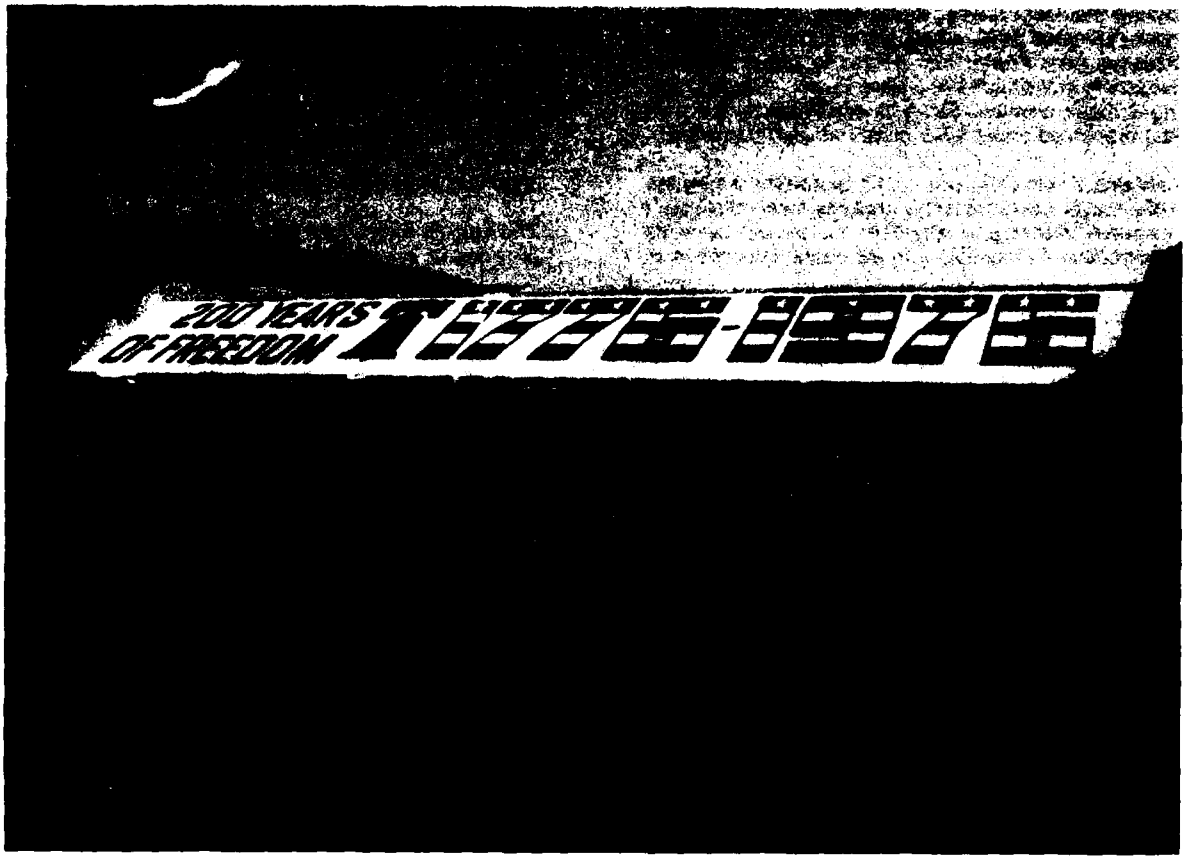
The five units — Mentone Dam, Prado Dam, Santa Ana River, Santiago Creek, and Oak Street drain — comprising the recommended plan of improvement are discussed in the following paragraphs.

Mentone Dam (Los Angeles District)
The recommended plan for Mentone Dam provides for construction of an earthfill structure with a maximum height of 230 feet and a length of 3.7 miles. The dam would form a reservoir with a capacity of 151,000 acre-feet. The dam would extend across the Santa Ana River near the community of East Highlands, in San Bernardino County. Because construction of Mentone Dam would directly affect the Mill Creek levees, discussed under a subsequent heading, the recommended plan provides for raising the levees and extending them 1.2 miles into the Mentone Reservoir area, thus ensuring that Mill Creek floodflows move into the reservoir.

The recommended plan also provides for development of recreational facilities, including a regional park and riding and hiking trails, in the reservoir area.

Prado Dam (Los Angeles District)
Prado Dam, on the Santa Ana River in Riverside County, is about 30 miles upstream from the mouth of the river. The dam is an earthfill structure 106 feet high and 2,280 feet long, forming a reservoir with a capacity of 195,000 acre-feet. Completed in 1941 at a Federal first cost of $9.5 million, the project unit is operated and maintained by the Corps of Engineers.

The reservoir area is in both Riverside and San Ber-



once the target of spray can-wielding vandals and miscreant graffiti artists, prado dam spillway now sports a colorful bicentennial look. the 100,000-sq.-ft. design was the work of a group of corona, california, high school students under sponsorship of the los angeles district of the u.s. army corps of engineers. the project was completed in time for the nation's 200th birthday celebration on july 4, 1976.

nardino Counties. It is being developed for recreational purposes under leases to the two counties, the City of Corona, and the Boy Scouts of America. Recreational facilities already constructed include two picnic areas, one organized camping area, and three baseball parks.

Future recreational developments planned by the four agencies include lakes for swimming, boating, and fishing; a motor-homes parking area; a minibike park; a 30-room motel; riding and hiking trails; a natural history interpretive center to be managed by the Riverside Museum; campgrounds; roads; and additional landscaping. Although recreational development has not been completed, 299,500 people enjoyed the area in 1975. Local interests have spent $1 million on recreational facilities and intend to invest an additional $29 million. Federal costs for recreational facilities total $159,000.

south coastal basins

During the 1969 floods, Prado Dam prevented damages estimated $440 million. Careful restriction of flood releases from Prado Dam helped to prevent serious breaching of the Santa Ana River levees, thus preventing a major disaster. Since its construction, the dam has prevented about $446 million in flood damages.

Although Prado Dam was a star performer during the 1969 floods, the urbanization that has taken place both upstream and downstream from the project since its construction — together with increased knowledge of basin hydrology — has shown that, under present conditions, a serious deficiency exists in the dam's ability to control a major flood. New information on rainfall history, improved hydrology methods, and increased development in the drainage area now indicates that Prado Dam will provide protection only against a flood with a 70-year frequency of occurrence. Floods greater than that could cause great damage to Orange County.

The recommended plan for modification of Prado Dam provides for raising the height of the dam 30 feet and

after the 1969 floods, prado dam impounded a lake 4 miles long, 3 miles wide and 68 feet deep.

raising the height of the spillway 20 feet. The outlet works would be enlarged and the reservoir area would be expanded by 1,670 acres — all in Riverside and San Bernardino Counties. The reservoir would have a gross capacity of 363,000 acre-feet. The enlarged outlet works would be designed for a maximum controlled release of 30,000 cubic feet per second.

Recreational facilities would include interconnecting recreational trails, three satellite lakes, riparian areas, campgrounds, and picnic areas.

Santa Ana River (Los Angeles District)
The recommended plan for the 35-mile reach of the Santa Ana River between Mentone Dam and Prado Reservoir provides for flood plain management in that reach. Instead of structural improvements, the plan provides for the Counties of San Bernardino and Riverside to restrict development along the river, thus ensuring that flood control releases from Mentone Dam — coupled with inflow from the tributaries between Mentone Dam and Prado Reservoir — would cause no damage. This would be accomplished by zoning and land-use controls or by acquisition of the land by the counties.

Downstream from Prado Dam, the plan provides for the Santa Ana Canyon to be taken into public ownership and left in its natural state. The only structural work would be some revetment to protect a railroad bridge, some curves on a freeway, and an existing trailer court. Otherwise, the canyon would become 1,760 acres of open space for public recreation and wildlife habitat.

Downstream from the canyon, Orange County has channelized the river and built a series of percolation basins for water salvage. This channel work would be improved to handle the flood control releases from Prado Dam plus inflow from tributaries and local drainage. The improved channel would accommodate floodflows ranging from 40,000 cubic feet per second near the canyon to 55,000 cubic feet per second in the downstream reaches of the river. The spreading basins would be retained and improved. At the mouth of the Santa Ana River, 92 acres of salt marsh and adjacent uplands would be acquired for wildlife habitat, including 84 acres for preservation of endangered species.

A recreational trail system (bicycle, hiking, and equestrian trails) would extend along the entire 66-mile reach of the river.

Santiago Creek Channel (Los Angeles District)
The recommended plan for improvement of Santiago Creek provides for construction of a concrete rectangular channel 2½ miles long, extending from Grand Avenue in the City of Orange downstream through the City of Santa Ana to the confluence with the Santa Ana River. The channel would be about 70 feet wide and 15 feet deep. The capacity of the channel would be 23,000 cubic feet per second. Ramps to the channel would provide access for its use as a hiking or bicycling trail.

buildings teeter on brink of santiago creek as floodwaters tear at foundations. february (1969) floodflows on the stream set a record high (6,600 c.f.s.).

Limited bank and channel improvements would be provided in the 3-mile urbanized reach upstream from the proposed concrete channel.

Oak Street Drain (Los Angeles District)
The recommended plan for the Oak Street drain, in Corona, provides for construction of a main channel, a collector system, and debris control measures. The main channel would be a concrete rectangular channel 2.7 miles long, extending from 600 feet upstream from Ontario Avenue to Temescal Wash. The channel, with a width ranging from 20 to 30 feet and a depth ranging from 10 to 14 feet, would accommodate flows ranging

oak street drain overflows severely damaged the main commercial district along west sixth street in corona in february 1969.

from 5,800 to 9,000 cubic feet per second. The collector system would include a channel from Lincoln Avenue to the Oak Street drain and improvement of the confluence with the Mangular Avenue channel. A debris basin would be provided south of Ontario Avenue to facilitate functioning of the main channel.

flood control projects in santa ana river basin and orange county

devil, east twin and warm creeks channel improvements and lytle creek levee
The improvements comprising this project are in San Bernardino County and were constructed in three parts as follows:

The Devil Creek diversion, completed in 1958, carries floodflows from Devil and Badger Creeks to the contiguous drainage area of Cajon Creek by an intercepting levee 1.3 miles long, an intake structure, and a concrete channel 2 miles long extending to Cajon Creek.

The East Twin and Warm Creeks improvements include the revetment of a 3.5-mile-long levee constructed by local interests along Waterman and East Twin Creeks, the construction of a 4.5-mile-long concrete channel along lower East Twin Creek and lower Warm Creek and the revetment of 1.4 miles of channel side slopes. The work was completed in 1961.

The Lytle Creek levee, which is an addition to the Lytle and Cajon Creeks channel improvements, extends 1.2 miles along the right side of Lytle Creek near Cajon Creek. The levee was completed in 1956.

The project was constructed at a total cost of $11.1 million (including $7.8 million in Federal cost). It prevented damages estimated at $2.7 million in the 1969 floods. It is designed to protect parts of the City of San Bernardino and nearby suburban areas from floods on Devil, Cable, Badger, Waterman, East Twin, and Warm Creeks, and to protect water supply wells for Rialto, Bloomington, and nearby irrigated areas. The project is maintained by the San Bernardino County Flood Control District.

lytle and cajon creeks channel improvements
The Lytle and Cajon Creeks channel improvements extend from 10 miles northwest to 2 miles south of the City of San Bernardino. Completed in 1948 at a Federal cost of $7.6 million and a non-Federal cost of $600,000, the improvements are operated and maintained by the San Bernardino County Flood Control District.

The improvements include collecting levees and groins on Lytle and Cajon Creeks, an improved channel generally along the West Branch of Lytle Creek, and provisions for bypassing excess flow into the East Branch of Lytle Creek.

During the 1969 floods, the improvements prevented flood damages estimated at $13.2 million. Since its completion, the project has prevented about $15.3 million in flood damages to parts of the Cities of San Bernardino and Colton, to adjacent suburban areas, and to parts of transcontinental transportation systems.

Lytle and Warm Creeks Project (Los Angeles District)
The Lytle and Warm Creeks project is scheduled for completion in the spring of 1977 at a Federal cost of about $32.2 million and a non-Federal cost of about $6.8 million. The project, which is in San Bernardino County, consists of a channel 3.5 miles long on the East Branch of Lytle Creek, a channel 1.5 miles long on Warm Creek, and channels and levees along a 1.8-mile reach of the Santa Ana River. The project is maintained by the San Bernardino County Flood Control District.

The project protects an overflow area of about 3,600 acres of valuable commercial, industrial, and residential property in the Cities of San Bernardino and Colton.

In addition to the functional, utilitarian, and economical aspects of the project, a beautification program has been developed to enhance the project site.

mill creek levees
The three Mill Creek levees are along the south side of Mill Creek near the base of the San Bernardino Mountains and about 5 miles northeast of the City of Redlands. The levees, with a total length of 2.4 miles, extend from the mouth of the canyon to a point near the confluence of Mill Creek and the Santa Ana River. The levees were completed in 1960 at a Federal cost of $618,000 and a non-Federal cost of $195,000.

During the 1969 floods, the levees prevented damages estimated at $11.4 million. The project protects the Cities of Redlands and Mentone and valuable citrus groves. It is maintained by the San Bernardino County Flood Control District.

Because construction of Mentone Dam would directly affect the Mill Creek levees, which have been nearly overtopped by past floodflows, preconstruction planning studies for Mentone Dam would include consideration of modifications to the Mill Creek levees.

riverside levees
The Riverside levees are along both sides of the Santa Ana River near the City of Riverside in Riverside County. The levees, with a total length of 5 miles, were completed in 1958 at a total cost of $4 million, including $2.1 million in Federal cost. They are maintained by the Riverside County Flood Control and Water Conservation District.

During the 1969 floods, the levees prevented damages estimated at $710,000. They are designed to provide protection to the northwestern part of the City of Riverside and to nearly all of the town of Rubidoux.

san antonio and chino creeks channel
San Antonio and Chino Creeks channel extends from San Antonio Dam downstream to Prado Dam, a distance of about 16 miles. The project consists of 10.5 miles of rectangular concrete channel along San Antonio Creek and 5.2 miles of trapezoidal concrete channel along Chino Creek. Completed in 1960 at a Federal first cost of $10.9 million, the channel is maintained by the Corps of Engineers.

Flood damages prevented by the channel improvements in combination with San Antonio Dam are estimated at $27.5 million.

san antonio dam
San Antonio Dam, in San Bernardino County, is on San Antonio Creek about 16 miles upstream from Prado Dam and 7.5 miles north of the City of Pomona. The dam is an earthfill structure 160 feet high and 3,850 feet long, forming a reservoir with a capacity of 7,700

riverside levees on the santa ana river.

acre-feet. Completed in 1956 at a Federal first cost of $7 million, the dam is operated and maintained by the Corps of Engineers.

San Antonio Dam, in combination with San Antonio and Chino Creeks channel, prevented damages estimated at $27 million during the 1969 floods. Since their completion, the combined parts of the project have prevented about $27.5 million in flood damages. The project protects agricultural lands and valuable residential, commercial, and industrial property in the Cities of Pomona, Claremont, Chino, Ontario, and Upland.

san jacinto river levee and bautista creek channel
The San Jacinto River levee and the Bautista Creek channel improvements are in Riverside County near the communities of San Jacinto, Hemet, and Valle Vista. They consist of a levee 3.9 miles long on the left side of the San Jacinto River and a concrete-lined channel 3 miles long on Bautista Creek upstream from State Highway 74. They were constructed at a Federal cost of $3 million and a non-Federal cost of $928,000.

The project is designed to protect San Jacinto, Hemet, Valle Vista, and nearby agricultural areas. Completed in 1961, the project is maintained by the Riverside County Flood Control and Water Conservation District. During the 1969 floods, it prevented damages estimated at $1.3 million.

santa ana river and orange county projects

inactive projects

Aliso Creek, San Juan, Trabuco, and Villa Park Dams
Aliso Creek, San Juan, Trabuco, and Villa Park Dams are authorized but inactive projects. The dams would be earthfill structures.

Aliso Creek Dam would be on Aliso Creek about 14 miles upstream from its mouth at the Pacific Ocean. San Juan Dam would be on San Juan Creek about 6 miles upstream from its mouth at the Pacific Ocean. Trabuco Dam would be on Arroyo Trabuco about 7 miles upstream from its mouth at the Pacific Ocean.

In September 1960, the California Department of Water Resources approved the application of the Orange County Flood Control District to construct Villa Park Dam (reservoir capacity, 15,600 acre-feet) as a local project. The dam was built in 1962 at a cost of about $2 million.

bautista creek channel improvements provide stable structures to handle floodflows.

Villa Park Dam is an earthfill dam on Santiago Creek about 9 miles upstream from its mouth at the Santa Ana River. The dam constructed by local interests is smaller than the authorized dam.

These inactive projects are being restudied as part of the review investigation of the Santa Ana River Basin and Orange County.

University Wash and Spring Brook Project (Los Angeles District)
The University Wash and Spring Brook project is inactive. As authorized, the project would consist of 4.9 miles of channel improvements in the City of Riverside. However, preconstruction planning studies indicate that the project is not economically feasible under present criteria.

multipurpose and flood control studies in santa ana river basin and orange county

Studies
General. Recognizing the need for additional flood control improvements to prevent catastrophic damages that can reasonably be expected to occur in the future, Congress in 1964 authorized a review investigation of the Santa Ana River Basin and Orange County. The

study area is in San Bernardino, Riverside, and Orange Counties, and a small part is in Los Angeles County. During the 1969 floods, the existing projects prevented damage estimated at $510 million. However, they are no longer adequate to protect one of the fastest growing areas in the nation. If a great flood should occur, catastrophic damage estimated at $3.3 billion would occur in Orange County alone. Flood control improvements under consideration include 60 miles of levees, 340 miles of channels, 11 reservoirs, 9 alternative reservoirs, and 24 debris basins. In addition, 7 existing reservoirs will be studied in detail. Detailed consideration will be given in the main report to the need for flood control improvements along streams not considered in the interim investigations, including the San Jacinto River; upper Warm Creek; and Salt, Day, East Etiwanda, San Sevaine, San Juan, and San Diego Creeks; and tributaries to Sunset Bay and Bolsa Chica.

In addition to flood control, problems of recreation and water supply including groundwater recharge and storage of imported water are also under consideration. The report on the study, which is scheduled for completion in 1981, will contain a water resources development plan that will satisfy present as well as future needs.

An interim investigation completed in 1976 was authorized in 1976 for preconstruction planning studies of the Santa Ana River from the San Bernardino Mountains to the ocean. The projects authorized for preconstruction planning studies include Mentone Dam; enlargement of Prado Dam; flood plain management along the Santa Ana River in the reach between Mentone Dam and Prado Dam and channelization of the river downstream from Prado Dam; channelization of the Oak Street Drain in Corona and the 6-mile downstream reach of Santiago Creek; and extending the Mill Creek levees 1.2 miles into the Mentone Reservoir area. Detailed information on these projects is given under preceding headings. Two interim investigations will be made as described in the following paragraphs.

Investigation of Temescal and San Timoteo Creeks. An interim investigation of Temescal and San Timoteo Creeks and tributaries will include consideration of channel improvements on Temescal Creek at Corona, San Timoteo Creek at Loma Linda, Zanja Creek at Redlands, and Wilson Creek at Yucaipa. The study is scheduled for completion in 1979.

Investigation of Coyote Creek and tributaries. An interim investigation of Coyote Creek and its tributaries will include consideration of channel improvements along the upstream 3-mile unimproved reach of Coyote Creek; modification of the operation of Brea, Fullerton, and Carbon Canyon Dams; and enlargement of existing channels along Brea, Fullerton, and Carbon Creeks to accommodate larger discharges from the dam downstream to the confluences with improved Coyote Creek channel. The study is scheduled for completion in 1980.

cooperative project

Hodges Dam (Los Angeles District)
Hodges Dam, which is inactive, would be a multiple purpose storage project for water conservation and flood control at the Hodges site on the San Dieguito River about 5 miles southeast of the City of Escondido. As authorized, the project would be constructed, owned, and operated by local interests, and the Federal Government would contribute toward the first cost of the project an amount commensurate with the flood control benefits. Its operation for flood control would be specified by the Corps of Engineers.

other flood control projects

Calleguas Creek from Simi Valley to Moorpark (Los Angeles District)
Preconstruction planning studies were authorized in 1976 for Calleguas Creek from Simi Valley to Moorpark, in Ventura County. The project plan provides for flood control improvements and recreational development along 13.2 miles of Calleguas Creek. The improvements would consist of 7.4 miles of channel and levee work, management of the flood plain along 5.8 miles of the stream, and recreational development throughout the 13.2-mile reach of improved stream. The Federal first cost of the project is estimated at $28.7 million (1976) and the non-Federal first cost of the project is estimated at $1.180 million (1976).

The project would alleviate serious flood problems along Calleguas Creek and would provide protection against floods to the communities of Simi Valley and Moorpark and to rapidly developing industrial and commercial property outside the populated areas. About 5,200 people reside in the overflow area, which comprises 2,395 acres. The present value of lands and improvements in the overflow area is about $205 million. Rapid development has been taking place in the overflow area during recent years. A recurrence of the 1969 floods, which caused damages of $340,000, would cause damages estimated at $1.5 million under present conditions; these damages would be prevented by the project.

south coastal basins

Kenter Canyon Conduit and Channel (Los Angeles District)
The Kenter Canyon conduit and channel was constructed in 1937 as an emergency relief project in the southwestern part of Los Angeles County. The project, which is 3 miles long, begins near the intersection of Wilshire Boulevard and McClellan Drive in Los Angeles and extends for the most part beneath Broadway and Colorado Avenues in Santa Monica, draining into the Pacific Ocean at Pico Boulevard. The Federal cost of the project was $1 million and the non-Federal cost was $125,000.

The project protects high-value residential and business property in Santa Monica. It is maintained by the Los Angeles County Flood Control District.

San Diego River Levee and Channel Improvements (Los Angeles District)
The San Diego River levee and channel improvements project, which was completed in 1953, is a unit of a dual-purpose project for flood control on the San Diego River and navigation in Mission Bay.[1]

The flood control features of the project consist of a leveed channel 3.3 miles long on the San Diego River to conduct flows from near Morena Boulevard directly to the ocean and the alteration of a railroad bridge over the floodway.

Since construction of the project, additional work has been done to provide increased protection against floods. The south jetty of the floodway has been extended and the middle jetty, a feature integral to both the Mission Bay Harbor entrance channel and the San Diego River floodway, has been restored at a Federal cost of about $412,000. Present plans call for removal of the sand barrier at the mouth of the floodway, except for a dike 100 feet wide measured at high-tide level, at a cost estimated at $1.2 million.

The improvements are maintained by the City of San Diego. In addition, local interests are required to protect the flood-carrying capacity of the channel from future encroachment or obstruction.

San Diego River (Mission Valley) Project (Los Angeles District)
The San Diego River (Mission Valley) project as authorized would consist of a channel about 5 miles long on the San Diego River, two inlet levees at the upstream end, and a transition at the downstream end to provide a connection with the existing channel; and short channels along the downstream reaches of three tributary streams — Alvarado, Murphy, and Murray Canyons.

Reformulation studies have shown that the authorized plan is no longer justified. Consideration is being given to other alternative plans including nonstructural measures.

San Luis Rey River Project (Los Angeles District)
The San Luis Rey River project, near the City of Oceanside, as authorized, would consist of channel improvements along the San Luis Rey River from Murray Road to the Pacific Ocean, a distance of about 7 miles. The improvements would consist of an earth-bottom channel (designed to protect against a standard project flood) about 5.7 miles long from Murray Road to about 1 mile upstream from U.S. Highway No. 101; about 1.5 miles of channel grading (mostly spoil-bank removal) from 1 mile upstream from Highway No. 101 through the Narrows to the Pacific Ocean; and 800 feet of stone-revetted levee on the south bank from the railroad to the ocean.

The project would provide protection against floods to lands and improvements in and near the City of Oceanside and would permit optimum development of the flood plain. The value of property in the overflow area is estimated to be $96 million. Although San Diego County was only on the southern fringes of the storm that caused the floods of 1969, the February 1969 flood caused damages estimated at $443,000 in the San Luis Rey River Basin.

The authorized project incorporated a program for mitigating the loss of wildlife habitat. This program consists of retention of in-channel vegetation, utilization of reclaimed waste water for waterfowl development, maintenance of vegetation along the outside of the channel, and preservation of the Narrows and the lagoon at the mouth of the river. About 26 acres of percolation ponds would be provided in a manner compatible with the flood control project.

In the preconstruction planning that has been initiated, project formulation will be reviewed and updated to determine whether the authorized project is still the best plan for the area. Consideration will be given to all viable alternatives in addition to the authorized project. Preconstruction planning is scheduled for completion by 1980.

The Federal first cost of the project is estimated at $15.7 million, and the non-Federal first cost is estimated at $5.8 million. The project would be maintained by local interests.

[1] See project entitled "Mission Bay Harbor" for discussion of the navigation features.

Santa Clara River Levee (Los Angeles District)
The Santa Clara River levee, completed in 1961, is one of the two units comprising the Santa Clara River Basin project. The levee extends 4.7 miles along the lower Santa Clara River in Ventura County. It was constructed at a cost of $3 million, of which $2.1 million was Federal cost. The other unit of the project is the Santa Paula Creek channel and debris basins, described under the next heading.

During the 1969 floods, the Santa Clara River levee protected 53,000 acres in and around the City of Oxnard as well as the U.S. Navy Base at Port Hueneme. The levee prevented damages estimated at $55 million. However, the levee suffered severe damage when deflected flood flows undercut the toe protection, causing failure of about 2,000 feet of levee and eroding the ground behind the levee for a distance of about 100 feet. Only round-the-clock work by Corps contractors prevented even more serious damage to the levee. Since its construction, the levee has prevented damages estimated at $68 million.

The levee is maintained by the Ventura County Flood Control District.

Santa Paula Creek Channel and Debris Basins (Including Mud Creek) (Los Angeles District)
The Santa Paula Creek channel and debris basins (including Mud Creek) comprise the second unit of the

▲ *the swollen santa clara river cut a broad swath of destruction on its course to the ocean during the 1969 floods. (photo courtesy of ventura county flood control district)*

◀ *the santa clara river levee prevented $55 million in damages during the 1969 floods. the levee, which was damaged by floodflows deflected by gravel-mining operations in the riverbed, was repaired by corps contractors working round-the-clock during the floods.*

Santa Clara River Basin project. The estimated Federal first cost of the Santa Paula Creek improvements is $19.5 million, and the estimated non-Federal first cost is about $2 million.

Construction of the downstream 1,700 feet of the Santa Paula Creek channel has been completed. However, construction on the rest of the project has been halted as a result of a complaint filed with the U.S. District Court by the Sierra Club, four local organizations concerned with environmental protection, and several individuals who oppose the flood control improvements. The Corps of Engineers has been enjoined to do no further construction on the project unit pending preparation, coordination, and filing of a new environmental impact statement.

A revised project plan was developed by the Los Angeles District Corps of Engineers after the 1969 floods demonstrated that the project unit as authorized was inadequate. At that time, floodflows poured mud up to 7 feet deep into homes and businesses in Santa Paula and carried boulders weighing up to one-third of a ton each into Santa Paula Creek. It was apparent that the authorized plan for a channel only along Santa Paula Creek would not solve the flood problem. The channel probably would be destroyed in a single flood by high-velocity flows carrying large boulders. Debris basins must be provided in conjunction with any channel improvements.

The revised project plan provides for construction of the Santa Paula Creek debris basin; the Santa Paula Creek channel, extending about 3.5 miles downstream from the basin to the Santa Clara River; the Mud Creek debris basin; and the Mud Creek channel, extending about three-quarters of a mile downstream from the basin to its confluence with Santa Paula Creek.

this ventura home survived the santa paula creek floodflows. note the pile of mud and the high water line on the window frames.

In developing the revised project plan, careful consideration was given to function and esthetics in the design of structures, to recreational facilities that would complement existing recreational facilities, and to beautification measures that would enhance the natural environment of the area.

The present plan includes a 12-acre lake for boating and fishing; two small waterfalls on Santa Paula Creek along a natural channel through the picnic areas; and a 30-acre riparian preserve with a companion riding, hiking, and nature trail extending through the area.

After the new environmental impact statement has been filed, and when again funded for construction, the revised project unit may proceed to completion.

Stewart Canyon Debris Basin and Channel (Los Angeles District)
The Stewart Canyon debris basin and channel project was completed in 1963 at a Federal cost of $940,000 and a non-Federal cost of $352,000. The project consists of a debris basin at the mouth of Stewart Canyon and a paved channel (half of which is a covered channel) extending 4,500 feet from the debris basin, through the City of Ojai, and thence to a natural channel south of the city. The project is maintained by the Ventura County Flood Control District.

By controlling most floods originating in Stewart Canyon, the project provides protection to the City of Ojai, nearby agricultural areas, a section of State Highway 150, and a branch line of the Southern Pacific Company. However, the project does not provide protection against floods originating east of Stewart Canyon; such floods have caused considerable damage since completion of the project. During the 1969 floods, runoff from an adjacent canyon combined with runoff from Thacher Creek, about 1 mile east of Ojai, caused severe damage; about 1,500 people were evacuated from their homes in and near Ojai.

Since its construction, the project has prevented about $2.1 million in flood damages, including $2 million during the 1969 floods.

Sweetwater River Project (Los Angeles District)
The Sweetwater River project, now in the preconstruc-

tion planning stage as part of a highway project, would consist of 3.4 miles of trapezoidal channel flanked on both sides by the proposed State Highway 54 along much of its length. The Federal first cost of the project is estimated at $12.9 million, and the non-Federal first cost is estimated at $13.1 million.

The combined flood control and highway plan would permit the most efficient use of the limited lands available in the Sweetwater River Valley, and would effect economies in the construction of both improvements. Less land would be required for rights-of-way, relocation costs would be shared, and excavated material from the channel would be used in the construction of the highway embankment.

Landscaping measures would be an important part of the project. Trees and shrubs that would be planted along both banks of the channel would serve as a screen for the channel. Equestrian and bicycle trails would be provided to complement development of the proposed Sweetwater Regional Park just upstream from the project. In addition, 172 acres of marshland at the mouth of the channel would be acquired as a habitat for rare and endangered species.

The project would provide protection against floods to an overflow area of about 800 acres of valuable residential, commercial, industrial, and recreational property in the rapidly developing areas of Chula Vista and National City.

Tijuana River International Flood Control Project (Los Angeles District)
The Tijuana River international flood control project was authorized for construction by the United States Commissioner of the International Boundary and Water Commission, United States and Mexico. The United States Commissioner requested that the Corps of Engineers make definite project studies of the improvement.

The proposed plan of improvement, which was filed with the Council on Environmental Quality June 7, 1976, and which is the plan selected by the San Diego City Council as being in keeping with its land-use concepts for the Tijuana River Valley, provides for construction of (a) about 1,400 feet of concrete-lined trapezoidal channel, beginning in the United States at the international boundary as a continuation of the concrete-lined Tijuana River channel in Mexico; (b) an energy dissipater 3,650 feet long to reduce accelerated floodflows; and (c) 9,100 feet of levees for the protection of lands in the United States and Mexico. The estimated Federal first cost of the improvements is $12,400,000; and the non-Federal cost is $2,200,000.

Preconstruction planning will begin when Mexico approves the proposed plan of improvement, probably in the near future. The project will fulfill the United States' international commitment to Mexico, allow Mexico to complete its channel to the international boundary, prevent backwater flooding into the City of Tijuana in Mexico, and reduce velocities of floodflows from the channel in Mexico. The project will provide protection against floods to about 400 acres of land in the border area.

Ventura River Levee (Los Angeles District)
The Ventura River levee is a rock-revetted earthfill structure along the left bank of the Ventura River. The levee, which is 2.64 miles long, was completed in 1948 at a cost of $1.5 million, including $140,000 in non-Federal cost.

The damages prevented by the levee during the 1969 floods are estimated at $3.1 million. The total damages prevented to date by the project are estimated at $3.7 million.

The overflow area protected by the levee comprises about 1,500 acres, including part of an oil field and agricultural, suburban, residential, and business property in and near Ventura.

the approaches of the santa ana boulevard bridge in live oak acres were washed out by the 1969 floods. (photo courtesy of ventura county flood control district)

south coastal basins

flood control studies

Dominguez Channel (Los Angeles District)
An investigation was authorized in 1976 to determine the feasibility and advisability of enlarging the Dominguez channel for flood control purposes. The investigation was authorized as part of the investigation of water and surface transportation needs resulting from the expansion and further development of the San Pedro Bay ports.

San Diego County Streams Flowing Into the Pacific Ocean (Los Angeles District)
An investigation of San Diego County streams flowing into the Pacific Ocean is presently under way. The area under study comprises about 1,810 square miles. Excluded from the study are the drainage areas of the Santa Margarita, San Luis Rey, and Tijuana Rivers and the main stem of the Sweetwater River, which have each been previously investigated.

The investigation will include consideration of the improvements recommended in the interim investigation, and consideration of channel improvements, multiple-purpose storage projects, recreational facilities, and nonstructural flood plain management. Of special concern will be the protection and enhancement of the existing environment. Although San Diego County was on the southern fringes of the 1969 floods, damages were estimated at $2.7 million.

The population of San Diego County in 1970 was 1.1 million and is expected to increase to 2.2 million by the year 2000. With increases in population and resultant changes in land use, existing problems in the study area will magnify and new problems will develop.

An interim investigation on Telegraph Canyon at Chula Vista is nearing completion. Improvements under consideration include a combination detention basin and channel plan and a channel only plan. The investigation is scheduled for completion in 1977.

The investigation of streams in the remaining areas of the county has been started. The final report is scheduled for completion in 1981.

Santa Clara River and Tributaries (Los Angeles District)
An investigation of the Santa Clara River and tributaries in Los Angeles and Ventura Counties began in 1965. Flood control improvements are necessary for this rapidly developing area, where agricultural lands are being subdivided for industrial, commercial, and residential development. The 1970 population of the basin was 110,000 with an expected increase to 630,000 by the year 2000. A comprehensive flood control plan will be developed to provide the best possible solutions to the present and future needs of the area. Consideration is being given to about 130 miles of channel improvements and 25 debris basins in Los Angeles County, and 60 miles of channel improvements and 10 debris basins in Ventura County. The study will also consider water supply, fish and wildlife, and recreation. The flood control aspects of the proposed Cold Springs and Topatopa Reservoirs (U.S. Bureau of Reclamation) and the completed Castaic Reservoir (State of California) have been evaluated. The investigation, which will include investigation of flood problems along Sespe Creek in the City of Fillmore, has no presently scheduled definite completion date.

An interim investigation of the South Fork of the Santa Clara River in Santa Clarita Valley is nearing completion. Improvements under consideration include a debris basin and channel. The investigation is scheduled for completion in 1977.

Ventura River (Los Angeles District)
A reconnaissance investigation of the Ventura River is being made with funds currently available. Its purpose will be to determine whether any modifications of recommendations contained in a prior report are advisable at the present time. Consideration will be given to providing flood control improvements in the Ventura River Basin and to the needs of the areas in and near Live Oak Acres and along San Antonio Creek in the Ojai Valley.

small flood-control projects

City Creek Levee (Los Angeles District)
The City Creek levee project is along City Creek about 5.5 miles east of San Bernardino. The project was completed in 1960 at a Federal cost of $400,000 and a non-Federal cost of $485,000. It includes 2,550 feet of new levee, 3,400 feet of revetted old levee, and 4,600 feet of excavated channel. The San Bernardino County Flood Control District maintains the project.

The project is designed to prevent City Creek from overflowing to the west toward the City of San Bernardino. During the 1969 floods, the project prevented damages estimated at $2.4 million.

Rose Creek Channel (Los Angeles District)
Rose Creek channel is along Rose Creek in the City of San Diego. The project was completed in 1970 at a Federal cost of $982,000 and a non-Federal cost of

$251,000. It consists of about 3,500 feet of channel improvements extending from near U.S. Highway No. 101 bridge southwestward to the Grand Avenue bridge at Mission Bay.

Rose Creek channel protects valuable residential and commercial property from flood damages. It is maintained by the City of San Diego.

beach erosion control and shore protection projects

Prefatory Note
The preservation of the shoreline of the South Coastal Basins has been an important part of the work of the Los Angeles District since the 1930s, when Congress authorized the Corps to cooperate with the states to devise effective means of controlling beach erosion. A major problem in the South Coastal Basins is the maintenance of beaches for the large population concentrated in urban areas along the coast. This problem has peculiar characteristics: In contrast to beaches elsewhere in the United States, the Southern California beaches are not always nourished by sand washed in from the ocean. Instead, much of the coastal region south of Los Angeles has relied upon the Los Angeles, San Gabriel and Santa Ana Rivers for replacement of sand, which the waves of the Pacific Ocean constantly swept downcoast and into offshore submarine canyons.

Originally, the concern with these rivers was their control during rainy seasons to prevent floodflows from devastating the coastal plain. By the 1940s, however, these rivers were tamed by forcing their flows into concrete channels, and the coastal plains were protected from the floodflows, but at a steep price — no longer were the rivers able to provide sand for the natural replenishment of the beaches.

In solving one vital problem, a new problem had been developed. It soon became obvious that every man-made facility on the coast or inland, economic or recreational, has some impact on the coast. For example, problems result from construction of piers, breakwaters and harbors that interfere with natural sand drift and set up new ocean wave patterns to produce disastrous effects. As a result, sandy beaches may disappear, and bluffs and homes may be undermined by new wave action and topple into the ocean.

The studies made by the Los Angeles District and the projects that have evolved as a result of these studies have played a large part in protecting and developing the invaluable coastal resources of the South Coastal Basins. The effort continues with the cooperation of Federal, State and local agencies to protect the scenic and environmental integrity of the coastline and to understand the movement of beach sand.

Anaheim Bay Harbor (Los Angeles District)
Anaheim Bay Harbor is located about 4 miles southeast of the mouth of the Los Angeles River on the coast of Southern California. This shore protection project, at Seal Beach just upcoast from the harbor, consists of a protective beach, with a width ranging from 300 to 1,200 feet and a length of 5,000 feet, formed by the deposition of 250,000 cubic yards of sand, and a groin 750 feet long. Work on the project was completed in 1959 at a Federal first cost of $89,000.

As originally authorized, the Anaheim Bay Harbor project also included a Federal contribution toward the first cost of creating a protective beach at Surfside by placing about 1 million cubic yards of sand on the shore. However, this work was deleted from the Anaheim Bay Harbor project and included in the San Gabriel River to Newport Bay (Orange County) project in 1962.

An investigation was authorized in 1974 to review the requirements of local cooperation with particular reference to Federal and non-Federal cost sharing for maintenance of a beach of adequate width at Seal Beach. The existing shore protection project at Seal Beach was completed in 1959. Estimates indicate that about 20,000 cubic yards of sand are lost each year along the 2-mile-long beach. The City of Seal Beach has requested that it be included in the 67 percent Federal participation in maintenance provisions authorized by Public Law 87-874, enacted since completion of the project. The investigation will begin when funds are made available.

Doheny State Beach (Los Angeles District)
The Doheny State Beach Shore Protection Project, completed in 1966, together with Dana Point Harbor immediately upcoast, comprises a sea-and-shore recreation complex that provides enjoyment for residents living near one of Southern California's prime coastal areas. The shore protection project consists of a protective beach, with a width ranging from 100 to 130 feet and a length of 6,000 feet, formed by the deposition of 934,000 cubic yards of sand, and of a groin 250 feet long. The project was built at a Federal first cost of $579,000 and a non-Federal first cost of $431,000. A unique feature of the shore protection project is an artificial surfing reef which was created as a by-product of dredging operations required for construction of Dana Point Harbor. Armed with a dredge that scooped 100

tons of rock in a single bite, the Corps of Engineers excavated about 125,000 cubic yards of rock from Dana Point Harbor and placed it about 3,000 feet off Doheny State Beach. This surfing reef may be the forerunner of similar reefs along the coast of Southern California.

Imperial Beach (Los Angeles District)
Imperial Beach, in San Diego County, is about 5 miles north of the Mexican border. The project provides for a Federal contribution toward the first cost of constructing five stone groins along the beach front. Two groins have been completed, and three groins have been deferred pending demonstration of need. The estimated Federal first cost of the project is $985,000, and the non-Federal first cost, $845,000.

After about 14 years of surveillance of the completed groins, it has become apparent that corrective measures are urgently needed to prevent further beach erosion. Further construction of the project has been suspended pending investigations of the effectiveness of the groin system, which now seems questionable. A model study is under way at the Corps of Engineers Waterways Experiment Station in Vicksburg, Miss., to determine the best plan of improvement for protection of Imperial Beach. The study is part of preconstruction planning work on the uncompleted parts of the project. A review investigation was authorized to determine the advisability of modifying the existing project for beach erosion control at Imperial Beach. The investigation, which began in 1966, was suspended in 1968 when surveys indicated that a general short-term accretion of sand was occurring along the Imperial Beach shoreline. However, the accretion was short-lived and serious erosion continues.

Ocean Beach (Los Angeles District)
Ocean Beach in the City of San Diego is essentially a pocket beach between the headland at Narragansett Avenue and the entrance jetties at Mission Bay. The project consists of a protective beach 200 feet wide and 1,700 feet long, formed by the deposition of 275,000 cubic yards of sand dredged from Mission Bay at no cost to the project, and of a stone groin 530 feet long. The project was completed in 1955 at a Federal cost of about $8,000 and a non-Federal cost of about $16,000.

Oceanside (Los Angeles District)
The Oceanside project is just downcoast from Oceanside Harbor in San Diego County. Constructed at a Federal cost of $1.4 million, the project consists of a protective beach with a width ranging from 100 to 200 feet and a length of about 3.3 miles, formed by the deposition of 3.8 million cubic yards of sand, and of a stone groin 1,223 feet long. The project was completed in 1963.

Since completion of the project, the beach has been periodically nourished as a byproduct of maintenance dredging of the navigation channels of Del Mar Boat Basin and Oceanside Harbor. However, the material made available in this manner has not been sufficient to maintain a beach of adequate width. In addition, the natural littoral processes that normally supply beach-building material for shorelines have been interrupted at Oceanside.

An investigation, which began in 1969, is now under way to determine the extent and rate of beach erosion, the most effective and economical means of preventing beach loss, the extent of periodic beach nourishment required to maintain a beach of adequate width, and the appropriate share of the construction cost to be borne by the Federal government. The scheduled completion date for the study is 1978.

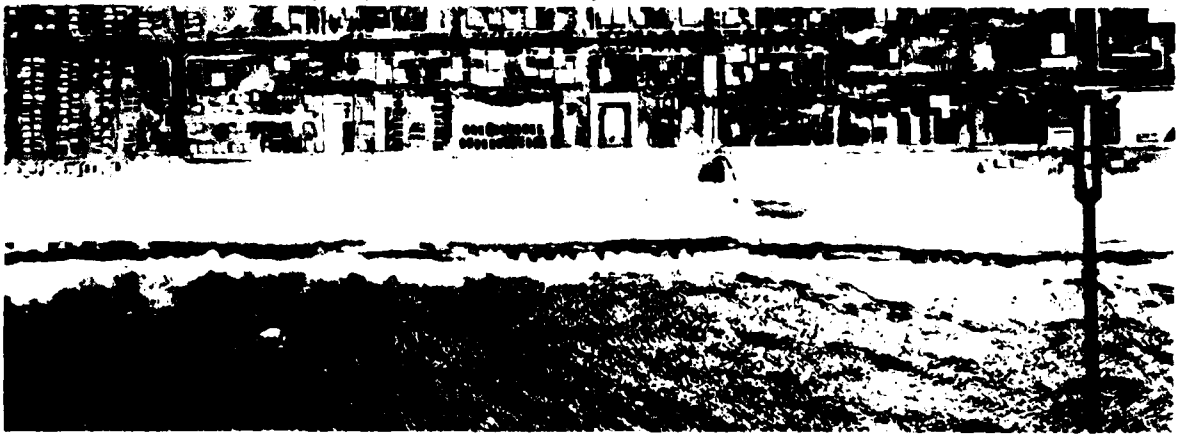
Point Mugu to San Pedro Breakwater (Los Angeles District)
This beach erosion control and shore protection project extends along the coast from Topanga Canyon on Santa Monica Bay to the San Pedro breakwater at Los Angeles Harbor. That part of the project between Topanga Canyon and Topaz Street in Redondo Beach has been deleted because the 16-year limit for completion of the work expired in 1970. All work on the rest of the project has been completed, including construction of a barrier groin at Cabrillo Beach and at Topaz Street and providing a protective beach between Topaz Street and Malaga Cove. The beach, which is 200 feet wide and 7,800 feet long, was formed by the deposition of 1.4 million cubic yards of sand. The work was done at a Federal cost of $1,254,000 and a non-Federal cost of $1,238,000. The project is maintained by local interests.

An investigation of Point Mugu to the San Pedro breakwater began in 1967. The study area covers a distance of about 50 miles from Sequit Point, at the Los Angeles County-Ventura County line, to Flat Rock Point at the northwestern tip of the Palos Verdes Peninsula. The Marina del Rey jetties and breakwater, the Santa Monica breakwater, 12 State beaches, 2 County beaches and 2 municipal beaches are in the study area.

The investigation will determine the extent and rate of beach erosion, the most effective and economical means for preventing loss of beach material, and the

▲ *1960 view of oceanside beach after beach was destroyed by eroding waves.*

corps deposited 3.6 million cubic yards of sand in 1963 beach restoration work at oceanside. ▼



1977 view of oceanside beach; a solitary beachgoer sits among the cobbles.

share of the cost to be borne by the Federal government for any remedial work. Completion date for the investigation is indefinite.

San Buenaventura State Beach (Los Angeles District)
San Buenaventura State Beach (Ventura Beach) is in the City of Ventura. The beach erosion control project provides for a Federal contribution toward the first cost of constructing groins and placing suitable material along a public beach from 800 feet upcoast from Ventura pier to Whitehaven Court at the downcoast end of the State beach. Seven groins were completed and about 882,000 cubic yards of beach fill were deposited on the beach by 1966 — almost one-half of the 1.5 million cubic yards authorized. During the spring of 1967, two groins were rehabilitated with rock from groin No. 1. This rock was removed when the beach appeared to be stable. However, severe erosion necessitated the rebuilding of groin No. 1 in 1973. The beach is under continuing surveillance. Additional construction is deferred pending a demonstration of need.

To date, Federal costs total $716,000, and non-Federal costs total $619,000. In addition, local interests have spent $117,000 on safety railings for the north and south jetties, two restrooms, and a parking area. The project was authorized as a result of a study made by the Corps of Engineers in cooperation with the State of California. Combinations of storm waves, strong onshore winds and high tides had attacked the beach area, reducing the once wide stretch of sand to a narrow strip of land littered with stones and cobbles. Concerned residents of the Pierpont Bay area requested the study. The completed parts of the project are maintained by local interests.

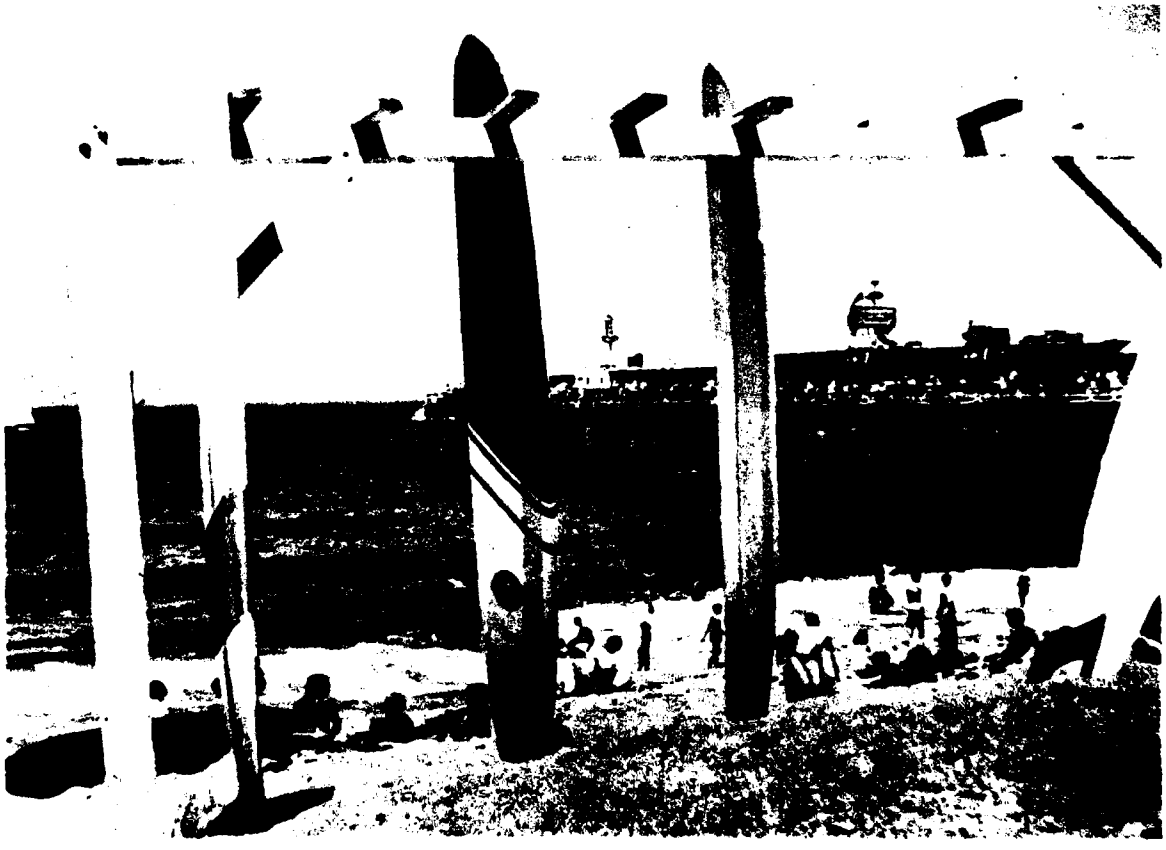
San Diego (Sunset Cliffs) (Los Angeles District)
This project was authorized to reduce the progressive erosion of the beach and cliffs in the Sunset Cliffs area in the City of San Diego. Retreat of the cliffs has damaged streets and destroyed both public and private land and improvements. An earthquake in 1968 caused parts of the cliffs to fall into the ocean. Large cracks have appeared along the edges of the bluffs.

The project provides for beach erosion control and shore protection in two areas at a total cost estimated at 3.3 million, shared equally by the Federal government and local interests.

The first area, Segment A, extends from Santa Cruz Avenue south to Osprey Street, where about 720,000 cubic yards of beach fill would be placed, to form a beach 200 feet wide and 4,000 feet long, and four stone groins would be built to protect that fill. This work has not been accomplished because of opposition by local residents who are of the opinion that development of a recreational beach would attract an excessive number of visitors to what is now a quiet residential area. Alternative plans are under consideration.

The second area, Segment B, extends from Osprey Street south to Ladera Street, where work included constructing 11 stone revetments and 2 stone dikes and sealing 2 hazardous cave entrances. The work was completed by the Corps in 1973.

the corps widened part of redondo beach improving its recreational potential.



south coastal basins

San Gabriel River to Newport Bay, Orange County (Los Angeles District)
This shore protection project extends along the coast of Southern California for about 17 miles from Anaheim Bay Harbor south to Newport Bay Harbor. Work on the project has been in process since 1964 when 4 million cubic yards of sand were placed on the Surfside-Sunset Beach. Before protective measures were undertaken, beach erosion had plagued the area for more than 50 years, threatening to destroy some of the most valuable beach property in the United States.

Completed work includes placement of 6.4 million cubic yards of beach fill at Surfside-Sunset beach and 1.8 million cubic yards at Newport Beach and construction of 9 sheet-pile and stone groins and rehabilitation of 2 sheet-pile groins at Newport Beach.

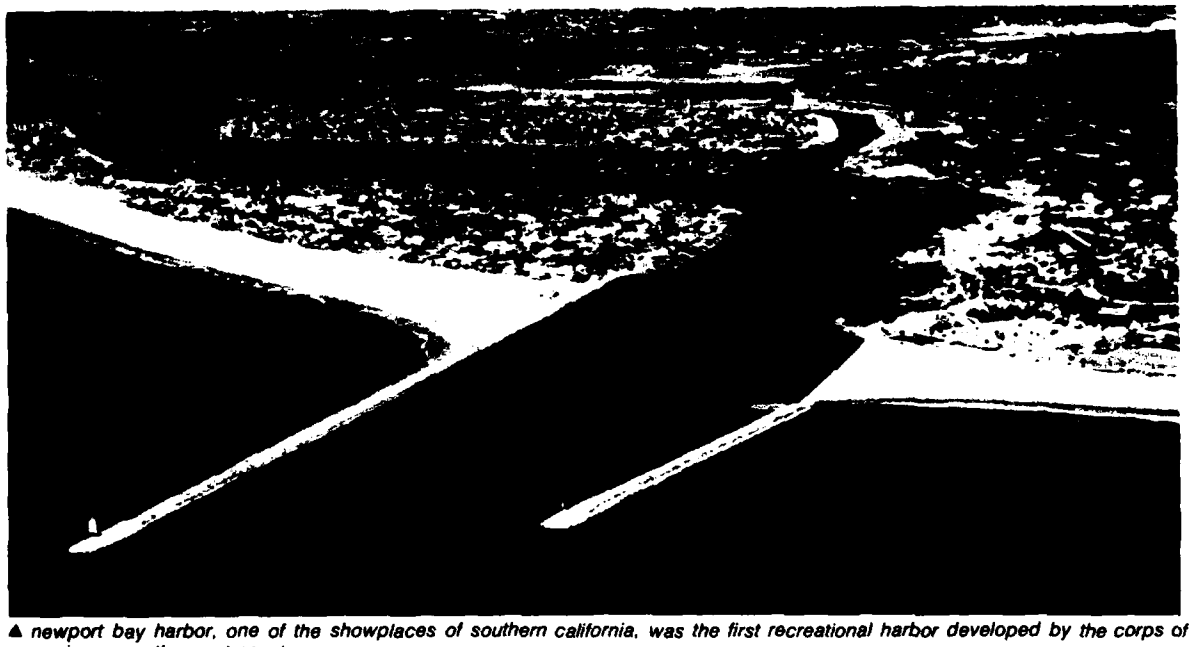
Additional work to be done is deferred pending demonstration of need. The deferred work includes construction of a detached offshore breakwater at Huntington State Beach, construction of a stone groin at Newport Beach (an extension of the south jetty at the Santa Ana River), and placement of 1.5 million cubic yards of fill material at Surfside-Sunset Beach. Total cost of the project is estimated at $15.1 million, of which $10.1 million is the Federal cost.

beach erosion control and shore protection study

Ventura County (Los Angeles)
An investigation of beach erosion in Ventura County is under way. The study area comprises a 41-mile reach of shoreline extending from Rincon Point to Sequit Point. The littoral regime in the area is affected by three major streams (the Ventura River, the Santa Clara River and Calleguas Creek), three harbors, two submarine canyons and a tidal lagoon. A major problem exists at Faria and Hobson Beach Parks, Emma Wood State Beach, and Oxnard Shores where periodic erosion has threatened public property and fine homes.

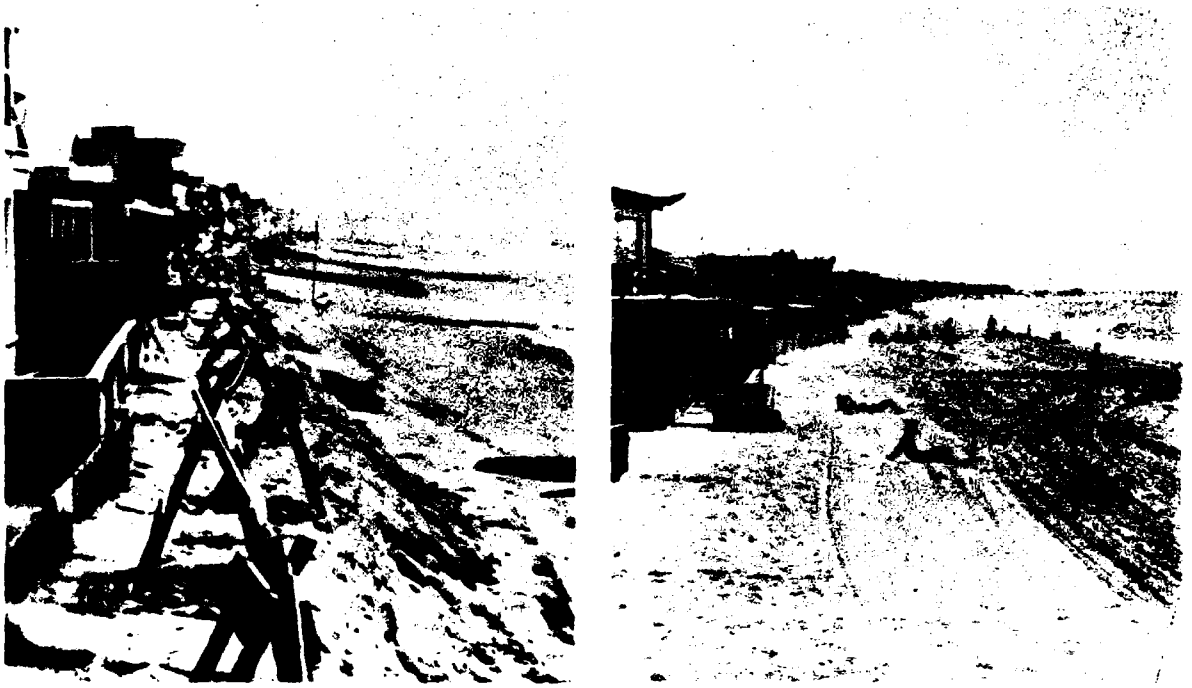
Consideration is being given to remedial measures for stabilizing the shoreline, including construction of stabilizing groins and placement of additional beach fill, construction of offshore breakwaters, and construction

these youths risk life and limb along sunset cliffs in san diego. several deaths have occurred from cave-ins.



▲ *newport bay harbor, one of the showplaces of southern california, was the first recreational harbor developed by the corps of engineers on the west coast.*

▼ *about 6,000 small craft are based at newport bay harbor, which is a highly developed area oriented toward water-related recreational and business activities. future corps plans call for widening the main channel and deepening other channels in the harbor to increase the capacity of what has become one of the most popular and highly developed small-craft anchorages in southern california.*



these photos show adjacent locations in newport beach before and after the corps placed about 1.5 million cubic yards of sand.

of rock revetment along the shore. The investigation is scheduled for completion in 1983.

small beach erosion control and shore protection projects

Bird Rock Area of La Jolla (Los Angeles District)
In 1966, the Corps of Engineers constructed a 1,300-foot-long stone revetment for the protection of the Bird Rock area of La Jolla from excessive erosion. The revetment was built at a cost of $102,000, including a non-Federal cost of $76,000. This area, one of the most spectacular scenic areas along the California coast, is known for its high bluffs that have been carved into strange shapes by eons of pounding waves. Before construction of the project, waves up to 15 feet high accelerated the erosion process, threatening not only the bluffs but also valuable residential property on top of the bluffs. The project is maintained by local interests.

Las Tunas Beach Park (Los Angeles District)
Las Tunas Beach Park, which is a State-owned park operated by Los Angeles County, consists of a 1,500-foot-long beach 4.8 miles east of Malibu Point. The beach has sustained erosion to such an extent that it is barely usable. Six existing sheet steel pile groins, which have greatly deteriorated, are now relatively ineffective in retaining the beach.

Shore protection improvements recommended for construction include two rubblemound groins, deposition of about 174,000 cubic yards of beach fill, removal of parts of four existing deteriorated groins, and extension of three existing road culverts to the restored grade. The estimated Federal first cost of the project is $531,000, and the estimated non-Federal first cost is $611,000. Work will begin when funds are available.

small beach erosion control and shore protection project study

Royal Palms Beach Park (Point Fermin Cliffs) (Los Angeles District)
A detailed project report will be prepared on Royal Palms Beach Park. The State-owned beach park,

which is leased to the County of Los Angeles, is downcoast from the Palos Verdes headland in a region of deficient littoral sand supply. The problems at the beach consist of cliff slippage and beach erosion. Possible corrective measures include providing stone revetments and building up an existing natural reef to protect the beach from erosion. The problem of cliff slippage is a responsibility of local interests who will have to provide adequate protective measures at their own expense to ensure safe use of the park. Work on the study will be resumed when funds are available.

special investigations

Coast of California, Protection Against Storm and Tidal Waves (Los Angeles and San Francisco Districts)
A special investigation of storm and tidal waves authorized by the 1965 Flood Control Act includes the ocean coasts of the South Coastal Basins. See page 31 for additional information on this study.

Pacific Palisades Area (Los Angeles District)
The Corps of Engineers and the U.S. Geological Survey have completed a special investigation of the Pacific Palisades area to find a feasible solution to long-standing landslide problems. The community of Pacific Palisades, built on mesas which overlook the Pacific Ocean, is part of the City of Los Angeles. Since about 1926 when subdivision work commenced in the now exclusive area, five major landslides have occurred. The 1969 landslide, triggered by the severe storms of January and February, caused damages estimated at $1.1 million. Earth movement in the area has damaged streets, utilities and highways forcing the City of Los Angeles to spend excessive amounts for continual repair work. To date $4 million has been spent for remedial measures.

The report on the investigation includes an evaluation of structural and non-structural alternatives and provides an updated version of the landslide map published by the U.S. Geological Survey in 1959. A geologic base map of the area was prepared by the U.S. Geological Survey as a supplement to the report. The report indicates that Federal participation in providing structural measures for present and future stabilization of the area cannot be economically justified. However, the report further indicates that Federal technical assistance will be available if the City of Los Angeles

stone revetment constructed by the corps protects bluffs in the bird rock area of la jolla from wave erosion.

heavy equipment works away at rubble left by the collapse of two veterans administration hospital buildings in sylmar following the 9 february 1971 earthquake. forty-five persons died. corps workers searching for victims rescued 15 persons.

decides to develop a long-range plan for a solution to the landslide problem. Such a plan would probably include control of subsurface drainage, area grading at the top and toe of slopes, selective treatment of building sites, enforcement of local building codes and improved measures for surface drainage. The problem in the Pacific Palisades area is not unlike the problem on many flood plains where development has occurred through ignorance or underestimation of the hazards involved.

The report on the investigation has been completed but has not as yet been submitted to Congress.

emergency work

Emergency work in excess of $56 million has been performed by the Corps of Engineers in the South Coastal Basins. The Corps has responded to emergencies resulting from earthquakes, floods, fires and dam failures. Other emergency work has included flood suppression activities, construction of debris basins, beach erosion controls and removal of wrecks and obstructions from coastal waters.

The most recent natural disaster to strike the South Coastal Basins was a killer earthquake that occurred in the San Fernando-Sylmar area in metropolitan Los Angeles on February 9, 1971, at 6:02 a.m. Within the hour, the Corps of Engineers dispatched a contractor and many engineers to the area, where two main buildings of the Veterans Administration Hospital had collapsed burying 60 people. The search for victims was a complicated and dangerous task. Huge pieces of the wreckage had to be removed without disturbing the mass and twisted debris had to be cut with concrete saws. Although the death toll reached 45, the searchers had the satisfaction of bringing 15 people out of the wreckage alive.

Meanwhile, Corps personnel at Van Norman Reservoir, a few miles away, desperately worked with Los Angeles Department of Water and Power employees to draw down the reservoir water level. The earthfill dam had sustained major damage during the quake and 80,000 people downstream were in imminent danger. Eleven pumps, including a huge dredge pump powered by a diesel engine that once drove a submarine, were hooked up for dewatering the reservoir. Fortunately, the dam held during the operations.

As a result of the earthquake, the Office of Emergency Preparedness requested the Corps of Engineers to provide water to the badly damaged City of San Fernando; repair water and sewer systems, streets, flood control facilities and public structures; and to demolish and clear away damaged buildings that constituted public dangers. Damages from the earthquake totaled more than $500 million. The cost of emergency operations was in excess of $28 million.

In 1970 the Corps was called upon when widespread fires during September, October and November burned in nine Southern California counties leaving large areas extremely vulnerable to winter mud slides and flood damage. These fires were the worst known to have occurred in California, burning more than 380,000 acres in the South Coastal Basins. The largest single portion was more than 175,000 acres burned in San Diego County.

Immediately following the fires, extensive work was undertaken by the Corps to prevent mud slides and flooding with the onset of the winter rains. The work comprised clearing stream channels; clearing, repairing and modifying existing debris barriers; constructing new debris barriers and check dams with spillways and outlets; and clearing burned and fallen timber. The cost of the work was $5.8 million.

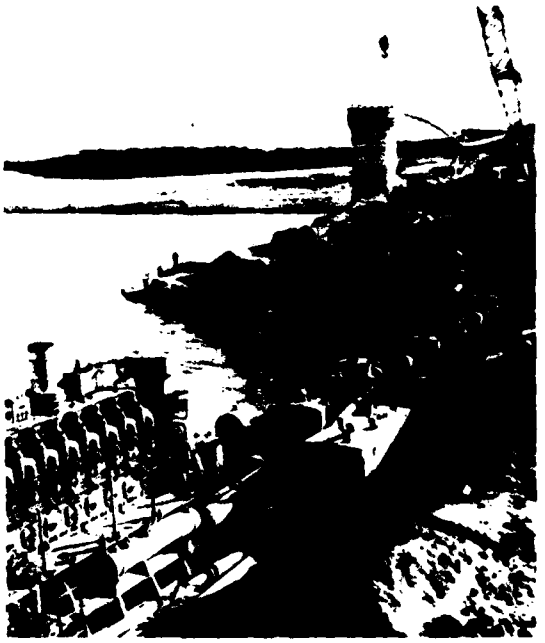
In 1969, more than 100 persons in the South Coastal Basins (including 57 people in Los Angeles County) lost their lives in the most devastating floods known in California. The floods struck the South Coastal Basins during the periods of 18-26 January and 20-26 February 1969. Earlier floods may have equaled the 1969 floods in magnitude, but they were far less damaging because they occurred when the area was less extensively developed. Over 10,000 persons had to be evacuated and many thousands were isolated in foothill and mountain canyons. Damage to homes, businesses and industrial establishments, agricultural areas, transportation facilities, public utility systems and recreational facilities was widespread and severe. Seven counties in Southern California were declared disaster areas as a result of the 1969 floods. Flood damages in the South Coastal Basins were estimated to be $157.9 million.

During the floods, the flood control districts of the affected counties coordinated floodfighting and rescue activities and directed the efforts of thousands of volunteer workers comprising employees of various city, county and State agencies; military personnel; college students and others. The floodfighting operations center of the Los Angeles District Corps of Engineers, among other emergency activities, directed the operation of the existing complex system of reservoirs and channels in a manner that ensured optimum flood control and water conservation. Extensive recovery operations were required.

van norman reservoir, severely damaged by quake, posed a threat to 80,000 people downstream. fast action by the corps and the l. a. department of water and power to draw down the water level kept the dam from breaching.

the quake broke up huge sections of the dam liner, allowing the slabs to settle below water level in critical areas of the dam.

following the earthquake the corps rushed 11 pumps to van norman reservoir to lower the water level. this former submarine engine drove a huge dredge pump.



fires blaze in the evening skies over malibu in the santa monica mountains, fall 1970.

Major types of work accomplished under continuing authorities available to the Corps of Engineers and the Office of Emergency Preparedness included the removal of mud, silt and other flood debris from stream channels, debris basins, roads, streets and beaches; repair and restoration of levees and revetments; rectification of stream channels; rehabilitation of reservoir areas; repair and restoration of public utilities, especially water and sanitary systems; and repair and reconstruction of roads and bridges. Costs for emergency recovery operations were $19 million.

On Saturday, 14 December 1963, at 3:38 p.m., the Baldwin Hills Dam in west-central Los Angeles failed. High-velocity flows from the municipally owned and operated water supply facility poured down a steep canyon, through highly developed residential and business areas, and into Ballona Creek. Most of the area devastated had been evacuated only 8 minutes before the dam failed and that narrow margin of safety accounted for the fact that only five deaths occurred. On 21 December, Los Angeles County was declared a disaster area. Repair and restoration activities consisted of dredging silt and debris from the mouth of Ballona Creek, repairing the creek channel, and restoring streets, utilities and storm drains. The emergency restoration work amounted to $1.4 million.

In December 1965, floods damaged areas along Arroyo Simi and its tributaries and along Mill Creek in the Santa Ana River Basin. Restoration work totaled nearly $700,000. In December 1966, floods again struck the Santa Ana River Basin necessitating an additional $443,000 of emergency work. The work included repairing levees and channels along Mill and Lytle Creeks and restoration work along the San Jacinto River.

Other work in 1966 included restoration of the channel of the San Gabriel River from the mouth of the canyon to Santa Fe Reservoir at a cost of $100,000. Pumping operations were initiated to draw down rising Tijuana River floodflows that were impounded behind the highway embankment at Smugglers Gulch. Collapse of the embankment, in which the main sewer outfall of Tijuana was embedded, would have allowed torrents of polluted floodwater to flow into the Pacific Ocean north of the international border. The work was done at a cost of $210,000.

In 1966 the Corps of Engineers placed a sandbag barrier along the ocean front in Newport Beach to protect homes threatened by high waves at a cost of $6,000. Floodflows from San Juan Creek, occurring during December 1966 and January 1967 storms, severely damaged the sheet-pile groin at Doheny State Beach; the cost of repairing the groin was $40,000.

Emergency shore protection work is sometimes undertaken under special Congressional authority. For example, in 1947, when severe beach erosion threatened the destruction of large homes in the Surfside Colony, the 80th Congress passed Public Law 122 to permit the Corps to correct the situation. The Corps deposited materials to widen the beach to a width of about 400 feet at the upcoast end and to a width of about 300 feet opposite the entrance to Surfside; the work was done at a cost of $250,000.

▲ *february 1969 floodflows from big tujunga canyon destroyed 2 bridges and 7 homes. dashed lines indicate the former location of bengal street and 3 residences. (photo courtesy of los angeles county flood control district)*

◀ *a pile of rubble is all that remains of a topanga canyon home where a mother and her two children were killed in a mud slide that engulfed their home during the january 1969 flood.*

The earliest emergency work in the South Coastal Basins was done in 1927 as a harbor improvement at a cost of $9,000, excluding labor. It consisted or rehabilitating a diverson dike along the San Deigo River in Old Town.

flood plain management services program

The following flood plain information studies for streams in the South Coastal Basins have been completed:

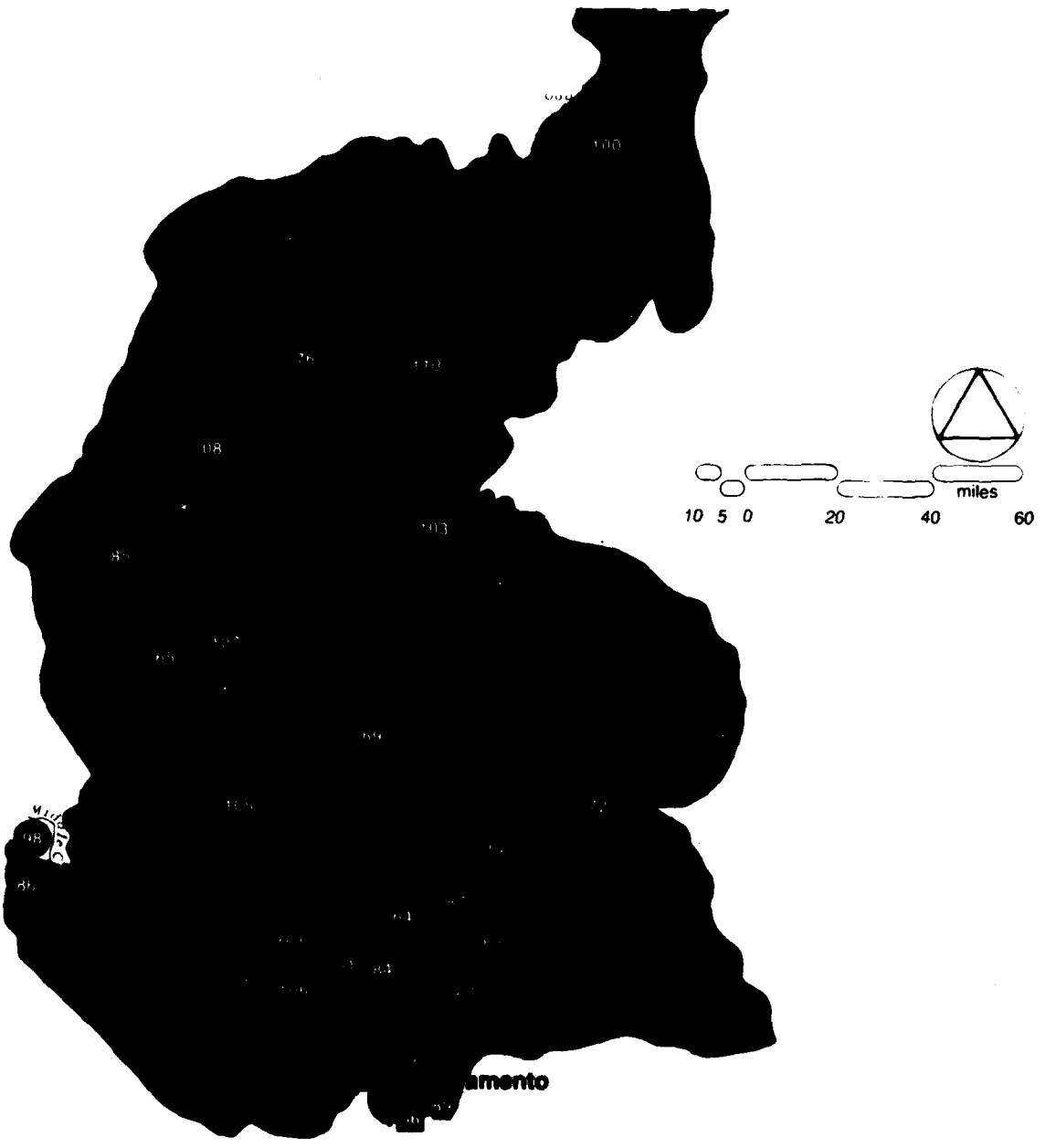
- Agua Hedionda Creek
- Aliso Creek
- Buena Vista Creek from Vista to the ocean
- Calleguas Creek:
  - From Somis to the ocean
  - In the vicinity of Moorpark
- Escondido Creek
- Laguna Canyon
- Las Chollas Creek
- Los Penasquitos drainage area
- Rose and San Clemente Canyons
- Salt Creek
- San Antonio Creek, Ventura County
- San Diego Creek and Peters Canyon Wash
- San Jacinto River from San Jacinto to Railroad Canyon
- San Juan Creek including Arroyo Trabuco and Oso Creek
- San Marcos Creek
- San Timoteo Creek
- Santa Ana River from Imperial Highway to Prado Dam
- Santa Clara River:
  - From Saticoy to the ocean
  - In the vicinity of Santa Paula
  - In the vicinity of Piru
  - In the vicinity of Sespe
- Lower Santiago Creek
- Spring Valley Creek
- Sweetwater River and Coyote Creek
- Ventura River
- Wilson and Wildwood Creeks
- Keys Canyon
- Moosa Canyon
- Otay River
- Upper Peters Canyon Wash
- Upper San Diego Creek tributaries
- San Luis Rey River

The following studies are in progress and are scheduled for completion in 1977:

- Point Mugu Naval Weapons Center
- Calleguas Creek

the 1963 failure of baldwin hills dam took five lives. the break in the dam and asphalt lining is evident in the upper photo. the lower photo shows part of the devastated residential area downstream from the dam, evacuated only 8 minutes before failure.

6 sacramento basin



project index

navigation projects

51 feather river
55 sacramento river deep water ship channel
56 sacramento river, shallow draft channels

debris control projects

62 harry l. englebright lake
63 north fork lake
64 yuba river restraining barriers

multipurpose projects

65 black butte lake
67 folsom lake
69 lake oroville
72 new bullards bar reservoir
76 shasta lake
84 bear river
85 cottonwood creek (dutch gulch & tehama lakes)
86 lakeport lake
87 marysville lake
89 morrison creek stream group

flood control projects

90 american river levee
98 middle creek improvement
100 north fork pit river at alturas
101 sacramento river flood control project
103 chester, north fork of feather river
105 sacramento river & major & minor tributaries
106 sacramento river bank protection
107 sacramento river, chico landing to red bluff
108 churn creek, shasta county
110 hat creek, shasta county

sacramento basin

description

The Sacramento Basin, situated in Northern California, is bounded by the Sierra Nevada on the east, the Coast Ranges on the west, the Cascade Range and Trinity Mountains on the north and the Delta-Central Sierra Area on the south. A portion of the watershed of the Pit River, the most northerly tributary of the Sacramento River, lies north of the basin in Oregon, but drains from Goose Lake through the Cascade Range into the Sacramento Basin proper. The Sacramento Basin is about 280 miles long and up to 150 miles wide and has a land area of 26,500 square miles and a water area of 440 square miles.

The Sacramento River is the principal stream in the basin. Its major tributaries are the Pit and McCloud Rivers, which join the Sacramento River from the north, and the Feather and American Rivers, which are tributary from the east. Numerous tributary creeks flow from the east and west. The average runoff from the basin is second only to the North Coastal Basins and is estimated at 21.3 million acre-feet per year. The melting snowpack in the Sierra Nevada maintains streamflow during most of the summer.

The climate of the valley floor areas of the basin is characterized by hot, dry summers and mild winters with relatively light precipitation. Warm, dry summers and cold winters with heavy rain and snow prevail in the mountainous areas. The average annual precipitation varies with elevation and ranges from less than 10 inches in the valley to over 95 inches in the Sierra Nevada and Cascade Range. Valley temperatures normally range from winter lows near freezing to summer highs of about 110 degrees. In the mountains, winter temperatures average about 30 degrees, and occasionally fall below zero.

The economy of the Sacramento Basin is based primarily on production of livestock and diversified crops. Related industries include food packing and processing, agricultural services and the farm equipment industry. Another important segment of the economy in the Sacramento Basin consists of military and other Federal government establishments, the State

(photo courtesy of u.s. bureau of reclamation)

government and the aerospace industry. The basin is served by a highly developed transportation system which includes Federal and State highways, airlines, railroads and waterways. A deep draft navigation channel extends from Sacramento to deep water in Suisun Bay, an arm of San Francisco Bay. The present population of the basin is 1.25 million and is expected to increase to 1.8 million by the year 2000.

Though substantial progress has been made in water resources development and in the solution of related problems, some basin areas are still threatened by floods and water shortages. Among these areas are the west side of Sacramento Valley, principally Yolo and Solano Counties; the Pit River Basin, primarily Big Valley; and scattered foothill and mountain areas on both the east and west sides of the Sacramento valley.

About 7,900 miles of channels are subject to continual streambank erosion. Average land loss from channel bank sloughing amounts to about 250 acres annually. Sheet erosion and scour occur on outwash fans. This type of erosion is generated by high flow rates in unconfined streamways and is particularly destructive to unused agricultural lands.

navigation projects

Feather River (Sacramento District)
The Feather River, the largest tributary of the Sacramento River, rises at high elevations in the Sierra Nevada. Below Oroville the main stream flows south for 65 miles where it empties into the Sacramento River near Verona.

The navigation project on the Feather River extends from the mouth of the river upstream to Marysville, a distance of about 28 miles. It consists of removal of obstructions and construction of wing dams to maintain channel depth. The project, constructed at a Federal cost of $10,000, is complete and in operation. No maintenance work has been required since 1951. One of the incidental benefits of the project is the improvement of the flood carrying capacity of the channel. In recent years, the channel has been used exclusively by pleasure craft.

william g. stone lock — the only navigation lock in california and the connecting link between deep draft navigation at the port of sacramento and shallow draft navigation in the sacramento river.

sacramento basin

the sacramento river deep water ship channel provides a direct route for oceangoing vessels bound for the port of sacramento, right foreground.

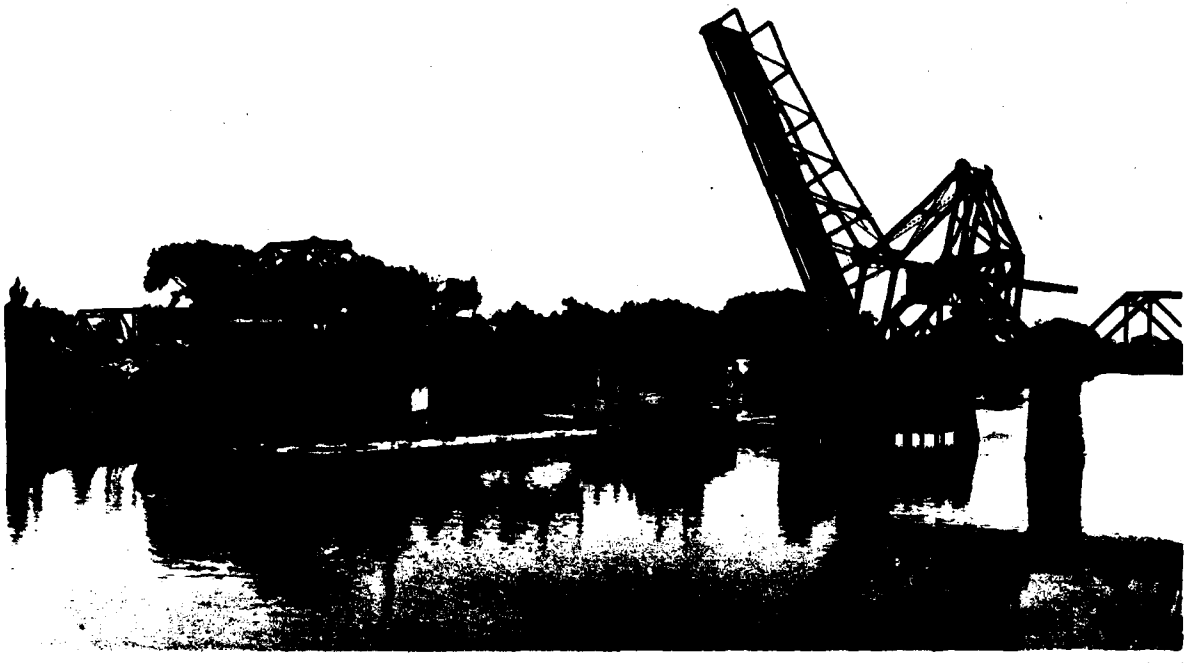
A study of shallow draft navigation in the Sacramento Valley is now underway to consider the feasibility of extending a navigation channel on the Sacramento River upstream from the City of Sacramento to the Cities of Nicolaus and Marysville, including about 30 miles of navigation channel along the Feather River.

Sacramento River, Shallow Draft Channels (Sacramento District)
The shallow draft navigation project on the Sacramento River provides for channel depths of 10 feet from the mouth of the river to Sacramento, 6 feet deep from Sacramento to Colusa, 5 feet deep from Colusa to Chico Landing and as practicable from Chico Landing to Red Bluff. Channel work from the mouth of the river upstream to Colusa has been completed at a cost of $643,000. Remaining work has been classified deferred pending economic feasibility. The shallow draft channel aids in flood control efforts and has resulted in the increased use of the river for navigation, principally by barges. Commerce in 1975 was over 129,000 tons. The southerly 65 miles of the project is located in the Delta-Central Sierra Area.

Public use of the Sacramento River and adjacent waterways for recreational and sport fishing purposes is increasing at a rapid rate. The present recreational use is estimated at more than 3 million user-days per year.

Sacramento River Deep Water Ship Channel
(Sacramento District)
The Sacramento River Deep Water Ship Channel Project is an extension of the Sacramento River Navigation Project. The channel extends from Suisun Bay to Sacramento, a distance of 43 miles. It is mostly in the Delta-Central Sierra Area, but is included in this chapter since the tributary trade area is located in the Sacramento Basin.

The channel was formed by widening and deepening existing channels from Suisun Bay to a point about 6 miles upstream from Rio Vista, and by excavating a new channel between that point and Lake Washington at the northern terminus of the project. In addition to the ship channel, the project consists of a triangular harbor and turning basin at Lake Washington, a connecting



oil barge under tow on the sacramento river near courtland.

barge canal with navigation lock from the harbor to the Sacramento River (for transfer of barges between the two waterways) and a single leaf combination highway and railroad bascule bridge across the canal at the harbor end of the navigation lock. Controlling minimum depths range from 13 feet in the barge canal to 30 feet in the ship channel.

The project was operationally complete in 1963 with the Federal portion completed in 1970. Total Federal cost of the project was about $39.9 million, including $300,000 for navigation aids provided by the U.S. Coast Guard.

Local cost of the project was about $14.8 million for lands, relocations and basic terminal facilities provided by the Sacramento-Yolo Port District. In addition, private interests provided associated terminal facilities at a cost of $7 million, and the State of California spent $3.2 million to build a new bridge at Rio Vista to permit the passage of oceangoing vessels.

The navigation project permits deep draft oceangoing vessels to proceed directly to the Port of Sacramento, thus reducing shipping costs to a trade area of about 75,000 square miles with a population of about 1.25 million. The project channel is used by a large percentage of barge traffic since it is shorter, straighter and deeper than the river route and lacks the variable currents present in the river. The major commodities handled on this waterway are petroleum products, rice and grains, cement, sand and gravel, animal feeds, oil seeds, food products and wood products. Total commerce on the project channel was in excess of 1.6 million tons in 1975, of which about 2.0 million tons represent deep draft traffic handled at the Port of Sacramento. The balance constitutes shallow draft traffic using the barge canal. Deep draft commerce consists principally of rice and sorghum grains, logs and wood chips and prepared animal feeds. Commerce on the barge canal, consisting of gasoline, other petroleum derivatives and cement was about 98,000 tons for 1975. In fiscal year 1975, traffic on the barge canal required more than 3,500 lockages.

Two review investigations, now combined in an overall project study, have been authorized to consider shoal-

sacramento basin

sugar beet barges ply the shallow draft navigation channel. ▶
(photo courtesy of harbor tug and barge co.)

the third stage of the saturn v launch vehicle, used in the apollo program, began its journey to cape kennedy on the sacramento river shallow draft channel. ▼

ing and sediment deposition problems, providing a channel turning basin and deepening the existing channel. The study is scheduled for completion in 1978.

navigation study

Sacramento Valley Navigation (Sacramento District)
The Sacramento Valley Navigation Study, authorized in 1962, includes investigation of the economic feasibility of extending and deepening the navigation channel in the Sacramento River between Sacramento and Red Bluff and of providing a 10 foot navigation channel along the Feather River. The Sacramento River channel is presently 6 feet deep from Sacramento to Colusa. Proposed depths are 5 feet from Colusa to Chico Landing, then as deep as practicable to Red Bluff.

The study is considering the feasibility of extending a navigation channel on the Sacramento River upstream from the City of Sacramento to the vicinity of the Cities of Nicolaus and Marysville, including about 30 miles of navigation channel along the Feather River. The study is scheduled for completion in 1979.

multipurpose projects

Black Butte Lake (Sacramento District)
Black Butte Lake is located on Stony Creek, a tributary of the Sacramento River, about 9 miles west of the City of Orland. The project consists of an earthfill dam 140 feet high and 2,970 feet long, 6 auxiliary earthfill dikes and a lake with a gross capacity of 160,000 acre-feet. Completed in 1963 at a Federal cost of $14.5 million, the project is operated and maintained by the Corps of Engineers. Local interests are required to reimburse the Federal government for project costs allocated to the water conservation function of this project.

The project provides flood protection to 64,000 acres of farmland lying along the lower reaches of Stony Creek, to the town of Hamilton City, the City of Orland and to the Interstate 5 Freeway. The project also helps to reduce floodflows along the Sacramento River and in Butte Basin. In addition, the project provides about 56,800 acre-feet of new water annually for irrigation and related purposes. If the project had been completed and in operation during the 1958 flood, it would have prevented flood damages estimated at $550,000.

black butte lake provides recreation opportunities for over 170,000 persons each year.

The project prevented damages of about $2.4 million during the floods of December 1964 and January 1970.

The Corps of Engineers has spent $500,000 to provide an observation point near the dam and public use facilities in three developed recreation areas. The public use facilities include campgrounds, picnic areas, boat launching ramps and associated access roads, parking areas and systems for water supply and sanitation. During 1975, public use of the project area was over 243,200 recreation-days.

An interim investigation of erosion and related problems on Stony Creek downstream from Black Butte Dam was authorized by the Chief of Engineers in 1973, initiated in 1974, and completed in 1976.

The study indicated no economically feasible solution to erosion problems along Stony Creek.

Bear River Project (Sacramento District)
The Bear River Project for the Linda and Olivehurst area will include enlargement of Linda Drain (including levees where needed) from just above Linda Road to the Southern Pacific Railroad; a new diversion channel paralleling and just upstream from the Southern Pacific Railroad from Linda Drain to Reeds Creek; a new channel paralleling Reeds Creek from the Southern Pacific Railroad to the Interceptor Canal to accommodate the diverted flows from the new diversion channel; a new levee along the right bank of Reeds Creek from the Interceptor Canal right bank levee to high ground along State Highway 65; a pumping plant and sump area near the intersection of the Interceptor Canal right bank levee and the new levee described above; acquisition of flowage easements for 450 acres of agriculture land, continued use of existing flowage easements for 3,300 acres of agriculture land, and environmental easements for 150 acres of land around Plumas Lake; and recreation facilities for a hiking and biking trail along the new Reeds Creek levee.

Federal first cost of the project is estimated at $3,400,000. Total non-Federal cost is estimated at $2,950,000, including a cash contribution for that portion of the cost of recreational facilities, which, added

artists conception of dutch gulch lake.

artist's conception of tehama lake.

to the cost of recreation lands, would amount to 50 percent of the total first cost of recreation lands and recreational facilities, currently estimated at $21,000. Operation and maintenance of the completed works is the responsibility of the local interests.

The project will provide for reduction of existing and future damages to the urban areas of Linda and Olivehurst. The levee and channel plan for Linda and Olivehurst would provide flood damage benefits to approximately 2,410 acres of existing and potential urban areas. In addition to the flood damage benefits, there are additional benefits in the form of a hiking and biking trail along the new Reeds Creek levee.

To compensate for the loss of about 500 lineal feet of natural stream vegetation along Reeds Creek and loss of existing vegetation along 5 miles of channel above Reeds Creek, about 150 additional acres of land will be acquired for environmental easements at Plumas Lake.

Funds have not yet been appropriated to initiate preconstruction planning.

Cottonwood Creek Project (Sacramento District) The Cottonwood Creek Project will consist of two multipurpose water storage facilities, one at the Dutch Gulch site on the main stem of Cottonwood Creek about 11 miles west of the town of Cottonwood and one at the Tehama site on the south fork of Cottonwood Creek about 9 miles southwest of Cottonwood. The dam at Dutch Gulch will have a maximum height of 268 feet and a crest length of 21,810 feet, impounding 1.1 million acre-feet of storage. The dam at Tehama will be 238 feet high with a 29,340 foot crest length, impounding a 900,000 acre-foot reservoir. The project was authorized for flood control, municipal and industrial water supply, irrigation, general recreation and the enhancement of the anadromous fishery.

The cost of the project is estimated at $285 million. Local interests are required to repay that part of the construction costs allocated to irrigation and municipal and industrial water supply, plus one-half of the separable costs allocated to recreation and fish and wildlife enhancement features, excluding the anadromous fishery. Reimbursement is currently estimated at about $215 million. Operation and maintenance of the com-

pleted project (other than for recreation facilities) will be the responsibility of the Federal government.

The project will provide flood protection to lands along Cottonwood Creek and the Sacramento River and will reduce damages in Butte and Colusa Basins. If this project had been completed and in operation during the January 1970 flood, it would have prevented an estimated $2.5 million in flood damages. Dutch Gulch and Tehama Lakes will provide 40,600 acre-feet of water annually for irrigation and 235,000 acre-feet annually for municipal and industrial use.

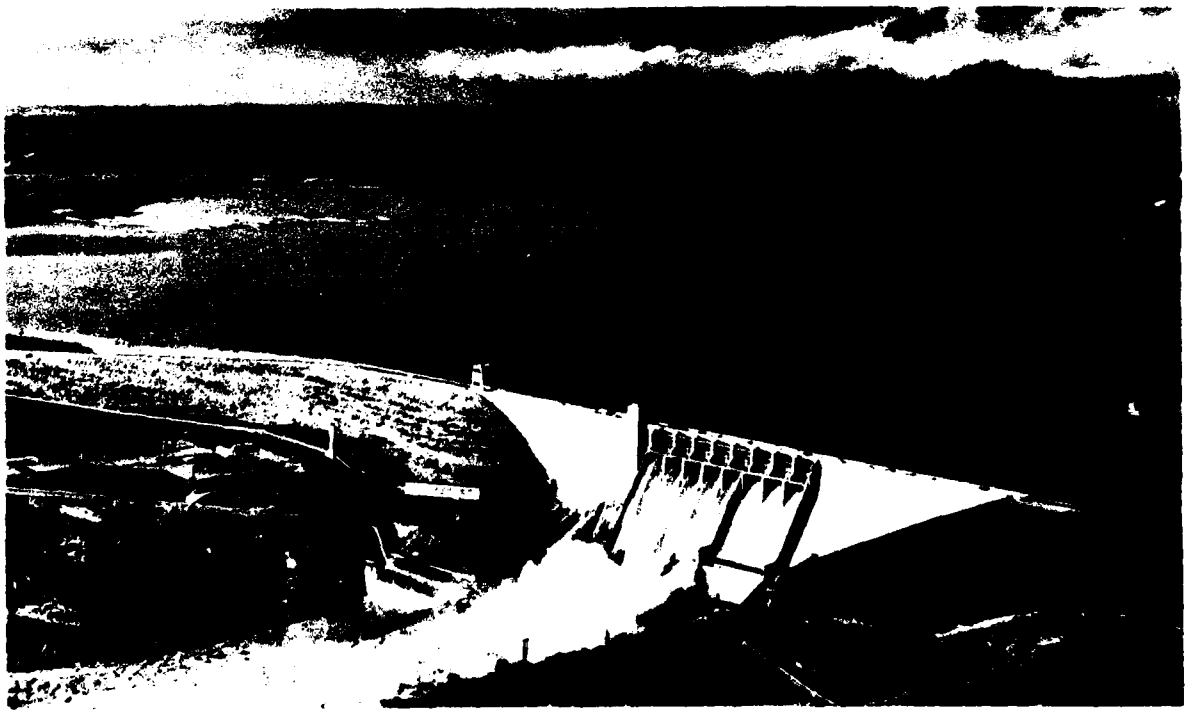
The dams and appurtenances will be designed to minimize their impact on the natural beauty of the area. To compensate for inundation of valuable wildlife habitat caused by the project, about 13,000 additional acres of land will be acquired and improved to provide the food and cover needed by wildlife. In addition, the project will provide opportunities for camping, picnicking and a variety of water-oriented activities.

Although the dams will block access of minor runs of chinook salmon and steelhead to upstream spawning areas, the project will include measures to improve the anadromous fishery downstream of the dams. Minimum releases will be made throughout the year, three miles of channel downstream from each dam will be acquired for control and management of spawning areas, salmon propagation facilities will be constructed downstream from Dutch Gulch Lake, a program of fish trapping and hauling will be developed and an existing hatchery will be expanded to maintain the steelhead run.

Preconstruction planning was initiated in October 1976 and is scheduled for completion in 1982.

Folsom Lake (Sacramento District)
Completed in 1956, the Folsom Lake Project is located on the main stem of the American River near the town of Folsom and 20 miles upstream from Sacramento. The project consists of a main concrete gravity dam with earthfill wing dams. Its total crest length is 10,200 feet and its maximum height is 340 feet. The project includes eight earthfill dikes, which, together with the

folsom dam and lake. (photo courtesy of california department of water resources.)



main dam, impound the 1 million acre-foot Folsom Lake.

Concurrent construction of a 162,000 kilowatt powerplant at Folsom Dam, an afterbay dam and 13,500 kilowatt powerplant at Nimbus and related transmission lines was accomplished by the Bureau of Reclamation. After completion, the Corps of Engineers project was transferred to the Bureau of Reclamation for operation and maintenance in conjunction with other units of the Central Valley Project.

Federal cost of the project totaled nearly $100 million, of which $63 million comprised the cost of storage facilities and $37 million the cost of power generation and associated works borne by the Bureau of Reclamation.

The project provides flood protection to the City of Sacramento and to adjacent suburban areas, makes available new irrigation and municipal water supplies estimated at 500,000 acre-feet a year and makes available about 500 million kilowatt hours of hydroelectric power annually. The project prevented $110 million in damages during the floods of 1955-1956, 1963 and 1964.

The project area, which has an extremely high recreational potential, has been developed as a State park by the California Division of Beaches and Parks. Annual public use of the area is about 2.6 million recreation-days.

Lakeport Lake (Sacramento District)
The authorized Lakeport Lake Project is to be located on Scotts Creek about 4 miles west of the town of Lakeport. The project will consist of a rolled earth and rockfill dam with a crest length of 1,540 feet and a maximum height of 203 feet, a lake with a gross capacity of 55,000 acre-feet and flowage easements along Scotts Creek with riparian preservation features. Federal first cost of the project is estimated at $28.1 million with local cost for flowage easement acquisition estimated at $270,000. In connection with the storage facilities, local interests must also reimburse the Federal government for project costs allocated to the water conservation function of the project and for one-half of

artist's conception of lakeport lake on scotts creek.

the separable costs allocated to recreation. When the project is completed, the storage facilities will be operated and maintained by the Federal government.

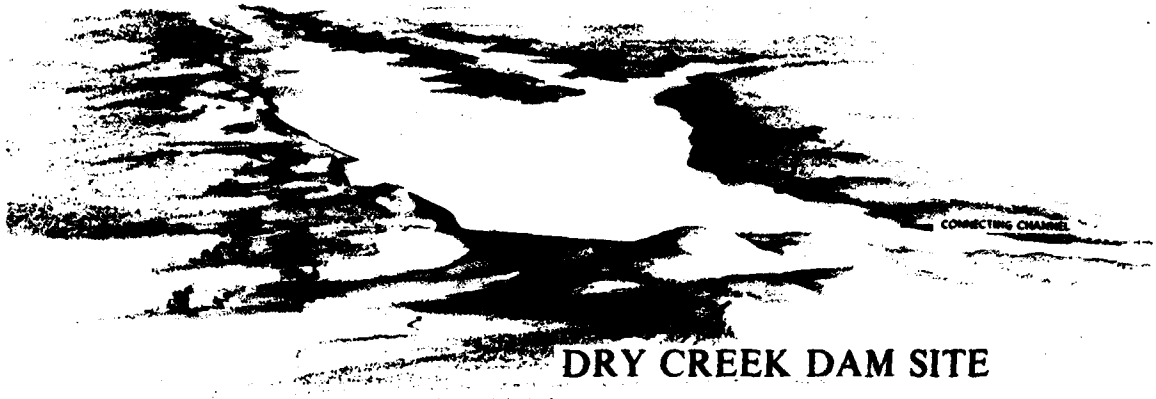
The completed project will provide flood protection to agricultural lands in Scotts Valley and downstream canyon areas; reduce flood damages around Clear Lake by controlling floodflows; provide a new irrigation water supply of 9,200 acre-feet per year; and provide a new municipal water supply of 8,400 acre-feet per year. Located in a rapidly developing area, the reservoir will also provide additional recreational opportunities.

The lake will inundate a portion of a small rainbow trout fishery and will reduce the spawning areas of the Sacramento Hitch which migrate out of Clear Lake. However, the lake will support a warm water fishery if a fish management plan involving the elimination of nongame fish and the stocking of game fish is implemented. The California Department of Fish and Game has agreed to carry out such a plan in cooperation with the Corps. A small fishery could also be sustained in Scotts Creek from Scotts Valley downstream to the irrigation diversion at Bachelor Valley. Land will be acquired to help offset the loss of wildlife habitat in the project area.

Preconstruction planning was completed in 1976. Initiation of construction is subject to receipt of assurances of local cooperation in accordance with Section 221, Flood Control Act of 1970 (Public Law 91-611).

Marysville Lake (Sacramento District)
The authorized multipurpose Marysville Lake Project is to be located at the Parks Bar site on the main stem of the Yuba River about 15 miles northeast of the City of Marysville. This plan provides for construction of two dams; one will be a 358-foot high concrete structure with earthfill abutments on the Yuba River, and the other a 317-foot high earthfill dam on Dry Creek to create a lake of 916,000 acre-feet for flood control, power, irrigation, general recreation and fish and wildlife purposes. Potential power capacity for the project is currently under study. A report on the Marysville Lake project, including peaking capacities of 900 megawatts at the main dam (pumped storage) and 20 megawatts at the afterbay (conventional), was reviewed by the Federal Power Commission (FPC). The FPC concluded that pumped storage development at the Marysville Lake Project would be economically justified and usable in Northern California by 1993. Ongoing studies of power development at the Marysville Lake project indicate that plants larger than 900 megawatts are feasible. The results of these studies which are being closely coordinated with the FPC will be included in the Phase I General Design Memorandum scheduled for completion in 1978.

PARKS BAR DAM SITE



DRY CREEK DAM SITE

Federal first cost for construction of the project is estimated at $708 million. However, the net Federal cost will be about $142 million after local interests repay costs allocated to water supply and power, and one-half of separable costs allocated to recreation and fish and wildlife enhancement. The project will be constructed, operated and maintained by the Corps of Engineers, with its operation integrated with the Bureau of Reclamation's Central Valley Project.

The hydroelectric powerplant will provide pollution-free power, and the project will provide 155,000 acre-feet per year of new water supply and will offer significant recreational opportunities.

About 33 miles of riparian wildlife habitat will be inundated by the lake. This type of habitat is in short supply, but its loss can be offset by acquiring and managing a comparable habitat nearby. Impacts on salmon spawning habitats will be offset by constructing a fish hatchery and providing flows for artificial spawning areas in a secondary channel downstream from the dam.

Coordinated flood control operation of Marysville Lake, New Bullards Bar Reservoir on the North Yuba River, Lake Oroville on the Feather River and the existing levee and bypass system will provide flood protection to 35,300 acres of highly improved land in the Yuba River flood plain and to 62,000 residents of Yuba City and Marysville. Two mainline railroads, various Federal highways, State and county roads and a 113,400 acre rural area along the Feather River will also be protected.

Preconstruction planning is in progress and Phase I is scheduled for completion in 1978.

If Marysville Lake, New Bullards Bar Reservoir and Lake Oroville had been completed and in operation during the December 1955 flood, their coordinated operation in conjunction with the existing levee and bypass system would have prevented the levee failures along the Feather River, the loss of 40 lives and most of the $53 million in flood damages. In conjunction with the existing levee and bypass system, the coordinated flood control operation of these storage projects during the December 1964 flood would have prevented about $4.2 million in damages, in addition to about $30 million that was actually prevented by operation of the partially completed Lake Oroville on the Feather River.

Morrison Creek Stream Group (Sacramento District)
The Morrison Creek Stream Group Project will consist of construction of a dam and 11,000 acre-foot reservoir at the Vineyard site on Elder and Laguna Creeks; diversion of Morrison Creek flows to this reservoir; construction of 26 miles of levee and 66 miles of channel work along streams in the basin; and purchase of lands and related construction for a 7,800 acre flood retardation basin in the Beach-Stone Lakes area. The reservoir would provide for flood control, recreation, and fish and wildlife enhancement; additional recreation opportunities would be provided by a trail system along the creeks; and the flood retardation basin would be developed for nature-oriented recreation and fish and wildlife management.

The cost of the project is estimated at $89,700,000 (at October 1976 price levels). Local interests are required, (a) with respect to the Vineyard Dam and Reservoir site, to (1) reimburse the United States for the actual costs for operation and maintenance of the reservoir for flood control; (2) pay one-half the separable first costs of the reservoir allocated to recreation and fish and wildlife; (3) administer all land and water areas of the reservoir dedicated to recreation and fish and wildlife, and operate and maintain all recreation and fish and wildlife facilities; (b) with respect to the levee and channel work (including drainage pumping plant), to (1) maintain and operate the levee and channel work for flood control after completion; (2) pay one-half of the separable first costs of the recreation developments along project levees and channels allocated to recreation; and (3) maintain and operate the recreation developments along project levees and channels; and (c) with respect to the Beach-Stone Lakes Flood Retardation Basin, to (1) maintain and operate the flood retardation basin for flood control after completion; (2) pay one-half the separable first costs of the flood retardation basin allocated to recreation and fish and wildlife; and (3) maintain and operate the recreation and fish and wildlife developments in the flood retardation basin.

In the Vineyard Reservoir, 9,000 acre-feet of storage space would be reserved for flood control, and 2,000 acre-feet would be used for general recreation and fish and wildlife, and sediment storage. Vineyard Reservoir would provide opportunities for general recreation and fish and wildlife-oriented recreation, and trails along some of the downstream creeks would provide opportunities for hiking, riding and bicycling.

There would be minimal adverse environmental effects associated with the project which would be more than offset by its positive effects. One of the principal objectives of the proposed plan is to preserve the natural greenbelt qualities of the area, and to make the area accessible to the people for their enjoyment. With the rapid urbanization of the Sacramento area, it is important to preserve the remaining marsh and grassland habitat that was once widespread throughout the California Central Valley.

Funds have not yet been appropriated to initiate preconstruction planning.

cooperative projects

Lake Oroville (Sacramento District)
Lake Oroville, a partnership project completed in 1967, is impounded by the highest earthfill dam in the nation. Constructed on the Feather River 4 miles northeast of

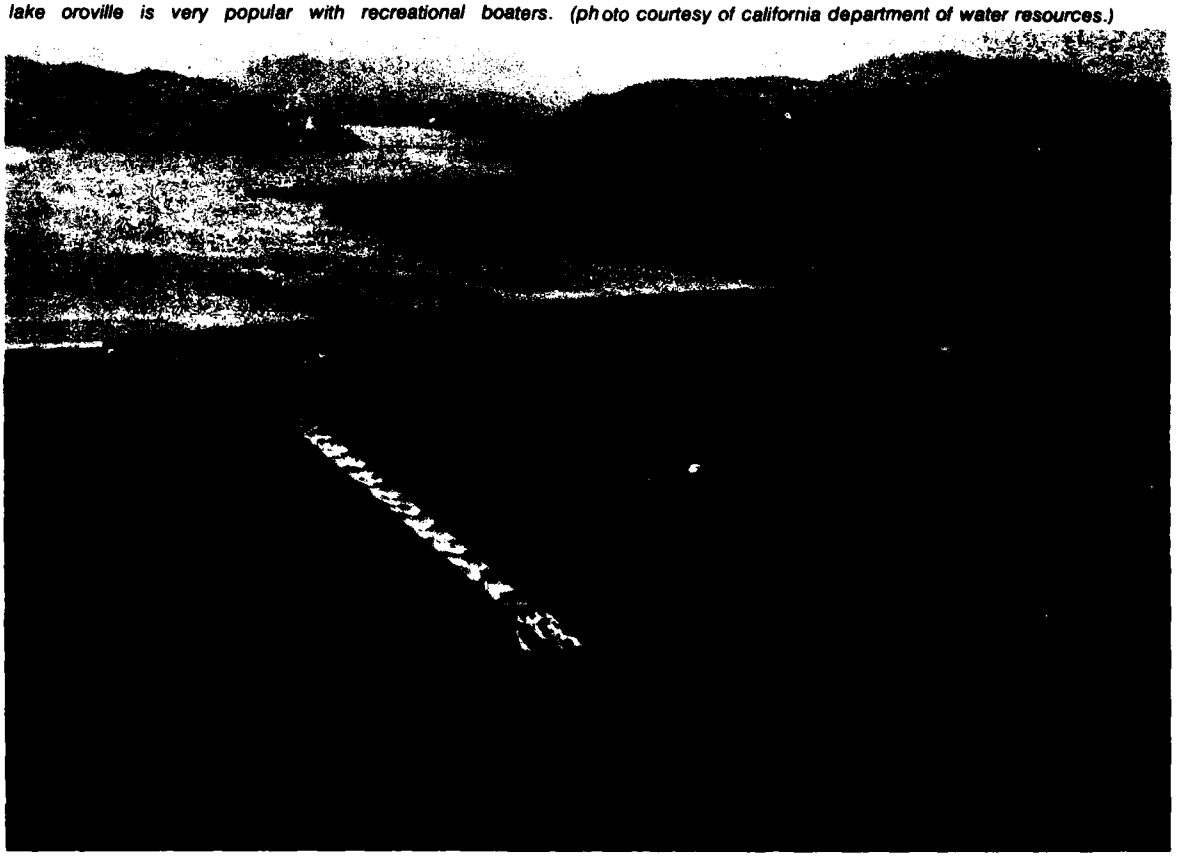
the town of Oroville, the earth and rockfill dam is 770 feet high and 6,850 feet long. The dam impounds a reservoir with a gross capacity of 3.5 million acre-feet and contains six hydropower generators with a capacity of 600,000 kilowatts.

The project was constructed by the State of California as the principal unit of the comprehensive California State Water Project. Construction of the dam commenced in 1962 and initial flood control service began in 1964.

The Lake Oroville Project provides flood protection to the cities of Oroville, Marysville and Yuba City; to many small communities in the flood plain; to 9,000 acres of urban and suburban lands and 283,000 acres of highly developed agricultural land; and to important highway and railroad routes. If Lake Oroville Reservoir on the Feather River and New Bullards Bar Reservoir on the North Yuba River had been in operation during the 1955-1956 floods, they would have prevented the flooding of Yuba City and Nicolaus and adjacent agricultural areas, the loss of 40 lives and the $50.5 million in damages that occurred on the Feather River below Lake Oroville. During the December 1964 flood, interim flood control operation of the completed portion of the project prevented flood damages of about $30 million in the downstream areas.

The cost of the project, exclusive of the power and recreation facilities, was $387 million. Of this, the Federal cost was $69.1 million, representing that portion of the construction cost attributable to flood control. The State of California operates the project for flood control in accordance with rules and regulations prescribed by the Secretary of the Army.

lake oroville is very popular with recreational boaters. (photo courtesy of california department of water resources.)



New Bullards Bar Reservoir (Sacramento District)
This multipurpose project consists of a 645 foot high concrete arch dam with a crest length of over 2,300 feet, a reservoir with a gross capacity of 960,000 acre-feet and new powerplants at the Colgate and Narrows sites. The dam is located 30 miles northeast of the City of Marysville and 1.5 miles downstream from the original Bullards Bar Dam. Construction of the dam and appurtenances was started in 1966 and completed in 1970.

The project was constructed by the Yuba County Water Agency. The Federal government provided a monetary contribution in an amount commensurate with the flood control benefits provided by the project. The local agency operates the project for flood control in accordance with rules and regulations prescribed by the Secretary of the Army.

Exclusive of power generation and recreation facilities, the cost of the project was $110.9 million, of which $12.9 was the Federal share. Annual operation, maintenance and replacement costs are the responsibility of local interests.

If the New Bullards Bar Reservoir on the North Yuba River together with Lake Oroville Reservoir on the Feather River had been in operation during the 1955-1956 floods, they would have prevented the loss of 40 lives and $50.5 million in damages that occurred on the Feather River.

Shasta Lake (Sacramento District)
Shasta Lake is a multipurpose facility located on the Sacramento River near Redding. The dam, constructed by the Bureau of Reclamation, is a concrete gravity structure 602 feet high and 3,460 feet long. The lake has a capacity of 4.5 million acre-feet.

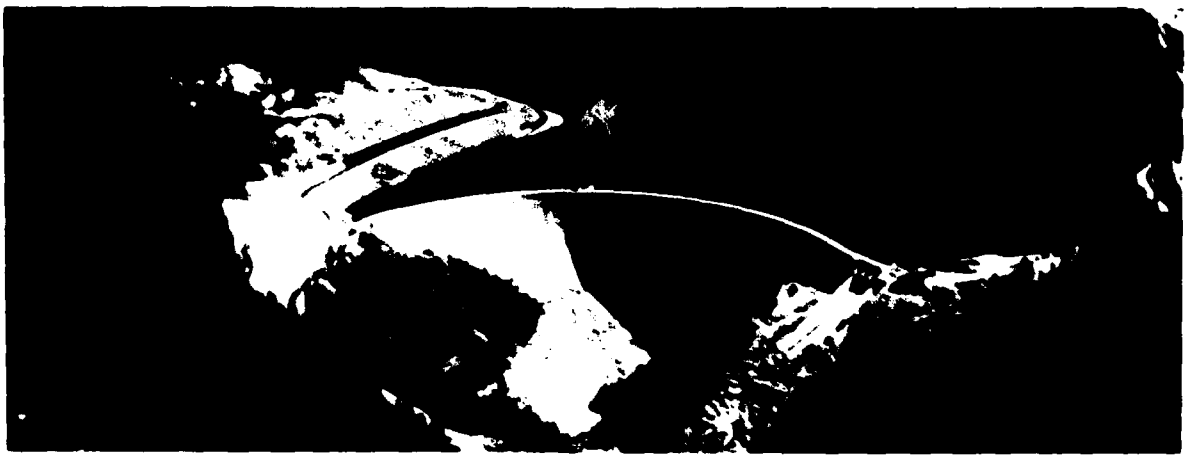
Shasta Lake is a key element of the Central Valley Project, one of the most extensive man-made water transport systems in the world. In addition to providing flood control, Shasta Lake provides water for irrigation, municipal and industrial water supply, generation of electric power, fish and wildlife conservation, recreation and flow to benefit shallow draft navigation on the Sacramento River. By providing year-round releases, it helps to protect the Sacramento-San Joaquin Delta from intrusion of saline water from the ocean.

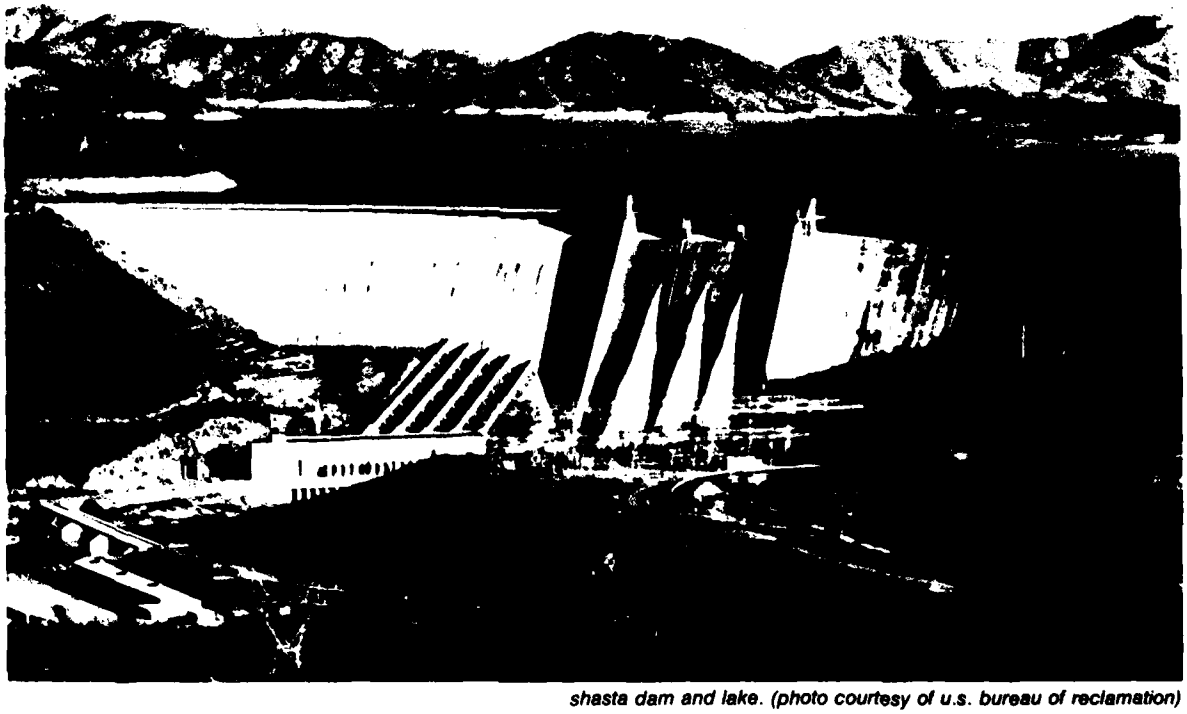
The project is operated in accordance with operating rules prescribed by the Secretary of the Army. These rules call for providing and operating a flood control reservation of 1.3 million acre-feet during the winter rainflood season.

flood control projects

American River Levee (Sacramento District)
The American River Levee Project consists of a rock revetted earthfill levee along the north bank of the American River in the vicinity of the City of Sacramento. The project levee begins at an existing levee near the Elvas Bridge and extends upstream to high ground near the suburban area of Carmichael, a distance of 7 miles. Two pumping plants to lift storm drainage water from adjacent areas into the river are also part of the project. The project was completed in

new bullards bar reservoir (photo courtesy of yuba county water agency)





shasta dam and lake. (photo courtesy of u.s. bureau of reclamation)

1958 and is being operated and maintained by local interests. The total Federal cost of the project was $2.1 million, of which local interests contributed $950,000.

The improvement is an integral part of the plan for flood control for the City of Sacramento and environs. This plan also includes Folsom Lake which provides flood control, power and irrigation. The levee permits lake releases from Folsom Dam of up to 115,000 cubic feet per second without flooding the city. The area protected includes 2,200 acres of land largely devoted to urban and suburban use.

Chester, North Fork of Feather River (Sacramento District)
The Chester Project consists of a diversion dam on the North Fork of the Feather River about 1¼ miles upstream from the town of Chester. It also includes a partially leveed floodway which allows floodflows to bypass the town and enter Lake Almanor. Construction of the channels and diversion dam was completed in October 1976. A planting mitigation contract is scheduled to begin in the summer of 1977 to replace vegetation that was lost during construction of the channels and diversion dam. The project is scheduled for completion in 1977.

The diversion dam is an earthfill structure with a maximum height of 41 feet above streambed and a crest length of 970 feet. The outlet works will release non-damaging flows to the downstream channel through the town of Chester. Floodflows in excess of the capacity of the outlet works will be diverted into the partially leveed floodway following an old stream channel into Lake Almanor. The 3 miles of levees vary in height from 2 to 16 feet. Special features are being designed in the diversion dam to facilitate passage of fish.

The cost of the project is estimated at $5.4 million, of which $3.8 million will be the Federal cost and $1.6 million will be the non-Federal cost. Upon completion, the project will be operated and maintained by local interests.

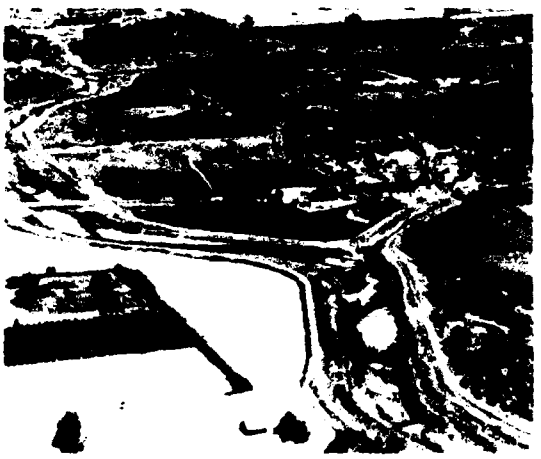
The project will provide flood protection to the town of Chester, which has experienced damaging floodflows on the average of once every 3 to 4 years. If the project had been completed and in operation during the December 1964 and January 1970 floods, it would have prevented damages estimated at $411,000.

Middle Creek Improvement, Lake County
(Sacramento District)
Improvement of Middle Creek in the vicinity of the town of Upper Lake was authorized for flood control purposes and completed in 1967. The project enlarged existing levees, constructed additional levees and improved channels along the lower 7 miles of Middle Creek and along tributary streams. A pumping plant was constructed to discharge interior drainage into Middle Creek and a 4,000 foot channel was constructed to divert overflow from Clover Creek around the town of Upper Lake.

The Federal cost of the project was about $2.6 million. Local interests contributed over $1.3 million, including $575,000 for land and $765,000 for roads and utility relocations. Local interests are responsible for the operation and maintenance of the project.

The project protects Upper Lake and 4,000 acres of highly developed agricultural land. The project prevented $1.1 million in damages during the floods of 1964, 1968 and 1970.

middle creek improvement at the town of upper lake.

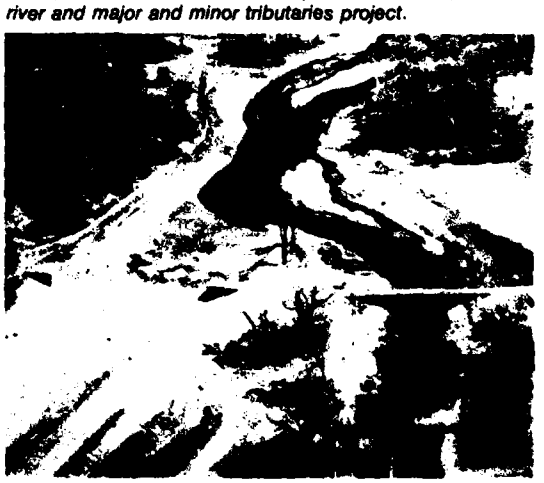


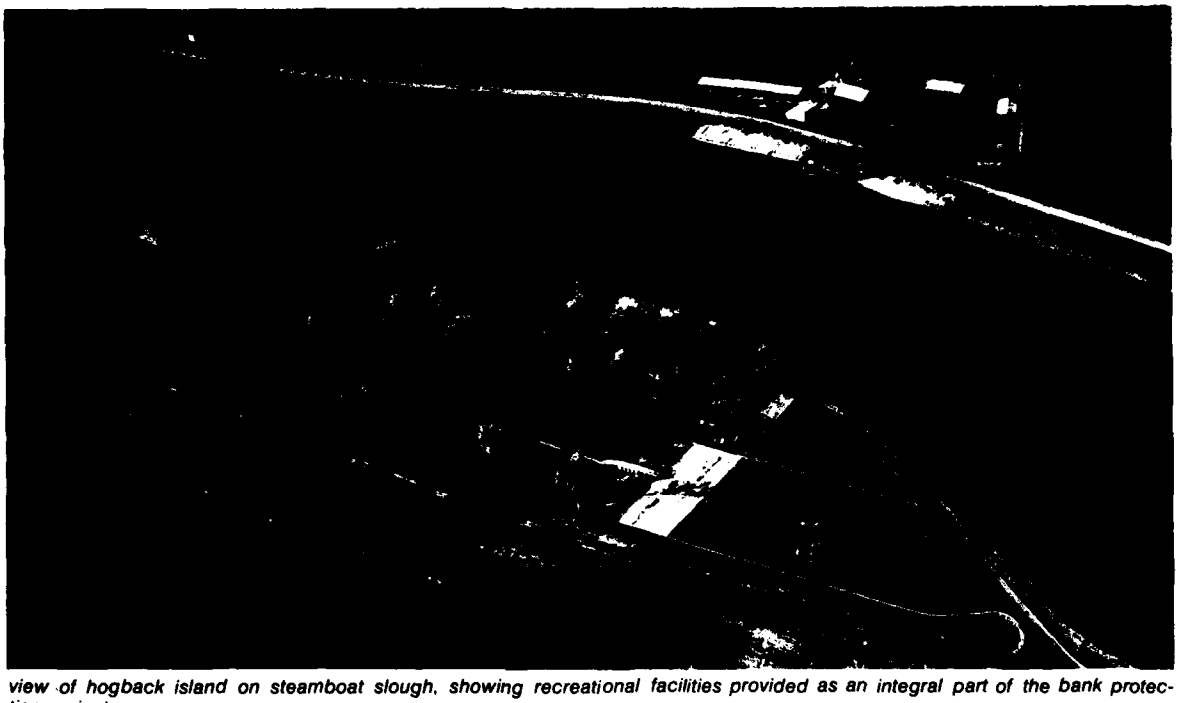
Sacramento River and Major and Minor Tributaries
(Sacramento District)
The Sacramento River and Major and Minor Tributaries Project, which supplements the existing Sacramento River Flood Control Project, is scheduled for completion in 1981. The project provides for enlargement of existing levees on the Sacramento River between Moulton Weir and Ord Bend; construction of new levees from the present levee terminus to the vicinity of Chico Landing; construction of a weir in the vicinity of Chico Landing; extension of Moulton Weir; construction of a bypass through Upper Butte Basin and construction of new levees in Lower Butte Basin.

The active portion of the project includes levee construction and channel enlargement on the following minor tributaries of the Sacramento River: Chico and Mud Creeks, Sandy Gulch, Butte and Little Chico Creeks, Cherokee Canal and Elder and Deer Creeks (Tehama County). Revetment work on levees in the Sutter, Tisdale, Sacramento and Yolo Bypasses is under construction. About 72 miles of channel improvements and 107 miles of levee construction have been completed. Improvement of Upper Butte Basin and Thomes Creek is being restudied. Except for modification of Moulton Weir, studies of Antelope Creek, Willow Creek and Lower Butte Basin have been classified as inactive.

Project construction was started in 1949, suspended in 1950 because of the Korean War and resumed in

diversion facilities on mud creek, a unit of the sacramento river and major and minor tributaries project.





view of hogback island on steamboat slough, showing recreational facilities provided as an integral part of the bank protection project.

1957. Except for the revetment of bypasses, all active portions of the project have been completed.

The total cost of the project is $18 million, of which $11.9 million is Federal cost and $6.1 million is local cost. Local interests are responsible for operation and maintenance of completed improvements.

The completed portion of the project, in conjunction with other authorized and existing flood control works in the Sacramento River Basin, protects all major cities along the river system and 880,000 acres of fertile agricultural lands. Most of these lands lie below the surface elevation of the river. During the December 1964-January 1965 floods, the project prevented damages estimated at $3.75 million. An additional $350,000 could have been prevented if the bypass revetment work had been completed. During the January 1970 floods, the project prevented damages estimated at $2 million.

Sacramento River Bank Protection (Sacramento District)
The Sacramento River Bank Protection Project is comprised of phased modification of the existing Sacramento River Flood Control Project. It includes a long range program for construction of bank erosion control works and setback levees. Approximately 35 miles of this project extend into the Delta-Central Sierra Area.

The project is required to maintain the integrity of the levee system of the Sacramento River Flood Control Project so that it can continue to furnish the degree of protection for which it was designed. It will also reduce the costs of emergency levee repairs and downstream dredging and will reduce land losses caused by bank erosion.

Recreational facilities are provided at a bank protection site on Steamboat Slough near the center of the Sacramento-San Joaquin Delta, at Garcia Bend on the Sacramento River near Sacramento and at a site in the Feather River Floodway near the town of Live Oak. These facilities, which also serve as integral parts of the bank protection work, include boat launching ramps, parking areas and access roads. Local interests operate and maintain these facilities and will provide additional facilities including water supplies, restrooms and picnicking or camping areas. Other sites where recreation potential exists will be considered in

the future. The Hogback Island Recreation Area won an honorable mention award (Distinguished Design Awards Program of the Chief of Engineers) for its conservation of natural beauty.

The estimated total cost of the long range plan is $168 million, of which $112 million is the Federal cost and $56 million is the non-Federal cost. The estimated total cost of the first of two phases of the project is $107 million, of which $71.3 million is to be Federal costs and $35.7 million is non-Federal. Construction of the first phase, consisting of over 81 miles of bank protection work, was started in 1963 and completed in December 1974. Construction of the second phase, consisting of over 76 miles of bank protection work, was started in June 1975 and is scheduled for completion in June 1984.

The Sacramento River Bank Protection Project requires work that might adversely affect the wildlife habitat and spoil the natural beauty of the area. To minimize these effects, construction practices have been implemented to retain trees, shrubs and other vegetation where practicable. Many scarred construction areas are being reseeded and replanted. A study is in progress to evaluate the need for mitigating wildlife habitat losses by purchasing lands on or adjacent to levees and providing suitable plantings.

Sacramento River, Chico Landing to Red Bluff (Sacramento District)
The Sacramento River, Chico Landing to Red Bluff Project is an extension of the existing Sacramento River Flood Control Project. It provides for construction of bank protection works and minor channel improvements. Flood plain regulation is provided by local interests in order to prevent development in the flood plain and to prevent future flood damages by guaranteeing waterway areas to carry maximum flood control releases from Shasta Lake. Local interests are required to provide assurances that adequate flood plain regulations will be implemented either by zoning ordinances or by some other means. Tehama County has adopted a flood plain zoning ordinance. The flood plain zoning requirements for Butte County and Glenn County were satisfied by the designation of primary floodways by the State of California and by passage of county building ordinances to control structures in the floodway.

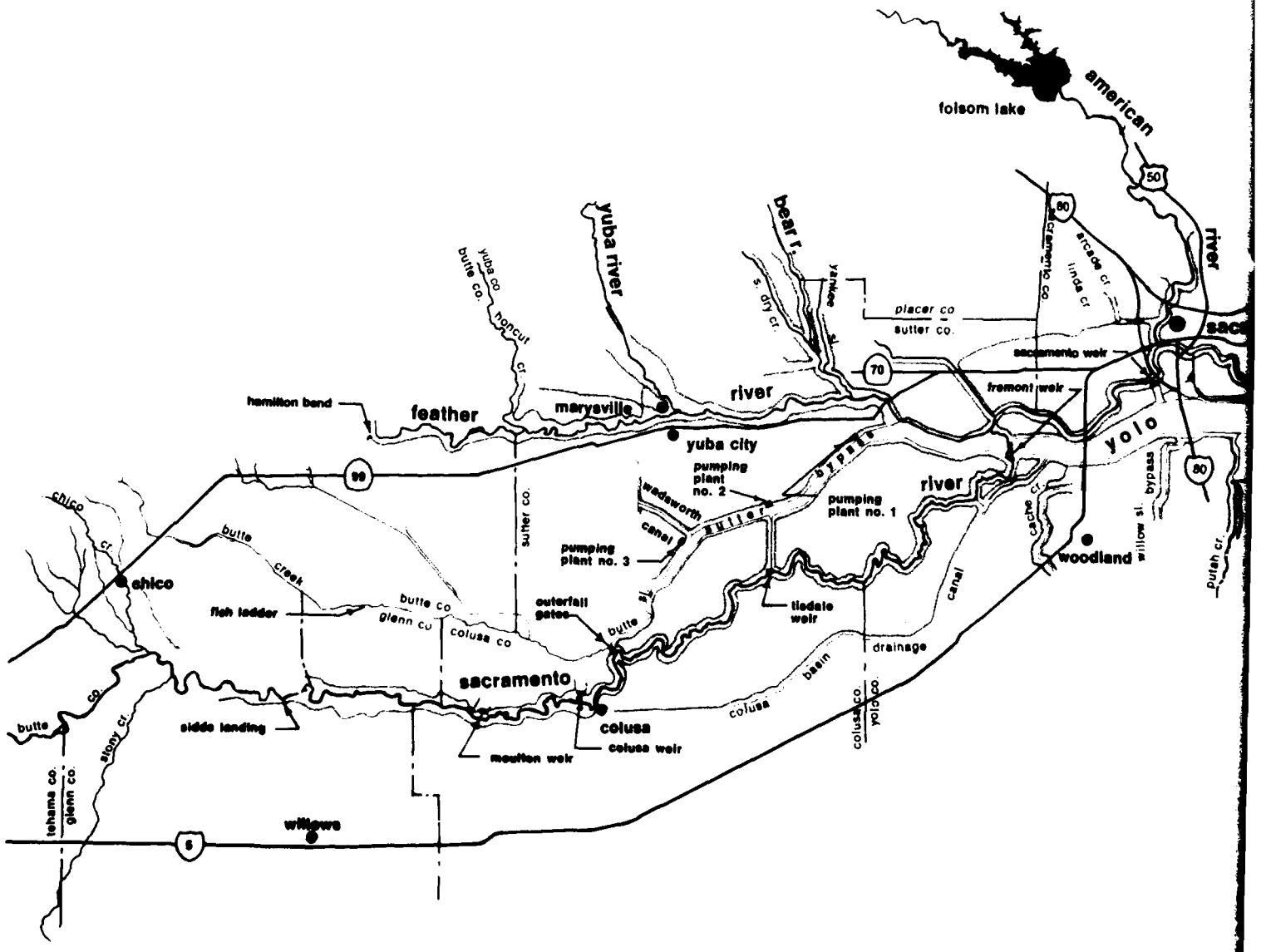
Bank protection work in Tehama County was completed in 1964. Additional sites were protected from 1967 through 1971. Work at critical erosion sites in Butte County was accomplished in 1973. Additional work at critical erosion sites in Butte, as well as in Glenn and Tehama Counties was completed in November 1976. Work at selected sites in Tehama and Glenn Counties is set to begin in the summer of 1977. Federal cost of the work in Tehama and Glenn Counties is estimated at $6.3 million, with non-Federal costs estimated at $510,000.

The project improves flow along the Sacramento River and helps to stabilize the main channel by preventing erosion and by reducing the amount of eroded material normally transported downstream. It is estimated that the project will save 40 acres of agricultural land per year and prevent erosion of 540,000 cubic yards of material per year, of which 200,000 cubic yards would have to be removed eventually from navigation and flood channels by dredging. During the December 1955-January 1956 floods, bank erosion of about 90 acres of land occurred and a considerable amount of eroded material was deposited in the river channels requiring dredging. The cost of the erosion damage was estimated at $35,000, and the cost of dredging of deposition from the channel was estimated at $240,000.

Sacramento River Flood Control Project (Sacramento District)
The project for improvement of the Sacramento River and its tributaries for flood control was authorized by the 1917 Flood Control Act. Since then it has been modified, extended and supplemented by a number of subsequent acts.

The project, generally referred to as the "Old Project," consists of a comprehensive system of levees, overflow weirs, pumping plants, bypass channels and channel enlargements. The active portion of the overall project was completed in 1968. The principal works of the project are levees and channel improvements along the Sacramento River from its mouth to near Chico Landing and along the lower reaches of the American, Bear, Yuba and Feather Rivers. It includes the Moulton, Colusa, Tisdale, Fremont and Sacramento overflow weirs and the Sacramento, Tisdale, Colusa, Sutter and Yolo bypasses. The total length of the project levees is 980 miles, including 35 miles that extend into the Delta-Central Sierra Area.

This project represents many years of planning and study and incorporates the needs of many Federal and State agencies and local interests. It is unusual because of its system of bypasses, which involves the transfer of floodwaters from the main river channel to leveed overflow areas. Total cost of the project was $163.7 million, of which $68.7 million was contributed by the Federal government and $95 million by local interests who are required to operate and maintain all completed improvements.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yuba river
bear r.
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butte co.
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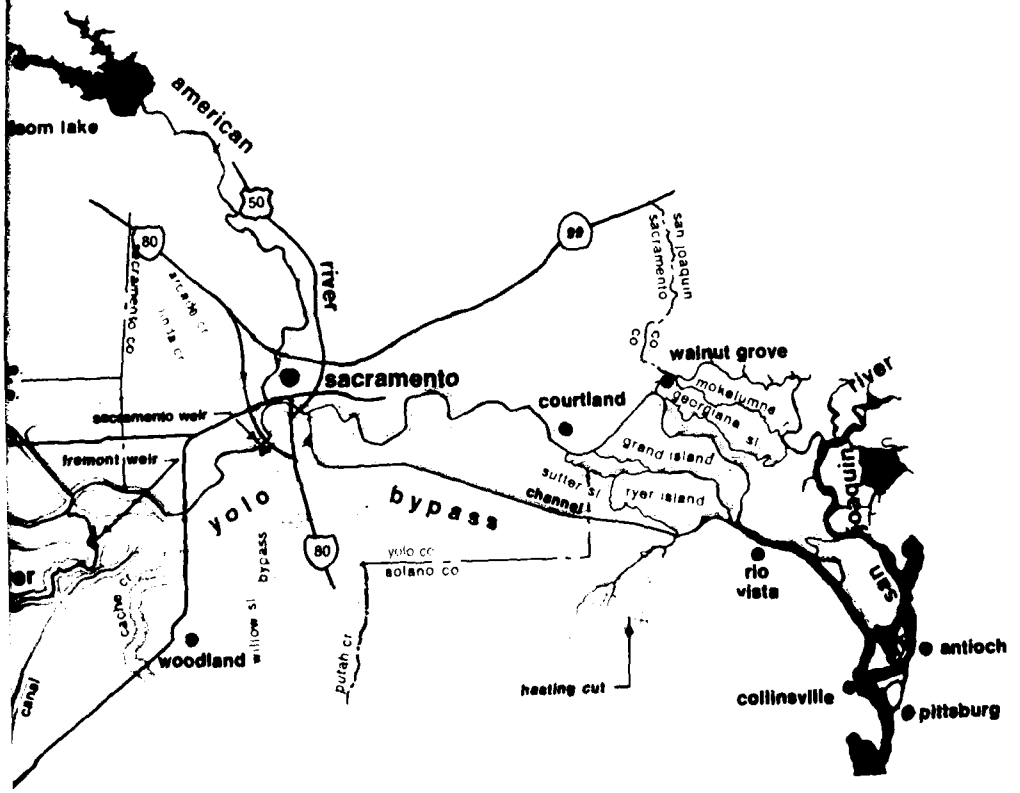
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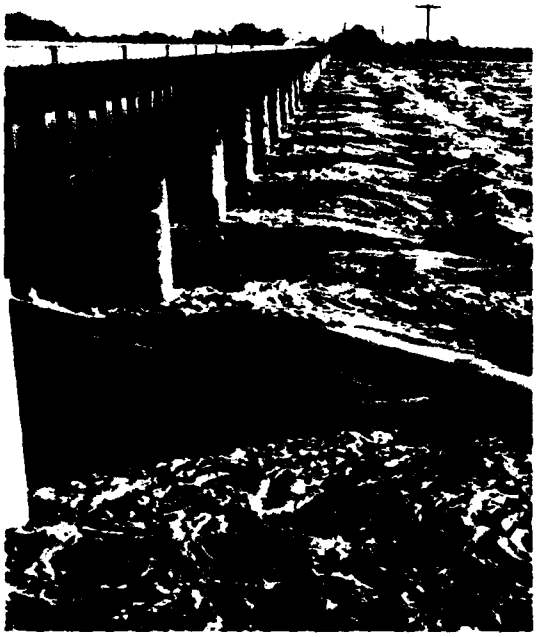


sacramento weir in operation during the 1967 flood.

a view of the sacramento weir discharging excess flow in the sacramento river into the yolo bypass, background.

Total flood damages prevented by the project during major floods since 1950 are estimated at $842 million. Reduction of the flood hazard has encouraged extensive beneficial use of lands along the Sacramento River and the lower reaches of its major tributaries. Former swamp and overflow lands are now prosperous farming areas, and the valley floor towns and cities have grown and expanded.

flood control studies

Northern California Streams (San Francisco and Sacramento Districts)
Authorized by The Flood Control Act of 1962, this study includes all streams in Northern California flowing into the Pacific Ocean, including the Sacramento River and its tributaries. Work on the study has been divided between the San Francisco and Sacramento Districts. The San Francisco District will study and report on the coastal streams and the Sacramento District will study and report upon the interior streams. A number of separately authorized studies will be completed within the framework of the comprehensive study.

In the Sacramento Basin, the most widespread and destructive flood since the legendary floods of 1862 and 1867 occurred in late December 1955 and early January 1956. For 12 days, heavy rain in headwater areas resulted in extensive flooding in the Sacramento Basin. Yuba City and Nicolaus were flooded. Damage in the Yuba City area totaled more than $41 million. Forty lives were lost and 3,100 homes were destroyed. In total, 263,000 acres in the basin were flooded and damage exceeded $65 million. Floodfighting, cleanup and repair and restoration costs exceeded $8.6 million.

In December 1964, another severe flood destroyed bridges, railroad tracks, roads and other public facilities along the Pit, Upper Sacramento and Feather Rivers and Thomes and Cottonwood Creeks. About $500,000 was spent for floodfighting and other emergency activities. Although no levees failed, many levees and channels were severely eroded. It was significant to note that damages during the flood would have exceeded those of the 1955-1956 flood if the flood control system had not been improved during the intervening 9 years.

These flood events demonstrate the continuing need

for flood control measures in the basin, and growing water requirements show the need for water conservation measures.

The Sacramento District portion of the study was started in 1965. Separately authorized studies to be accomplished within the framework of the comprehensive study include those on Cache Creek. One interim report completed within the framework of the comprehensive study has resulted in authorization of the Cottonwood Creek Project. Completion of the Sacramento District portion of the study is scheduled for 1980. Discussions of the San Francisco District portions of this study are on pages 30 and 63.

cache creek basin
Cache Creek drains a portion of the eastern slopes of the Coast Ranges in Lake and Yolo Counties and discharges through the Yolo Bypass into the Sacramento River. Clear Lake, the principal source of Cache Creek and an important recreational area, lies within the study area.

The study of water problems in the Cache Creek area was started in 1948 and has continued intermittently since that time. The study in progress is presently scheduled for completion in 1978.

Two interim studies have been completed within the framework of the basin-wide study authority. A report on Scotts Creek, a tributary to Clear Lake, was completed in 1963. It proposed a 55,000 acre-foot multipurpose storage project, Lakeport Lake, which has been authorized (see pg. 152). The second interim report recommended levee and channel improvements on Middle Creek in the vicinity of Clear Lake. This project, the Middle Creek Improvement, was started in 1958 and completed in 1967.

The principal remaining areas of flood damage are along the main stem of Cache Creek downstream from Rumsey, along the perimeter of Clear Lake, Scotts Valley and the Kelseyville area. There is an increasing need for additional irrigation water in the area due to lowering groundwater levels. Proposed solutions to these problems involve channel improvements. Debris carried by floodwaters is also a major problem that may be solved by enlarging the Cache Creek settling basin.

sacramento river tributaries, red bluff to shasta dam
An interim investigation of tributaries to the Sacramento River from Red Bluff to Shasta Dam was authorized by the Chief of Engineers in 1970. The principal streams in the study area are Cow, Bear and Battle Creeks. Cottonwood Creek, which was studied separately, is excluded. The study was initiated in 1971 and terminated in 1976 due to the lack of a justifiable plan of improvement.

stony creek
The study of Stony Creek is discussed in conjunction with Black Butte Lake on page 148.

Sacramento River and Tributaries, Bank Protection and Erosion Control (Sacramento District)
An investigation of erosion problems along some 312 miles of the Sacramento River from Collinsville to Shasta Dam and along the lower reaches of the principal tributary streams was authorized in 1970 and initiated in 1976.

Local interests believe that various factors including reservoir control have worsened erosion problems along the banks of the streams in the area. They have requested assistance in providing needed bank protection. Also, due to the greatly increased use of the Sacramento River by recreational boats, erosion by wavewash has become a significant problem.

The study considers protective measures to stabilize stream channels, reduce bank erosion and preserve riparian vegetation.

Upper Putah Creek (Sacramento District)
Study of the Upper Putah Creek area was authorized in 1963. Its purpose is to determine the feasibility of flood protection or multipurpose storage projects on the Putah Creek upstream from Lake Berryessa, a Bureau of Reclamation project. The Coyote and Collayomi Valleys have fertile agricultural lands subject to flooding and erosion. A portion of the community of Middletown is often flooded by tributaries of Putah Creek. There is also a need for additional water supply for irrigation. The study was started in 1963. There is no economically feasible solution to the flood problem at present. A negative report is being prepared.

small flood-control projects

Churn Creek, Shasta County (Sacramento District)
A small flood-control project on Churn Creek near the City of Redding was authorized in 1971. The project, now suspended, would consist of a diversion structure and leveed diversion channel from Churn Creek near Rancho Road to the Sacramento River. Two bridges will be built to carry Interstate Highway 5 traffic across the diversion channel. The project will also include channel clearing and improvement downstream from the diversion to accommodate storm runoff from this area. Streambanks disturbed by construction activities would be replanted to restore them to their natural state and provisions would be made for anadromous fish spawning. The project will protect an agricultural area that is being urbanized and will reduce average annual

flood damages by about $60,000.

The project will cost an estimated $1.6 million, which will be shared equally by the Federal government and by local interests. The project has been suspended because local interests have not provided the required assurances on cost sharing.

North Fork Pit River at Alturas (Sacramento District)
A small flood-control project on the North Fork of Pit River at Alturas, Modoc County, was authorized in 1967. Construction was begun in 1969 and completed in 1972. The project consists of about 2 miles of channel enlargement and rectification to carry floodflows through the City of Alturas. It is estimated that the project will reduce the average annual flood damages by more than $81,000.

The Federal cost of the project was $905,000 and the non-Federal cost $320,000. The improvements are being maintained by local interests.

Hat Creek, Shasta County (Sacramento District)
A small flood-control project on Hat Creek was authorized in 1976. The plan of improvement as indicated by a reconnaissance study conducted in 1975 would involve building a concrete diversion structure with gated conduit to pass low flows, some stream channelization, construction of a diversion channel approximately ¼ mile long and building of a new highway bridge over the diversion channel. Detailed project studies are scheduled for completion in 1977.

debris control facilities

To date, three projects for the control or storage of hydraulic mining debris have been completed by the California Debris Commission. They are Harry L. Englebright Lake on the Yuba River, North Fork Lake on the North Fork of the American River and the Yuba River Restraining Barriers.

Harry L. Englebright Lake, Yuba River (Sacramento District)
Harry L. Englebright Lake, formerly known as the Upper Narrows Reservoir, is a unit of the Sacramento River Debris Control Project. The project consists of a lake and dam on the Yuba River about 20 miles northeast of the City of Marysville. The dam is a concrete

harry l. englebright dam and reservoir on the yuba river.

arch structure 260 feet high and 1,142 feet long. The project has a debris storage capacity of 118 million cubic yards. It was completed in 1941 at a total Federal cost of $3.9 million.

Since 1958, the Federal government has provided public use facilities at an additional cost of about $367,000, and a concessionaire has invested about $137,000 to provide boating and other facilities. The reservoir is extremely popular for boating and other water-oriented recreational activities.

When hydraulic mining was in progress, the mining companies made payments to the Federal government on the basis of the quantity of material excavated in their operations. The Pacific Gas and Electric Company and the Yuba County Water Agency pay the Federal government for the value of falling water for power generation at the site.

North Fork Lake, North Fork, American River (Sacramento District)
North Fork Lake, located on the North Fork of the American River about 5 miles northeast of the City of Auburn, is a unit of the Sacramento River Debris Control Project. North Fork Dam is a concrete arch structure 155 feet high and 620 feet long. The debris storage capacity of the project is 26 million cubic yards. It was completed in 1939 at a total Federal construction cost of $700,000. The authorized Auburn Reservoir, a Bureau of Reclamation project now under construction, will inundate North Fork Lake.

The lake is a popular public boating and outdoor recreational area. A local agency provides the public use facilities under a license granted by the Federal government.

Yuba River Restraining Barriers (Sacramento District)
Federal laws enacted at the turn of the century authorized the construction of works on the Yuba River to control debris from hydraulic mining. The laws provided that all project costs for construction, maintenance and replacement be borne equally by the Federal government and the State of California. The project, located

◀ *north fork dam will soon be inundated by auburn reservoir.*

about 10 miles upstream from Marysville, consists of the Daguerre Point Dam, which forms a storage basin for debris, and training walls and other regulatory works downstream from the dam. Fifteen miles of training walls confine flows to narrow channels and prevent river meander and downstream movement of old debris deposits in the flood plain. These facilities prevent debris from being carried downstream into the navigation channels of the Feather and Sacramento Rivers. The project was completed in 1935 at a total Federal construction cost of $360,000.

emergency work

The Corps of Engineers has spent in excess of $20 million in the Sacramento Basin for emergency activities including levee and dam repairs; snagging, clearing and debris removal; bank protection; flood-fighting and rescue operations; flood damage surveys and reports and investigations of rehabilitation work.

The most widespread and destructive flood in the recorded history of the basin since the floods of 1862 and 1867 occurred in December 1955. During a 12-day period, 30 inches of rain fell in the headwaters of the Sacramento, Feather and American Rivers. Although levees prevented the Sacramento River from overflowing its banks, flooding did occur within the project floodways and natural storage basins, and the rain soaked levees along the swollen Feather River failed just south of Marysville and in the vicinity of Nicolaus. Damage in the Yuba City area amounted to $41.2 million. The flood destroyed 3,100 homes and 40 people lost their lives. Basin-wide, about 263,000 acres were flooded and damages exceeded $65 million. Flood-fighting, cleanup costs and other emergency repair work directly attributable to the flood exceeded $3.2 million. An additional $4.8 million was spent to restore and repair levees along the Feather River.

The second most destructive and costly flood in the basin occurred in December 1964. Unusually heavy precipitation in the northern part of the basin quickly brought streams to flood levels. Bridges, railroad tracks, roads and other public facilities were destroyed

daguerre point dam retains debris from hydraulic mining operations on the lower yuba river.

◀ *feather river levee near failure, december 1955.*

the december 1955 floods inundated yuba city, taking 40 lives. levees protecting marysville, background, withstood ▼ *the flood.*

flooding along the east side of the sacramento river at tehama, january 1970. (photo courtesy of the sacramento bee.) ▶

part of the extensive flooding along the sacramento river in january 1969. view from just west of chico, looking toward the sacramento river in background. (photo courtesy of clair hill and associates) ▼

a barge-mounted clamshell crane clears stumps, underbrush, and other debris from the american river to improve navigation for small boats. the combustible matter is burned in an incinerator at one end of the barge.

along the Pit, upper Sacramento and Feather Rivers and Thomes and Cottonwood Creeks. Approximately $500,000 was spent for floodfighting and other emergency activities. Although no levees failed, considerable erosion did occur to levees and channels. Flood damages would have exceeded those of the 1955-1956 flood if it were not for the construction of flood control improvements during the intervening 9 years. Total damages from the flood exceeded $39 million.

Intense winter precipitation from a series of eight Pacific Ocean frontal systems passing over the Sacramento River Basin caused extensive flooding in January 1970. Although record precipitation occurred, peak floodflows were generally less than previous record flows except in the Pit River Basin and along some streams of the Redding Stream Group. The flood, the third most destructive known, caused $28.5 million in damages. Agricultural losses amounted to $15 million. Approximately $1.5 million was spent for emergency activities such as bank protection, levee restoration and debris removal.

Less costly floods occurred in 1950 and 1958. These floods caused damages totaling $18.8 million. Over $800,000 was spent for repairs and emergency activities.

Emergency operations under Operation Foresight were implemented by the Corps of Engineers in the Sacramento River Basin in March 1969. Emergency work included shaping and revetting existing levees, building stone wing dams, providing bank restoration, channel clearing and stone protection for levees. The total cost of emergency work on the Sacramento and Yuba Rivers was $194,000. An estimated $250,000 in damages was prevented.

Following the January 1974 floods, $1.2 million was spent for levee restoration and bank protection, principally in the upper Sacramento River area. Since 1955, the Federal government has spent approximately $4.2 million in the Sacramento Basin for emergency work performed under Public Law 91-606 and antecedent legislation. About $4 million was spent in 1955 and 1964 for emergency rehabilitation work which included debris removal, bank protection, channel and levee restoration and rebuilding destroyed or damaged public utility facilities. After the 1970 floods, the Corps engaged in emergency repair and restoration work costing $230,000 and made repayment evaluation reports for work amounting to $1.9 million in 10 counties in the basin.

As a result of the January 1974 floods, local interests are proceeding with an estimated $500,000 in restoration work. The Corps of Engineers is preparing repayment evaluations for this work.

flood plain management services program

The following flood plain information studies for streams in the Sacramento Basin have been completed:

- American River Flood Plain (Antelope Creek, Secret Ravine and Tributaries, Rocklin)
- Big Valley Streams, Kelseyville
- Churn Creek, Enterprise
- Cow Creek, Palo Cedro
- Dry Creek and Tributaries, Roseville
- Feather River, Nicolaus
- Feather and Yuba Rivers, Marysville-Yuba City
- Morrison Creek Basin
- North Yuba and Downie Rivers, Downieville
- Northeastern Sacramento County
- Snodgrass Slough Flood Plain

The following studies are in progress:

- Clover Creek and Stillwater Creek and Tributaries, Loomis Corners
- Sacramento River from Anderson Creek to Paines Creek and Lower Cottonwood and Battle Creeks, Bend

7 delta-central sierra area

project index

navigation projects

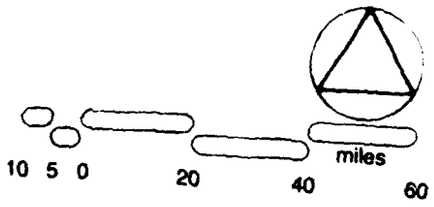
21 *san francisco bay to stockton (john f. baldwin & stockton ship channels)*
52 *middle river & connecting channels*
53 *mokelumne river*
54 old river
55 *sacramento river deep water ship channel*
57 *san joaquin river, stockton deep water channel & burns cutoff*
58 stockton & *mormon channels*

multipurpose projects

66 *camanche reservoir*
74 new hogan lake

flood control projects

91 *bear creek channel, san joaquin county*
93 duck creek (small project)
94 farmington dam
96 lower san joaquin river & tributaries
99 *mormon slough, calaveras river*



description

The Delta-Central Sierra Area, situated in Central California, extends from Sacramento on the north to Stockton on the south and from the crest of the Sierra Nevada on the east to the foothills of the Coast Ranges on the west. The area is about 120 miles long and 60 miles wide and covers approximately 5,000 square miles.

It includes the Sacramento-San Joaquin Delta, a low-lying tidal area consisting of 500,000 acres of highly productive farmland reclaimed from swamp. This farmland is protected by more than 1,000 miles of levees along natural channels and dredge cuts that divide the area into about 100 tracts, locally known as "islands." Land surface elevations in the delta range from 10 feet below sea level in the central portion to 20 feet above sea level along the periphery.

The lower reaches of the Sacramento and San Joaquin Rivers are the principal streams in the Delta-Central Sierra Area. The Sacramento River drains a small portion of the northwesterly sector of the area, and the San Joaquin and its principal tributaries drain the rest. Within the area, Cache Slough is the principal tributary to the Sacramento River, and the Cosumnes, Mokelumne and Calaveras Rivers are principal tributaries to the San Joaquin River.

The climate of the Delta-Central Sierra Area is characterized by hot, dry summers and mild winters with relatively light precipitation. The mountains to the east have warm, dry summers and cold winters with heavy rain and snow. Average annual precipitation varies with elevation, ranging from less than 10 inches on the valley floor to over 96 inches in the Sierra Nevada. Temperatures on the valley floor normally range from winter lows near freezing to summer highs of about 100 degrees, while those in the Sierra Nevada range from below zero in the winter to around 90 degrees in the summer.

The economy of the Delta-Central Sierra Area is basically agricultural and is supplemented by related manufacturing and industrial activities such as food processing and the fabrication of agricultural machinery. Other significant economic activities include the production of natural gas, clay and clay products, limestone, sand and gravel and lumber and forest products.

delta-central sierra area

Highly developed Federal, State and local road systems afford ready access to all parts of the area and to adjoining areas. It is also served by air and rail lines and the Stockton and Sacramento Deep Water Ship Channels. The present population, 335,000 is expected to increase to 600,000 by the year 2000.

The Delta-Central Sierra Area is affected by a number of water-related problems. Flood problems are increasing as residential and industrial developments expand into the flood plain areas. Levees protecting the "islands" and their small communities in the delta area are subject to continual erosion from wave action generated by high winds, high tides and the passage of boats. Many levees are subject to subsidence due to peat foundations. Although the area has an ample water supply, it does have water quality problems, especially in the delta area where the water is becoming fouled with discharges of agricultural return flows and industrial wastes. In addition, the waters of the delta are subject to intrusion of salinity from the ocean. These pollution and salinity problems will continue to become more acute unless protective actions are taken.

navigation projects

Middle River and Connecting Channels (Sacramento District)
This navigation project is located within the complicated network of tidal channels in the San Joaquin River Delta. The project was developed by dredging navigation channels in Middle River, Latham Slough, Empire Cut and Turner Cut. The channels are 9 feet deep and 100 feet wide. Total Federal cost of the project was $10,000. Waterborne commerce amounted to 12,000 tons in 1975.

Mokelumne River (Sacramento District)
Improvement of the Mokelumne River for navigation was completed in 1885 at a Federal construction cost of $10,000.

The Mokelumne River rises near the crest of the Sierra Nevada and empties into the San Joaquin River in the Sacramento-San Joaquin Delta. In its lower reach, the river divides into two forks which reunite about 4 miles above the mouth. Project improvements consisted of removal of snags and other obstructions from the river channels and dredging of shoals in the main stream and in both forks from the mouth of the river to the Galt-New Hope bridge. The project provides about 35 miles of navigable channels which are extensively used by pleasure craft. Waterborne commerce totaled slightly more than 20,000 tons in 1975.

Old River (Sacramento District)
The navigation project for Old River, the most westerly branch of the interconnecting tidal channels into which the San Joaquin River divides in crossing its delta, involved the enlargement and deepening of Old River and nearby channels. Current channel depths range from 5 to 10 feet.

The project adequately serves the navigation needs of the area. The project was constructed at a cost of $23,000. Annual dredging is required to maintain project depths and widths to permit navigation. Waterborne commerce was 33,000 tons in 1975.

Like many of the other navigation channels in the Sacramento-San Joaquin Delta, the Old River Project channels also serve to carry floodflows. In addition, they carry water in transit from the Sacramento River to the Delta-Mendota Canal, a unit of the Central Valley Project of the U.S. Bureau of Reclamation, and to the California Aqueduct, a unit of the State Water Project.

Sacramento River Deep Water Ship Channel (Sacramento District)
The Sacramento River Deep Water Ship Channel consists of a deep draft channel extending from tidewater in Suisun Bay to deep draft terminal facilities at Sacramento, a distance of 43 miles. Although the deep draft channel portion of the project is located in the Delta-Central Sierra Area, the total project is discussed in the chapter on the Sacramento Basin because related shallow draft navigation facilities and the tributary trade area are located in that basin. See page 145 for detailed information.

San Francisco Bay to Stockton (John F. Baldwin and Stockton Ship Channels) (San Francisco and Sacramento Districts)
This project consists of improving navigation channels, constructing certain new navigation facilities and providing associated recreation facilities. It affects five existing navigation projects, four of which are in the San Francisco Bay Area. They are discussed on page 48.

The fifth part of the project involves deepening the Stockton Deep Water Ship Channel from 30 to 35 feet, realigning the channel to follow the False River route, adding a new turning basin and maneuvering area, constructing public recreation facilities and placing rock revetment on levees bordering the channel.

San Joaquin River, Stockton Deep Water Channel and Burns Cutoff (Sacramento District)
This navigation project provides a 40-mile deep draft

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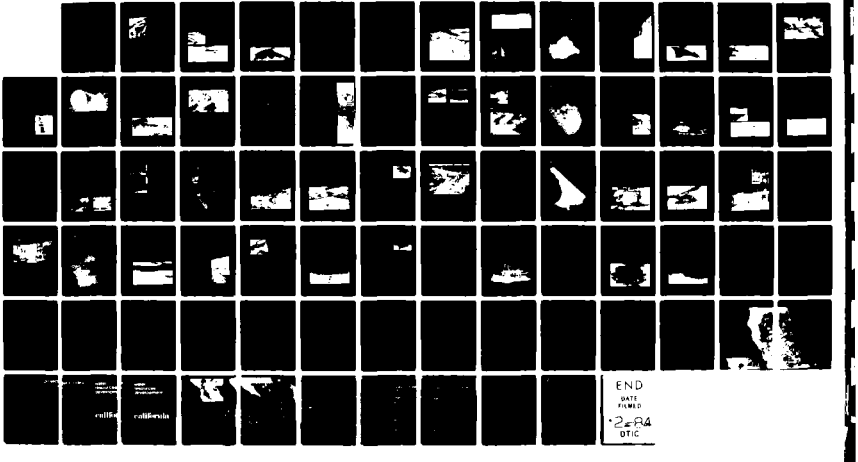
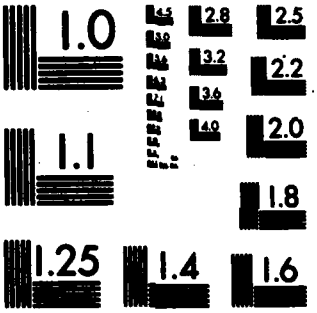




MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

the port of stockton is the terminus of the stockton deep water ship channel.

channel from the mouth of the San Joaquin River to the City of Stockton, and an 85-mile shallow draft channel that continues from Stockton upstream to Hills Ferry in the San Joaquin Basin. This portion of the project facilitates light draft navigation.

The Stockton Deep Water Channel serves the southern half of the highly productive Central Valley. Waterborne commerce on project channels in 1975 was 4.1 million tons and has averaged about 4.9 million tons per year for the period 1964-1975.

All work authorized prior to 1950 has been completed by the Corps of Engineers. This work consisted of channel construction and improvements; construction of wing dams, levees and terminal facilities; snagging and clearing and construction of two passing and settling basins. Federal costs were approximately $4 million. Local interests contributed $2.4 million, exclusive of terminal facilities.

Additional work, authorized in 1950, has been completed and includes enlargements of the existing turning basin and bank protection for levees critically damaged by wave action resulting from deep draft traffic. Federal costs were approximately $1.8 million.

As noted elsewhere, this project will be modified under the San Francisco Bay to Stockton Project.

Stockton and Mormon Channels (Diverting Canal) (Sacramento District)
This project diverts the waters of Mormon Slough to the lower Calaveras River merging at a point just north of the City of Stockton. It consists of a dam across Mormon Slough, a diverting canal and levee and enlargement of the channel of the Calaveras River.

The project was completed in 1923 at a total Federal cost of about $250,000. The primary purpose of the diverting canal is to prevent deposition of silt and debris in the Stockton and Mormon Channels. In addition, the levee provides flood protection to a large part of the City of Stockton and adjacent suburban areas. Although authorized as a navigation improvement, the project has afforded some flood protection to adjacent lands and has prevented substantial flood damages in Stockton, which would otherwise have occurred an average of about once every 5 to 6 years.

multipurpose project

New Hogan Lake (Sacramento District)
The New Hogan Lake Project, authorized for flood control, irrigation and other purposes, consists of a rockfill dam located immediately downstream from old Hogan Lake on the Calaveras River, four earthfill dikes and a 325,000 acre-foot lake. The new dam and appurtenances were constructed approximately 28 miles northeast of Stockton. The dam is 200 feet high and 1,960 feet long. The $16.9 million project was completed in 1964 and is operated and maintained by the Corps of Engineers.

The New Hogan Lake Project provides a high degree of flood protection to 46,000 acres of agricultural land along the Calaveras River, to the City of Stockton and its rapidly growing suburban areas and to important rail and highway transportation facilities. In addition, it provides 40,000 acre-feet of new water annually for irrigation in an area where the present supply is inadequate and overdraft pumping is depleting groundwater supplies.

New Hogan Lake, in conjunction with the flood control improvements on Mormon Slough, would have pre-

vented flood damage of $3.4 million which occurred downstream from the project site in December 1955-January 1956 and in 1958. During the 1964 and 1969 floods, the project prevented damages estimated at $1.2 million.

The Corps of Engineers has spent more than $900,000 to provide recreational facilities which include an observation point, campgrounds, picnic areas, boat launching ramps, associated access roads, parking areas and systems for water supply and sanitation. During 1976, public use of the project area was more than 194,000 recreation-days.

cooperative project

Camanche Reservoir (Sacramento District)
This project — an earth and rockfill dam 171 feet high and 2,450 feet long, six gravel and earthfill dikes and a 431,500 *acre-foot reservoir* — is located on Mokelumne River about 5 miles northeast of Clements. It was completed in 1964 by the East Bay Municipal Utility District.

Total cost of the Camanche Reservoir Project was about $36.7 million, of which $26 million was the non-Federal cost and $10.7 million was contributed by the Federal government for flood control benefits.

◀ *new hogan lake offers campgrounds, picnic areas and boat launching facilities as part of the recreational facilities.*

▼ *camanche dam and reservoir on the mokelumne river.*

A contract with the East Bay Municipal Utility District provides for operation of the project for flood control in accordance with rules and regulations prescribed by the Secretary of the Army. In addition, if the project should cause any damages to fish and wildlife, the East Bay Municipal Utility District will act to mitigate these damages, consistent with the efficient operation of the project for its primary purposes.

The project, in conjunction with the Pardee, Salt Springs and Bear River Reservoirs, offers flood protection to 69,000 acres of agricultural land and 3,000 acres of urban and suburban land including the City of Lodi and the town of Woodbridge. During the floods of 1964 and 1968-1969, the project prevented damages estimated at about $2 million.

flood control projects

Bear Creek Channel, San Joaquin County (Sacramento District)
The Bear Creek Channel Project consists of 41 miles of low levees and 24 miles of channel improvements along Bear Creek in San Joaquin County. The levee and channel improvements extend along the south channel of Bear Creek from Jack Tone Road, about 2 miles south of Lockeford, to Disappointment Slough, a delta channel that connects with the San Joaquin River.

The project provides flood protection to 30,000 acres of highly developed orchards, vineyards and croplands; suburban areas adjacent to the City of Stockton; and main highways, railroads and industrial installations. Construction of the project was started in 1963 and completed in 1967. The total Federal cost was about $3.2 million. Local interests provided the necessary lands, rights-of-way and utility alterations at an estimated cost of $3.7 million. Operation and maintenance of the project are the responsibility of local interests. During the December 1964 and December 1966 floods, the project prevented damages estimated at $950,000.

Farmington Dam (Sacramento District)
The Farmington Dam Project consists of an earthfill flood detention dam and ungated spillway on Littlejohn Creek about 3.5 miles upstream from Farmington and about 10 miles east of Stockton. The dam has a maximum height of 58 feet and a crest length of 5,800 feet. Gross flood detention capacity is 52,000 acre-feet. Channel improvements on Littlejohn Creek below the dam and appurtenant facilities for diverting Duck Creek floodwaters to Littlejohn Creek are also part of the project.

Completed in 1955, the dam is operated by the Corps of Engineers. Local interests are responsible for operation and maintenance of the channel improvements.

bear creek channel provides flood protection to about 30,000 acres in san joaquin county.

Total Federal construction cost of the project was about $3.7 million. Local interests were required to furnish rights-of-way and utility relocations for the channel improvements at a cost of about $319,000.

About 58,000 acres of agricultural land, suburban areas and industrial sites in the area immediately southeast of Stockton are protected by the project. During the 1955-1956, 1958 and 1968 floods, the project prevented damages estimated at $6.8 million.

Lower San Joaquin River and Tributaries (Sacramento District)
The project for flood control along the lower San Joaquin River and tributaries is situated mostly in the San Joaquin Basin. It is discussed in detail in Chapter 8, which is devoted to that basin. In the Delta-Central Sierra Area, the project extends from near Stockton upstream to the Banta-Carbona Canal. Project facilities in the area consist primarily of levee construction and rehabilitation along the San Joaquin River, Old River and Paradise Cut. All authorized work has been completed.

Mormon Slough, Calaveras River (Sacramento District)
Mormon Slough, a distributary of the Calaveras River, originates near the town of Bellota, about 17 miles east of Stockton. Water from Mormon Slough is diverted back into the Calaveras River by means of a dam and diversion canal completed in 1910.

Improvements completed in 1970 increased the flood carrying capacity of existing channels from Bellota downstream to the lower end of the diverting canal by means of channel clearing and enlargement. In addition, a new levee was constructed along the north bank of the diverting canal. The increased channel capacity made it possible to convey floodflows, including maximum controlled flood releases from New Hogan Lake, which is located about 15 miles upstream from Bellota.

The cost of the project was $5.7 million, which was divided equally between the Federal government and the local interests concerned.

The project provides flood protection to the City of Stockton and adjoining suburban area, and to frequently flooded areas north of the diverting canal. It prevents flooding of Federal highways, State highways, county roads and mainline railroads, and provides for the most efficient flood control operation of the New Hogan Lake. It is estimated that this project, together with New Hogan Lake, would have prevented $1 million in flood damages if they had been completed and in operation at the time of the 1958 flood.

flood control study

Sacramento-San Joaquin Delta (Sacramento District)
The Sacramento-San Joaquin Delta consists of about 500,000 acres of highly productive agricultural lands segregated by interconnecting waterways into about 100 tracts locally known as "islands." The waterways are confined by 1,100 miles of levees designed to protect the islands from inundation during high tides or high river stages. The entire delta, which was reclaimed from swamp, is subject to tidal action.

Many existing levees in the delta are on unstable peat foundations that continually subside. Sherman Island was inundated by floods that occurred in 1969 and the Andrus-Brannan island tracts were inundated when a levee failed in the summer of 1972. It is estimated that inundation of the entire delta during a major flood would cause damages of more than $100 million.

The purpose of the study of the Sacramento-San Joaquin Delta is to determine the advisability of reclaiming certain tracts continually subject to inundation by tidal actions and to consider closing some channels to floodflows and navigational use in order to reduce levee maintenance. The transfer of fresh water from north to south will also be considered.

The investigation, suspended several times since its start in 1949, is currently active. With the exception of Bethel Island, which has been undergoing a high degree of urbanization in recent years, flood problems in the delta generally involve agricultural lands. An urgent need exists on Bethel Island for greater flood protection than that which is now provided. Levees surrounding the island are low, of inadequate cross section and situated on unstable foundation materials. Emergency action by the State of California and the Corps of Engineers has saved Bethel Island from inundation several times.

In October 1973 the State of California requested that the delta study be resumed and a report be prepared by the Corps to determine the extent of Federal participation in saving and improving delta levees. The Sacramento-San Joaquin Delta Study was consolidated with the Sacramento-San Joaquin Delta Recreation Study and the comprehensive investigation resumed in 1974. The study is scheduled for completion in 1980.

small flood-control project

Duck Creek, San Joaquin County (Sacramento District)
Duck Creek, a minor tributary of the San Joaquin River, is located east of the City of Stockton between Calaveras River-Mormon Slough and Littlejohn Creek. Prior to its improvement, floodflows exceeded channel capacity along the lower reaches of Duck Creek an average of once every five years, causing substantial damage.

The Duck Creek Project was completed in 1967. The project improved 14 miles of channel to provide a carrying capacity of 700 to 900 cubic feet per second. The project cost was $1.3 million, of which 50 percent was provided by the Federal government.

special investigation

San Francisco Bay and Sacramento-San Joaquin Delta Water Quality and Waste Disposal (San Francisco District)
A special investigation of water quality, waste disposal and wastewater management covering the Sacramento-San Joaquin Delta has no currently scheduled completion date. As indicated by its title, the investigation also covers the San Francisco Bay Area. The study is being accomplished by the San Francisco District and is discussed in detail in Chapter 3, page 65.

emergency work

The unusual topographical features of the Delta-Central Sierra Area have led the Corps of Engineers to perform emergency operations unique to an area that contains land elevations varying from 10 feet below sea level to 10,000 feet above, and where the rivers of the Central Valley form their delta to flow to the sea.

Emergency work has cost in excess of $4.4 million and has consisted primarily of levee repairs and bank protection in the delta area. Other work consisted of snagging and clearing, removal of wrecked vessels and floodfighting and rescue operations. The Corps has also conducted flood damage surveys and investigated rehabilitation work.

The most recent application of emergency work performed by the Corps under available authorities and at the request of the OEP followed the 21 June 1972 failure of a levee bordering Andrus Island. This non-project levee failed from unknown causes in the middle of the night permitting about 200,000 acre-feet of water from the San Joaquin River to inundate Andrus Island and adjoining Brannan Island. Damage to private property was estimated at $17 million largely attributed to the inundation of homes and businesses in the town of Isleton. Public property, including roads and utilities, suffered losses of $4 million and losses to crops and agricultural areas amounted to $7 million.

Floodfighting efforts of the Corps of Engineers consisted of a losing battle to construct a temporary levee to protect the town of Isleton.

Following dewatering of Andrus Island, the levee break was repaired at a cost of $1.8 million. Other items of work included restoration of the sewage system and streets, removal of rock placed on the land side of the Andrus and Brannan Island levees to protect them from wind-generated wavewash after the islands were inundated, and removal of debris. In total, work done by the Corps at the request of the OEP totaled $2.6 million. In addition, the Corps prepared repayment evaluation reports for restoration work done by local interests at a cost of $2.5 million. Work done at the request of the OEP as a result of other emergencies consisted of removal of debris and restoration of public facilities, levees and channels at a cost of $418,000, and preparation of repayment evaluations for work done by local interests at a cost of $120,000.

The largest and most costly rainflood in the Delta-Central Sierra Area occurred in early 1969. Rainfall of about 20 inches in the mountainous headwater areas resulted in extremely large streamflows that were met with high tides in the delta. The combination produced conditions critical to the weakening rain-soaked levees. Deep draft traffic on the main navigation channels was stopped to reduce wave erosion. On 20 January, the levee on the San Joaquin River side of Sherman Island failed and the island was flooded. More than 20,000 tons of rock and about 350,000 cubic yards of sand were required to close the 270-foot break. The cost for closure, restoration and dewatering the island was about $425,000. Other costs for floodfighting were $532,000. Total damages during the flood amounted to about $15 million.

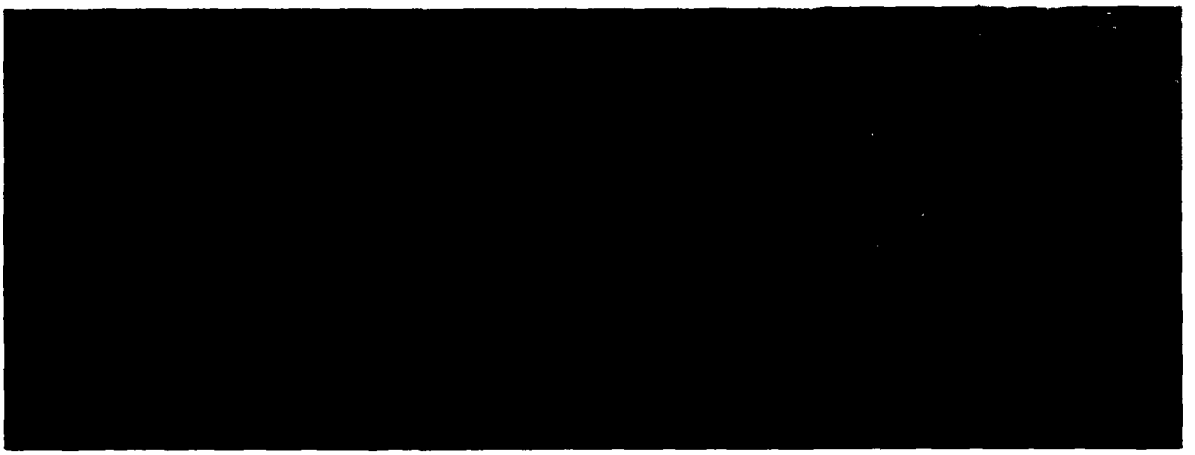
During the spring and early summer of 1969, $80,000 was spent under the authority of Operation Foresight to prevent damage from anticipated snowmelt. This work was done at four locations in the area and consisted of raising, strengthening and repairing levees and re-

delta-central sierra area

habilitating flood diversion facilities. These activities prevented an estimated $2.1 million in snowmelt flood damage.

Emergency operations performed during the 1955-1956 floods consisted of floodfighting, levee restoration and bank protection work that cost $1.3 million. At that time, 15 inches of rain over tributary streams and a large volume of snowmelt caused widespread flooding. In the delta, flood conditions were aggravated by unusually high tides. No levee failure occurred, but flood damage amounted to about $12 million.

the city of isleton in june 1972. the sewage treatment plant, in the foreground, was soon protected by a new levee and dewatered, and restoration work was begun. ▼



the june 1972 levee failure flooded andrus island, lower right. this photo, taken in july, shows the break nearly closed.

in january 1969 flood waters caused the failure of a levee protecting sherman island. this photo shows the clamshell dredge which completed closure of the break in february.

flood plain management services program

The following flood plain information studies for streams in the Delta-Central Sierra Area have been completed:

- Alamo and Ulatis Creeks, Vacaville
- Cosumnes River Basin
- Northeast Stream Group (Calaveras River, Mormon Slough and Bear, Mosher and Paddy Creeks), Stockton
- Northwest Stream Group (San Joaquin and Calaveras Rivers, Bear and Lower Mosher Creeks, and Disappointment and Fourteen Mile Sloughs), Stockton
- Southeast Stream Group (Duck, Littlejohn and Lone Tree Creeks), Stockton
- Southwest Stream Group (San Joaquin River, Mormon Channel, Duck Creek, and Walker and French Camp Sloughs), Stockton.

8 san joaquin basin

project index

navigation projects

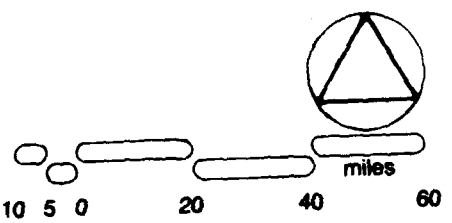
57 san joaquin river, stockton deep water channel & burns cutoff

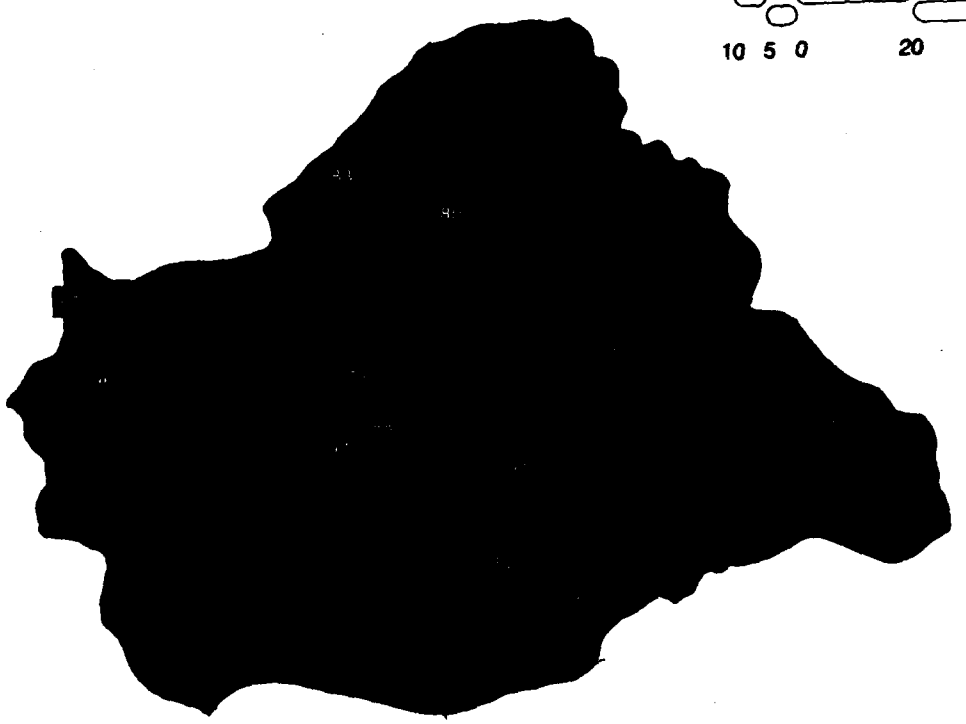
multipurpose projects

71 *millerton lake*
73 new exchequer reservoir
80 tuolumne river reservoirs project
81 buchanan dam
82 hidden dam
83 new melones lake
88 merced county streams

flood control projects

96 lower san joaquin river and tributaries
97 merced county stream group





description

The San Joaquin Basin, situated in Central California, extends from near Stockton on the north to the Fresno area on the south. The crests of Sierra Nevada and the Coast Ranges border the basin on the east and west. The basin is about 110 miles long and 95 miles wide. It has a land area of nearly 11,000 square miles and a water area of 97 square miles.

The climate of the lower elevations of the basin is characterized by hot, dry summers and mild winters with little precipitation. Warm, dry summers and cold winters with heavy rain and snow are the norm in the mountainous areas. The average annual precipitation varies with elevation, ranging from about 5 inches in the southern part of the valley floor to over 70 inches in the Sierra Nevada. Temperatures normally range from winter lows below zero in mountain areas to summer highs of about 115 degrees on the valley floor.

The San Joaquin Basin has a population of about 435,000 and is expected to exceed 700,000 by the year 2000. Its economy is dominated by highly diversified irrigated agriculture and related manufacturing and industrial activities. Mining and lumbering are significant industries in the Sierra Nevada. Irrigation development began in the basin in the 1870s with diversions of water from major rivers. Expansion of irrigated acreage has continued at a rate of about 10 to 15 percent per decade.

Transportation facilities are extensive, with highly developed Federal, State and county road systems affording ready access to all parts of the basin and to adjoining areas. The area is also served by airlines, rail lines and the Stockton Deep Water Ship Channel.

The San Joaquin River is the principal stream in the basin. Originating in glacial lakes in the Sierra Nevada, it flows southwesterly to the vicinity of Mendota, then northwesterly to its mouth in Suisun Bay. The principal tributaries of the San Joaquin River within the basin are the Stanislaus, Tuolumne and Merced Rivers. A number of minor tributaries, most of which are dry during the summer, join the river from the east and west. The average annual runoff from the San Joaquin River and its major tributaries is estimated at about 6 million acre-feet. Melting of the snowpack in the Sierra Nevada generally maintains flow in the major streams throughout most of the summer. During the late fall and

(photo courtesy of vtn.)

winter months, flooding occurs primarily as a result of prolonged general rainstorms in the mountain and valley floor areas. Floods also occur during the spring and early summer months, primarily as a result of unseasonable and rapid melting of the winter snowpack in the high areas of the Sierra Nevada.

Although flood control measures have been taken to reduce floodflows and resulting damage, problems still exist in some areas, especially along streams of the Merced County and Madera County groups. Streambank erosion and eroding land pose a significant threat, especially in the lower elevations and valley areas where intensive agricultural development exists. About 2,780 miles of stream channels have erosion problems with 350 miles considered to be serious. Annual loss of land due to bank sloughing is estimated at about 60 acres, 30 percent of which occurs in urban areas.

Because of the low flows in the San Joaquin River during non-flood periods and relatively steep stream gradients, shallow draft commercial navigation is infeasible at the present time. Approximately 66 miles of waterway in the basin are suitable for recreational navigation, including 62 miles on the San Joaquin River downstream of the Merced River and 4 miles on the lower Tuolumne River. Summer flows in the Merced and Stanislaus Rivers, except in years of heavy snowmelt runoff, are so low that these streams are unsuitable for recreational navigation.

navigation project

San Joaquin River, Stockton Deep Water Channel and Burns Cutoff (Sacramento District)
A portion of the project for navigation on the San Joaquin River is within the boundaries of the San Joaquin Basin. To facilitate shallow draft navigation in the river reach between the mouths of the Merced and Stanislaus Rivers, a distance of about 55 miles, project work consisted of snagging, removal of overhanging trees and other obstructions and construction of wing dams. The work has been complete for many years. Additional information on this project is on page 173.

multipurpose projects

Buchanan Dam (H. V. Eastman Lake) (Sacramento District)
The Buchanan Dam Project, scheduled for completion in 1977, is on the Chowchilla River about 16 miles northeast of the City of Chowchilla. The project consists of an earth and rockfill dam and a lake for flood control, recreation and fish and wildlife purposes. The project includes supplemental channel improvement work downstream from the dam, which has a maximum height of 205 feet and a crest length of 1,800 feet. The gross capacity of the lake is 150,000 acre-feet. Preconstruction planning and land acquisition are complete and construction of the main dam was completed in November 1974.

a view of buchanan dam and lake. construction of the main dam was completed in 1974.

The channel improvement work, consisting of levee construction and channel clearing and enlargement along two segments totaling about 20 miles, was completed in April 1976. Portions of the channels were enlarged by the State of California as part of its "San Joaquin River Flood Control Project, Friant Dam to Merced River."

The Federal cost for construction of the project is estimated at $26.9 million. For lands, easements, rights-of-way and relocations required in connection with the channel improvement work, the local interests' cost is estimated at $1.6 million. Repayment for irrigation service will be financially integrated into the Central Valley Project of the Bureau of Reclamation.

H. V. Eastman Lake will provide flood protection to the City of Chowchilla and to suburban, industrial and agricultural areas along the Chowchilla River and its distributaries and will assist in controlling floods on the San Joaquin River. If the project had been completed and in operation during the January 1969 flood, it would have prevented damages estimated at $1.0 million.

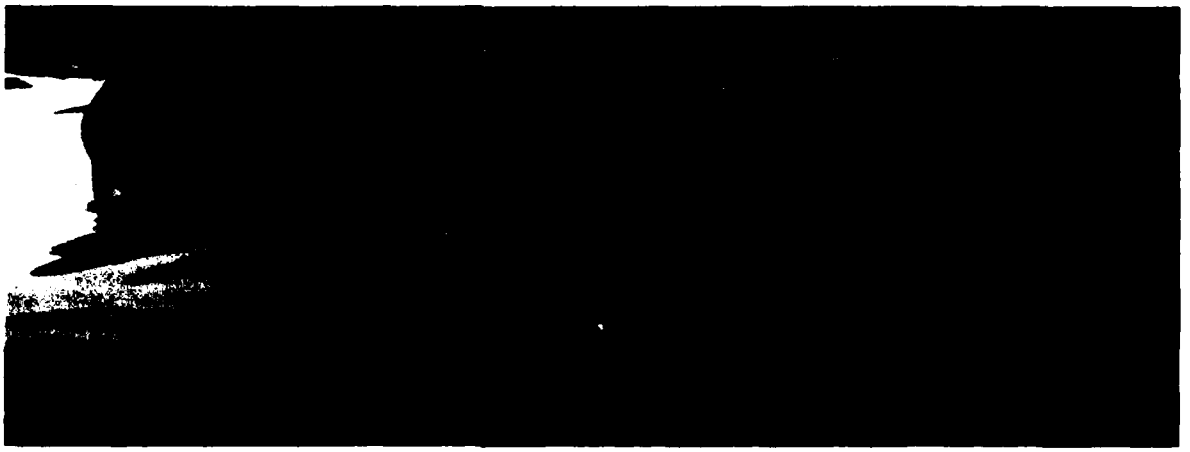
The project will make available a new water supply averaging 24,000 acre-feet per year, will improve the water quality of the Chowchilla River by eliminating some turbidity and sediment and will allow for greater recharge of groundwater.

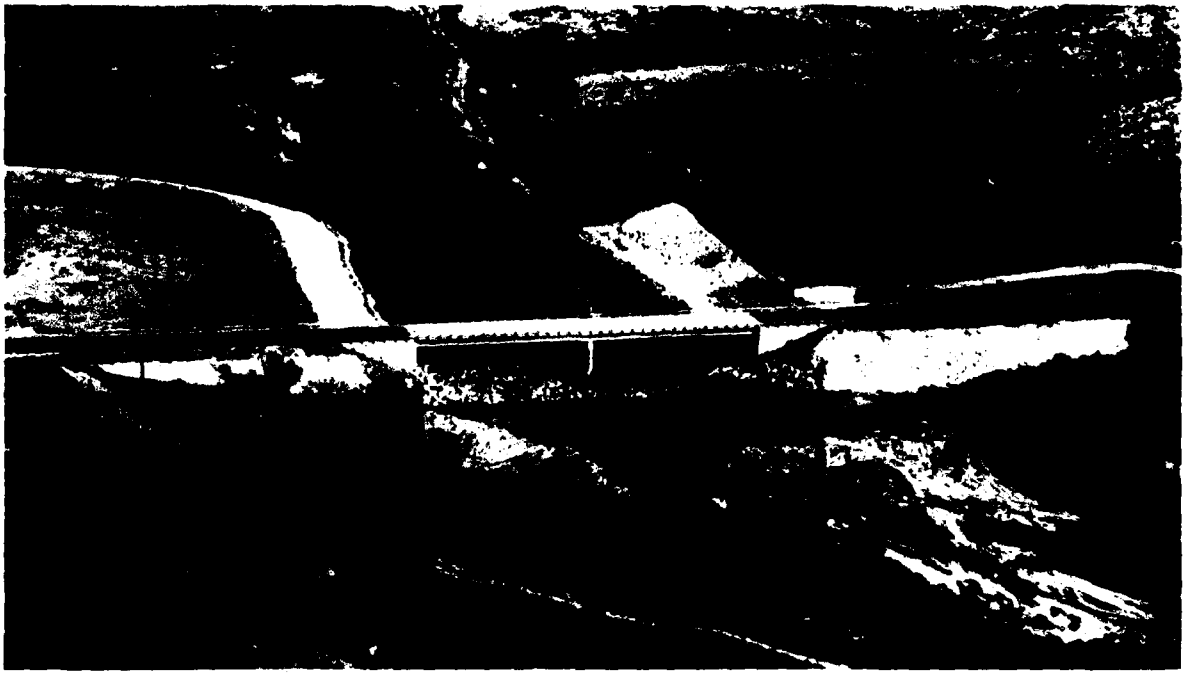
Construction of the Chowchilla and Codorniz recreation areas, which will provide boat launching ramps and about 100 camping and picnic facilities, are features of the project, which will also provide a warm-water fishery in the lake and enhance downstream flows to allow a new fishery there. About 1,500 acres of project land and water area will be dedicated to fish and wildlife management in order to mitigate the effects of the lake on existing habitat.

Hidden Dam (Hensley Lake) (Sacramento District) Hidden Dam Project, now under construction, is located on the Fresno River about 15 miles northeast of the City of Madera. The project consists of a dam and lake for flood control, irrigation, recreation, fish and wildlife purposes, as well as supplemental channel improvements designed to increase the capacity of the Fresno River downstream from the dam. The dam will be of earthfill construction with a maximum height of 163 feet and a crest length of 5,730 feet. The storage capacity of the lake will be 90,000 acre-feet. Construction of the main dam was completed in November 1974, and the entire project is scheduled for completion in 1977.

The channel improvement work was completed in April 1976 and consisted of the construction of about 7 miles of leveed channel along a new alignment from the Chowchilla Canal crossing upstream to the vicinity of the Fresno River bypass. From there, levee construction and channel clearing and enlargement were completed upstream along the Fresno River for a distance of about 6 miles. The channel of the Fresno River, downstream from the Chowchilla Canal crossing, was enlarged by the State of California as part of its "San

hidden dam stretches over one mile in length along its crest.





these channel improvements on the fresno river are part of the hidden dam project.

Joaquin River Flood Control Project, Friant Dam to Merced River."

The total Federal cost for construction of the project is estimated at $30.8 million. For lands, easements, rights-of-way and relocations required in connection with the channel improvement work, the local interests' cost is estimated at $1.2 million. That part of the project allocated to irrigation will be paid through the sale of water from the Central Valley Project of the Bureau of Reclamation.

The Hidden Dam Project will provide flood protection to the City of Madera and to suburban, industrial and agricultural areas along the Fresno River and will assist in controlling floods on the San Joaquin River. If the project had been completed and in operation during the January 1969 flood, it would have prevented damages estimated at $2.6 million.

The project will make available a new water supply averaging 23,800 acre-feet per year and will improve water quality in the Fresno River by eliminating some of the turbidity and sediment frequently associated with floodflows. Flood control releases and delivery of stored irrigation water by way of the river will allow for greater channel percolation and recharge of groundwater.

Hensley Lake will provide new recreational opportunities including construction of the Hidden View and Buck Ridge recreation areas. These will include boat launching ramps and 130 picnic and camping sites. It will provide a warm-water lake fishery and will help stabilize the intermittent downstream flows in the Fresno River, enabling a fishery to be established there.

About 320 acres of project land will be devoted to fish and wildlife management in order to help compensate for the loss of habitat inundated by Hensley Lake.

Merced County Streams (Sacramento District)
The Merced County Streams Project will modify and extend the existing single-purpose flood control project (Merced County Stream Group Project), which consists of flood retention dams on Burns, Bear, Owens and Mariposa Creeks in the Sierra Nevada foothills east of the City of Merced; diversion canals from Black Rascal Creek to Bear Creek and from Owens Creek to

Mariposa Creek; and improvement of stream channels on the valley floor in the vicinity of Merced. Flood retention capacity of the project is 33,300 acre-feet. The project was completed in 1957 and is operated by the Corps of Engineers with the exception of channel improvements, which are maintained by local interests.

Total Federal construction cost of the project was $1.8 million, with local interests contributing $1.2 million.

The existing project provides flood control protection to 136,000 acres of agricultural land, the City of Merced and several other small towns and farm communities and important transportation facilities. In addition, it reduces floodflow from the stream group into the San Joaquin River. During the floods of 1955-1956, 1958 and 1968-1969, the project prevented damages estimated at $19.4 million.

In 1970, a new project was authorized to provide three new water storage facilities, to enlarge and modify the four existing flood retention dams to provide a total storage capacity of 126,700 acre-feet, and to construct 52 miles of levee and channel improvement. Three of the water storage facilities would be for flood control only, two for flood control and recreation, one for flood control and irrigation and one for all three purposes. The levee and channel improvements would convey floodwaters to the bypass system of the San Joaquin River Flood Control Project.

The total Federal cost for the project is estimated at $59 million and local costs are estimated at $4.2 million. In addition, local interests must arrange to repay part of the project costs allocated to irrigation and recreation.

The new project will increase the area protected from floods to include the City of Merced, Castle Air Force Base and extensive agricultural areas. It will also increase opportunities for water-oriented recreational activities and make available a new water supply averaging about 7,300 acre-feet per year for irrigation. If the project, authorized in 1970, had been completed and in operation during the January 1969 floods, it would have prevented damages estimated at more than $900,000 in addition to $9 million damage prevented by the existing project.

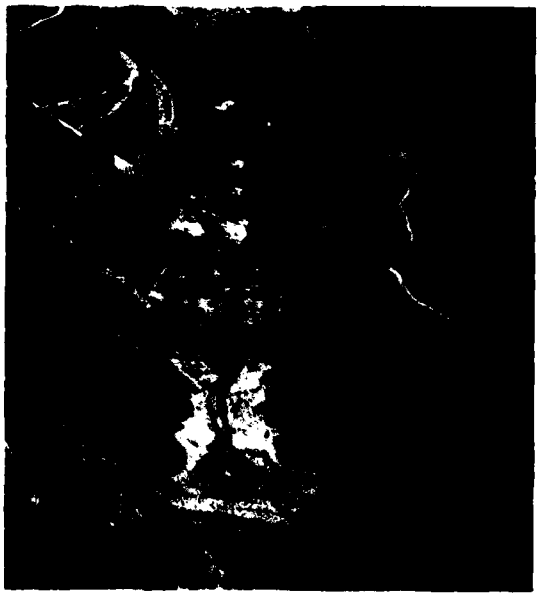
During preconstruction planning for the project, studies will be made to determine measures to be utilized in mitigating the effects of the project on existing wildlife habitat. Possible enhancement of the fishery resources of the area will also be studied. Preconstruction planning was initiated in 1973 and is scheduled for completion in 1979.

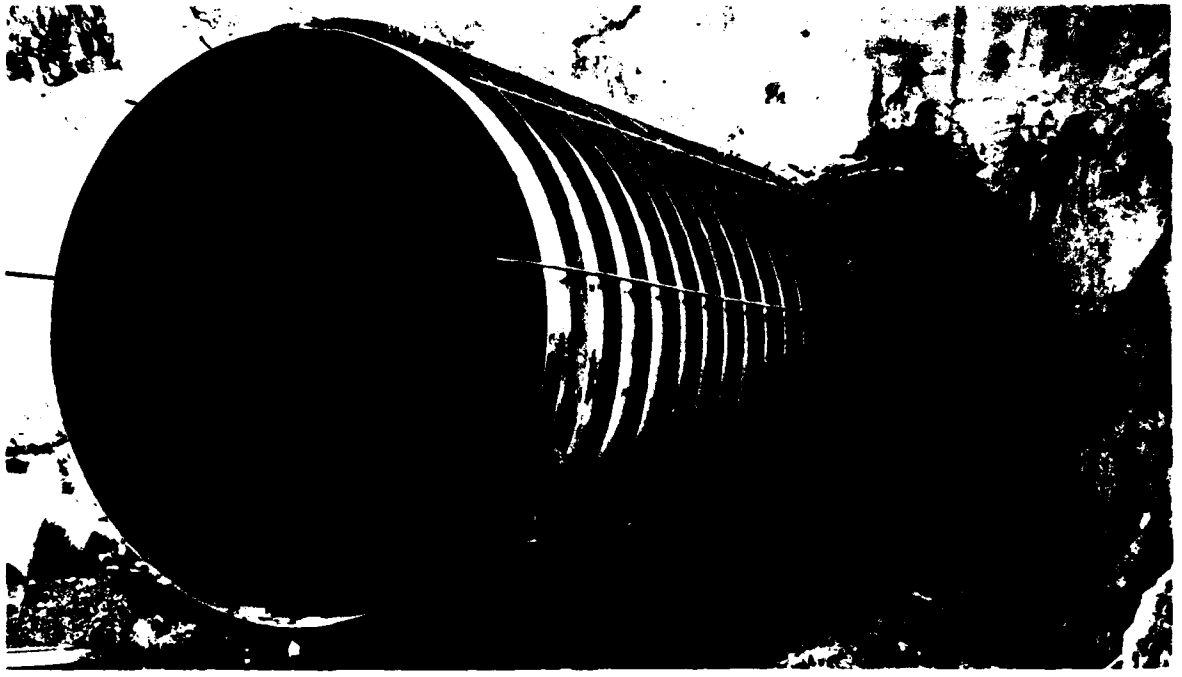
New Melones Lake (Sacramento District)
The New Melones Lake Project, now under construction, is located on the Stanislaus River about 45 miles east of Stockton. The project, when completed, will provide flood control, irrigation, power, general recreation, enhancement of fish and wildlife and other benefits. The project will consist of a dam, lake and powerplant.

The earth and rockfill dam will be 625 feet high and have a crest length of 1,560 feet. The lake will have a gross capacity of 2.4 million acre-feet for water conservation, power generation, water quality control, recreation, fish and wildlife enhancement and flood control purposes. It will inundate an existing reservoir, which is owned and operated by the South San Joaquin and Oakdale Irrigation Districts. A powerplant with a generating capacity of 300,000 kilowatts will be built.

When construction is complete, the project will provide flood protection to 35,000 acres of highly developed

aerial view upstream along iron canyon, site of the new melones dam construction on the stanislaus river.





an 80-foot-long by 23-foot diameter steel liner being eased into the main diversion tunnel at the new melones project.

agricultural land along the Stanislaus River. In conjunction with other projects on the lower San Joaquin and Tuolumne Rivers, it will materially aid in reducing flood stages along the lower San Joaquin River and in the San Joaquin Delta, thereby assisting in the protection of an additional 235,000 acres of intensively developed agricultural lands, military installations and industrial and suburban areas in the vicinity of Stockton. In addition, the project will provide a new irrigation supply averaging about 285,000 acre-feet annually to relieve present deficiencies and provide water to presently undeveloped agricultural lands. If the New Melones Project had been completed and in operation during the floods of 1964, 1967 and 1968-1969, it would have prevented damages estimated at nearly $4.5 million.

The project is being built at an estimated cost of $306 million by the Corps of Engineers. Upon completion, scheduled for 1980, the project will be transferred to the Bureau of Reclamation for operation and maintenance in conjunction with other units of the Central Valley Project. Operation for flood control will be accomplished according to rules and regulations prescribed by the Secretary of the Army.

New Melones Dam was authorized by the 1944 and 1962 Flood Control Acts. Initial construction began in 1966. The diversion tunnel was completed in 1973, with work beginning on the main dam and appurtenances in 1974. The main dam closure is scheduled for November 1978, with contract completion in March 1979. The powerplant and appurtenances contract was started in February 1976. Thirteen supply contracts for the turbines, generators, transformers and other power equipment have been awarded to date; the last two contracts will be awarded in 1977. Power on the line is scheduled for January 1979. The contract for relocation of State Highway 49 was completed in December 1976. The contract for relocation of Camp Nine Road was awarded in July 1976 and is scheduled for completion in 1978; the contract for relocation of Parrotts Ferry Road is scheduled to be awarded in February 1977.

Environmentalists have opposed construction of a dam of this magnitude on the Stanislaus River because of the effect it would have on the environment. Evidence indicates, however, that the environmental benefits of the New Melones Project will be greater than the losses that might occur. At present, agricultural and other

pollutants cause water quality problems in the Stanislaus River during periods of low flow. Releases for water quality enhancement will substantially correct deficiencies in dissolved oxygen and high levels of dissolved solids, and will benefit fish resources and agricultural uses. The hydroelectric powerplant will provide a clean source of energy.

Wildlife management areas adjacent to the river downstream and at the lake will be provided to compensate for the loss of the habitat in the lake area.

cooperative projects

Millerton Lake (Friant Dam) (Sacramento District) Millerton Lake (Friant Dam) is a multipurpose project on the San Joaquin River in the foothills of the Sierra Nevada 25 miles northeast of Fresno. The dam, completed by the Bureau of Reclamation, is a concrete gravity structure 319 feet high and 3,488 feet long. The lake has a capacity of over 500,000 acre-feet. Operation of Millerton Lake as a Section 7 project provides for a flood control reservation of 170,000 acre-feet during the winter rainflood season and 390,000 acre-feet during the snowmelt flood season.

New Exchequer Reservoir (Sacramento District) The multipurpose New Exchequer Dam and Reservoir Project consists of a rockfill dam with a maximum height of 480 feet and a crest length of 1,200 feet and a reservoir with a gross capacity of slightly more than 1 million acre-feet. The project was built by the Merced Irrigation District on the Merced River. Completed in 1966, the project expanded the gross capacity of the old reservoir nearly fourfold. The old dam was incorporated into the upstream toe of the new rockfill structure which has a concrete face. A powerplant with an installed capacity of 80,000 kilowatts and provision for future expansion to 125,000 kilowatts is located at the dam. In addition, a 9,700 acre-foot afterbay and a 9,000 kilowatt capacity powerplant are located 6 miles downstream.

Cost of the project, exclusive of power and recreation facilities, was $28.9 million. Federal cost was $10.9 million, which represents that portion of the construction cost attributable to flood control. The Merced Irrigation District operates the project for flood control in accordance with rules and regulations prescribed by the Secretary of the Army.

New Exchequer Reservoir provides flood protection to small downstream communities and to 50,000 acres of agricultural land in the Merced River flood plain. It will significantly reduce flood damage along the lower San Joaquin River and in the Sacramento-San Joaquin Delta. The project will also help to meet the increasing demand for irrigation water and electrical energy. Dur-

new exchequer dam and reservoir on the merced river. (photo courtesy of m. dias)

san joaquin basin

new don pedro dam and reservoir on the tuolumne river. (photo courtesy of modesto bee)

ing the 1966-1967 and 1968-1969 flood seasons, the project prevented damages estimated at $2.8 million.

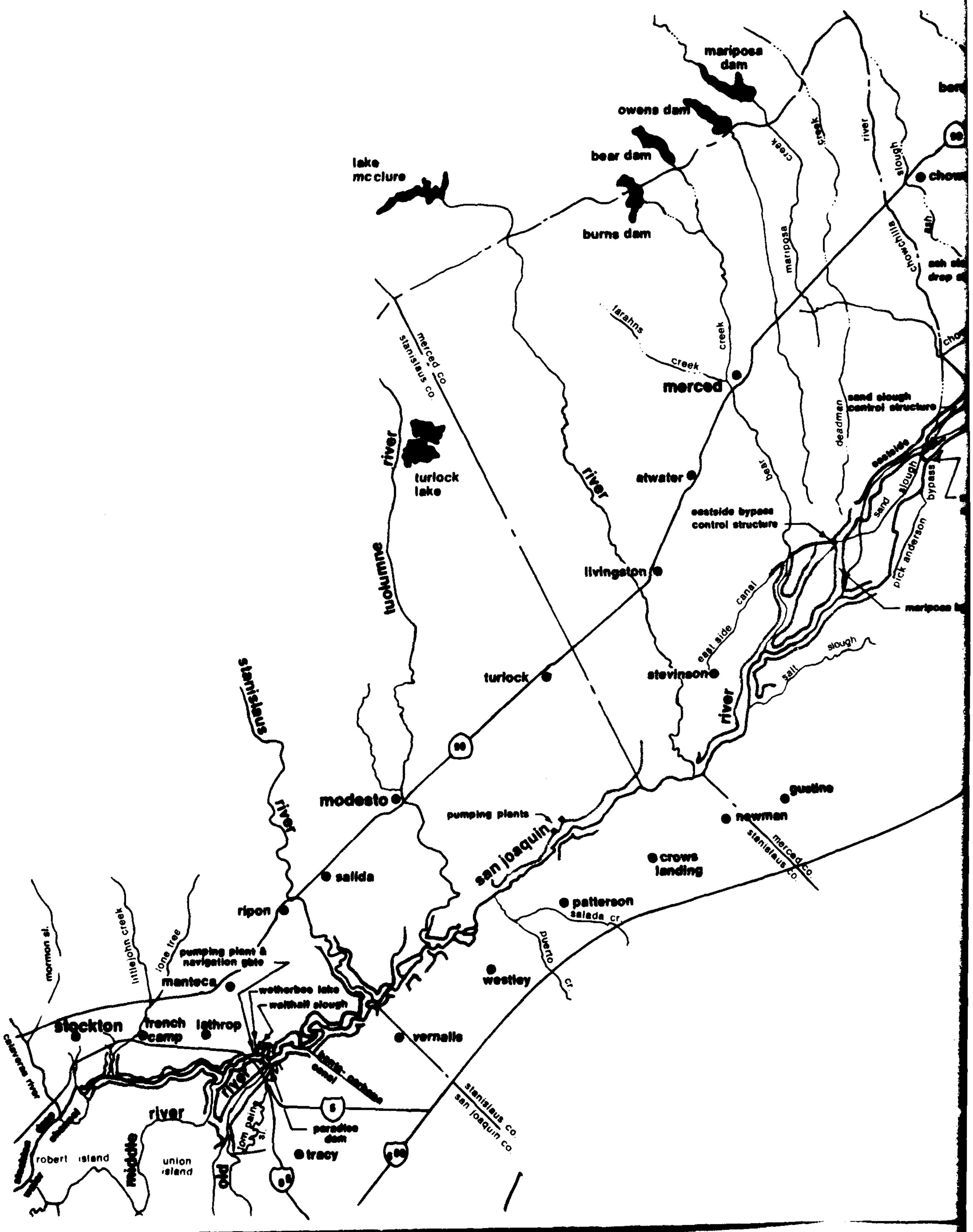
Tuolumne River Reservoirs Project (Sacramento District)
The program of development on the Tuolumne River involved a cooperative arrangement between the Federal government and local interests, consisting of the City and County of San Francisco and the Turlock and Modesto Irrigation Districts. Under an initial phase of the arrangement, local interests built Cherry Valley Reservoir with financial assistance from the Federal government and, in return for such assistance, operated the reservoir in conjunction with Lake Eleanor, Hetch Hetchy and Don Pedro Reservoirs to provide partial flood control on an interim basis. Under the final phase of the program, local interests constructed New Don Pedro Reservoir, with further financial assistance from the Federal government, and provide a 340,000 acre-foot flood control reservation to be operated as prescribed by the Secretary of the Army. Federal participation in the project totaled $14.5 million.

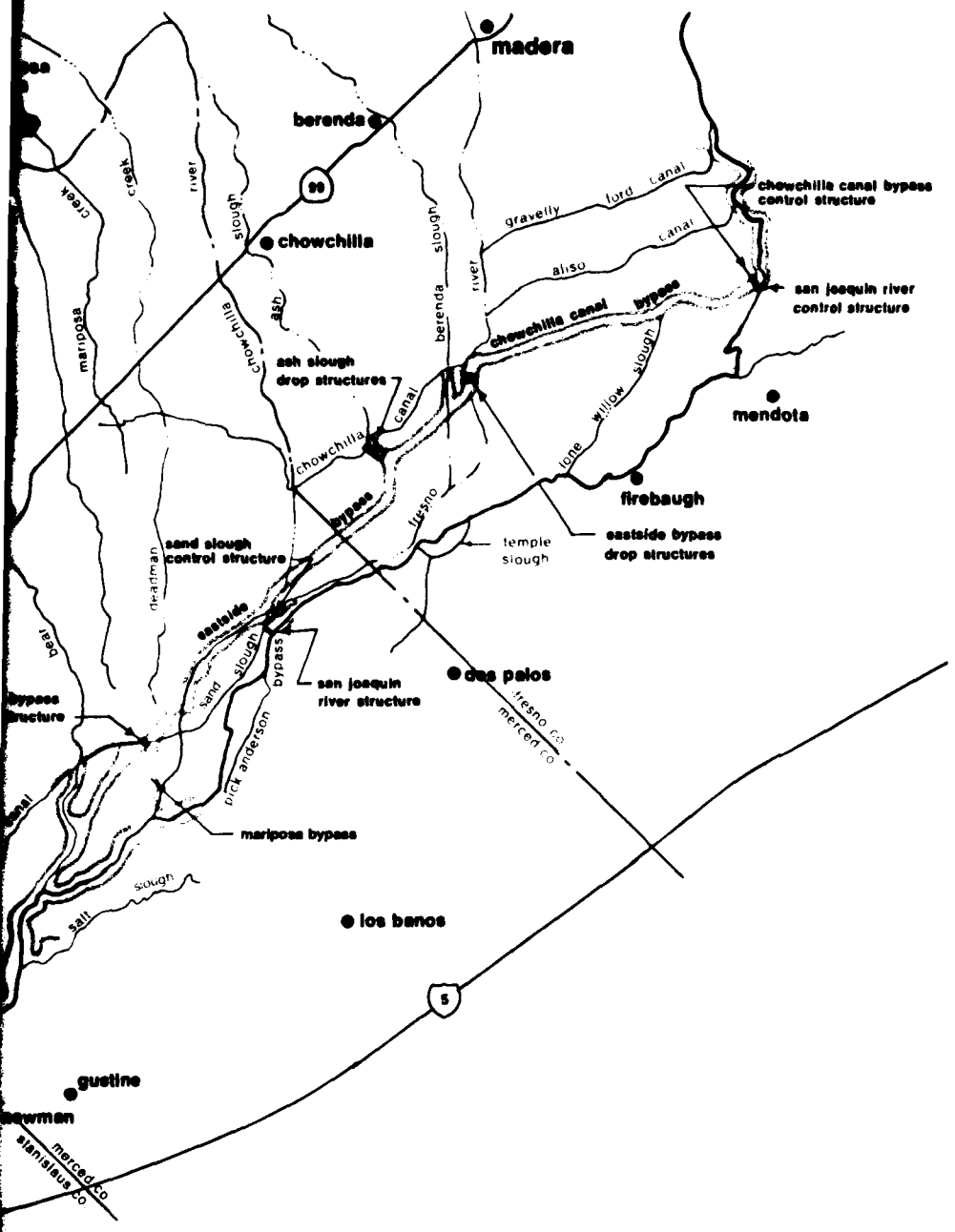
New Don Pedro Reservoir, completed in 1971, is an integral unit of the plan for flood control on the lower San Joaquin River and its tributaries. It provides flood protection to the City of Modesto, to a number of rural communities located in the flood plain and to 8,000 acres of agricultural land along the lower San Joaquin River and in the San Joaquin Delta. It also aids in the protection of industrial and suburban areas in the vicinity of Stockton, a number of military installations and 140,000 acres of highly developed agricultural lands.

Operation of initial phase features of the project prevented damages estimated at nearly $5 million during the 1964, 1966-1967 and 1968-1969 floods.

flood control project

Lower San Joaquin River and Tributaries (Sacramento District)
This flood control project consisted of improving the levee system on the lower San Joaquin River and its tributaries with construction of new levees, raising and


mariposa dam
owens dam
bear dam
burns dam
lake mc clure
creek
creek
river
slough
chowchilla
mariposa
ash slough drop
farahns
creek
creek
merced
merced co.
stanislaus co.
sand slough control structure
deadman
river
atwater
bear
eastside bypass control structure
eastside
sand
slough
bypass
pick anderson
livingston
canal
east side
mariposa
turlock lake
river
tuolumne
turlock
stevinson
river
salt
slough
stanislaus
99
modesto
river
pumping plants
gustine
newman
merced co.
stanislaus co.
san joaquin
crows landing
salida
ripon
patterson
salada cr.
mormon sl.
littlejohn creek
lone tree
pumping plant & navigation gate
manteca
westley
puerto cr.
wetherbee lake
walthall slough
stockton
french camp
lathrop
vernalis
calaveras river
river
canal
stanislaus co.
san joaquin co.
river
5
paradise dam
tom paine sl.
robert island
middle
union island
old
tracy
580


madera
berenda
chowchilla
99
creek
river
slough
mariposa
ash slough
drop structures
chowchilla canal bypass
control structure
gravelly ford canal
aliso canal
san joaquin river
control structure
chowchilla canal bypass
berenda slough
river
willow slough
mendota
firebaugh
lone
fresno
bypass
temple slough
eastside bypass
drop structures
sand slough
control structure
deadman
eastside
bypass
san joaquin
river structure
dos palos
fresno co
merced co
bypass
structure
canal
dick anderson
mariposa bypass
slough
los banos
5
gustine
newman
stanislaus co
merced co

1

2

strengthening existing levees, removing accumulated snags from the main river channel, protecting banks where required and by acquiring flowage rights on natural overflow lands where necessary to ensure continued effectiveness of channel capacities. The project also protects flood plain areas along the San Joaquin River upstream from the mouth of the Merced River through levees and channel improvements constructed by the State of California. These improvements were coordinated with those built by the Corps of Engineers to ensure the effectiveness of the Federal portion of the project. The project complements other flood control projects on the Tuolumne and Stanislaus Rivers. About 20 miles of the project area extend into the Delta-Central Sierra Area.

Local interests were required to bear the costs of improvements upstream from the mouth of the Merced River and to cooperate in the Federal improvement downstream. The cost of the project to local interests was about $30 million. Its operation and maintenance are the responsibility of local interests. State construction above the mouth of the Merced River includes about 190 miles of levees and several major bridges and flow-control structures. This work was completed in 1968.

Federal construction, totaling $13.1 million, included improvement of existing levees and construction of new levees along more than 100 miles of the San Joaquin River and along the lower reaches of its principal tributaries from the mouth of the Merced River downstream to Stockton. Work on the Federal portion of the project was started in 1956 and was essentially completed in 1968. The last portion, including about one mile of new levee and the rehabilitation of 5 miles of existing levee was completed in 1972.

All completed units have been transferred to the State Reclamation Board for operation and maintenance.

During the course of the levee improvements, careful selection of borrow sites was planned to avoid additional disturbance to existing vegetation. Work and borrow areas were reseeded with grasses, and trees were planted in order to mitigate environmental losses. The completed project is not expected to appreciably affect the agricultural land uses in the area.

This project provides an effective system of levees that, in conjunction with authorized flood control storage projects on the Stanislaus and Tuolumne Rivers, provides flood protection to suburban areas in the vicinity of Stockton and to 140,000 acres of highly developed agricultural land along the San Joaquin River and in the upper Sacramento-San Joaquin Delta. If the project had been completed and in operation during the 1955-1956, 1958 and 1966-1967 floods, it would have prevented damages estimated at nearly $2.7 million. During the 1968-1969 floods, the Federal portion of the project prevented damages estimated at $10.7 million while State improvements were credited with preventing an estimated $10 million in damages.

flood control study

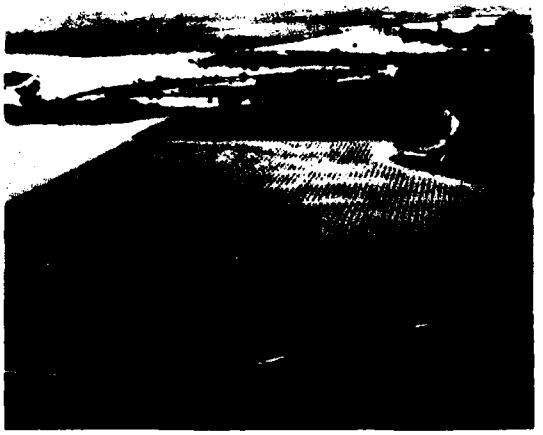
San Joaquin River Basin (Sacrmaento District)
The San Joaquin River Basin Study was authorized in 1964 and initiated in 1968. The study area encompasses the southern portion of the Central Valley, including part of the Delta-Central Sierra Area and all of the San Joaquin and Tulare Lake Basins. Within the framework of the comprehensive planning study, the problems of flood control, irrigation, municipal water supply, power, recreation, fish and wildlife and water quality are being investigated.

The study area is the site of many complex water supply and water transportation problems. The main sources of usable water in California are in the North Coastal and Sacramento Basins, although some undeveloped supplies do exist in the San Joaquin and Tulare Lake Basins. Water from Northern California is transported through these latter basins in order to reach the major population centers located in the southern part of the state. Also, the study area itself is developing rapidly.

Flooding is a major problem in the study area. During the severe floods of 1969, the area experienced over $100 million in damages.

The California Water Plan (California Department of Water Resources Bulletin No. 3) will serve as a guide to development, and extensive use will be made of data in the California Region Framework Study. Projects to be considered include dams and reservoirs, stream diversion, bank protection and levee and channel improvements. Urgent problems may require the preparation of interim reports. Studies of Red Bank and Fancher Creeks, the Coalinga Stream Group and Isabella Lake on Kern River (all of which are in the Tulare Lake Basin) will be accomplished within the framework of the comprehensive study, which is scheduled for completion about 1982.

san joaquin basin



snowmelt flooding south of state highway 132, west side of the san joaquin river, summer 1967. (photo courtesy of california department of water resources)

extensive farmland areas were flooded in january 1969 near the confluence of the stanislaus and san joaquin rivers.

emergency work

Total expenditure under Public Law 84-99 for emergency activities in the San Joaquin Basin have amounted to over $5 million. These activities included levee repair, snagging and clearing, bank protection, dam repair, floodfighting and rescue and the preparation of flood damage surveys and reports. More than $3.1 million of the cost of emergency work has been for levee repairs.

About $680,000 was expended for emergency repair and restoration under Public Law 84-99 after the floods of 1955-1956. After the December 1964-January 1965 floods, $100,000 was spent for repair work, with $76,000 of that amount required for levee repairs along the Stanislaus River.

The rain and snowmelt floods of 1968-1969 were the most severe ever to occur in the San Joaquin Basin. Damages totaled more than $42 million on 285,000 acres of agricultural land. About $700,000 in emergency work that included major repairs on the Chowchilla, Fresno and Stanislaus Rivers and the Chowchilla Canal Bypass was accomplished in 1969.

Emergency operations under Operation Foresight were undertaken by the Corps of Engineers in March 1969. It is estimated that protective measures provided under this program, which included strengthening and repairing existing levees and constructing new levees, reduced potential snowmelt flood damage in the basin by about $550,000. The work was undertaken at seven sites on the Stanislaus and San Joaquin Rivers and cost nearly $160,000.

Since 1955, $800,000 has been spent by the Corps of Engineers at the request of OEP for repair and restoration of flood damaged facilities under emergency work authorities antecedent to Public Law 93-266. Following the floods of 1955-1956, the OEP requested $518,000 of emergency work which consisted of debris removal and channel rectification of the Merced, Tuolumne and Stanislaus Rivers. During the 1964-1965 floods, the Corps of Engineers cleaned an 18-mile reach of the river extending from Orange Blossom Bridge downstream to the San Joaquin River at a cost of $274,000. Subsequent to the 1969 floods, the Corps of Engineers prepared favorable repayment evaluation reports for restoration work amounting to $230,000 in Madera, Merced and Stanislaus Counties.

flood plain management services program

The following flood plain information study for streams in the San Joaquin Basin has been completed:

Fresno River and Cottonwood, Root and Little Dry Creeks, vicinity of Madera

◀ *floodwaters from the tuolumne river in modesto, january 1969. (photo courtesy of the modesto bee)*

▼ *levee break near the mouth of the stanislaus river, january 1969.*

9 tulare lake basin

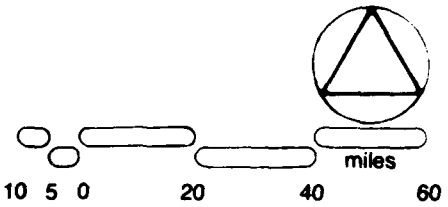
project index

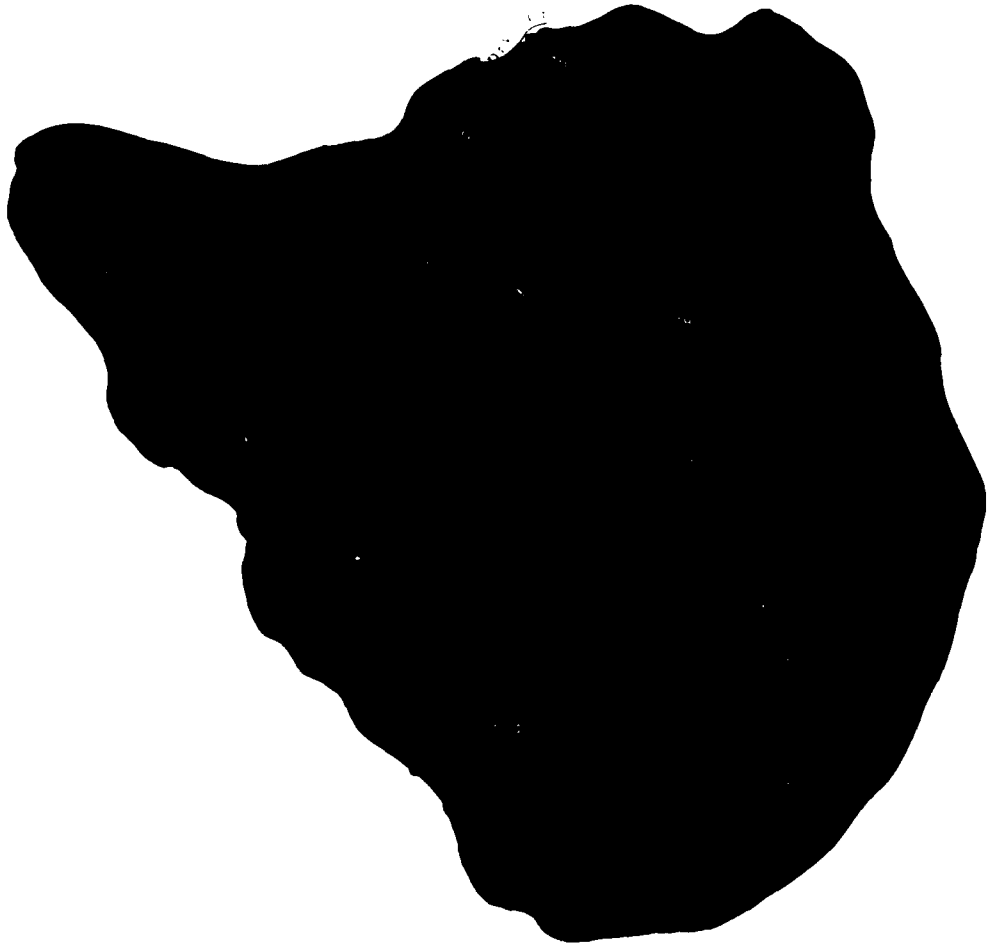
multipurpose projects

68 isabella lake
75 pine flat lake & kings river
77 success lake
78 terminus dam (lake kaweah)

flood control projects

92 big dry creek dam & diversion
104 kern river — california aqueduct intertie (small project)





description

The Tulare Lake Basin encompasses that portion of California's great Central Valley generally south of Fresno. It is bounded by the Tehachapi Mountains on the south, the Sierra Nevada on the east and the Coast Ranges on the west. The basin contains nearly 17,500 square miles, with a water area of 84 square miles.

The population of the basin is currently 1.1 million and is projected to reach 1.4 million by the year 2000. Diversified agriculture and the extraction and processing of petroleum are the basic economic activities. Mining and lumbering are also significant enterprises in the rural portions of the basin, while light manufacturing is increasing in importance in urban centers. Transportation facilities are extensive with highly developed Federal, State and county road systems that provide ready access to all parts of the basin and to adjoining areas. The basin is also served by railroads and commercial airlines.

Due to extreme differences in elevation within the Tulare Lake Basin, temperatures and levels of precipitation vary widely. The climate of the valley floor is characterized by hot, dry summers and mild winters. In the Sierra Nevada, winters are very cold with heavy rain and snow. The average annual precipitation ranges from 5 inches on the valley floor to 10 to 20 inches in high mountain areas to the south and west and 50 inches in the Sierra Nevada.

The major streams in the basin, the Kings, Kaweah, Tule and Kern Rivers, generally flow throughout most of the summer due to runoff from melting snowpacks. Except for one distributary of the Kings River, the basin has no low-level outlet to the sea, and is separated from the San Joaquin River Basin by a low alluvial ridge. The major streams rise in the Sierra Nevada and terminate in ancient lakebeds located in the lowest parts of the valley floor.

A number of minor streams drain the northern slopes of the Tehachapi Mountains, the eastern slopes of the Coast Ranges and the areas between the major stream basins. Most of these streams are dry in the summer and their channels are poorly defined or modified by agricultural operations on the valley floors.

In general, the Tulare Lake Basin is water deficient. The development of irrigation, municipal and industrial supplies has resulted in an overdraft of groundwater, almost complete conservation of surface runoff and importation of water from Northern California.

The Tulare Lake Basin is subject to floods that occur during late fall and winter due to prolonged rainstorms and floods that result from the melting winter snowpack during spring and early summer.

Since 1955, flood damage in the basin has exceeded $120 million. The 1968-1969 floods were the most severe recorded in the basin resulting in $76 million in damages. Although a high degree of flood control has been developed for the basin, problems still exist in some areas. In the valley, considerable streambank and other types of erosion result in annual land loss damage estimated at $200,000.

multipurpose projects

Isabella Lake (Sacramento District)
The Isabella Lake Project consists of an earthfill dam 185 feet high and 1,725 feet long, an auxiliary earthfill dam 100 feet high and 3,257 feet long and a lake with a gross capacity of 570,000 acre-feet. The project is located on the Kern River about 35 miles northeast of the City of Bakersfield. This $22 million project was completed in 1953 and is operated and maintained by the Corps of Engineers.

isabella lake project consists of a main dam (left background) and an auxiliary dam.

tulare lake basin

The project provides flood protection for the City of Bakersfield and about 350,000 acres of agricultural land and oil fields in the Kern River area. In conjunction with projects on the Kings, Kaweah and Tule Rivers, Isabella Lake serves to reduce flood damages on 260,000 acres of cropland in the Tulare Lake area. The operation of Isabella Lake during the 1955-1956, 1958 and 1966 floods prevented damages estimated at nearly $54 million; $1 million, $1.5 million and $51.3 million respectively. The project prevented flood damages estimated at $27.6 million during the rainstorms in January-February 1969 and $19.5 million from the April-June 1969 snowmelt.

The project improves irrigation water supply by producing about 50,000 acre-feet of new water annually through reduction in evaporation losses, and provides a means for regulating the present irrigation supply. Although no new power facilities are provided, existing downstream powerplants benefit incidentally from the regulation of streamflow.

The Corps of Engineers administers the project area for recreational use, providing public use facilities in nine developed recreation areas. More than $1 million has been spent by the Corps of Engineers, Kern County and its concessionaires to provide an observation point, campgrounds, picnic areas, boat launching ramps, marinas, associated access roads and parking areas and systems for water supply and sanitation. During 1975, public use of the project area was about 847,870 recreation-days.

An investigation of Isabella Lake was authorized by Congressional resolutions adopted in 1962 to determine whether the project should be modified to provide supplemental multipurpose storage. The study is to be accomplished as an interim investigation within the framework of the comprehensive investigation of the San Joaquin River Basin (see page 190). Completion of the interim study is indefinite.

Pine Flat Lake and Kings River (Sacramento District) The Pine Flat Lake and Kings River Project consists of a concrete dam 429 feet high and 1,820 feet long on the Kings River in the Sierra Nevada foothills, and levees, levee rehabilitation, channel clearing and modification of control structures on the valley floor. The design of Pine Flat Dam provides for future installation of power generating facilities. Pine Flat Lake, about 25 miles east of Fresno, has a storage capacity of 1 million acre-feet. The dam was completed in 1954 at a cost of $39.1 million; downstream channel improvements were completed in 1976 at a cost of about $2.4 million. Local interests will reimburse the Federal government for costs allocated to irrigation, a sum of about $14.3 million.

The project provides flood protection to about 80,000 acres of rich agricultural land along the Kings River,

recreation facilities at pine flat lake are very popular.

reduces flood damage on 260,000 acres of cropland in the Tulare Lake area in conjunction with other storage projects and contributes to flood damage reduction along the San Joaquin River. Since its completion, the project has prevented an estimated $80 million in flood damage. It has also improved the local irrigation water supply on about 720,000 acres of agricultural land in the Kings River and Tulare Lake areas by providing an average of 165,000 acre-feet of new water annually and by providing better regulation of the preproject supply. The lake also serves as an afterbay for upstream hydropower development and thereby prevents an undesirable fluctuation in downstream flow. Water quality in the lake is being continuously monitored along with continuing environmental study.

Pine Flat Lake provides extensive opportunities for water-oriented recreational activities. Seven recreation areas have been jointly developed by the Corps of Engineers, Fresno County and the U.S. Forest Service. Facilities that have been provided include an observation point at the dam, campgrounds, picnic areas, boat launching ramps, marinas, access roads, parking areas and systems for water supply and sanitation.

Success Lake (Sacramento District)
The Success Lake Project consists of an earthfill dam 142 feet high and 3,490 feet long, an auxiliary earthfill dike 42 feet high and 7,650 feet long and a lake with a gross capacity of 85,000 acre-feet. The project, located on the Tule River about 5 miles upstream from the City

◀ *pine flat dam with a dry face in april 1969 as the reservoir was drawn down to meet the record snowpack from the high sierra nevada.*

▼ *success dam and lake on the tule river.*

of Porterville, includes downstream channels and other facilities for disposal of excess floodwaters. The $14.3 million project was completed in 1961 and is operated and maintained by the Corps of Engineers.

The Success Lake Project provides flood protection to about 60,000 acres of highly developed agricultural land in the Tule River area and to the City of Porterville. In conjunction with flood control projects on the Kings, Kaweah and Kern Rivers, it will reduce flood damages on 260,000 acres of cropland in the Tulare Lake area. It also serves as a means of regulating the present irrigation supply for more efficient use and increases the average annual irrigation supply by an estimated 6,000 acre-feet, chiefly by decreasing evaporation in Tulare Lake.

During the record-breaking rains of December 1966, this project prevented flood damages estimated at $10.4 million along the Tule River and in Tulare Lakebed where flooding formerly took high-yielding agricultural land out of production for periods ranging up to two or three years. During the devastating 1969 rainfloods and snowmelt floods, the project prevented damages of about $6.6 million.

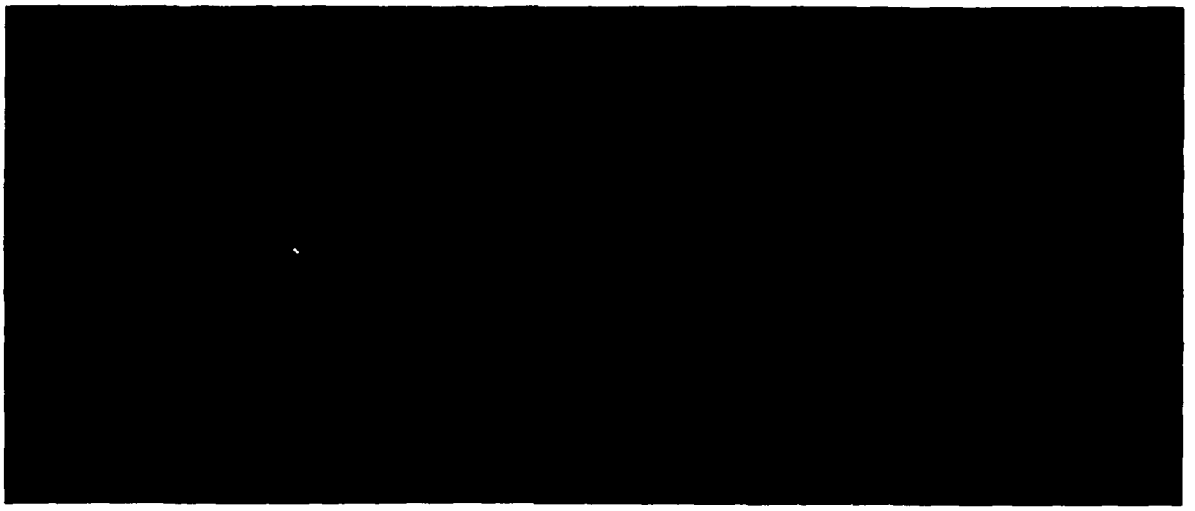
The Corps of Engineers administers the project area for public recreational use and, in conjunction with Tulare County and its concessionaires, has spent about $1 million for development of five recreational areas. Included in these areas are campgrounds, picnic areas, a marina, a hunting area, access roads, water and sanitation facilities and an observation point.

Terminus Dam (Lake Kaweah) (Sacramento District) The Terminus Dam Project consists of an earthfill dam 250 feet high and 2,375 feet long, an auxiliary earthfill dike 130 feet high and 870 feet long and a lake with a gross capacity of 150,000 acre-feet. The project, located on the Kaweah River about 20 miles upstream from the City of Visalia, also includes downstream channels and other facilities on the valley floor for the disposal of floodwaters. Completed in 1962, the project cost $19.3 million and is operated and maintained by the Corps of Engineers. Local interests reimburse the Federal government for water conservation benefits.

The project provides a moderate degree of flood protection to the City of Visalia and about 126,000 acres of agricultural land in the Kaweah River area. In conjunction with projects on the Kings, Tule and Kern Rivers, it will reduce flood damages on 260,000 acres of cropland in the Tulare Lake area. The project also provides a new and redistributed average annual irrigation supply by decreasing evaporation in Tulare Lake by an estimated 55,000 acre-feet and by regulating the present irrigation supply for more efficient use.

During the record-breaking rainflood of December 1966, this project prevented damages estimated at

terminus dam and lake kaweah on the kaweah river.



$19.6 million along the Kaweah River and in the Tulare Lake area. During the 1969 January-February rainfloods and the April-June snowmelt floods, the project prevented damages of about $8.9 million.

The Corps of Engineers administers the project area for recreational use and has provided facilities which include an observation point, campgrounds, picnic areas, boat launching ramps, a marina, access roads, parking areas and systems for water supply and sanitation. To date, the Corps of Engineers and Tulare County and its concessionaires have spent about $950,000 to provide these facilities in five developed recreation areas.

flood control project

Big Dry Creek Dam and Diversion (Sacramento District)
The project is located on Big Dry Creek about 10 miles northeast of the City of Fresno and consists of an earthfill detention dam with a height of 40 feet and a maximum length of 20,000 feet and appurtenant diversion facilities both upstream and downstream from the dam. Its flood detention capacity is 16,250 acre-feet. Completed in 1948 by the Corps of Engineers, the project was transferred to the State for operation and maintenance. Remedial work consisting of structures to control hillside erosion was completed in 1955. Total Federal cost of the project was $1.4 million. Non-Federal cost of rights-of-way and utility relocations was about $400,000.

The project provides a high degree of flood protection to the Cities of Fresno and Clovis and their suburban areas by diverting the flows of Dog and Big Dry Creeks to Little Dry Creek and the San Joaquin River. Operation of the project during the 1955-1956, 1958 and 1968 floods prevented damages estimated at $14 million. The need for modification of the project is presently being restudied as part of the Red Bank and Fancher Creek Investigation, which is scheduled for completion in 1977.

flood control studies

San Joaquin River Basin (Sacramento District)
The comprehensive study of the San Joaquin River Basin, scheduled for completion about 1982, includes the entire Tulare Lake Basin. A number of separately authorized studies of streams in the basin are to be accomplished within the framework of the comprehensive investigation. These include studies of Red Bank and Fancher Creeks near Fresno, the Coalinga Stream Group in southwest Fresno County and the Isabella Lake Project on Kern River.

coalinga stream group
The streams of the Coalinga Group (Los Gatos, Warthan, Jacalitos and Zapato Chino Creeks) rise on the eastern slopes of the Coast Ranges and flow easterly toward Tulare Lakebed, some passing to the south and some to the north of Coalinga. An investigation of the stream group, completed in 1976, determined that constructing levees, channel improvements and upstream storage projects were not feasible.

isabella lake
The study of Isabella Lake is discussed in conjunction with the project on page 194.

red bank and fancher creeks
The sources of Red Bank and Fancher Creeks are at low elevations in the foothills of the Sierra Nevada east of Fresno. An investigation of these streams is necessary to determine the feasibility of providing flood protection to the Fresno-Clovis metropolitan area. As this urban-suburban complex expands into surrounding agricultural lands, the flood problem becomes increasingly more significant. The existing flood detention reservoir and drainage improvements constructed by the local flood control district do not provide an adequate degree of protection to the metropolitan area. The Big Dry Creek and Dam Diversion Project is also being studied as part of this investigation, which is scheduled for completion in 1977. Possible solutions include flood detention reservoirs, channel improvement work and stream diversion.

small flood-control project

Kern River — California Aqueduct Intertie (Sacramento District)
The Kern River — California Aqueduct Intertie Project was authorized as a small flood control project, at an estimated cost of $2 million, to be located in the vicinity of Buena Vista Lake, about 20 miles southeast of Bakersfield. While Isabella Lake provides substantial flood protection on the Kern River, floods continue to cause agricultural damages estimated at $400,000 annually in the Tulare Lakebed area.

The project will consist of a gated gravity connection between the Kern River and the California Aqueduct for the purpose of disposing of damaging snowmelt floodflows from the Kern River.

tulare lake basin

Construction of the project was initiated in 1976 and is scheduled for completion in 1977.

emergency work

Emergency flood control work performed by the Corps of Engineers in the Tulare Lake Basin includes levee repair, snagging, clearing, various forms of floodfighting and rescue operations. The cost of these activities has exceeded $5.4 million.

Following a series of disastrous floods that occurred from 1938-1943, $1.3 million was spent in 1944 to repair levees in the Tulare Lake area. These floods inundated thousands of acres of highly productive grain and other cropland vitally needed in producing food and fiber for the war effort.

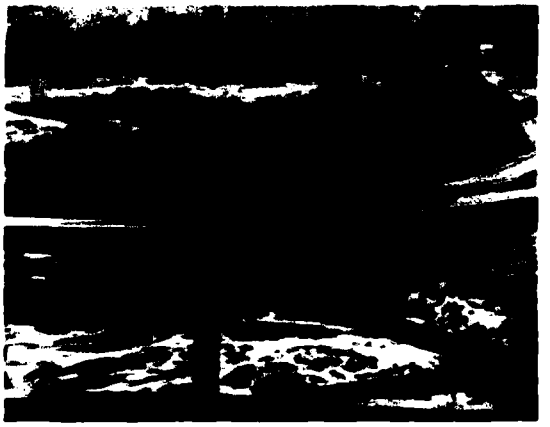
Floods that occurred during the 1955-1956, 1966-1967 and 1968-1969 flood seasons are considered to be among the most severe, although other floods may have caused higher flows on individual streams. In late December 1955, intense rainstorms resulted in exceptionally large streamflows and subsequent flooding. About 183,000 acres of agricultural lands were inundated with damages totaling nearly $18 million. Floodfighting and restoration costs under Public Law 84-99 totaled about $550,000. Devastating floodflows in December 1966-January 1967 resulted in the loss of three lives, inundation of 142,000 acres and damages of $26.4 million. Emergency repair and restoration work under Public Law 84-99 cost $130,000.

Rain and snowmelt floods occurred in the basin during the 1968-1969 flood season. Heavy rains over the high areas in January-February 1969 caused widespread flooding that resulted in $182,000 in repairs under Public Law 84-99 authority. In addition to causing rainfloods, the storms left a snowpack of unprecedented depth and water content in the high Sierra Nevada. The flood season was climaxed during the April-July period when near-record snowmelt flooding inundated about 180,000 acres and caused damages of about $21 million. Total volume of snowmelt for the basin was estimated at 5.8 million acre-feet, which approached the previous record of 1906. In all, Corps of Engineers and other existing projects prevented more than $62 million in flood damages in the basin during the 1969 snowmelt flood season.

Emergency operations under Operation Foresight were conducted by the Corps of Engineers in the Tulare Lake Basin in March 1969. It is estimated that protective measures under the program reduced potential snowmelt flood damage by $8.6 million. Work was done at 11 sites on the Kings, Tule, Kaweah and Kern Rivers and in Tulare Lakebed. The work, accomplished at a Federal cost of $2.2 million and a non-Federal cost of about $670,000, comprised levee

floodwaters on the kern river tore out this bridge in kernville in 1969. (photo courtesy of gil jimenez kbak-tv, bakersfield)

floodflows on the kaweah river at three rivers, december 1966. (photo courtesy of fresno bee)



floodwaters from mill creek on the main street of visalia, january 1956.

restoration, channel rectification, levee strengthening and constructing spillway barriers.

Another unique effort to prevent snowmelt flood damage in the Tulare Lake Basin in 1969 involved use of the California Aqueduct. Simply stated, this operation comprised pumping floodwater from an existing flood channel into the aqueduct, directing it north (up the aqueduct) by a series of temporary pumping lifts at existing permanent check structures, allowing the water to find its own level, then diverting it to areas of beneficial use west of the aqueduct and 63 miles north — "upstream" — of the point of introduction. The California Department of Water Resources and a local reclamation district cooperated in this effort, which prevented about 55,000 acre-feet of potentially damaging flood water from entering Tulare Lakebed.

Since 1955, emergency work performed by the Corps of Engineers at the request of the OEP under authorities antecedent to Public Law 89-288, has amounted to $1.3 million in the basin. As a result of the December 1955-January 1956 floods, expenditures for levee and channel restoration and debris removal in Tulare County totaled $320,000. Subsequent to the floods of 1966-1967, about $860,000 was spent for channel rehabilitation and debris removal, primarily on the Kaweah, Kern and Tule Rivers. In addition, the Corps of Engineers acted as an engineering and construction agency for emergency rehabilitation work costing more than $960,000 in the Tulare Lake Basin. After the January-February 1969 rainfloods, the Corps of Engineers performed emergency work amounting to $87,000 and prepared favorable repayment evaluation reports for restoration work costing over $1.2 million at 25 locations.

flood plain management services program

Flood plain information studies have been completed for the following streams in the Tulare Lake Basin:

- Deer Creek and White River, Earlimart
- Kaweah River, Three Rivers
- Kern River, Bakersfield
- Kern River, Kernville
- Kings River, Sanger
- Sand and Cottonwood Creeks and Lower Kaweah River, Visalia
- Sandy Creek, Taft and Ford City
- Tule River, Springville

Numerous streams along the west side of the San Joaquin Valley were investigated in 1965 to develop flood damage data, hydrologic data and information on the extent of flood plains. Most of the streams studied were in the Tulare Lake Basin. This study was requested and funded by the State of California to acquire data for use in the design and construction of the California Aqueduct and the Westside Freeway (Interstate 5). The streamcourses studied in detail were: Arroyo Robador, Bitterwater, Santiago, San Emigdio, Pleito and Pastoria Creeks; streams near Lost Hills; and streams in Buena Vista Valley (Tulare Lake Basin); Del Puerto Creek (San Joaquin Basin); and Corral Hollow Creek (Delta-Central Sierra Area).

10 north lahontan territory

project index

multipurpose projects

70 martis creek lake

79 truckee river reservoirs

flood control projects

102 truckee river tributaries

10 5 0 20 40 60 miles

description

The North Lahontan Territory is situated in eastern and northeastern California. It extends from the Oregon border on the north to about Bridgeport, Mono County, on the south, and from the California-Nevada boundary on the east to the crests of the Sierra Nevada, Cascade Range and Warner Mountains on the west. The territory is about 250 miles long and between 5 and 60 miles wide. It contains 6,000 square miles, including 392 square miles of water area.

Most of the territory's population of 50,000 is concentrated in the Lake Tahoe area. By the year 2000, population is expected to reach 70,000. Except for the Lake Tahoe area, where recreation activities serve as an economic base, the economy of the territory is largely dependent on agriculture, lumbering and mining. The principal agricultural activities are production of livestock and forage crops. With the exception of the Lake Tahoe area, transportation facilities are not extensive. South Lake Tahoe is the only city in the territory to which commercial airlines maintain scheduled flights. However, a major north-south highway traverses the territory and a number of State highways and rail lines provide access to adjacent areas.

Included in the North Lahontan Territory are the California portions of the Susan, Carson and Walker River Basins; Surprise Valley; and the Lake Tahoe-Truckee River Basin. Since there are no surface outlets to the sea, streamcourses terminate in lakes or playas that are remnants of ancient Lake Lahontan.

The territory contains widely varying topographical areas that range from flat valley lands and high desert plateaus to the steep, forested eastern slopes of the Sierra Nevada. The lowlands have short, hot summers, long, cold winters and wide ranges in daily temperatures. In the mountainous areas, summers are short and mild and winters are long and severe. The average annual precipitation in the territory varies from a low of 4 to 6 inches in the lee of the mountains on the west to as much as 50 inches in the Sierra Nevada. The average annual runoff is estimated at 1.5 million acre-feet.

(photo courtesy of vtn.)

north lahontan territory

The North Lahontan Territory does not have a highly developed flood protection system. The flooding that occurred in 1950-1951, 1962-1963 and 1964-1965 caused an estimated $2.5 million in damages to rural and urban properties. General rainstorms during the winter and intense local rainstorms during the spring are responsible for most of the flooding. Summer thunderstorms, which produce high intensity rainfall and high volume runoff, compound the problem. The most serious flood problems occur along Bidwell Creek and the Susan, Truckee, Carson and Walker Rivers. The Susan River, streams in Surprise Valley and streams tributary to Lake Tahoe all have critical erosion problems resulting in the combined annual loss of over 100 acres of land. This problem is particularly serious in the Lake Tahoe area where creekside land is undergoing urban development. The projected increases in population, development and economic growth within the territory will increase the potential for flood damages if additional control measures are not provided.

multipurpose project

Martis Creek Lake (Sacramento District)
The Martis Creek Lake Project is on Martis Creek (in California) about 2 miles above its confluence with the Truckee River and about 32 miles upstream from the City of Reno. The project consists of a dam and lake for flood control, recreation and future water supply, and about 1 mile of channel improvement work by local interests on the Truckee River in Reno. Construction was started in 1967 and completed in 1972. Capacity of the lake is 20,400 acre-feet.

The channel improvement work along the Truckee River in Reno consisted mainly of improvements providing flood carrying capacity through the city. These improvements were completed by local interests at their own expense. The total Federal cost of the project was $8.6 million, $100,000 of which was provided by local interests.

martis creek dam and lake near truckee.

Martis Creek Lake is an important unit of the ultimate plan for flood protection in the Truckee River Basin. It augments flood protection provided by Bureau of Reclamation projects in the basin, which alone reduce the frequency of flooding in Reno from once in about 15 years on the average to once in about 40 years. Martis Creek Lake further reduces the frequency of flooding in Reno to once in about 60 years. The combination of projects produces a fairly high degree of flood protection to Reno and some degree of protection in all reaches of the Truckee River between Martis Creek and Pyramid Lake. In addition, the lake provides needed recreational opportunities and, when required in the future, will augment existing water supply storage in the Truckee River Basin.

cooperative project

Truckee River Reservoirs (Sacramento District)
There are three Bureau of Reclamation projects in the North Lahontan Territory for which operating rules and regulations for flood control have been prepared by the Corps of Engineers under the authority of Section 7 of the 1944 Flood Control Act. These are Boca and Stampede Reservoirs on the Little Truckee River, completed in 1939 and 1970, respectively, and Prosser Creek Reservoir on Prosser Creek, completed in 1962. These projects are operated for flood control purposes in conjunction with Martis Creek Lake and Lake Tahoe, primarily to reduce the Truckee River floodflows through the City of Reno.

flood control project

Truckee River and Tributaries, California and Nevada (Sacramento District)
Interim channel improvements have been constructed on the Truckee River and its tributaries in California and Nevada as part of a $1.2 million flood control project. Of this, local interests provided $200,000. Although most of the project was finished in 1968, minor channel improvements between Lake Tahoe and the community of Truckee have not yet been completed. This work has been deferred indefinitely at the request of the State of California.

The project protects shoreline residential property at Lake Tahoe and has provided a measure of protection against flood damages on 7,500 acres of agricultural lands along the Truckee River and in Truckee Meadows. It is designed to conform with a basin flood control plan, which includes Martis Creek Lake as well as certain features of the Washoe Reclamation and Truckee Storage Projects of the U.S. Bureau of Reclamation. The improvements at Truckee Meadows have made the drainage and sanitary conditions in the outskirts of Reno and Sparks function more efficiently and have greatly reduced the frequency and duration of flooding in a large agricultural area.

truckee river channel improvement.

Project work in California consisted of enlarging the Truckee River channel from the existing control structure at Lake Tahoe to a point 3,200 feet downstream. This improvement more effectively prevents the lake level from exceeding 6,229.1 feet, the maximum allowable specified in a Federal court decree. The improved channel permits greater releases during high water stages.

emergency work

The Corps of Engineers has spent in excess of $300,000 in the North Lahontan Territory for floodfighting and flood suppression activities, snagging, channel clearing operations and channel rectification.

During the 1950-1951 floods, about 5,000 acres were inundated along streams in the North Lahontan Territory. Damages totaled about $800,000. Costs of floodfighting and emergency snagging and channel clearing work amounted to $40,000.

In 1962-1963, flooding caused extensive damage in the Carson River Basin where about 19,000 acres were inundated and flood losses estimated at

record-breaking outflow from lake tahoe in june 1969 eventually overtopped this homemade barrier on the truckee river near tahoe city. (photo courtesy of sacramento bee)

$820,000. Costs of emergency repair and restoration work by the Corps of Engineers totaled $60,000.

In March 1969, preventive maintenance work for flood suppression under Operation Foresight included channel clearing and rectification at four sites on the West Walker River near Coleville. This work cost $5,000 and reduced potential snowmelt flood damage by an estimated $10,000.

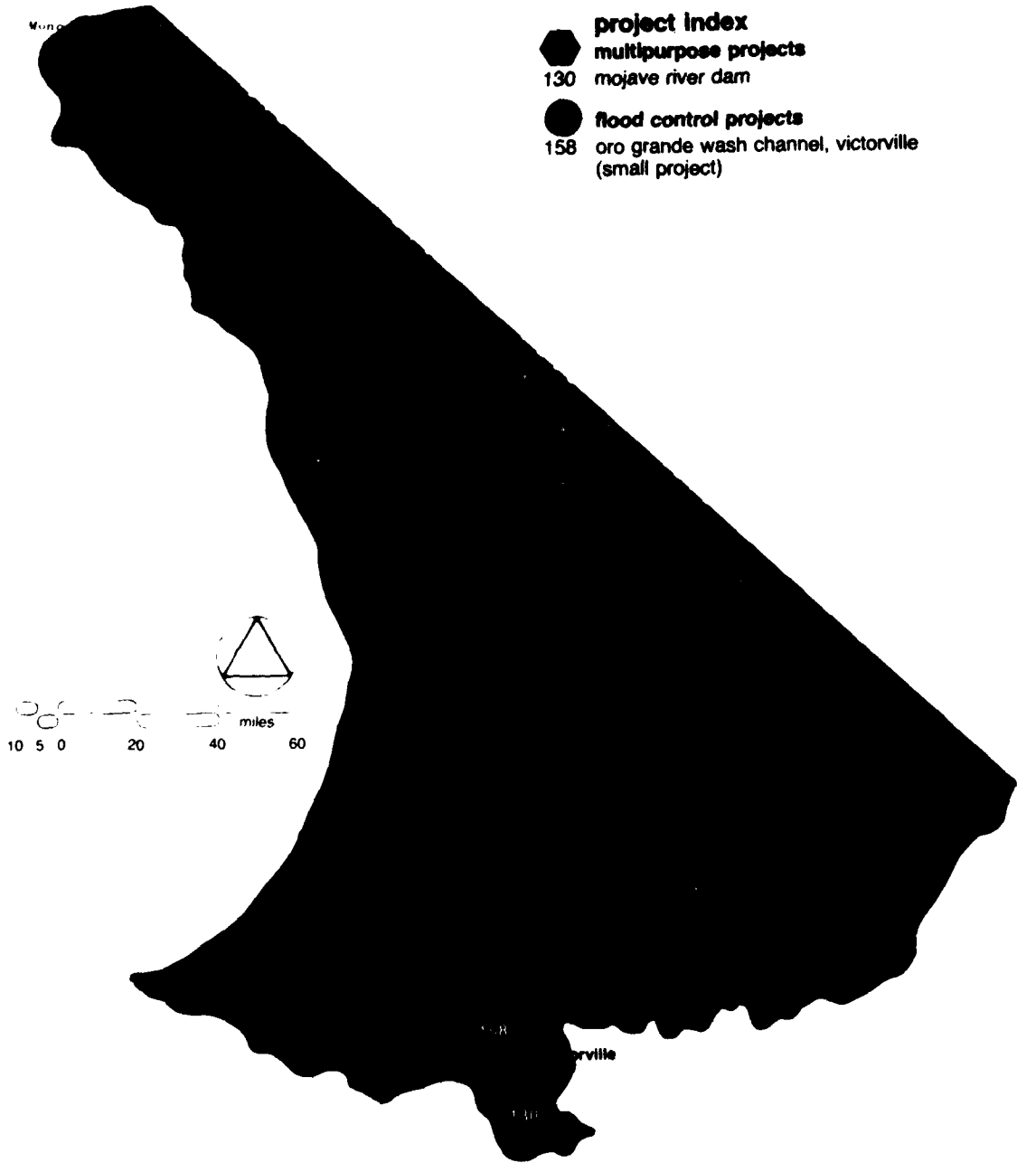
Repair and restoration work performed by the Corps of Engineers at the request of the OEP, primarily the removal of debris from stream channels, has cost $200,000. The runway and appurtenant facilities at Tahoe Airport (South Lake Tahoe) were restored following the floods of 1964-1965. Other repair and restoration work has been evaluated for eligibility and inspected on completion under emergency rehabilitation authorities administered by the OEP.

flood plain management services program

The following flood plain information studies for streams in the North Lahontan Territory have been completed:

Trout and Bijou Creeks, South Lake Tahoe
Truckee River and Martis Creek, Truckee
Upper Truckee River, South Lake Tahoe
Truckee River, Tahoe City

11 south lahontan territory



description

The South Lahontan Territory is a sparsely inhabited, strikingly beautiful area of arid desert lands and high mountains. Situated along the California-Nevada border, it includes the eastern portion of Los Angeles and Kern Counties; the northern portion of San Bernardino County, all of Inyo County and part of Mono County. The territory's 27,050 square mile area is characterized by great contrasts: the highest and lowest points in the continental United States — Mount Whitney and Death Valley. Clear lakes abound in the high, heavily timbered Sierra Nevada, and dry, alkaline flats stretch for miles in the low desert lands. Annual precipitation ranges from about 2 inches in the desert areas to about 50 inches in the high mountains. The principal streams in the area include the Mojave River, Big Rock and Little Rock Creeks (in Antelope Valley), the Amargosa and Owens Rivers and Furnace and Bishop Creeks.

The territory is affected by two types of storms: The occasional winter storm that may last as long as four days and the sudden thunderstorm with high-intensity short-duration rainfall that may occur any time from spring through fall. In general, the winter storms create the worst flood damages and disrupt large areas of the territory's economy. Great damage is also sustained when floods generated by thunderstorms occur upstream from urban areas. Damaging floods occurred in 1938, 1943, 1961, 1963, 1965, 1966 and 1969.

Major urban centers are Barstow, Bishop, Lancaster, Palmdale, California City, Ridgecrest and Victorville. The economy of the area is based on agriculture; defense activities related to flight testing and research; mining; manufacturing; and recreation, particularly in Death Valley and the Mono Lake-Owens Valley areas. Recreational opportunities in the territory will be further enhanced with the development of facilities planned for the Cedar Springs Reservoir and Mojave River Dam.

Because development in the territory has been sparse, few major flood control improvements have been warranted. However, land use in the area is rapidly changing as agricultural and unused lands are developed for residential, commercial and industrial uses. The popu-

(photo courtesy of vtn.)

south lahontan territory

lation of the area was about 275,000 in 1970 and is expected to increase to 516,000 by the year 2000. With changes in land use and increases in population, existing flood problems will magnify and new problems will develop.

Serious erosion problems are proportional to flood problems of the area. Of the 23,500 miles of stream channels in the territory, less than 50 miles have been improved with limited capacity levees and channels. Streambank stabilization work has been done on only an additional 50 miles of channels. Of the 3,650 miles of channels subject to erosion, 490 miles sustain serious erosion damage amounting to about $1.2 million annually.

Although the flood problems in the territory will be somewhat alleviated by the existing and proposed projects, additional levee and channel projects and detention structures will be required to control floodflows and to provide required floodflow carrying capacities. Flood plain management also must become an important part of community planning in the South Lahontan Territory.

Any plans developed by the Corps for flood control improvements in the South Lahontan Territory would include plans for optimum conservation of floodwaters to replenish existing groundwater basins, which are currently being overdrawn to meet agricultural and urban needs in Antelope Valley and the Mojave River Basin. The water supply of both of these areas is to be augmented by water from the State Water Project. Of paramount concern to Corps planners, who recognize the comprehensive nature and interrelationship of environmental problems, is the need to protect the fragile desert and mountain environment of the territory.

multipurpose project

Mojave River Dam (Los Angeles District)
The Mojave River Dam, a rolled earthfill structure with a crest length of 2,200 feet and a maximum height of 200 feet, is at the Forks site on the Mojave River about

mojave river dam protects the cities of victorville and barstow from floods.

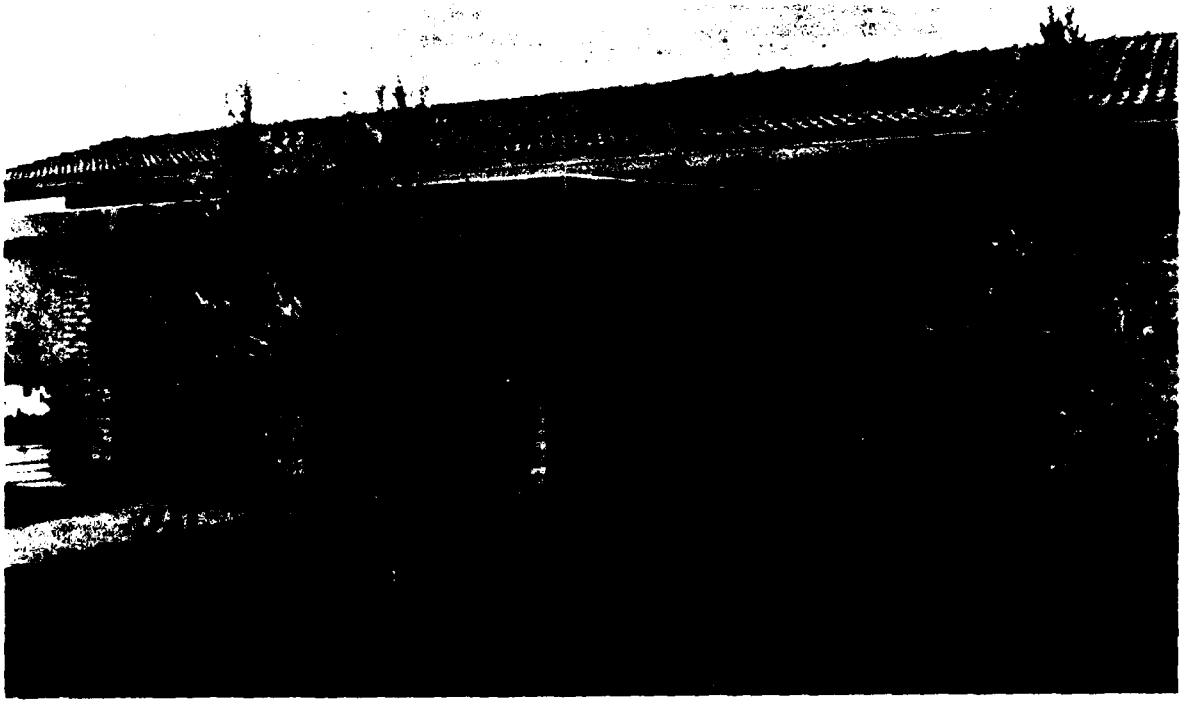
14 miles upstream from Victorville. The reservoir has a gross capacity of 89,700 acre-feet. Completed in 1971, the project consists of a dam and reservoir for flood control, recreation, and other purposes. The project provides a high degree of protection against floods to the Cities of Victorville and Barstow, to about 19,000 acres of agricultural land, and to important surface transportation facilities. The project was built at a Federal cost of $18.1 million and a non-Federal cost of $290,000.

The project also provides incidental water conservation benefits by reducing large floodflows to sustained reservoir releases that recharge the downstream groundwater basins.

Recreation is an important byproduct of the project. The Corps has constructed facilities for initial recreational development including a camping-picnicking area, a trailer camp, natural and equestrian areas, an administration area, and the Forks overlook, which provides a view of the project as well as the Mojave Desert.

▲ *rustic recreation areas at mojave river dam reflect the region's character.*

administration building at mojave river dam fits into the high-desert environment. ▼



south lahontan territory

Further recreational development will be undertaken by San Bernardino County to provide additional facilities including boating and fishing areas and golf, and archery and shooting ranges.

The Corps has attempted to insure that the project is developed in accord with the history and the environment of its surroundings. The rustic atmosphere of the site has been preserved by using materials such as rough-sawn lumber, used railroad ties, boulders, and slump rock. Beautification measures include protecting existing stands of trees and other natural vegetation as well as bringing in other indigenous plants.

About 50,000 people visited the project in 1975, and estimates indicate that the number of visitors will increase to about 450,000 by the year 2000.

flood control study

Antelope Valley Streams (Los Angeles District)
An investigation of streams in Antelope Valley was begun in 1970. Its purpose is to determine the need for flood control, water conservation and related improvements in a rapidly developing area that includes the City of Palmdale and the towns of Lancaster and Edwards. The population of the once-rural valley was about 100,000 in 1970 and is expected to increase to about 260,000 by the year 2000. Substantial future development as a result of spillover from the Los Angeles metropolitan area is expected to take place. This will substantially increase the potential losses from future floods in the valley.

During the 1969 floods, three persons lost their lives and damages totaled $2.2 million. Floodflows damaged railroad tracks, bridges and roads; interrupted telephone and power service throughout the valley; and inundated homes, businesses and agricultural property.

The investigation now in progress will consider multipurpose reservoirs in the foothill areas, debris basins, channel improvements on the valley floor and flood plain management. Completion date of the investigation is 1981.

small flood-control project

Oro Grande Wash Channel, Victorville (Los Angeles District)
A small flood-control project on Oro Grande Wash at Victorville was completed in 1969 at a cost of $1.5 million, of which $500,000 was provided by local interests. The project consists of inlet levees and a 1.25 mile concrete channel extending from the southeast limits of Victorville to the Mojave River. The project drains 25 square miles and was designed to provide protection to Victorville, which lies in the natural swale of Oro Grande Wash.

In formulating the project plan, careful consideration was given to both esthetic and economic considerations. The upstream part of the channel (2,150 feet of open channel) is located between existing streets, thus permitting development on each side of the channel and along the streets; one reach skirts a park and has a minimal effect on park activities. The rest of the channel (4,249 feet) is underground, mostly under city streets, and does not interfere with public and private activities.

Although the project reduces damages from large floods, it does not give full protection against all floods. Local residents have been informed that a large flood could cause extensive damage to valuable developments and agricultural lands in the overflow area. At this time, the Corps is not presently authorized to conduct further studies.

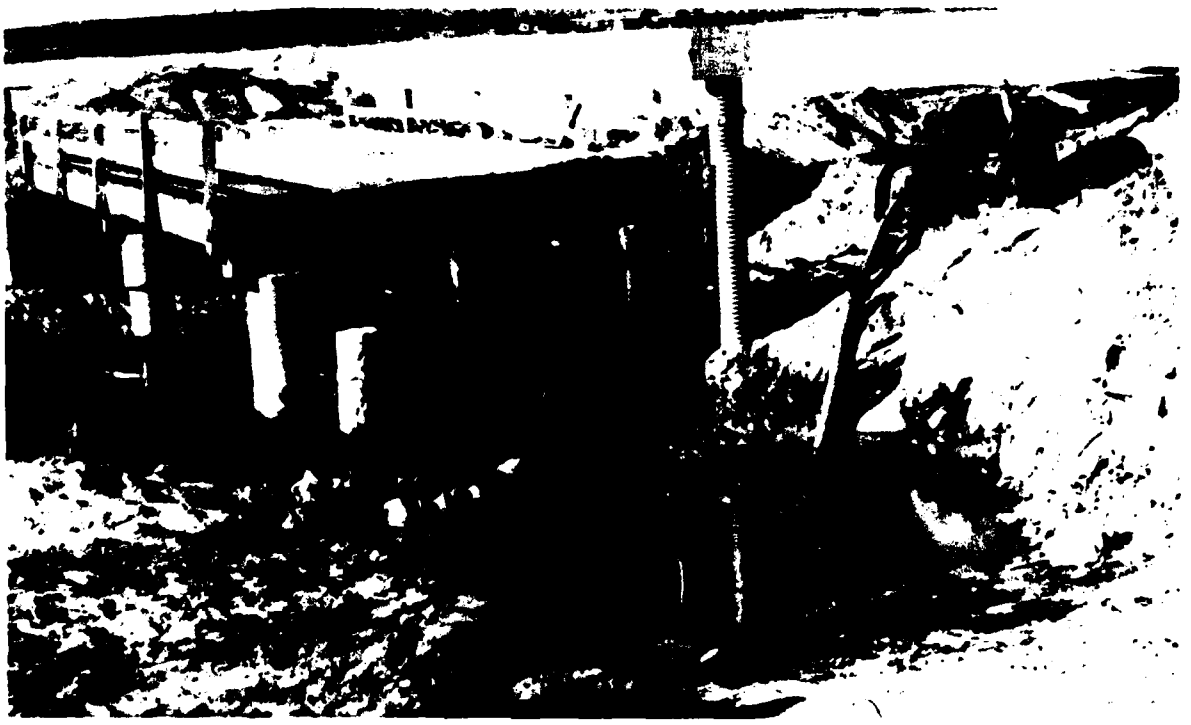
emergency work

More than $1.5 million has been spent by the Corps of Engineers for emergency operations in the South Lahontan Territory. The work has consisted of flood-fighting and suppression, restoration activities and debris removal.

Seven devastating floods have occurred in the area in the last 35 years killing ten persons and causing damages estimated at $13 million.

In San Bernardino County the floods of January and February 1969 were the most damaging known and probably constituted the worst disaster in the county's history. In the Mojave River Basin, four people lost their lives and flood damages totaled $11.4 million. Roads, highways and bridges were damaged or destroyed; fields and pastures were turned into lakes; and ranchers herded their livestock to higher ground and evacuated their families to safer areas.

The northern part of the City of Barstow was inundated. U.S. Air Force personnel joined local emergency forces in aiding 3,000 residents who were forced to leave their flood-threatened homes. In Swarthout Valley, water and debris flowed into the valley from Sheep Creek and its tributaries and through Flume and Heath Canyons. The community of Wrightwood was also inundated. Volunteers from George Air Force Base and from the



indian trail road bridge in the spring of 1970 following floods on the mojave river. the corps of engineers rebuilt the bridge.

City of Victorville joined local residents in an all-out floodfighting effort.

After the 1969 floods, emergency restoration work performed by the Corps consisted of repairing flood control works along the Mojave River downstream from Daggett; removing flood-borne silt and debris deposited at bridge crossings and in the pilot channel; and replacing 2 miles of destroyed or damaged revetment. The work was done at a cost of $228,000.

The storms that caused the January and February floods left a deep mountain snowpack that was predicted to result in near-record snowmelt flooding. Consequently, prior to the snowmelt, emergency advance preparations under Operation Foresight were made. The work included channel rectification; raising, strengthening, repairing and protecting levees; and constructing new levees in Owens Valley and on the north slope of the San Bernardino Mountains. The work was done at a cost of about $587,000 and prevented damages estimated to be $700,000.

At the request of the OEP, approximately $150,000 was spent by the Corps to rehabilitate damaged levees and channels in Heath Canyon near the community of Wrightwood following the 1965, 1966 and 1969 floods.

The 1969 floods also caused severe damage along the Mojave River. Restoration work consisted of repairing and rebuilding flood damaged channel revetments, bridges and stream crossings and was done at the request of the OEP. Cost of the work was $546,000.

flood plain management services program

Two flood plain information reports have been completed for areas in the South Lahontan Territory. One is for the Mojave River in the vicinity of Barstow, the other for the Mojave River in the vicinity of Victorville.

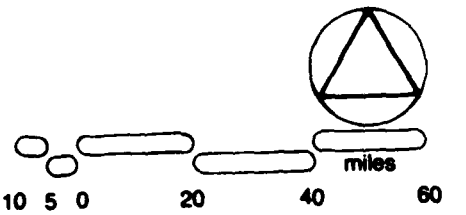
Flood plain information reports on China Lake, Ridgecrest and vicinity, and El Mirage and Copper Dry Lakes are scheduled for completion in 1977.

12 colorado desert

project index

● **flood control projects**

153 banning levee (small project)
154 chino canyon improvements (small project)
157 needles, san bernardino county (small project)
159 quail wash levee (small project)
165 tahchevah creek detention basin & channel improvements
172 tahquitz creek



description

The Colorado Desert portion of California extends from the international boundary on the south to the South Lahontan Territory on the north, and from the California-Nevada boundary and Colorado River on the east to the crests of the San Bernardino and San Jacinto Mountains and Peninsular Ranges on the west. It includes all of Imperial County and parts of San Diego, Riverside and San Bernardino Counties.

The Colorado Desert area comprises a number of closed desert basins as well as all those lands in California draining into the Colorado River. It has a land area of 19,000 square miles and a water area of 405 square miles, including the 350-square-mile Salton Sea. About one-half of the land area is valley and mesa land and the rest is mountainous.

The climate of the Colorado Desert is arid and is typified by short, mild winters and exceptionally hot, dry summers with extremely low humidity. In winter, the mild, dry climate makes the desert an outstanding resort area that attracts visitors from many parts of the world. Palm Springs is considered to be one of the most fashionable desert winter resorts in the United States. Desert Hot Springs and Twentynine Palms are also popular recreational resort areas.

Urban centers include Banning, Blythe, Brawley, Calexico, Calipatria, El Centro, Holtville, Imperial, Indio, Needles and Palm Springs.

The economy of the Colorado Desert is based principally upon agricultural development in the Imperial, Coachella and Palo Verde Valleys. Irrigated by surface water from the Colorado River and by pumped groundwater in the Coachella Valley, extensive areas have been transformed into productive farm lands that make the desert one of the most outstanding agricultural areas in the country. The area is noted for crops such as citrus fruits, dates, table grapes and off-season vegetables. The long growing season permits as many as three crops in two years in some localities. The

(photo courtesy of vtn.)

colorado desert

population of the area was about 240,000 in 1970 and is expected to increase to about 391,000 by the year 2000.

The major streams in the Colorado Desert are the Whitewater, Colorado, New and Alamo Rivers. All except the Colorado drain into the Salton Sea. The New and Alamo Rivers are old overflow channels of the Colorado River that flow north from Mexico to the Salton Sea and now carry only waste and other drainage waters from irrigated lands of the Imperial Valley and the Mexicali Valley in Mexico. Streams directly tributary to the Colorado River are small and none has perennial flow.

Very little streamflow occurs in the area except at high elevations in the winter and spring months, and in the desert valleys during and immediately after rainstorms. Most damaging floods result from general winter storms, which may last as long as four days and result in rainfall over large areas. Winter storms are generally of north Pacific origin. Damaging floods may also result from intense rainfall accompanying tropical hurricanes that originate off the west coast of Mexico and move north of their usual path to cross Southern California. Thunderstorms may also cause short-duration, high-intensity rainfall over small areas either independently or in conjunction with general storms. Damaging floods occurred in the Colorado Desert in 1916, 1927, 1938, 1961, 1965, 1966 and 1969.

Three persons lost their lives during the 1965 flood in the Whitewater River Basin and property damage exceeded $3 million. During the 1969 floods, a boy was drowned and property damage totaled $11.8 million. In the Cities of Cabazon and Palm Springs, about 600 residents had to be evacuated from inundated areas.

Although some areas are protected by flood control improvements, flood problems exist where improvements are lacking, or where existing measures are inadequate to mitigate damages that each year pose an increasing threat to an expanding economy. Streambank erosion and sediment deposition are major problems. Out of a total of 15,400 miles of tributary channel banks, about 1,930 miles have erosion problems. One hundred sixty miles are considered to be in a state of serious erosion.

flood control projects

Tahchevah Creek Detention Basin and Channel Improvements (Los Angeles District)
This project consists of a 945 acre-foot detention reservoir and channel improvements on Tahchevah Creek in the City of Palm Springs. Completed in 1965 at a cost of $2.8 million, the project is operated and maintained by local interests. The Federal government provided 50 percent of project costs.

The project includes an earthfill dam just downstream from the mouth of Tahchevah Canyon, an underground conduit 9,400 feet long from the dam to a point about 2,000 feet upstream from the junction of Tahchevah and Baristo Creeks and a rectangular section concrete channel from the conduit to Baristo Creek.

Operation of the detention reservoir reduces the peak floodflows of Tahchevah Creek, and the improved

tahchevah creek detention dam provides flood protection to palm springs. the spillway is in the background.

another view of the tahchevah creek dam with the spillway in the foreground.

channel and conduit sections pass the reduced flows through Palm Springs and part of the Agua Caliente Indian Reservation to the partly improved channel of Baristo Creek.

Since its completion, the project has prevented flood damages estimated to be $430,000.

Tahquitz Creek Project (Los Angeles District)
The Tahquitz Creek project would be within the city limits of Palm Springs, in Riverside County. The project would consist of a debris basin and channel. The debris basin, with a capacity of 400 acre feet, would be just downstream from the mouth of Tahquitz Canyon, and the channel, which would be a concrete trapezoidal channel 3.5 miles long, would extend along Tahquitz Creek from the debris basin to the confluence with Palm Canyon Wash.

The project would provide protection against floods to about 1,200 acres, including valuable residential, business, and public property in the City of Palm Springs. The estimated first cost of the project is $15.9 million ($12.1 in Federal cost and $3.8 in non-Federal cost).

Although preconstruction planning has been completed, the future of the project is not favorable. The Tribal Council of the Agua Caliente Band of Mission Indians opposes the project because the debris basin would be on Tribal Council land containing archeological resources.

flood control study

Whitewater River (Los Angeles District)
An investigation of the Whitewater River, suspended several times since its authorization in 1937, was resumed in 1967 and suspended again in 1974. The purpose of the investigation is to consider justification of additional flood control projects on the basis of current and expected future development in the area.

The study area, which comprises about 1,950 square miles in San Bernardino and Riverside Counties, extends from the City of Banning to the Salton Sea, a distance of about 70 miles. The population of the area was about 103,000 in 1970 and is expected to increase to 195,000 by the year 2000.

Past floods have caused severe damages in the Whitewater River Basin. The floods of January and February 1969 caused damages estimated at $11.7 million. Earlier records show that damages estimated at $3 million resulted from the November 1965 flood and that comparable damages resulted from the December 1966 flood.

As a result of interim reports, the following projects have been constructed:

San Gorgonio River levee at Banning
Tahchevah Creek detention reservoir and channel improvements in the City of Palm Springs
Chino Canyon improvements in the City of Palm Springs

Also, a debris basin and channel have been authorized for Tahquitz Creek at Palm Springs.

Major items of water resources development that have been investigated in the basin are:

a. Justification of flood-control improvements to protect rich agricultural areas in the lower basin and fast-growing desert cities and communities along the Whitewater River and its tributaries.

b. Groundwater recharge that may result from the control of floodwaters.

c. Development of recreational facilities in conjunction with flood-control improvements.

Single and multipurpose reservoirs, debris basins, and channel and levee improvements will be considered in developing a comprehensive plan for flood control and allied purposes. No funds have been allotted for this study since fiscal year 1974. The completion date of the study is indefinite.

colorado desert

small flood-control projects

Banning Levee (Los Angeles District)
The Banning levee project was completed in 1965. The improvement consists of about 0.4 mile of revetted levee along the right side of the San Gorgonio River at Banning.

The Federal cost of the levee was about $98,000.

Local interests provided lands, easements, and rights-of-way at an estimated cost of $20,000. Since its completion the project has prevented flood damages estimated at $145,000.

Chino Canyon Improvements (Los Angeles District)
The Chino Canyon improvements were completed in 1972. The project consists of 3.4 miles of levee, 1.6 miles of excavated channel, and 11 directional groins. The improvements, which are on the alluvial cone of Chino Canyon, extend along the right bank of the Whitewater River.

The Federal first cost of the project was about $820,000, and the non-Federal first cost — including lands, easements, rights-of-way, relocations, and related improvements plus a $10,000 cash contribution — was about $330,000.

The project provides protection against floods to 9,000 acres of valuable property in the City of Palm Springs.

Needles, San Bernardino County (Los Angeles District)
A small flood-control project to protect residential, commercial, and public property in the City of Needles was completed in 1973. Needles is along the Colorado River and about 280 miles northeast of Los Angeles.

The project, which is along "S" Street Wash, consists of two inlet levees with a combined length of 0.4 mile, 0.6 mile of rectangular concrete channel, 0.3 mile of unlined trapezoidal diversion channel, 0.4 mile of diversion levee, and two deflection levees with a combined length of 0.15 mile.

The Federal first cost of the project was $978,000, and the non-Federal first cost was $782,000.

The project protects valuable property in Needles from floods on "S" Street Wash and Sidewinder Wash.

Quail Wash Levee (Los Angeles District)
The Quail Wash Levee Project, located about one-half mile southeast of the community of Joshua Tree and 76 miles east of San Bernardino, was completed in 1961. The project includes 0.5 mile of levee with grouted stone revetment, an access road and access ramps.

The Federal first cost of the project was about $213,000. Local interests provided lands, easements, rights-of-way and relocations at a first cost of about

the needles small flood-control project protects property from floods along "s" street and sidewinder washes.

$39,000. The project is maintained by the San Bernardino County Flood Control District.

The levee is designed to prevent Quail Wash floodwater from flowing westward through the community of Joshua Tree.

small flood-control project study

Yucca Valley, San Bernardino County (Los Angeles District)
Yucca Valley, which is situated on an alluvial cone downstream from the mouth of Water Canyon, is subject to damage from sediment-laden floodflows emerging from the canyon. Floodflows move across the alluvial cone in poorly defined and shifting channels that extend through Yucca Valley's residential and business districts.

A detailed project report covering proposed improvements to protect Yucca Valley has been initiated. Although flood control improvements for the area may be justified, completion of the report is pending receipt of assurances that local interests, represented by the San Bernardino County Flood Control District, will assume the costs of required local cooperation.

emergency work

Emergency repair and restoration work performed by the Corps of Engineers in the Colorado Desert totals $4 million. The work was done after floods that occurred in November 1965, December 1966, and January and February 1969.

Emergency rehabilitation work at the request of the OEP has been performed by the Corps in the Colorado Desert at a cost of more than $3.6 million. The work included repairing and protecting levees, restoring channels, and removing debris along the Whitewater River and Palm Canyon Wash and restoring streets and the water supply system in the City of Cabazon, damaged by floodflows from the San Gorgonio River; the work was done at a cost of $2.6 million after the record-breaking floods of 1969. After the December 1966 floods, rehabilitation work included restoration (and debris removal) of the storm-water channel of the Coachella Valley County Water District in the Whitewater River Basin at a cost of $898,000, providing gabions for protection of the Banning levee at a cost of $28,000, and restoring the channel of Tahquitz Creek at a cost of $50,000.

in january 1969 the san gorgonio river flooded extensive areas, including cabazon, where one person drowned in the floodflows.

flood plain management services program

The following flood plain information reports for streams in the Colorado Desert have been completed:

New River in the vicinity of Brawley
San Gorgonio River and its tributary Smith Creek
San Gorgonio River tributaries (except Smith Creek)

No future studies are scheduled at this time.

13 the corps of engineers civil works program

general information

The U.S. Army Corps of Engineers has been the principal water resources development agency of the Federal government since 1824. Through its Civil Works Program, the Corps carries out a comprehensive nationwide effort in water resources planning, construction and operation. These activities are carried out in accordance with directives from Congress, and are supervised by the Chief of Engineers under the direction of the Secretary of the Army. Work is accomplished in close cooperation with other Federal agencies concerned, and with interested State and local authorities and organizations to provide beneficial improvements desired by the citizens of the communities and areas most affected.

The Civil Works Program is directed toward the development of water resources in a way that will lead to the satisfaction of all water related requirements — both immediate and long-range. These include navigation, flood control, major drainage, water supply for irrigation and municipal-industrial uses, regulation of hydraulic mining debris, hurricane flood protection, water quality control and waste water disposal, hydroelectric power, shore protection and beach stabilization, water-oriented recreation, enhancement of fish and wildlife resources and the preservation of esthetic and ecological values. Special emphasis is being placed on flood plain management in support of a national effort to reduce flood losses through appropriate State and local regulation of the use of flood prone areas.

Under continuing Congressional authorities, the Corps of Engineers engages in a variety of emergency activities in the interest of navigation and flood control, in the repair and restoration of flood damaged facilities and in supplementing the resources of local interests in coping with floods. It also provides engineering assistance to localities affected by major natural disasters such as hurricanes, tornadoes, earthquakes and wildfires, and serves at the request of the Federal Disaster Assistance Administration as an engineering and construction agency in the restoration of essential public facilities that have been damaged or destroyed.

authority for corps of engineers participation in civil works

The basic authority for Corps of Engineers' participation in the development of water resources lies in the commerce clause of the Constitution, which gave Congress the power "to regulate commerce with foreign nations, and among the several states, and with the Indian tribes." Under this authority, during the 1820s, Congress assigned the Corps of Engineers the responsibility for projects dealing with navigation on the Ohio and Mississippi Rivers. This basic authority, which pertained solely to navigation, was subsequently expanded by Congress to include the many related aspects of comprehensive water resources development.

The National Environmental Policy Act of 1969 established a policy that will encourage productive and enjoyable harmony between man and his environment, promote efforts to prevent or eliminate damage to the environment, stimulate the health and welfare of man and enrich the understanding of ecological systems and natural resources important to the nation. Under Section 102 of that act, all Federal agencies must, among other requirements, include in every recommendation a detailed statement on

- The environmental impact of the proposed action;
- Adverse environmental effects that cannot be avoided should the proposal be implemented;
- Alternatives to the proposed action;
- The relationship between local, short-term use of the environment and the maintenance and enhancement of long-term productivity;
- Any irreversible and irretrievable commitments of resources that would be involved in the proposed action should it be implemented;
- The coordination of the proposal with interested Federal, State and local agencies.

Considering the complexities associated with water as a natural resource and its essentiality to all living things, the Corps of Engineers has recognized the necessity of instituting environmental analysis and planning as an integral factor in water resources studies and project formulation. The Corps of Engineers worked as a representative member of the Special Task Force of the President's Water Resources Council in developing the role of environmental considerations in solutions to water problems. On the individual District level, the Corps has established environmental elements staffed with biologists, ecologists, oceanographers, foresters, sanitary and civil engineers, recreation specialists and others who contributed the expertise of their educational disciplines to environmental considerations.

The 1970 River and Harbor Act provides that the Corps of Engineers assure that possible adverse economic, social and environmental effects relating to any proposed project have been fully considered, and that final decisions on the project are made in the best overall public interest, taking into account the need for flood control, navigation and associated facilities, the cost of

eliminating or minimizing such adverse effects, and

- Air, noise and water pollution;
- Destruction or disruption of man-made and natural resources, esthetic values, community cohesion and the availability of public facilities and services;
- Adverse employment effects and tax and property value losses;
- Injurious displacement of people, businesses and farms;
- Disruption of desirable community and regional growth.

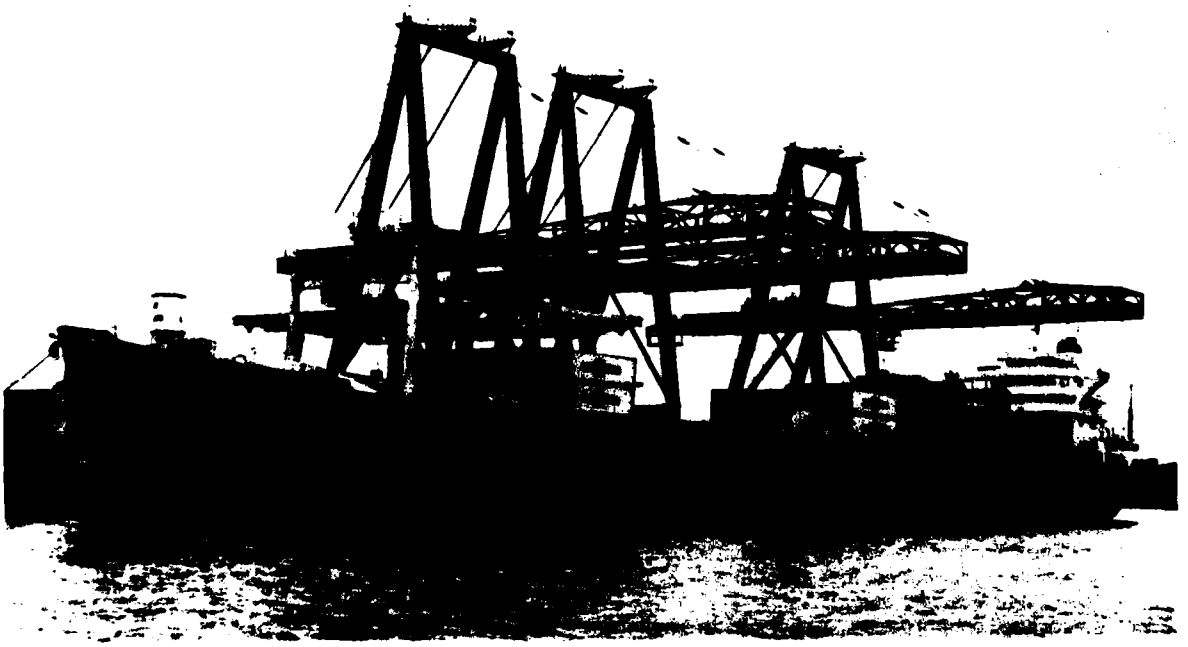
Section 73 of the 1974 Water Resources Development Act requires consideration of non-structural alternatives in the investigation, planning and design of Federal projects involving flood control. Non-structural alternatives to flood control projects such as dams and levees do not lessen the magnitude of flooding or reduce the extent of areas flooded. They do, however, reduce the damaging effects of floods through control of the uses and development of flood plains.

Further information on basic authorities of the Corps of Engineers is contained in the following paragraphs.

Navigation Projects

Navigation improvements are directed by Congress primarily to assist in the development and conduct of waterborne commerce. In general, improvements for navigation may be divided into two types, coastal harbors and inland waterways. The former comprise channels and anchorages to accommodate both deep draft and shallow draft shipping, harbors to provide refuge for small craft and breakwaters and jetties to provide protection against wave action. Shallow draft navigation includes commercial fishing, recreation boating and barge traffic. Improvements of inland waterways consist essentially of deepening and widening the waterways to facilitate the economical transportation of bulk commodities by boat or barge. Integrated with railroads and highways, improved waterways help to meet increasing transportation needs.

Beginning with an act approved 24 May 1824, investigations and improvements for navigation and related purposes have been authorized by a series of River and Harbor Acts, and basic policies and procedures have been established by these laws. The 1920 River and Harbor Act expanded the Federal policy regarding navigational improvements and established general



requirements for local cooperation where the benefits from such improvements are mainly local in nature. Subsequent acts have further clarified and expanded the Federal policy, and have authorized many specific navigation projects. Any special conditions and requirements pertaining to a specific project are included in the authorizing act. Section 117 of the 1968 River and Harbor Act permits the Corps of Engineers to maintain navigation channels in excess of authorized project depths when such depths were provided for defense purposes and also serve essential needs of general commerce. Section 6 of the Water Resources Development Act of 1974 provides that the cost of the operation and maintenance of the general navigation features of certain small boat harbors (recreational boating) shall be borne by the Federal government.

Flood Control Projects

The purpose of flood control projects is to regulate floodflows and thus prevent flood damages. This is accomplished with flood control storage or levee and channel improvement works, separately or in combination. In a flood control storage project, floodwaters are stored and later released at non-damaging rates. The majority of storage projects are authorized for multiple purposes, i.e., flood control and other purposes, including hydroelectric power, irrigation, navigation, municipal and industrial water supplies, water quality control, recreation and enhancement of fish and wildlife resources. Some storage projects authorized primarily for flood control may also be used incidentally for other purposes such as recreation or fish and wildlife enhancement. In levee and channel improvement projects, sufficient channel capacity to carry peak flows is provided by dredging, clearing and straightening the waterway; by constructing levees; by building a channel with smooth surfaces to improve flow characteristics; by providing bypasses; or by some combination of these methods. Recreation facilities may be included in levee and channel improvement projects.

In 1917, the Corps of Engineers was assigned the responsibility for flood control work on the Sacramento and Mississippi Rivers and since 1936 has been responsible for the general flood control program throughout the United States. Section 1 of the 1936 Flood Control Act, which established Federal policy on flood control works, reads in pertinent part:

> "... that it is the sense of Congress that flood control on navigable waters or their tributaries is a proper activity of the Federal Government in cooperation with States, their political subdivisions, and localities thereof ..."

Each Federal flood control project, except certain small improvements and emergency work, must be specifically authorized by Congress. The procedures for obtaining authorization and construction of a project are covered in subsequent paragraphs. Since authorizing acts generally do not carry appropriations for undertaking projects, funds for design and construction must be provided by subsequent appropriation acts.

Upon completion, levee and channel improvement projects usually are transferred to local authorities for operation and maintenance. Flood control storage projects are operated and maintained by the Corps of Engineers unless the protection provided is essentially local in nature.

Beach Erosion Control Projects

The purpose of beach erosion control projects is to prevent damage to beaches and shoreline properties by waves and tidal currents, and to promote and encourage healthful public recreation. Protection is generally provided by constructing bulkheads, seawalls or revetments to prevent erosion of shoreline cliffs; by constructing groins to retain or build beaches; by artificial beach replenishment (importation of sand) to supplement natural shore processes or by some combination of these methods. Maintenance of completed beach erosion control improvements is generally a responsibility of local interests.

The 1930 River and Harbor Act authorized the Corps of Engineers to investigate shore processes and beach erosion problems in cooperation with the States. Later authorizations (1946, 1956, and 1962 and 1968) permit the Federal government to assume up to 50 percent of the construction cost for protecting certain publicly owned or publicly used beaches, up to 70 percent of the construction cost for protecting certain publicly owned shore parks or conservation areas and to make limited contribution toward the cost of protecting privately owned shore areas. Non-Federal interests must assume all remaining costs and meet certain other requirements of local cooperation. Investigations of beach erosion and related problems, which may be carried out entirely at Federal expense, must be authorized by River and Harbor Acts or by resolutions of the Senate or House Committee on Public Works. Federal participation in beach erosion control and shore protection projects must be specifically authorized by Congress, except for construction of certain small improvements, and construction, operation and maintenance of projects (costing less than $1 million) needed to prevent or mitigate shore damages attributable to Federal navigation works, which may be authorized by the Chief of Engineers.

Projects Approved By the Public Works Committees

Section 201 of the 1965 Flood Control Act authorizes the Secretary of the Army, acting through the Chief of Engineers, to construct, operate and maintain single purpose and multipurpose water resources development projects involving, but not limited to, navigation, flood control and shore protection if the Federal cost is less than $10 million. Such projects must be approved by resolutions adopted by the Public Works Committees of the Senate and House of Representatives, and are subject to the same requirements of local cooperation as projects costing $10 million or more.

Regulation of Hydraulic Mining

After its beginning in 1853, hydraulic mining became a highly important activity in California. However, it resulted in large deposits of silt, sand and gravel in the main waterways of the Sacramento and San Joaquin Valleys. This debris was deposited in such large quantities that it greatly impaired the usefulness of these channels for navigation and flood-carrying purposes. Widespread agitation about these detrimental effects finally resulted in a United States Circuit Court decree prohibiting uncontrolled deposition of hydraulic mining debris. This decree was issued in 1884, and in the next few years practically all mines operating without means of restraining debris were closed. Due to the importance of hydraulic mining, Congress in 1893 created the California Debris Commission (as an organizational element of the Corps of Engineers) to regulate hydraulic mining activities. The act creating the Debris Commission permitted resumption of hydraulic mining under conditions that would prevent debris from entering navigable waters or otherwise causing damage. In general, the law requires that prospective hydraulic mine operators provide debris-restraining facilities considered satisfactory by the California Debris Commission, or agree to make appropriate payment for debris storage in debris control reservoirs built by the Federal government.

In addition to its continuing regulatory functions, the California Debris Commission acts as a construction agency in the building of Federal debris control facilities. These works retain hydraulic mining debris in foothill regions and prevent its deposition in main stream channels.

the corps of engineers civil works program

Recreation

Outdoor recreation is recognized by the Corps of Engineers as a tangible and important function of water resources development, and it is given the same consideration as other needs and potentialities in the planning of water resources development projects. Authority to participate in recreational developments was provided by Section 4 of the 1944 Flood Control Act as amended by the 1946, 1954, 1960 and 1962 Flood Control Acts. Under these continuing authorities, the Corps of Engineers constructs, operates and maintains public park and recreational facilities at water resources development projects under its control, and may permit construction, operation and maintenance of such facilities by local interests.

Recreation facilities for public use are generally provided through cooperative efforts of the Corps of Engineers and a non-Federal agency, and when appropriate, by private interests on a concessionaire basis. The 1965 Federal Water Project Recreation Act, as amended by the Water Resources Development Act of 1974, authorized the Corps of Engineers to participate and cooperate with states and local interests in developing the recreational potential of any Federal water project. Under these authorities, the Federal government assumes responsibility for major recreational development provided that non-Federal public bodies agree in advance to administer project land and water areas for recreation or fish and wildlife enhancement, and to bear not less than one-half the separable project costs allocated to recreation and one-quarter of the costs allocated to fish and wildlife enhancement.

Public use of land and water areas at Corps of Engineers storage projects in the past decade has more than tripled. Facilities provided for public use include access roads, boat launching ramps, parking areas, observation points, picnic areas, campgrounds and water supply and sanitation systems. Provisions are also made for the preservation and enhancement of fish and wildlife resources in accordance with the Fish and Wildlife Coordination Act of 1958. Facilities and services such as motels, boatels, restaurants, marina installations and sporting goods stores are generally provided on adjacent private lands, although such facilities are sometimes located on Federal lands on a concessionaire basis. Some flood detention basins,

which generally do not have permanent recreation pools, have recreational facilities comprising bridle paths, hiking trails, golf courses, archery ranges, playgrounds, day camping and picnicking facilities, water supply and sanitation systems and parking areas and access roads. Similar facilities, as appropriate, may be provided in conjunction with levee and channel improvement projects. Information folders are available on request from the Public Affairs Office of the District having jurisdiction.

Water Pollution and Water Quality Control
Under the 1948 Water Pollution Control Act, as amended, other related legislation and certain Executive Orders, water quality and pollution control are given full consideration in the planning and construction of Federal water resources development projects. In water storage projects, adequate capacity may be included for regulation of streamflow to maintain high water quality, but not as a substitute for treatment or other methods of controlling waste at the source.

Under long-standing procedures evolving from the River and Harbor Act of 1899, the Corps of Engineers had administered a permit program for structures and operations in navigable waters. Decisions of the Supreme Court now construe that Act as being directed at pollution as well as obstructions to navigation. To make the most effective use of existing legislation to achieve compliance with water quality standards and abate pollution, a permit program under the 1899 Act was initiated pursuant to Executive Order 11574, which was issued on 23 December 1970. Under this program permits will be required for all present and future discharges into navigable waters or their tributaries. From 23 December 1970 to 18 October 1972, the program was administered by the Corps of Engineers in cooperation with the various States and the Environmental Protection Agency. On 18 October 1972, passage of the Federal Water Pollution Act Amendment of 1972 lodged the entire responsibility for the program with the Environmental Protection Agency. As provided in the 1972 Amendment, the program in California is now the responsibility of the Water Quality Control Board with review of applications by the Corps of Engineers and veto power by the Environmental Protection Agency.

Development of Water Supplies
The 1958 Water Supply Act, as amended, permits the Corps of Engineers to participate and cooperate with states and local interests in developing domestic, municipal and industrial water supplies in connection with the construction, maintenance and operation of Federal navigation, flood control, irrigation and multipurpose projects. Space for storage of municipal and industrial water supplies may be included in the Corps of Engineers storage projects if local interests agree to pay the percentage of project cost allocated to that function.

Flood Plain Management Services Program
In recognition of the increasing use and development of flood plain areas and the need for flood hazard information to guide such development in a way that would minimize future flood damage, but permit optimum use and development of flood-prone lands, Section 206 of the 1960 Flood Control Act (as amended by the 1966 and 1970 Flood Control Acts and the Water Resources Development Act of 1974) and Executive Order 11296, 10 August 1966, authorized the Corps of Engineers to establish and carry out a flood plain management services program. Its objective is comprehensive flood damage prevention planning that, at all levels of government, encourages and guides wise use of flood plains. Under the program, the Corps of Engineers prepares flood plain information reports, provides technical assistance and guidance, conducts related research on various phases of flood plain management and plans long-range flood plain management activities. In compliance with Executive Order 11296, the Corps of Engineers prepares specific flood hazard reports wherever buildings, roads and other facilities are either federally owned, federally financed or involved in federally administered programs, and wherever disposal of Federal land and property is involved.

flood plain information reports
Flood plain information reports are prepared at the request of local interests to delineate flood problems in specific communities or along specific stream reaches in suburban and rural areas.

technical assistance and guidance
The Corps of Engineers stands ready to provide technical assistance and guidance to Federal, State and local agencies in the interpretation and application of data in flood plain information reports. This includes providing additional data pertinent to but not published in the report, assisting in the preparation of flood plain regulations and suggesting floodway areas and evaluating the effects of such floodways. Technical assistance and guidance also includes furnishing generalized information on flood damage reduction by corrective or preventive measures.

guidance materials and research
The Flood Plain Management Services Program includes studies to improve methods and procedures for flood damage prevention and abatement, and the

preparation of guides and pamphlets on various approaches to flood damage prevention. The research effort under the program is conducted under the direction of the Chief of Engineers and is closely coordinated with related research programs of other Federal agencies and the various states.

flood plain management planning
To achieve the basic objective of the Flood Plain Management Services Program, the Corps of Engineers works with and through the proper state agency and provides the guidance, engineering services and other technical assistance necessary for sound management of flood plain areas. State and local officials are brought fully into planning actions and consideration is given to alternative or supplementary measures. Thus, planning considers flood control works, flood proofing of buildings, flood forecasting, zoning subdivision regulations, building codes, city policies and other elements to find the combination that gives the best solution. An addition to flood plain management planning is the Corps of Engineers role in the National Flood Insurance Program. This comprises making hydrologic studies necessary to establish the premium rates for flood insurance at the request of the Federal Insurance Administration, Department of Housing and Urban Development.

Special Authorities
In addition to water resources development projects that must be authorized by Congress, the Corps of Engineers may undertake certain small projects, certain projects approved only by the Public Works Committees of the Senate and House and varied emergency work under continuing authorities. Also, the Corps of Engineers reevaluates completed projects on operational and environmental considerations, when changed conditions so warrant; and cooperates in the projects of other agencies. Certain laws enacted to preserve and protect navigable waters are administered by the Corps of Engineers.

small projects
Under continuing authorities and when approved by the Chief of Engineers, small navigation, flood control and beach erosion control and shore protection projects may be undertaken by the Corps of Engineers without the specific authorization of Congress. Works constructed under small project authorities must be complete in themselves, constitute a complete solution to the problem and not commit the Federal government to additional improvements to ensure effective operation. Small projects are subject to the same requirements of feasibility, economic justification and cost sharing as projects that require the specific authorization of Congress and must be coordinated with the State or other local interests concerned. They are based upon favorable reconnaissance-type investigations and subsequent detailed project reports, which serve as bases for authorization of projects and preparation of plans and specifications. The allotments for small projects, which are made annually by Congress on a lump-sum country-wide basis, cannot exceed $30 million for small flood-control projects or $25 million each for small navigation projects and small beach-erosion control projects for any one year, and usually not more than $1 million (Federal cost) can be allotted for construction of any single project.

Small navigation projects are undertaken through the provisions of Section 107 of the 1960 River and Harbor Act, as amended by Section 310 of the 1965 River and Harbor Act, and by Section 112 of the River and Harbor Act of 1970.

Authority to investigate and construct small flood-control projects is contained in Section 205 of the 1947 Flood Control Act (as amended by the 1950, 1952 and 1970 Flood Control Acts and the Water Resources Development Acts of 1974 and 1976). The 1976 amendment increases the allowance for projects to $3 million if a project will protect an area which has been declared a major disaster area in the 5-year period preceding the date of project approval.

Small beach-erosion control and shore protection projects are undertaken through the provisions of Section 3 of "An Act Authorizing Federal Participation in the Cost of Protecting the Shores of Publicly Owned Property" (13 August 1946), as amended, principally by the 1962, 1965 and 1970 River and Harbor Acts.

emergency flood control work
Emergency work in the interest of flood control is ordinarily undertaken under three general Congressional authorizations with funds appropriated annually. Although emergency projects to which these general authorizations apply need not be specifically authorized by Congress, they are subject to the same principles of economic feasibility that pertain to authorized projects. Emergency flood control work falls into three general categories:

a. Emergency bank protection (Section 14, 1946 Flood Control Act, as amended). Within the limit of available funds, the Corps of Engineers is authorized to spend up to $250,000 annually in a single locality for the construction of emergency bank protection works to prevent flood damages along shorelines or to highways, bridge approaches

and other public works endangered by bank erosion. Public works within the meaning of the authorization are Federal, State and local facilities, or those of non-profit organizations serving the general public.

b. Snagging and clearing (Section 208, 1954 Flood Control Act, as amended). Within the limit of available funds, the Corps of Engineers is authorized to spend up to $250,000 annually on any one single tributary for removal of accumulated snags and other debris, and for the clearing and straightening of channels in navigable streams and tributaries thereof when, in the opinion of the Chief of Engineers, such work is advisable in the interest of flood control.

c. Floodfighting, rescue and repair work (Public Law 84-99 and antecedent legislation). Within the limit of available funds, the Corps of Engineers is authorized to engage in floodfighting and rescue operations and to repair or restore flood control works threatened or destroyed by floods. Repairs or restoration of flood control works includes strengthening or otherwise modifying damaged or threatened flood control structures to ensure adequate functioning.

emergency navigation work
Emergency navigation work under general Congressional authorization falls into two general categories:

a. Removal of wrecks and obstructions (Public Law 55-189). The Corps of Engineers is authorized, within the limit of available funds, to investigate wrecked vessels and other obstructions to navigation, and to ensure removal at the expense of the owner or, under certain specific conditions, at the expense of the Federal government.

b. Snagging and clearing (Section 3, 1945 River and Harbor Act). Within the limit of available funds, the Corps of Engineers is authorized to remove accumulated snags and other debris and to protect, clear and straighten channels in navigable harbors and navigable streams and tributaries thereof when, in the opinion of the Chief of Engineers, such work is advisable in the interest of navigation or flood control.

emergency rehabilitation work under public law 93-288
Under authority provided by Public Law 93-288 (Disaster Relief Act of 1974) and antecedent legislation — Public laws 81-875, 89-769, 91-79 and 91-606, and Executive Order 10427 — the Federal Disaster Assistance Administration (FDAA) coordinates the relief and recovery activities of all Federal agencies during major disasters. During such periods, the FDAA may request the Corps of Engineers to act as an engineering and construction agency to rehabilitate or restore damaged or destroyed facilities, prepare evaluation reports on requests to the FDAA for repayment of local costs for repair and restoration work, inspect such work on its completion or perform other disaster recovery and relief activities. At present, little emergency work under the authority of Public Law 93-288 has been required. All past work of this nature in California has been accomplished under antecedent legislation at the request of the OEP, antecedent agency to the FDAA.

reevaluation of completed projects
Section 216 of the 1970 Flood Control Act authorized the Corps of Engineers to review completed navigation and flood control projects when found advisable due to significantly changed physical and economic conditions. The findings of such review investigations would be reported to Congress with recommendations for modifying the structures or their operation and for improving the quality of the environment in the overall public interest.

cooperative projects
Section 7 of the 1944 Flood Control Act assigned the Secretary of the Army the responsibility for prescribing regulations for the use of storage space reserved for flood control or navigation in all reservoirs constructed wholly or in part with Federal funds. In carrying out that responsibility, operating regulations for flood control space have been developed for several Bureau of Reclamation projects.

The Corps of Engineers also cooperates in the Watershed Studies Program of the Soil Conservation Service and the Small Reclamation Project Program of the Bureau of Reclamation.

When authorized by Congress in recognition of a potential flood control accomplishment, the Federal government may contribute part of the construction cost of water resources development projects built by local interests. Such contribution, the amount of which is determined by detailed cost allocation studies and reflects the specific flood control accomplishment to be realized, relates to actual construction costs, exclusive of costs for other functions of the projects such as recreation, irrigation or hydroelectric power, and exclusive of an additional Federal expenditure for studies and administration of funds. Dams and reservoirs built under the foregoing arrangement are known as "Partnership Projects" and must be operated for flood

control according to regulations established by the Corps of Engineers.

regulatory functions
In addition to other civil works activities, the Corps of Engineers is responsible for administering certain laws enacted for the preservation and protection of navigable waters. Among other things, these laws pertain to:

Approval of sites and plans for dams and dikes.

Permits for structures or operations in navigable waters.

Removal of sunken vessels or other obstructions endangering navigation.

Establishment of danger zones, dumping grounds, restricted areas, fishing areas and harbor lines.

Cargo Statistics
Under assigned civil works functions, the Corps of Engineers also collects and compiles annual statistics of commercial cargoes and passengers handled by coastal and inland ports. These data are highly important in determining the need and justification of the improvement and maintenance of rivers and harbors for commerce and navigation. They are also of value to commercial and shipping concerns, various Federal and local agencies and others interested in transportation.

initiation, authorization and construction of corps of engineers projects

The Corps of Engineers never initiates an investigation or a project. Actually, local interests initiate, Congress authorizes and the Corps of Engineers studies, plans and constructs Federal water resources development projects. The major steps in initiating and processing such projects are briefly outlined as follows:

a. Local interests inform their Senator or Representative of a navigation, beach erosion control, flood control or related water resource improvement they desire, and request that Federal provision of the desired improvement be investigated. Local interests may also consult with representatives of the Corps of Engineers on appropriate procedures, particularly on whether a study and project may be accomplished under one of the continuing authorities for small projects (see page 225).

Two courses of action are open to the Member of Congress. He may request the Senate or House Committee on Public Works to authorize a review of any previous reports on investigations of the area to determine whether modification of such reports would be advisable. If a review report is appropriate, the Committee will adopt a resolution authorizing the Corps of Engineers to make the review. If no previous report has been made, the Member of Congress may request the Committee to include authorization of a study in either an omnibus river and harbor and flood control bill or in a separate bill. When passed, the bill becomes authorization for the study.

b. When the investigation is authorized, the Chief of Engineers assigns it to the appropriate Division Engineer, who usually refers it to a District Engineer for accomplishment. Following the receipt of the directive and funds for the study (which must be appropriated by Congress), the District Engineer, in close cooperation with local authorities and other Federal agencies, begins the necessary engineering, economic, and environmental investigations.

An initial public meeting is held to advise local people on the nature and scope of the investigation and to ascertain their views on problems, needs and the type of improvement desired. After careful consideration of this information, and study of data obtained through field and office investigations, the District Engineer develops alternative plans of improvement believed suitable to the problem under consideration. Before a plan is tentatively selected, a second public meeting is held to assure that all interested parties understand how their interests are affected by the problems and proposals under consideration; to present expected environmental impacts of alternative plans; to reveal situations of dissent, controversy or support and delineate areas of conflict or misunderstanding that need to be resolved. As the study nears completion, an environmental impact statement draft is prepared and coordinated. When a plan is selected, local interests must indicate their support of the proposal and their intent to meet the requirements of local cooperation. These data and the recommendations of the District Engineer are included in the report. A favorable recommendation by the District Engineer is largely dependent upon local acceptance of the proposed project and its economic justification. A third public meeting is held prior to completion of the report and its submittal to the Division Engineer.

c. The Division Engineer reviews the report, adds his recommendations and transmits it to the Chief of Engineers for consideration and referral to the Board of Engineers for Rivers and Harbors for review. All interested parties receive a public notice that summarizes the findings and recommendations of the District and Division Engineers, and informs them that they may present their view on the matter to the Board of

Engineers for Rivers and Harbors. At this time, the field report is considered complete and it may be purchased at the cost of reproduction. Another public meeting may be held if requested by non-Federal interests and deemed advisable by the Board.

d. The Board of Engineers for Rivers and Harbors reviews the reports of the District and Division Engineers and carefully considers any additional information received from interested parties. The Board prepares its report, including recommendations, and transmits it to the Chief of Engineers who prepares the report for submittal to Congress. Interested Federal agencies and Governors of affected States are given opportunity to comment on the recommended improvements. The environmental impact statement is also circulated for comment at this time. After full consideration of all comments, the Chief of Engineers submits the report to the Secretary of the Army who obtains the views of the Office of Management and Budget before transmitting the report to the Congress. These steps complete the action required by the Chief of Engineers and Secretary of the Army in complying with the resolution or act authorizing the study. The final environmental impact statement is filed with the Council on Environmental Quality at this time and becomes available to the public.

e. The House and Senate Committees on Public Works may hold hearings on the report with a view toward formulating a bill including authorization of the recommended project. If the project is included in an authorization bill, its enactment constitutes authorization of the project.

Funds for constructing authorized projects are not provided by the authorizing act, but are supplied under subsequent appropriation acts. After authorization, projects are designed and built in accordance with the authorizing acts and such other general laws as may be applicable at a rate determined by appropriation of funds. After funds are made available, construction will require 3 to 4 or more years depending on the size and complexity of the project. Section 12 of the Water Resources Development Act of 1974 provides that water resources development improvements authorized for construction, but for which appropriations have not been provided for a period of 8 years, may be deauthorized. Project deauthorizations would be coordinated with interested Federal agencies and the Governor of the State in which the project is located.

local interests' share in federal projects

The cost of a Federal water resources project is usually divided between the Federal government and the local interests directly benefited. The local interests' share of the cost is determined by the requirements included in the authorizing act. These requirements are not necessarily the same for every project because each project is separately and specifically authorized. Such requirements may include several of the following items:

a. Providing lands, easements, rights-of-way, utility relocations, disposal areas, royalty-free rock, miscellaneous harbor and related improvements, supplemental dredging and jettywork and cash contributions toward new work;

b. Operating and maintaining the completed improvements, maintaining and preserving certain channel capacities and preventing any future encroachments on project channels;

c. Adjusting all water rights claims resulting from operation of the improvements;

d. Holding and saving the United States free from damages resulting from construction and operation of the improvements;

e. Contracting to repay all or a portion of the costs allocated to irrigation, municipal and industrial water supplies, recreation, fish and wildlife enhancement and any other project facilities especially beneficial to local interests.

The best method for meeting the requirements of local cooperation in any water resources project is for local interests to be represented by a legal sponsoring agency. Such an agency should be a local governmental unit or some type of special district with the necessary legal authority and financial ability to meet the local-cooperation requirements specified in the authorizing act.

Whenever a project requiring local cooperation is authorized by Congress, and preferably before the project is authorized, local interests should examine State, county and local laws to determine whether such a sponsoring agency exists or can be legally formed. If the necessary legal authority does not exist, local interests should take action to obtain the necessary enabling legislation, and to organize the sponsoring agency in accordance with the enabling legislation.

index

a

b

c

d

index

e

f

g

h

i

j

k

l

m

Index

q

r

s

Index

t

u

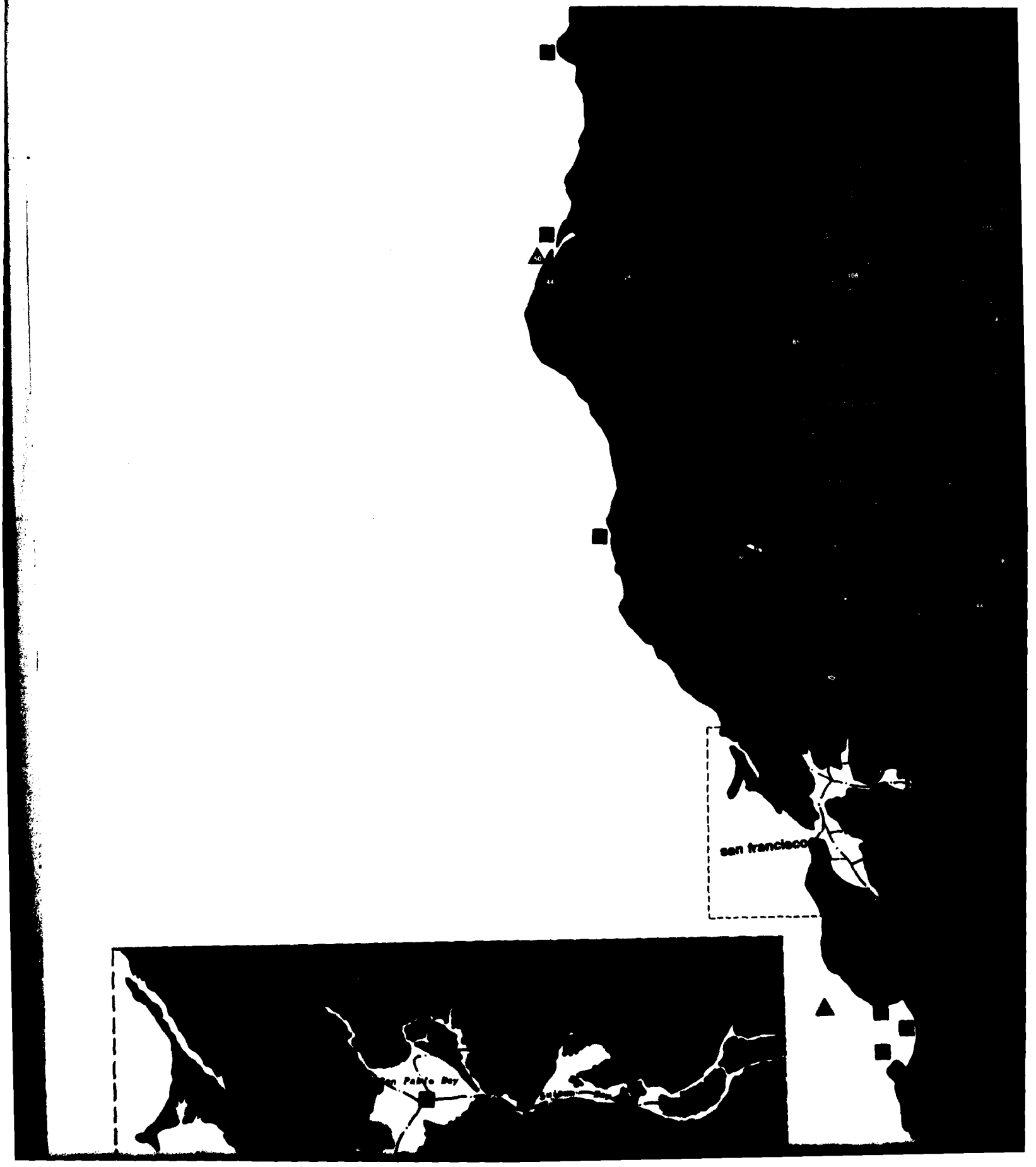
v

index

w

y

z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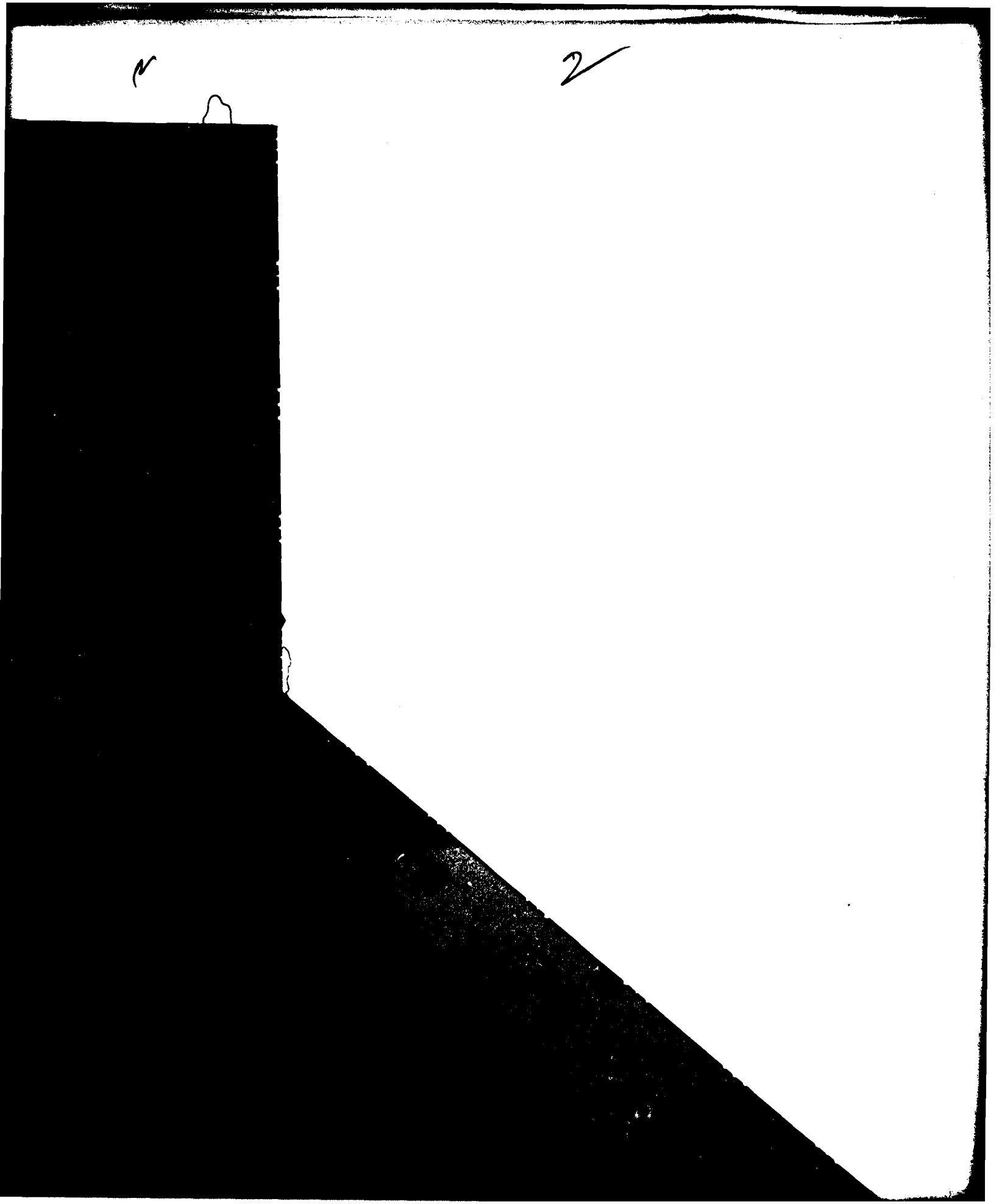

project

san francis

navigation projects

completed

1 berkeley harbor (small project)
2 bodega harbor
3 crescent city harbor
4 gas house cove (east harbor facility, san francisco marina)
5 half moon bay harbor
6 humboldt harbor & bay
7 monterey harbor
8 moss landing harbor
9 napa river
10 noyo river & harbor
11 oakland harbor
12 petaluma river
13 redwood city harbor
14 richmond harbor
15 san francisco harbor
16 san leandro marina (breakwater, small proj
17 san pablo bay & mare island strait
18 san rafael creek
19 santa cruz harbor

under construction

20 islais creek
21 san francisco bay to stockton (john f. baldwin & stockton ship channels) (a)

authorized but not started

22 san francisco harbor & bay, collection & removal of drift
23 san leandro marina

multipurpose projects

completed

24 lake mendocino

under construction

25 dry creek (warm springs) lake and channe

sacramen

navigation projects

completed

51 feather river
52 middle river & connecting channels
53 mokelumne river
54 old river
55 sacramento river deep water ship chann
56 sacramento river, shallow draft channels
57 san joaquin river, stockton deep water channel & burns cutoff
58 stockton & mormon channels
59 suisun bay channel
60 suisun channel
61 suisun point channel (small project)

debris control projects

completed

62 harry l. englebright lake
63 north fork lake
64 yuba river restraining barriers

multipurpose projects

completed

ject index

ancisco district

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mall project)

or
east harbor facility.
na)
bor
bay

bor

or

bor

bor
na (breakwater, small project)
mare island strait

tio

to stockton
stockton
)
not started

rbor & bay,
oval of drift
na

projects

ctio
springs) lake and channel

authorized but not started

26 butler valley dam
27 knights valley lake

● **flood control projects**
completed

28 alameda creek
29 coyote creek (small project)
30 east weaver creek (small project)
31 klamath river
32 mad river-blue lakes (small project)
33 pajaro river basin
34 pinole creek (small project)
35 redwood creek (humboldt county)
36 rheem creek (small project)
37 rodeo creek (small project)
38 san leandro creek (small project)
39 san lorenzo creek, alameda county
40 san lorenzo river, santa cruz county

under construction

41 corte madera creek
42 walnut creek

authorized but not started

43 alhambra creek
44 eel river, sandy prairie & delta area
45 napa river basin
46 salinas river basin project
47 sonoma creek basin
48 wildcat-san pablo creeks

▲ **beach erosion control and shore protection projects**
completed

49 santa cruz county

authorized but not started

50 buhne point, humboldt county

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projects

under construction

81 buchanan dam
82 hidden dam
83 new melones lake

authorized but not started

84 bear river
85 cottonwood creek (dutch gulch & tehama lakes)
86 lakeport lake
87 marysville lake
88 merced county streams
89 morrison creek stream group

● **flood control projects**
completed

90 american river levee
91 bear creek channel, san joaquin county
92 big dry creek dam & diversion
93 duck creek (small project)
94 farmington dam
95 green valley creek (small project)
96 lower san joaquin river & tributaries
97 merced county stream group
98 middle creek improvement
99 [illegible]

water resources development

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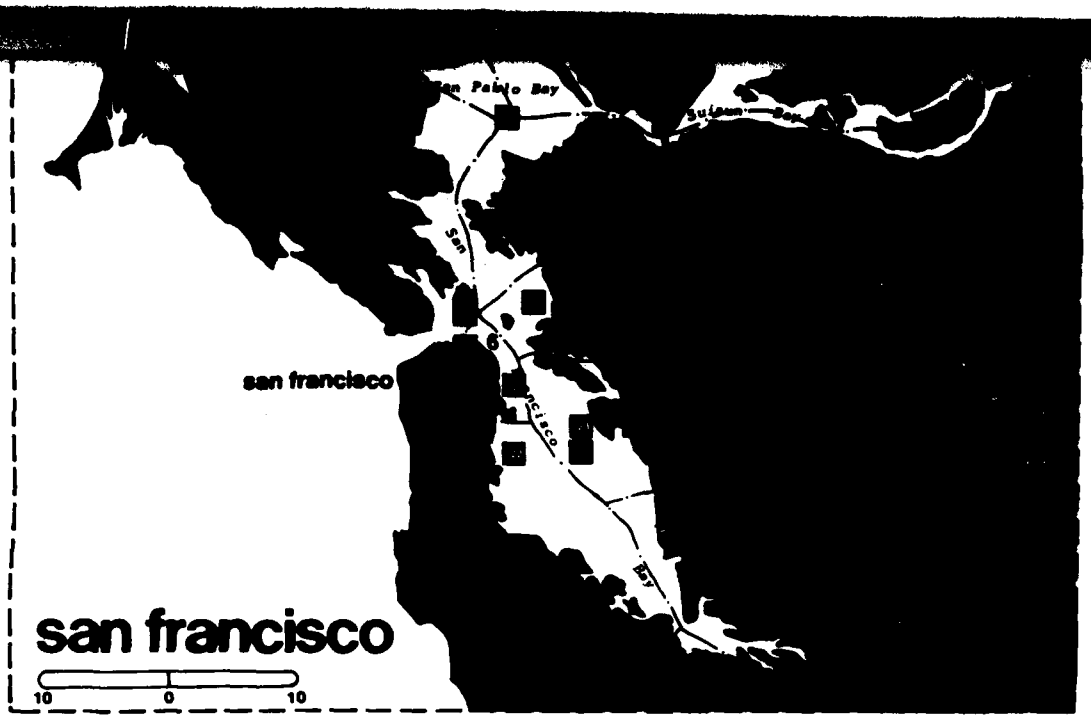
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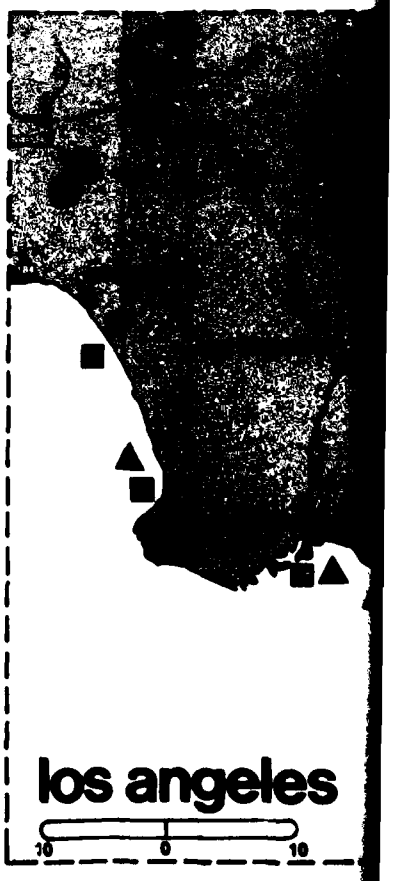
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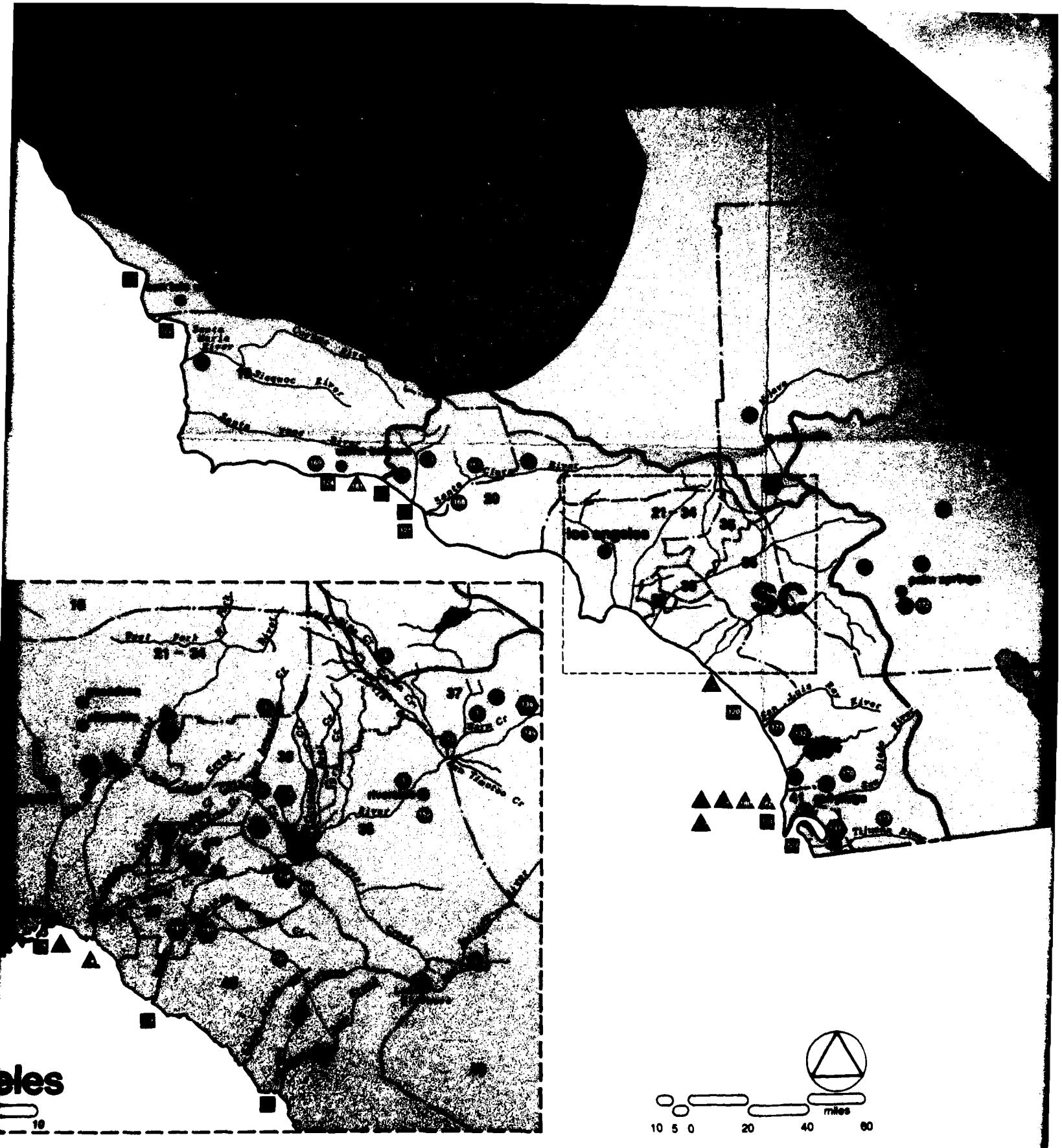
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64 yuba river restraining dam

multipurpose projects
completed
65 black butte lake
66 camanche reservoir
67 folsom lake
68 isabella lake
69 lake oroville
70 martis creek lake
71 millerton lake
72 new bullards bar reservoir
73 new exchequer reservoir
74 new hogan lake
75 pine flat lake & kings river
76 shasta lake
77 success lake
78 terminus dam (lake kaweah)
79 truckee river reservoirs
80 tuolumne river reservoirs project

los ang

navigation projects
completed
111 channel islands harbor
112 dana point harbor
113 marina del rey
114 san diego river and mission bay ha
115 morro bay harbor
116 redondo beach king harbor
117 ventura marina
under construction
118 los angeles & long beach harbors
119 newport bay harbor
120 oceanside harbor (maintenance)
121 port hueneme harbor
122 port san luis
123 san diego harbor
124 santa barbara harbor

multipurpose projects
completed
los angeles county drainage area pr
units (dams)
125 hansen dam
126 lopez dam
127 santa fe dam
128 sepulveda dam
129 whittier narrows dam
130 mojave river dam
under construction
131 los angeles county drainage area
authorized but not started
132 hodges dam
133 sweetwater river project

multipurpose and flood cont projects—santa ana river ba orange county
multipurpose projects
completed
134 brea dam
135 carbon canyon dam & channel
136 fullerton dam
under construction
137 cucamonga creek & tributaries pr
138 prado dam
authorized but not started
139 mentone dam
140 santiago creek channel
141 santa ana river channel

flood control projects
completed
142 devil, east twin & warm creeks ch
improvements & lytle creek levee
143 lytle & cajon creeks channel impr

ng barriers

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reservoir

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eservoirs
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95 tunnington dam
95 green valley creek (small project)
96 lower san joaquin river & tributaries
97 merced county stream group
98 middle creek improvement
99 mormon slough, calaveras river
100 north fork pit river at alturas
101 sacramento river flood control project
102 truckee river tributaries

under construction

103 chester, no. fork of feather river
104 kern river, california aqueduct intertie (small project)
105 sacramento river & major & minor tributaries
106 sacramento river bank protection
107 sacramento river, chico landing to red bluff

authorized but not started

108 churn creek, shasta county
109 fairfield vicinity streams
110 hat creek, shasta county

location and stat
1977

angeles district

legend

projects

ds harbor
arbor
y
er and mission bay harbor
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truction
& long beach harbors
harbor
arbor (maintenance)
e harbor
arbor
a harbor

ose projects

county drainage area project
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county drainage area project
but not started
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river project

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-santa ana river basin and
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creek & tributaries project
but not started
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ek channel
iver channel

rol projects

win & warm creeks channel
s & lytle creek levee
creeks channel improvements

144 lytle & warm creeks project
145 riverside levees
146 san antonio & chino creeks channel
147 san antonio dam
148 san jacinto river levee & bautista creek channel

under construction

149 mill creek levees

authorized but not started

150 aliso creek, san juan, trabuco & villa park dams
151 oak street drain
152 university wash & spring brook project

other flood control projects

completed

153 banning levee (small project)
154 chino canyon improvements (small project)
155 city creek levee (small project)
156 kenter canyon conduit and channel
157 needles, san bernardino county (small project)
158 oro grande wash channel, victorville (small project)
159 quail wash levee (small project)
160 rose creek channel (small project)
161 san diego river levee & channel improvements
162 santa clara river levee
163 santa maria river basin project
164 stewart canyon debris basin & channel
165 tahchevah creek detention basin & channel improvements
166 ventura river levee

under construction

167 santa paula creek channel & debris basins (including mud creek)

authorized but not started

168 calleguas creek from simi valley to moorpark
169 goleta & vicinity project
170 san diego river (mission valley) project
171 san luis rey river project
172 tahquitz creek project
173 tijuana river international flood control project

beach erosion control and shore protection projects

completed

174 anaheim bay harbor
175 bird rock area of la jolla (small project)
176 doheny state beach
177 ocean beach
178 oceanside
179 point mugu to san pedro breakwater

under construction

180 imperial beach
181 san buenaventura state beach
182 san diego (sunset cliffs)
183 san gabriel river to newport bay, orange county

authorized but not started

184 las tunas beach park (small project)

corps of engineers districts

- san francisco
- sacramento
- los angeles

hydrographic area

- nc north coastal basins
- sf san francisco bay area
- cc central coastal basins
- sc south coastal basins
- sb sacramento basin
- dc delta-central sierra area
- sj san joaquin basin
- ti tulare lake basin
- nl north lahontan territory
- sl south lahontan territory
- cd colorado desert

projects

- completed
- under construction
- authorized but not started
- storage projects
- navigation projects
- debris control projects
- multipurpose projects
- flood control projects
- beach erosion control & shore protection proj

29 **congressional districts**

1 9

location and status of projects 1977

legend

corps of engineers districts

- san francisco
- sacramento
- los angeles

hydrographic area

nc	north coastal basins
sf	san francisco bay area
cc	central coastal basins
sc	south coastal basins
sb	sacramento basin
dc	delta-central sierra area
sj	san joaquin basin
tl	tulare lake basin
nl	north lahontan territory
sl	south lahontan territory
cd	colorado desert

projects

- completed
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- debris control projects
- multipurpose projects
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- beach erosion control & shore protection projects

congressional districts

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Provide information on accomplishments of the Corps of Engineers and on the scope and progress of current programs. It contains information on the role of the Corps in planning, constructing and operating water resources development projects; on general investigation studies; on projects that are completed, under construction or in the planning stage; and on Corps of Engineers authorities for participating in water resources development. Data on investigations and projects are grouped by hydrographic areas of

California, which have been selected on the basis of major drainage patterns.


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