US Army Corps
of Engineers®

INTERIM
WATER CONTROL PLAN
(DURING CONSTRUCTION)

PRADO DAM & RESERVOIR
SANTA ANA RIVER, ORANGE COUNTY, CALIFORNIA

MAY 2003

PRADO DAM AND RESERVOIR
RIVERSIDE COUNTY, CALIFORNIA
PERTINENT DATA
(EXISTING PROJECT - Revised January 1993)

Construction Completed		April 1941
Stream System		Santa Ana River
Drainage Area	sq. mi.	2,255
Reservoir:		
Elevation		
Streambed at Dam	ft., m.s.l.	460.0
Debris Pool	ft., m.s.l.	490.0
Buffer Poll (Flood Season)	ft., m.s.l.	494.0
(Non-flood Season)	ft., m.s.l.	505.0
Spillway Crest	ft., m.s.l.	543.0
Revised Standard Project Flood Level (1969)	ft., m.s.l.	554.6
Spillway Design Surcharge Level (1941)	ft;. m.s.l.	556.0
Top of Dam	ft., m.s.l.	566.0
Revised Probable Maximum Flood Level (1969)	ft., m.s.l.	570.3**
Area		
Debris Pool	acres	768
Buffer Pool (Flood Season)	acres	1,081
(Non-flood Season)	acres	2,123
Spillway Crest	acres	6,566
Revised Standard Project Flood Level (1969)	acres	8,485.3
Spillway Design Surcharge Level (1941)	acres	8,769.5
Top of Dam	acres	11,030
Revised Probable Maximum Flood Level (1969)	acres	11,900**
Capacity, Gross (1988 Survey)		
Debris Pool	ac-ft(in.)	4,689 (0.04*)
Buffer Pool (Flood Season)	ac-ft(in.)	8,437 (0.07*)
(Non-flood Season)	ac-ft(in.)	25,760 (0.2*)
Spillway Crest	ac-ft(in.)	187,700 (1.50*)
Revised Standard Project Flood Level (1969)	ac-ft(in.)	283,414 (2.36*)
Spillway Design Surcharge Level (1941)	ac-ft(in.)	295,581 (2.46*)
Top of Dam	ac-ft(in.)	383,500 (3.10*)
Revised Probable Maximum Flood Level (1969)	ac-ft(in.)	436,000 (3.62*)**
Allowance for Sediment (50-year)	ac-ft(in.)	12,000 (0.10*)
Dam: - Type		Earth-fill
Height above Original Streambed	ft.	106
Top Length	ft.	2,280
Top Width	ft.	30
Design Freeboard (1941)	ft.	10
Spillway: - Type		Ungated Ogee
Crest Length	ft.	1,000
Design Surcharge/Discharge (1941)	ft/cfs	13/181,000
Outlets:		
Uncontrolled (Note: Both uncontrolled outlets are plugged)		
Controlled		
Gate Type		Vertical Lift
Number and Size		6 - 7'W x 12'H
Entrance Invert Elevation	ft., m.s.l.	460
Conduits		
Number and Size		2 - 13.5'W x 13.5'H
Length	ft., m.s.l.	750
Maximum Capacity at Spillway Crest	cfs	17,000
Maximum Regulated Reservoir Release	cfs	5,000
Revised Standard Project Flood (1969):		
Duration (Inflow)	days	4
Total Volume	ac-ft(in.)	488,000 (4.05*)
Maximum Water Surface Elevation	ft., m.s.l.	554.59
Inflow Peak	cfs	282,000
Outflow Peak	cfs	150,000
Revised Probable Maximum Flood (1969):		
Duration (Inflow)	days	6**
Total Volume	ac-ft(in.)	1,447,000 (12.24*)**
Maximum Water Surface Elevation	ft., m.s.l.	570.3**
Inflow Peak	cfs	670,000**
Outflow Peak	cfs	603,000**
Historic Maximums:		
Maximum Discharge on Record	cfs	5,992
Date		2-22-80
Maximum Water Surface Elevation	ft., m.s.l. (ac-ft)	528.0 (111,316)
Date		2-22-80

* Inches of Runoff over Watershed
** Note: Dam is Over-topped

DEPARTMENT OF THE ARMY
SOUTH PACIFIC DIVISION, CORPS OF ENGINEERS
333 Market Street, Room 923
San Francisco, California 94105-2195

REPLY TO
ATTENTION OF

CESPD-MT-E

JUL 18 2008

MEMORANDUM FOR Commander, Los Angeles District, ATTN: CESPL-ED-HR

SUBJECT: Approval – Prado Dam Interim Water Control Manual During Construction

The South Pacific Division, Water Management Team has completed the policy compliance and quality assurance review of subject document. A final copy should be provided to this office once completed. If you have any questions, please do not hesitate in contacting Ms. Theresa Mendoza of my staff at (415) 977-8106.

FOR THE COMMANDER:

Marda Q Stothers

MARDA Q. STOTHERS
Chief, Engineering & Construction Division

PRADO DAM
INTERIM WATER CONTROL PLAN
DURING CONSTRUCTION

MAY 2003

Prado Dam
Interim Water Control Plan During Construction
Table of Contents

I - INTRODUCTION 1-1
1-01. Background 1-2
1-02. Purpose 1-3
1-03. Project Features 1-3
a. Dam Embankment and Cofferdam 1-3
b. Existing Outlet Works 1-3
c. Stilling Basin 1-4
d. Spillway 1-4

II - WATERSHED CHARACTERISTICS 2-1
2-01 General Characteristics 2-2
2-02 Topography 2-2
2-03 Structures Affecting Runoff 2-2

III - CONSTRUCTION SCHEDULE 3-1
3-01 General 3-1
3-02 Prado Dam Construction Schedule 3-1
a. Construction Stage 1 3-1
b. Construction Stage 2A, 2B, and 2C 3-2
c. Construction Stage 3 3-2
3-03 Lower Santa Ana River Construction Project (Reach 9) 3-3
a. Upper Highway 91 Embankment 3-3
b. Green River Housing Estate 3-4
c. Green River Mobile Home Park 3-4
d. Green River Golf Course 3-4
e. Lower Highway 91 Embankment 3-4
f. Car Wash and Strip Mall Protection 3-5

IV - DIVERSION AND CONTROL OF WATER DURING CONSTRUCTION 4-1
4-01 General 4-1
4-02 Possible Downstream Channel Limitations 4-1
a. Existing Santa Ana River Interceptor Line (SARI) 4-1
b. Possible Construction Activities - Lower Santa Ana River (Reach 9) 4-2
c. Possible Construction Activities during the Relocation of the SARI Line 4-2
d. Bank Protection and Bridges within the Santa Ana River between Prado Dam and Weir Canyon Road 4-2
e. Construction of the Groundwater Replenishment System (GWRS) Pipeline 4-3
4-03 Interim Water Control Plan 4-3

a. Plan A - Using the Existing Outlet Works 4-3
(1) WSE 460.0 - 490.0 (Debris Pool) 4-4
(2) WSE 490.0 - 494.0/505.0 (Buffer Pool) 4-5
(i) Winter Flood Season 4-5
(ii) Non-Flood Season 4-6
(3) WSE 494.0/505.0 - 520.0 feet, NGVD 4-8
(4) WSE 520.0 - 525.0 feet, NGVD 4-9
(5) WSE 525.0 - 543.0 feet, NGVD 4-10
(6) WSE 543 and above (Spillway Flow) 4-10
4-04 Channel Observation Teams 4-11
4-05 Rate of Release Change 4-11
4-06 Level of Protection 4-12
4-07 Flood Emergency Action Plan 4-12

V - FLOOD NOTIFICATION PLAN 5-1
5-01 Hydrologic Gathering Network 5-1
5-02 Notification and Coordination Plan 5-2
5-03 Downstream Evacuation 5-3

VI - Summary 6-1

TABLES AND FIGURES

TABLE 2-1. Major Water Storage Facilities Within the Santa Ana River Watershed
TABLE 4-1. Suggested Rate of Release Change – Prado Dam
FIGURE 3-1. Prado Dam Embankment and Outlet Works Construction Schedule
FIGURE 3-2. Santa Ana River Construction Schedule (Reach 9)

PLATE NO.	PLATES
2-01	Santa Ana River Drainage Area
2-02	Schematic of the Santa Ana River Watershed
3-01	Stage 1 Construction
3-02	Stage 2A Construction
3-03	Stage 2B Construction
3-04	Stage 2C Construction
3-05	Stage 3 Construction
3-06	Lower Santa Ana River Construction (Reach 9)
4-01	Water Control Diagram - Plan A
4-02	Prado Reservoir Storage Allocation Diagram (During Construction - Plan A)
5-01	Hydrometeorological Instrumentation Pertinent to Prado Dam
5-02	Precipitation Stations Pertinent to Prado Dam
5-03	Santa Ana River Interceptor (SARI Line) – Potential Scour Areas
5-04 to 5-11	Prado Dam Emergency Action Plan Inundation Maps (Downstream and Upstream)

LIST OF ABBREVIATIONS

ac-ft	Acre-feet
cfs	Cubic feet per second
COE	Corps of Engineers
CWMS	Corps Water Management System
EM	Engineering Manual
EOC	Emergency Operations Center of the U.S. Army Corps of Engineers (Construction-Operations Division)
ER	Engineering Regulation
ft	feet
GDM	General Design Memorandum
LAD	Los Angeles District, Corps of Engineers
LATS	Los Angeles Telemetry System
HECDSS	Hydrologic Engineering Center Data Storage System
LAD	Los Angeles District
MOA	Memorandum of Agreement
NGVD	National Geodetic Vertical Datum
NWS	National Weather Service
OCPF&RD	Orange County Public Facilities and Resources Department
OCWD	Orange County Water District
PL	Public Law
PMF	Probable Maximum Flood
ROC	Reservoir Operations Center (LAD Engineering Division)
SPF	Standard Project Flood
sq mi	Square mile
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WCDS	Water Control Data System
WSE	Water Surface Elevation

I. INTRODUCTION

I - INTRODUCTION

1-01. Background. Authorization for the modification of Prado Dam is contained in the Water Resources Development Act of 1986, (P.L. 99-662). The purpose of this modification is to provide additional capacity for storage of floodwaters and sediment by enlarging the existing Prado Dam and Reservoir and to take advantage of increased downstream channel capacity by increasing the release capacity of the outlet works. The modification authorized by Congress is based on the plan recommended by the Los Angeles District of the U.S. Army Corps of Engineers, as described in a document entitled, Design Memorandum No. 1, Phase II GDM on the Santa Ana River Mainstem including Santiago Creek, Volume 2 - Prado Dam, dated August 1988. The environmental justification for this modification is provided within the report entitled, "Supplemental EIS and Project EIR for Prado Basin including Stabilization of the Bluff Toe at Norco Bluffs," dated December 2001.

This proposed flood control improvement includes (a) raising the top of the existing Prado Dam from elevation 566 to 594.4 feet, NGVD; (b) construction of a new intake structure and outlet conduits; (c) modification of the spillway by raising its crest elevation to 563 feet, NGVD; (d) construction of a new auxiliary PMF dike along the Santa Fe Railway from the existing spillway to Serfas Club Drive; (e) modification of a portion of the existing Highway 71 (Corona Expressway) and construction of a dike to elevation 594.4 feet, NGVD; (f) construction of ring dikes to prevent flooding of the Corona Sewage Treatment Plant, the Alcoa Aluminum Plant, the Corona National Housing Tract, the Prado Petroleum Tank Farm, and the California Institution for Women; the construction of floodwalls and levees for River Road and the Yorba Slaughter Adobe; and (g) acquisition of rights-of-way or easements between the existing reservoir taking line and to the new taking line elevation of 566 feet, NGVD.

This report, entitled "Prado Dam Interim Water Control Plan During Construction" documents the water control plan necessary to ensure that Prado Dam will perform safely and effectively while it is undergoing modification. The dam will be

operated to provide water conservation and flood control benefits, while at the same time protecting the construction area.

At the time this Interim Water Control Plan was prepared there were uncertainties concerning the condition of the lower Santa Ana River during the Prado Dam construction, which could affect the implementation of the Prado Interim Water Control Plan. The remaining construction on the Santa Ana River channel (Reach 9) may overlap the Prado Dam construction. Furthermore, a four-mile segment of the Orange County Sanitation District's Santa Ana River Interceptor (SARI) Line constructed under the Santa Ana River starting from the Green River Golf Course to the SAVI Ranch just upstream of Weir Canyon Road, reportedly could be exposed and damaged by flows that exceed 5,000 cfs. There are currently alternative plans to improve and realign this pipeline. Section 4-02.c. contains information about the SARI line and its possible realignment. Other improvement projects proposed during Prado Dam construction is the joint project between the Orange County Water District and the Orange County Sanitation District to install a groundwater replenishment (GWR) pipeline along a segment of the Santa Ana River channel. Details about the GWR project are contained in section 4-02.e. The Interim Water Control Plan contained in this document was developed with provisions for possible overlaps in the construction schedules. In addition, adjustments due to any other unforeseen conditions will be made as necessary, in order to operate Prado Dam effectively. Once the new outlet works are complete, this document will be modified to utilize these new features of Prado Dam. Other documents to be prepared subsequent to this manual are the Preliminary Water Control Plan (prepared at least 60 days prior to the completion of the modification project), and the Final Water Control Plan and Manual (prepared within 1 year after operation of the completed project begins).

1-02. <u>Purpose.</u> The purpose of this document is to provide a detailed plan for the safe and effective operation of Prado Dam during the construction period. The current Prado Dam Water Control Manual, dated September 1994 contains all the pertinent information about the existing Prado Dam, and shall be used to complement this document. There are two basic plans necessary during the entire construction period, namely: 1) Plan A -

Using the Existing Outlet Works, which will be implemented at the start of construction of the new outlet works; and 2) Plan B - Using the New Outlet Works, which will be implemented when the new outlet works are operational. Once implemented, Plan B is to remain in force until the modification project is completed and formally accepted for full-scale normal operation. This document currently contains Plan A, and will be updated to contain Plan B once the new outlet works are ready for operation.

1-03. Project Features. Chapter III of this document describes the Prado Dam construction schedule. During construction stages 1, 2A, 2B, and 2C, Prado Dam will be operated with the existing outlet works (Plan A). The dam's features that are pertinent to the implementation of Plan A are described as follows:

a. Dam Embankment and Cofferdam. The existing Prado Dam embankment is a compacted multi-zoned earth-filled embankment with a crest length of approximately 2,200 feet and a height of about 106 feet above the original streambed. During construction stages 1, 2A, 2B and 2C, excavation of the existing embankment will take place for the construction of the new outlet works. During this time, the construction area will be protected by a cofferdam, which will be constructed to a maximum elevation of 525 feet, NGVD. The cofferdam will provide protection for events up to the 40-year frequency flood.

b. Existing Outlet Works. The existing outlet works are located in the west abutment of the dam and consist of (1) an approach channel, 2) a 195-foot long intake structure, 3) a 591-foot long double box conduit, and 4) a 366-foot long rectangular concrete outlet channel. The intake structure is formed by two gravity-type concrete walls and a reinforced concrete invert (invert elevation is 460 feet, NGVD). The center portion of the intake structure is divided into six bays by five concrete piers. A 7-foot wide by 12-foot high cable operated tractor gate is located at the downstream end of each bay. A 90-foot long transition section joins the six-gated bays with the double box conduit. The double box conduit consists of two box conduits, each 13.5-foot high by 13.5 foot wide. The maximum capacity of each conduit is 8,500 cfs with reservoir pool

level at spillway crest (543 feet, NGVD).

c. Stilling Basin. The stilling basin is 120 feet long, with a tapered cross section, which increases in width from 70 feet to approximately 76 feet. Two staggered rows of baffle piers, 8 feet long by 3.5 feet wide and 5-feet high are spaced at 3.5-foot intervals across the basin at elevation 439.0 feet, NGVD. The baffle piers insure the formation of a hydraulic jump in the basin. The last 50 feet of the basin floor is covered with derrick stone, the voids of which have been grouted. The design capacity of the stilling basin is 10,000 cfs.

d. Spillway. The detached spillway is constructed through a bluff forming the east abutment. The spillway control section is a reinforced concrete ogee with a crest length of 1,000 feet and a crest elevation of 543.0 feet, NGVD.

II. WATERSHED CHARACTERISTICS

II - WATERSHED CHARACTERISTICS

2-01 **General Characteristics.** Prado Dam is the primary flood control facility within the Santa Ana River watershed. The Santa Ana River watershed has an area of approximately 2,450 square miles, excluding a closed area of 32 square miles tributary to Baldwin Lake. During flood events, Prado Dam is operated as a component of the Santa Ana River flood control system. Using real-time telemetry and weather and runoff forecasts, releases from Prado Dam are coordinated with releases from other related Corps projects, such as San Antonio and Carbon Canyon Dams, to attain maximum flood protection for areas below these facilities. Of the total watershed, 2,255 square miles (or about 92 percent) are above Prado Dam. This includes approximately 177 square miles of the watershed above Seven Oaks Dam, which is another flood control project located on the upper Santa Ana River. While Seven Oaks Dam has an impact on inflow into Prado Dam, it is not yet operated for flood control purposes. Seven Oaks Dam will be operated for flood control prior to the start of water year 2003/2004, after the completion and acceptance of its final Water Control Manual in summer 2003. The Santa River basin and the existing flood control structures are shown on Plate 2-01.

Approximately 23 % of the watershed is within the rugged San Gabriel and San Bernardino Mountains, about 9 % is in the San Jacinto Mountains, and 5% is within the Santa Ana Mountains. Most of the remaining area is in valleys formed by broad alluvial fans along the base of these mountains and by the alluvial flood plains further downstream. The numerous low hills in the alluvial valley areas include a few low hills north of San Bernardino; the Crafton Hills east of Redlands; the Jurupa Mountains north and west of Riverside; the Box Springs Mountains and the Badlands located east of Riverside; the Chino Hills and the Peralta Hills northeast of Anaheim. In general, the mountain ranges are steep and sharply dissected. The maximum elevation at San Antonio Peak in the San Gabriel Mountains is 10,064 feet; at San Gorgonio Mountain in

the San Bernardino Mountains, the maximum elevation is 11,499 feet; and at Mount San Jacinto in the San Jacinto Mountains, the maximum elevation is 10,834 feet.

2-02 Topography. The San Bernardino Mountains are the source of the Santa Ana River and of two of its principal tributaries, Bear and Mill Creeks. Lytle Creek, the largest tributary originating in the San Gabriel Mountains, is in the northwest part of the drainage area. The San Jacinto River has its origin in the San Jacinto Mountains southeast of Beaumont. The main tributary in the lower part of the watershed (i.e., below Prado Dam) is Santiago Creek, which originates in the Santa Ana Mountains. The Santa Ana River has an average gradient of about 240 feet/mile in the mountains, about 20 feet/mile near Prado Dam, and about 15 feet/mile below the dam. The average gradient of the tributaries is about 700 feet/mile in the mountains and 30 feet/mile in the valleys.

Well developed growths of white fir, ponderosa pine, sugar pine, and Jeffrey pine occur above elevations of about 5,000 feet. Sparse growths of conifers and brush, including chaparral and manzanita, are common on the steep, rocky slopes of the higher mountains. Large areas on the higher slopes are covered by brush that has replaced timber removed by small-scale lumbering or that has been destroyed by forest fires. Oak and other deciduous trees, brush, and native grasses are the principal vegetal cover on the slopes below an elevation of about 5,000 feet. Large areas on the plateaus and hills are covered with grass and brush. Because of extensive urbanization, large segments of the valley areas have been cleared of most native vegetation. The remaining valley areas are covered mainly with orchards and crops.

2-03 Structures Affecting Runoff. There are currently five dams within the Santa Ana River watershed, which provide some degree of flood control. Three of the five dams are owned and operated by the U.S. Army Corps of Engineers, Los Angeles District; Prado, San Antonio, and Carbon Canyon Dams. Seven Oaks Dam was also constructed by the Corps of Engineers and has been turned over to the local sponsors for

regulation and operation and maintenance, effective October 1, 2003. Virtually all of the storage in the three Corps owned and operated projects are allocated for flood control and closely related purposes such as debris pools. At Prado Dam, the debris pool and an additional buffer pool are also operated for water conservation when they are not needed for flood control. The Corps cooperates with the Orange County Water District in achieving this purpose. Storage space at Seven Oaks Dam will also be dedicated to flood control, starting water year 2003/2004. Flood control operation of Seven Oaks Dam has been allowed as a result of the completion of the Section 7 consultation with the U.S. Fish and Wildlife Service for the evaluation of the original design document's prescribed water control plan to minimize impacts to endangered species. The final water control manual includes the design document's water control plan with built-in flexibilities to allow operation for endangered species, and scheduled to be completed in the summer of 2003. Until the approval of this manual, the approved Seven Oaks Dam Interim Water Control Plan (dated January 2000) will be followed.

The fifth dam is Villa Park Dam, which is owned and operated by the Orange County Public Facilities and Roads Department. The storage at this facility has been allocated for both flood control and water conservation purposes. The pertinent data sheet for Prado Dam is shown on the inside cover of this manual, and Exhibit A contains the Pertinent Data Sheets for San Antonio, Carbon Canyon, Seven Oaks, and Villa Park Dams.

In addition to these four dams, there are over 100 other water storage facilities within the Santa Ana River watershed having storage capacities ranging from 5 acre-feet, to 182,000 acre-feet. These other facilities can affect the flow of the Santa Ana River, but they do not provide any control of flood flows. Table 2-1 is a summary of the major water storage facilities within the Santa Ana River Watershed. Plate 2-02 is a schematic of the Santa Ana River Watershed showing the relative locations of the listed facilities.

Table 2-1
Major Water Storage Facilities
Within the Santa Ana River Watershed

Location	Drainage Area (sq-mi)	Storage (acre-feet)	Flood Control Capability
Prado Dam	2,255.0	196,235	Yes
Seven Oaks Dam	177	113,600	Yes**
San Antonio Dam	27.0	7,703	Yes
Carbon Canyon Dam	19.3	6,614	Yes
Villa Park Dam	20.4	16,044	Yes
Big Bear Lake	38.0	63,381	No
Railroad Canyon Reservoir	641.0	11,459	No
Lake Elsinore	52.0	122,500	Overflow/ Pumped*
Miller Basin	14.2	23	No
Santiago Dam	63.2	25,000	No
Santiago Creek Gravel Pits	9.1	13,299	No
Lake Mathews	40.0	182,804	No
Lake Hemet	67.0	14,000	No
Lake Perris	10.0	100,000	No

*Lake Elsinore acts as a natural sump for the San Jacinto River sub-basin. Flows from Lake Elsinore only occur during major flood events, when the lake is either pumped or actually overflows into Temescal Creek.

**Dam has been recently completed. Its operation for flood control is pending completion of the final Water Control Manual in the summer of 2003.

III. CONSTRUCTION SCHEDULE

III - CONSTRUCTION SCHEDULE

3-01 General. Figure 3-1 shows the schedule for the Prado Dam embankment and outlet works construction. The overall project is scheduled for completion within three years after the start of construction. The construction schedule is subject to modification as necessary based on total project requirements. As mentioned previously, the remaining construction in the lower Santa Ana River (Reach 9) may also be done at the same time that Prado Dam is undergoing modification. Figure 3-2 shows the lower Santa Ana River (Reach 9) construction schedule. Because each project may not necessarily start at the same time, "construction years" shown in both schedules are independent from each other.

3-02. Prado Dam Construction Schedule. There will be five stages of construction involved in the Prado Dam modification. These stages are designated Stages 1, 2A, 2B, 2C, and 3. The first four stages will consist of excavation/backfill, construction of the new intake structure, and restoring the dam's embankment back to the current top of dam elevation of 566 feet, NGVD. During Stage 3, with the new outlet works operational, the entire embankment will be further raised to the new height of 594.4 feet, NGVD. All stages are shown in detail on Plates 3-01 to 3-05. Detailed information concerning project features can be found in the Corps document entitled Design Memorandum No. 1, Phase II GDM on the Santa Ana River Mainstem including Santiago Creek, Volume 2 - Prado Dam, dated August 1988. The following paragraphs provide brief descriptions of each project stage.

a. Construction Stage 1. Activities included during this stage are shown in Plate 3-01, and include excavation for the intake structure and outlet conduit (up to station 14+00), outlet channel excavation, construction of the concrete intake structure, construction of the concrete conduit transition (up to station 14+00), and construction of the access road. Prior to commencement of excavation work upstream, a cofferdam will be constructed to provide protection from inundation by reservoir pools in the elevation range between 505 feet, NGVD and 525 feet, NGVD. The cofferdam will remain to

protect the area where construction will take place during construction Stages 1, 2A, and 2B of the new outlet works. The cofferdam will be removed toward the end of Stage 2C, once the outlet gates at the new intake tower have been installed. Excavation for the stilling basin may also occur during Stage 1, or per construction contractor's schedule. Stage 1 construction will require approximately 17 months to complete.

b. <u>Stages 2A, 2B, and 2C</u>. Excavation for the new concrete outlet conduits will continue downstream from station 14+00 to station 18+13 (see Plates 3-02 to 3-04). With the construction of the concrete transition conduits and the intake structure complete, the dam's main embankment above the concrete transition conduits (up to STA 14+00) will be reconstructed up to elevation 540 feet, NGVD during Stage 2A. During Stage 2B, the main embankment will be further restored up to elevation 566 feet, NGVD, which is the current top of dam elevation. Construction of the concrete conduit from station 14+00 to station 18+13 will be completed during Stage 2C. The construction of the concrete stilling basin structure may also be done during Stage 2C, or per construction contractor's schedule. Also during Stage 2C, the outlet gates will be completely installed. Following the installation of the outlet gates is the excavation for the upstream approach channel and construction of the intake retaining walls. As mentioned, the cofferdam will be removed after the outlet gates have been installed. Construction of Stages 2A, 2B, and 2C will require approximately 12 months.

c. <u>Stage 3</u>. During this stage, the dam's embankment will be constructed up to elevation 594.4 feet, NGVD. Also to be constructed during this stage are the road to the maintenance deck and to the stilling basin, the generator tower, and the tower access bridge. All of the mechanical and electrical equipment for the operation of the new outlet gates will be installed. The existing intake tower will not be removed until the new intake tower is operational. A pilot channel will be excavated to create a new flow path for drainage toward the new outlet works. See Plate 3-05 for details of this stage. Construction in this stage will require approximately 12 months to complete.

3-03. <u>Lower Santa Ana River Construction Project (Reach 9)</u>. Figure 3-02 outlines the construction schedule for Reach 9 of the Lower Santa Ana River channel. The Reach

9 channel segment extends from the Prado Dam Outlet Channel to the Weir Canyon Road bridge crossing. During the modification of Prado Dam, this final phase of the lower Santa Ana River construction project may also be taking place. If such is the case, releases from Prado Dam will have to be coordinated with the status of the downstream construction, as necessary. Prior to the start of each flood season pre-storm season meetings are conducted between the Corps of Engineers, the Orange County Public Facilities and Resources Department (OCPF&RD), the Orange County Water District (OCWD), the National Weather Service, and any others that are impacted by the operations at Prado Dam. These pre-storm season meetings serve to identify the status of all on-going construction projects upstream and downstream of Prado Dam and to coordinate notification procedures for emergencies. The contractors for Reach 9 must prepare their own contingency plans for emergency evacuation, and coordinate this plan, if necessary, with the Corps (Reservoir Regulation Section).

When completed, the Reach 9 long-term channel capacity will be increased to 30,000 cfs. Brief descriptions of the scope of the Reach 9 construction are provided in the following paragraphs. Plate 3-06 shows the locations of construction within Reach 9 of the Santa Ana River. References to the left and right side of the channel are based upon looking in the downstream direction.

a. <u>Upper Highway 91 Embankment</u>. Immediately downstream of the drop structure and gaging station below Prado Dam, the existing slope of Highway 91 on the left bank of the Santa Ana River is currently unprotected. The Reach 9 construction includes stabilization measures to reinforce the 91 Freeway embankment. The approximately 2,000 feet of bank protection would consist of a 33-inch thick riprap overlay with the top bank elevation varying from 449 feet, NGVD to 454 feet, NGVD, with corresponding toe elevations that vary from 425 feet, NGVD to 430 feet, NGVD.

b. <u>Green River Housing Estate</u>. The Green River Housing Estate (GRHE) is just upstream of the Atchison, Topeka and Santa Fe (AT&SF) railroad on the left bank of the Santa Ana River channel. The existing slope has already failed in areas where the

river impinges upon it. The existing riprap is therefore inadequate to handle 30,000 cfs and additional toe-down is needed. The proposed bank stabilization in this reach segment would protect the GRHE upstream of the AT&SF railroad embankment. The proposed revetment varies between a 27-inch thick riprap layer to a 15-inch thick layer of grouted stone. The top of bank protection elevations vary from 439 feet, NGVD to 446 feet, NGVD while the corresponding toe elevations would vary from 402 feet, NGVD to 416 feet, NGVD.

c. Green River Mobile Home Park. The Green River Mobile Home Park (GRMPH) is located just downstream of the AT&SF railroad on the left bank of the Santa Ana River channel. As documented in the Phase II GDM, the GRMHP requires approximately 1,600 feet of new levee in order to safely pass the design discharges from the modified Prado Dam outlet works. The proposed levee would extend upstream to the AT&SF railroad abutment and would be armored with a 15-inch thick layer of grouted stone. The top of bank protection elevations will range from 432 feet, NGVD to 437 feet, NGVD, while the toe elevations will vary from 397 feet, NGVD to 401 feet, NGVD.

d. Green River Golf Course. The existing channel through the Green River Golf Course includes a concrete lined low flow channel. In order to protect the 91 freeway from flood discharges, Caltrans improved the left bank of the channel with soil-cement protection with a toe depth of 5 feet. This improvement, however, was found to be inadequate for increased release rates which would result from the modification of Prado Dam outlet works. The proposed improvements would provide an increased toe depth to 20 feet along approximately 5,500 feet with a 15-inch grouted riprap revetment.

e. Lower Highway 91 Embankment. Caltrans has improved the left bank of a segment of Reach 9 located between Gypsum Canyon Road and Weir Canyon Road with an existing soil-cement lining that extends approximately 5 feet below the surface in order to protect Highway 91 from flood discharges. Past storm flows have damaged the bank protection in this area, and low flows are currently impinging on the bank. Under the Santa Ana River project, this improvement will be replaced by a bank protection

ranging from a 21-inch thick riprap layer to a 25-inch thick grouted stone layer to a depth of 10 feet extending approximately 1,900 feet. The top of the new bank protection would range from elevation 360 feet, NGVD to elevation 365 feet, NGVD. The toe elevations would range from 330 feet, NGVD to 338 feet, NGVD.

f. Car Wash and Strip Mall Protection. North of Weir Canyon Road, there is a mini-mall on top of a bluff approximately 50 feet above the riverbed. The low flow channel of the Santa Ana River is currently impinging on the bank in this area and there is evidence of two active slope-failure slides as well as a 6-inch settlement of the building closest to the cliff. Under the lower Santa Ana River project, bank protection consisting of a 550-foot length of grouted stone revetment will be provided in this area. The top of the bank protection would vary from elevation 335 to 344 feet, NGVD. Toe elevations range from 313 to 316 feet, NGVD, which is approximately 5 feet below the channel thalweg.

FIGURE 3-1. PRADO DAM EMBANKMENT AND OUTLET WORKS CONSTRUCTION SCHEDULE

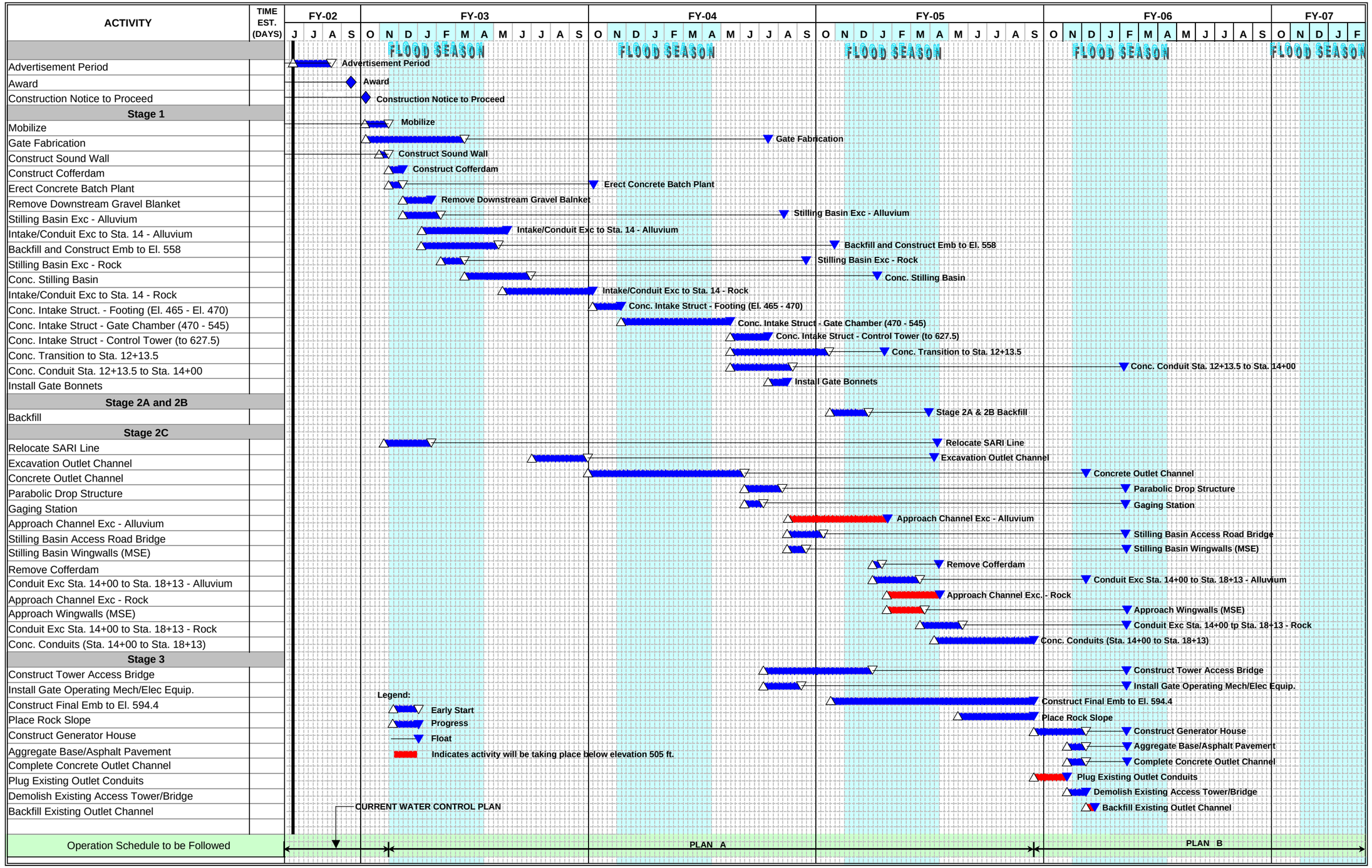


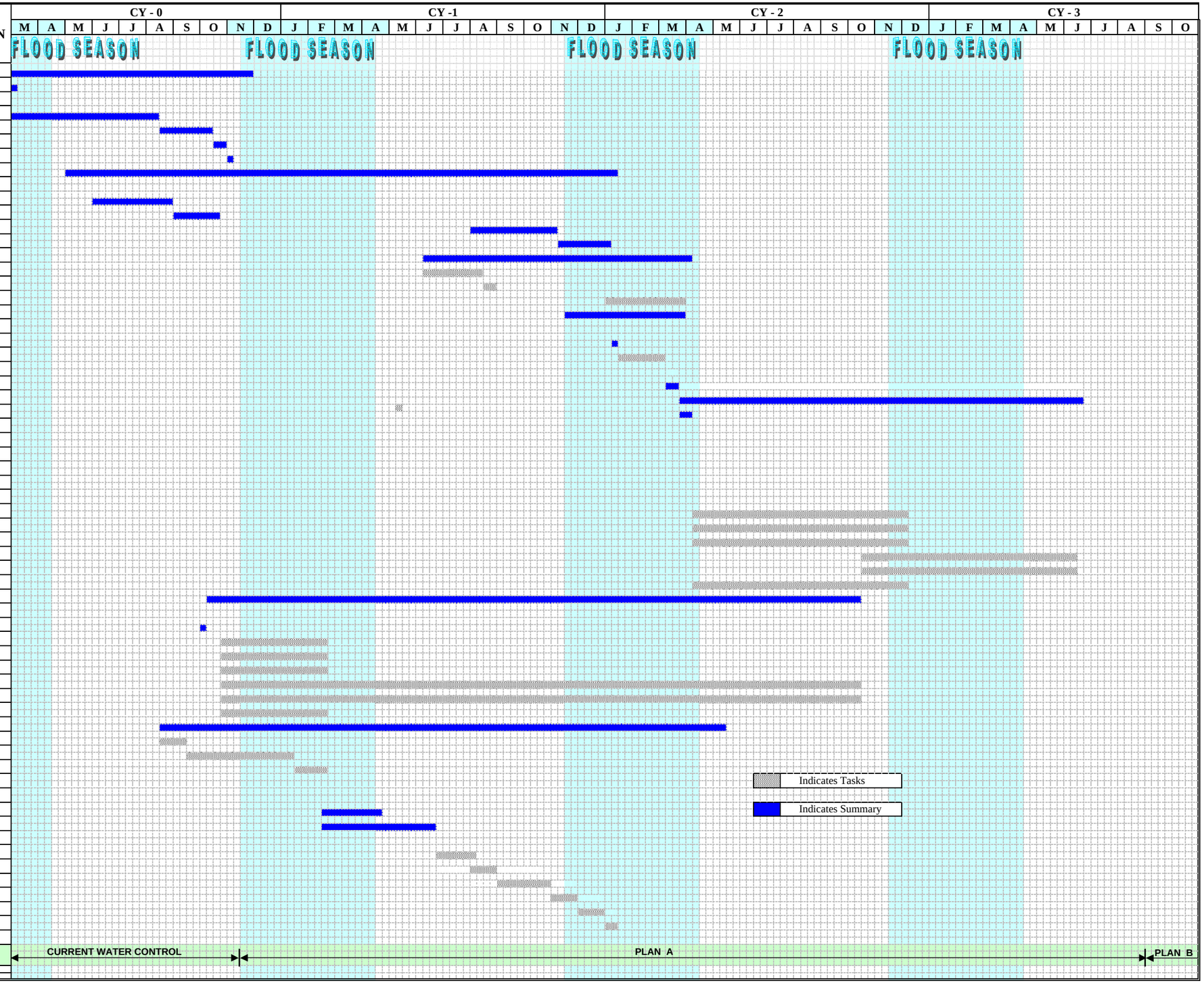
FIGURE 3-1

Notes:

1. During the construction period when "PLAN A" will be followed, operation of the dam will be performed by using the existing outlet works and the height of the dam's embankment limited by the height of the coffer dam (El 525 ft).
2. During the construction period when "PLAN B" will be followed, operation of the dam will be performed by using the new outlet works and the dam's embankment restored back up to elevation 566 ft.
3. Construction years shown in this figure are independent from construction years shown on Figure 3-2.

FIGURE 3-2. LOWER SANTA ANA RIVER (REACH 9)
CONSTRUCTION SCHEDULE

ID	TASK NAME	DURATION
1	**Design Memorandum (DM)**	**186d**
2	DM initiated	0d
3	Pre-design Meeting	1d
4	Interim DM due/review	123d
5	Final DM due/review	40d
6	Sponsor completes review	18d
7	DM approved	4d
8	**Plans & Spec's (P&S)**	**420d**
9	P&S initiated	0d
10	Preliminary P&S/review	65d
11	Intermediate P&S/review	40d
12	Final P&S/review	55d
13	P&S Approved	40d
14	**Clearing & Grubbing, if req.**	**205d**
15	Clearing & Grub Eng'g	60ed
16	Clreaing & Grub Proc. (IDIQ)	15ed
17	Clearing & Grub Work	90ed
18	**Construction Procurement**	**92d**
19	Advertise/CBD	0d
20	Issue P&S	5d
21	Bid Duration	45ed
22	Bid Opening	0d
23	Award	10d
24	**Construction (Phased)**	**314d**
25	Notice to proceed	10d
26	Constr. Start 1	0d
27	Constr. Start 2	0d
28	Constr. Start 3	0d
29	Constr. Start 4	0d
30	Constr. Start 5	0d
31	Constr. Start 6	0d
32	Constr. Finish 1	240ed
33	Constr. Finish 2	240ed
34	Constr. Finish 3	240ed
35	Constr. Finish 4	240ed
36	Constr. Finish 5	240ed
37	Constr. Finish 6	240ed
38	**Real Estate**	**529d**
39	Coordination Mtg	0d
40	Site tour (determine access)	1d
41	1) Yorba Sur Levee	120ed
42	2) CALTRANS 1 (soil cmnt)	120ed
43	3) CALTRANS 2 (soil cmnt)	120ed
44	4) Mobile Home Park	720ed
45	5) Green River Housing	720ed
46	6) CALTRANS 3 (Bank)	120ed
47	**Environmental (SEIS)**	**397d**
48	Formulation of Alternatives	30ed
49	Prep. Draft Preli. EISA	120ed
50	I/H Review	30ed
51	NEPA Notice of Intent	0d
52	CEQA Notice of Preparation	0d
53	Preliminary Draft SEIS/R	45d
54	BA	40d
55	Draft SEIS/R	0d
56	Public Review	50ed
57	Final SEIS/R	25ed
58	Final Agency Review	60ed
59	ROD	30ed
60	BO	30ed
61	Input into P&S	15ed
62	Permits, if any	120ed
	Operation Schedule to be Followed	



Note: Construction years shown on this figure are independent from the construction years shown on Figure 3-1.

FIGURE 3-2

IV. DIVERSION AND CONTROL OF WATER DURING CONSTRUCTION

IV - INTERIM WATER CONTROL PLAN DURING CONSTRUCTION

4-01 **General**. During the entire construction period, Prado Dam will be operated to meet the following objectives in order of priority: 1) preserve dam safety; 2) provide flood control; 3) provide water conservation; and 4) facilitate construction inside the basin and in Reach 9 of the Santa Ana River project downstream. The operation during the entire construction period is divided into two main plans; Plan A - Using the Existing Outlet Works, and Plan B - Using the New Outlet Works. The progress of construction will dictate the activation of each plan as shown on the construction schedule on Figure 3-1. This document currently contains Plan A, which will be effective during construction stages 1, 2A, 2B and 2C. The document will be updated to contain Plan B prior to the start of construction stage 3.

The condition of the Santa Ana River channel downstream and possible construction activities occurring at the same time as the construction of Prado Dam could pose constraints to the operation of the dam. As a result, flexibility is included in the interim plan to allow the appropriate operation of the dam under any downstream condition. Section 4-02 describes the known possible causes of constraints.

4-02. **Possible Downstream Channel Limitations.** Possible limitations within the downstream Santa Ana River during the effective period of this interim plan are as follows:

a. **Existing Santa Ana River Interceptor Line (SARI)**. The SARI line is a regional sewer pipeline that serves Orange, Riverside and San Bernardino Counties. Orange County Sanitation District (OCSD) owns and maintains the lower (downstream) 23 miles of the pipeline, from the Orange/San Bernardino County Line to the OCSD sewage treatment plant in Fountain Valley. The upstream most four miles of the OCSD's segment of the pipeline was constructed under the Santa Ana River, from the county line to the eastern boundary of the SAVI Ranch. The OCSD has reported that this segment may be damaged when outflows from Prado Dam into the lower Santa Ana River exceed

5,000 cfs. Outflows greater than 5,000 cfs will require monitoring of the downstream channel and the SARI line by OCSD, and adjustments to Prado Dam releases will be made as appropriate. Chapter 5 of this document contains the necessary notifications and coordination between the Corps and the local agencies.

b. Possible Construction Activities –Lower Santa Ana River Project (Reach 9). During some stages of the Prado Dam construction period, the final phase of the Lower Santa Ana River Project (Reach 9) could also be under construction. The channel capacity during this period could be limited and will vary depending on the progress of the Reach 9 construction. Critical outflow rates will be determined in each phase of the downstream construction, and adjustments to the Prado Dam releases will be made as appropriate.

c. Possible Construction Activities during the relocation of the SARI line. The Orange County Sanitation District and the Santa Ana Watershed Project Authority are currently considering improvements to and realignment of the existing SARI line. Construction activities to implement these modifications could occur during the effective period of this interim plan. The channel capacity during this period may be limited and will likely vary depending on the progress of the SARI line construction. Critical outflow rates will be determined in each phase of the SARI line construction, and adjustments to the Prado Dam releases will be made as appropriate.

d. Bank Protection and Bridges within the Santa Ana River between Prado Dam and Weir Canyon Road. As a result of the recent completion of the lower Santa Ana River construction (Reach 1 to Reach 8), the available downstream channel capacity has increased from a minimum of 37,000 cfs starting at Weir Canyon Road up to a maximum of 47,000 cfs at its most downstream reach. This new capacity is more than sufficient to convey the outflow that can be physically made from the existing Prado Dam outlet works. However, in its current state, the Santa Ana River from Prado Dam to Weir Canyon Road (Reach 9) has never carried more than a 6,000 cfs release from Prado Dam and most likely would begin to suffer damage if flows were to exceed 5,000 cfs.

In addition to the items discussed in 4-02 above, areas where damage may occur include the reaches of existing bank protection, which is to be upgraded as part of the Reach 9 Santa Ana River Project, and the bridge crossing within the Green River Golf Course.

e. Construction of the Groundwater Replenishment System (GWRS) Pipeline. This is a proposed joint project between the Orange County Water District and the Orange County Sanitation District to construct a facility for high quality recycled wastewater from the Advanced Water Treatment Facility in Fountain Valley south of the 405 freeway, to the Kraemer and Miller recharge basins lying northerly of Miraloma in Anaheim. This project proposes to install a steel pipeline, varying in size from 60-inch to 78-inch diameter and approximately 13 miles long. The groundwater recharge pipeline will be constructed in the westerly levee of the Santa Ana River for its entire length from the Advanced Water Treatment Facility to Highway 91, and along the Carbon Canyon Diversion Channel to the recharge basins. The estimated completion time for this project is in 2007. Currently, it is in the design phase.

4-03 Interim Water Control Plan. This interim water control plan (Plan A) was developed using the existing outlet works and is to be effective during construction stages 1, 2A, 2B and 2C. During construction stage 3, the plan will be updated to utilize the dam's new outlet works (Plan B).

a. Plan A - Using the Existing Outlet Works. This operation plan was developed based on the following: 1) the current approved water control plan as contained in the Prado Dam Water Control Manual, dated September 1994, 2) the April 1995 cooperative agreement signed by the Corps of Engineers, Orange County Water District and the U.S. Fish and Wildlife Service regarding seasonal additional water conservation, 3) the USFWS' Biological Opinion titled "Section 7 Consultation on the Prado Basin Water Conservation and Water Control Operations Project, Prado Basin, Riverside and San Bernardino Counties, California (1-6-99-F-75)", dated February 10, 2000, and 4) the construction activities as contained in the Santa Ana River - Phase II GDM, Volume II, Prado Dam, dated August 1988. Provisions were also made in

consideration of the possible construction activities and the condition of the lower Santa Ana River discussed in Section 4-02 above. This operation plan will be in effect during Prado Dam construction stages 1, 2A, 2B, and 2C (see Figure 3-1), during which time, the dam will be operated using the existing outlet works to provide water conservation benefits and flood control protection. Protection of the new outlet construction is to be provided by a cofferdam with a top elevation of 525 feet, NGVD. Overtopping the cofferdam would result in inundation of the new outlet works construction area.

Plate 4-01 shows the release schedule for Plan A - Using the Existing Outlet Works. Under "normal conditions", the release rate is determined by the water control manager at the Reservoir Operation Center (ROC), Los Angeles District after close examination of the current hydrometeorologic conditions, the weather and runoff forecasts for the Santa Ana River Basin, the condition of the downstream channel, and the state of the on-going construction activities both at the dam and in the downstream channel. Available forecast methods are outlined in Chapter 6 of the current Prado Dam Water Control Manual, dated September 1994. It should be noted that the upper water surface elevations for each release range are "target" water surface elevations. Since weather and runoff forecasts are rarely 100% accurate, it is anticipated that the target water surface elevations will, at times, be exceeded without a corresponding change in release. Whether or not the water control manager deems it necessary to implement the next release recommended in the schedule will depend upon the magnitude of the encroachment into the next elevation range, the current weather and runoff forecast, and concurrent downstream conditions. The following paragraphs detail the operation schedule shown on Plate 4-01.

(1) <u>WSE 460.0 - 490.0 (Debris Pool)</u>. (Release range: 0-600 cfs) The debris pool is allowed to fill prior to flood control releases in order to prevent debris from entering and plugging the outlet works. There are no seasonal restrictions for inundation of the debris pool. Releases from the debris pool are normally coordinated with the OCWD and are set equal to the spreading capacity of the downstream groundwater recharge facility.

(2) <u>WSE 490.0 - 494.0*/505.0 (Buffer Pool)</u>. (Release range: 200/500 - 5,000 cfs). The purpose of the buffer pool is 1) to ease the transition between small debris pool releases and relatively large flood control releases, 2) to facilitate downstream water conservation through groundwater recharge when it will not impact flood protection, 3) to simplify the lengthy notification process, and 4) to buy some time for downstream activities and interests to prepare for and recover from larger releases.

Due to the increasing need for water conservation and the presence of the endangered Least Bell's vireo (LBVI) within the Prado Flood Control Basin, buffer pool regulation differs during the winter flood season and the non-flood season as described below.

(i) <u>Winter Flood Season</u>. (1 October to 28 February; Release Range 200 – 5,000 cfs). During the Winter Flood Season, the top of the buffer pool is at elevation 494 feet NGVD. Within this pool, the appropriate release rate is calculated based on a real-time forecast of inflow volume. If it is expected that the buffer pool space will not be needed for flood control, the pool may be allowed to fill and the release rate adjusted in coordination with the groundwater recharge efforts of OCWD, with a normal minimum release of 200 cfs. If it is expected that the buffer pool space will be needed for flood control, the buffer pool will be evacuated with a maximum release rate of 5,000 cfs. If there is significant construction activity downstream, the water control manager has the discretion to moderate releases based upon an evaluation of the impacts to the construction versus the effect upon the level of flood protection provided by the project. If releases are increased to flow rates that could impact construction activities in the downstream channel, coordination with personnel responsible for the construction project(s) will be made in order to minimize damages. Prior to making potentially

---

* With the acceptance of the latest Water Conservation Feasibility Study, elevation 494 ft, NGVD may be increased to 498 ft, NGVD during construction of new Prado. Water conservation operation up to elevation 498 feet will be able to commence after (1) the Assistant Secretary of the Army for Civil Works approves the Prado Basin Water Supply Feasibility Study final report-environmental impact statement and signs the Record of Decision, and (2) all of the environmental commitments and implementation requirements are in place.

damaging releases, a channel observation team will be dispatched to key locations of the downstream channel, the unprotected areas of the on-going construction activities, and other areas susceptible to damage during large flows.

(ii) <u>Non-Flood Season</u>. (1 March to 30 September; Release Range 500 – 5,000 cfs). As agreed upon in the MOA signed in 1993 by the Corps, the USFWS and OCWD to increase water conservation, the size and operation of the buffer pool are modified during the non-flood season. Beginning on the 1st day of March, the allowable maximum reservoir water surface elevation is increased from water surface elevation 494 feet, NGVD to water surface elevation 505 feet, NGVD by the 10th of March, at a rate of 1.1 feet/day, or higher, at the discretion of the water control managers within the Reservoir Operation Center (ROC). The decision will be based on, but not limited to, the following: 1) the condition of the dam, 2) the current reservoir status, 3) forecasted inflow, 4) the capacity/condition of the downstream channel, and 5) on-going construction activities both in the channel and at the dam site. The reservoir elevation may be maintained as high as WSE 505 feet, NGVD, until 31 August, provided that hydrologic forecasts and reservoir conditions do not indicate that reservoir elevation will rise above elevation 505 feet, NGVD. This operation helps to prevent the endangered least Bell's Vireo (LBVI) from nesting and rearing their young within the reservoir area below elevation 505 feet, NGVD. Nesting season for the LBVI usually starts in the middle of March and lasts until late summer. The operation of the dam in this range is dictated by the agreement among the USWFS, the Corps and the OCWD as contained in the 2000 Biological Opinion:

> "*Because the paragraph 9 of the 1995 Cooperative Agreement was found to be inconsistent with the physical and operational capabilities for Prado Dam, the Corps revised the minimum release rates during the non-flood season. During the period from March 1 – September 30, the release rates when the pool is between 494 feet and 505 feet may range from 350 cfs to 650 cfs provided the running average outflow is always greater than or equal to 500 cfs. Release rates tend to be higher at the*

beginning of the season and taper off toward the end of the season. Therefore, the running average for the period from March 1 – September 30 when the pool is between 494 feet to 505 feet would tend to start above 500 cfs and gradually approach 500 cfs as the season progresses. In addition, when the OCWD spreading capacity exceeds 500 cfs, the outflow from the dam will be increased up to a level of the recharge capacity of the OCWD downstream recharge basins."

However, if, based on observed precipitation, hydrologic forecasts and reservoir conditions indicate that the WSE will exceed 505 feet because high inflow, the water control manager at the ROC will match inflow with outflow, up to 5,000 cfs to prevent the reservoir from exceeding elevation 505 feet, or an elevation within 3 feet of the elevation of the lowest occupied vireo nest located lower than 505 feet. OCWD shall furnish the elevation of the lowest located vireo nest to the Corps Reservoir Regulation Section and shall update this information as necessary throughout the vireo nesting season (15 March – 31 July). If vireo nests can be relocated to a higher position, the level of the water surface can be raised to an elevation no higher than 3 feet below the elevation of the lowest located nest, to a maximum elevation of 505 feet. If no occupied nest exits below 505 feet, water can be held to 505 feet as long as the lowest vireo nest is located no lower than 506 feet. If a pool elevation of 505 feet is exceeded, the dam releases at the maximum non-damaging rate (i.e., 5,000 cfs) will be maintained until the pool level has declined to 505 feet.

Typically, if sufficient inflow is available, the water conservation pool is incrementally raised (per 1994 Water Control Plan and adjusted operations for water conservation) from 494 feet to 505 feet between March 1 and March 10. However, if the reservoir is empty and an impending storm may fill the water conservation pool after March 10, the

Corps will contact the Service and OCWD to coordinate the movement of vireo nests, if necessary.

The months of July, August and September are designated for maintenance purposes. However, if summer flood runoff occurs during these months, the dam can be operated to store water for water conservation up to WSE 505 feet, provided that the impoundment does not interfere with the maintenance requirements."

(3) <u>WSE 494.0/505.0 - 520.0</u>. (Nominal Release: Up to 10,000 cfs). Within this pool, the appropriate release rate is calculated based on a real-time forecast of inflow volume. If the water surface elevation within the reservoir is not forecast to reach elevation 543 feet NGVD, then releases will match inflow up to 5,000 cfs with the goal being to have the reservoir pool at the top of the buffer pool at the end of any forecast flood event. However, if inflow forecasts indicate that the reservoir water surface may reach spillway crest (543 feet, NGVD), releases will be increased up to 10,000 cfs. Prior to making releases greater than 5,000 cfs, channel observation and hydraulic verification teams will be dispatched to key locations of the downstream channel, areas of concern within the on-going construction activities, and other areas susceptible to damage during large flows. Although protecting the downstream construction is of secondary importance, the water control manager has the discretion to adjust releases based upon an evaluation of the impacts to downstream interests versus the effect upon the risk to construction protected by the cofferdam within the basin and the overall level of flood protection provided by the project.

If necessary, a dam safety inspection team will dispatched to monitor the condition of the dam embankment and the cofferdam. During recession, the resulting maximum release shall be maintained for as long as necessary in order to safely evacuate the excess reservoir pool as quickly as possible. Note that the design capacity of the stilling basin is 10,000 cfs.

(4) <u>WSE 520.0 – 525.0 feet, NGVD</u> (Nominal Release: Up to 10,000 cfs). Within this elevation range, the appropriate release is calculated based on real-time forecast of inflow volume. If the water surface elevation is forecast not to exceed 525 feet and overtop the cofferdam, limit the release to a maximum of 5,000 cfs. However, if the forecast indicates that the water surface elevation will exceed 525 feet while outflow is kept at 5,000 cfs, the water control managers will need to evaluate the benefits and risks and consider increasing the outflow as necessary to prevent overtopping the cofferdam. Prior to making releases greater than 5,000 cfs, channel observation and hydraulic verification teams should be dispatched to key locations of the downstream channel, areas of concern within the areas of on-going construction site, and other areas susceptible to damage during large flows. Although protecting the downstream construction is of secondary importance, the water control manager has the discretion to adjust releases based on the evaluation of the impacts to downstream interests versus the risk to construction protected by the cofferdam within the basin and the overall level of protection provided by the project.

The maximum design capacity of the existing Prado outlet works is 10,000 cfs. If a decision is made to exceed this release rate, extreme caution should be used. A dam safety inspection team should be present at the site to monitor the condition of the outlet works and dam embankment whenever releases greater than 10,000 cfs are made. Note that the maximum possible release rate within this elevation range is dictated not by the outlet gates, but by the two conduits, and it ranges from 14,140 cfs at elevation 520 feet, NGVD to 14,800 cfs at 525 feet, NGVD. During recession, the resulting maximum release shall be maintained for as long as necessary in order to safely evacuate the excess reservoir pool as quickly as possible.

(5) <u>WSE 525.0 - 543 feet, NGVD</u> (Nominal Release: Up to 10,000 cfs). Pool elevations greater than 525 feet, NGVD overtop the cofferdam and subject the upstream construction site to flooding. If there is a reasonable expectation that spillway flow will occur, the resulting maximum release from the previous elevation range will be maintained in order to minimize the maximum forecasted spillway flow from the dam.

As with the lower pool elevation ranges, the water control manager maintains the discretion to adjust releases based upon an evaluation of the impacts to downstream interests versus the effect upon the risk to the overall level of flood protection provided by the project. The maximum release rate physically possible within this elevation range is from 14,100 cfs to 17,000 cfs.

The maximum design capacity of the existing Prado outlet works is 10,000 cfs. If a decision is made to exceed this release rate, extreme caution should be used. A dam safety inspection team should be present at the site to monitor the condition of the outlet works and dam embankment whenever releases greater than 10,000 cfs are made. During recession, the resulting maximum release shall be maintained for as long as necessary in order to safely evacuate the excess reservoir pool as quickly as possible.

(6) <u>WSE 543 and above (Spillway Flow)</u>. Once elevation 543 feet, NGVD is reached, the operation of the dam shifts to primarily minimize the possibility of overtopping the dam, which could lead to a dam failure. If overtopping of the embankment or dam break is not imminent at the low end of this elevation range, the outlet gates can be operated in conjunction with the spillway to maintain the resulting maximum outflow prior to spilling, in order to minimize flood damages downstream. With all gates closed, spillway flow discharge of 5,000 cfs is reached at water surface elevation 544.30 feet, NGVD; 9,200 cfs at elevation 545.00 feet, NGVD; and a discharge of 17,000 cfs at elevation 545.97 feet, NGVD. As the water level approaches the spillway crest elevation, frequent communication between the ROC and the dam tender is necessary so that gate adjustments can be made to transfer reservoir outflow from the outlet works to the spillway. Under the extremely remote circumstance that the embankment is in danger of overtopping, or if a dam failure is imminent, the outlet works gates are to be set to their maximum opening of 12 feet in order to minimize the possibility of a dam break.

The maximum design capacity of the existing Prado outlet works is 10,000 cfs. If a decision is made to exceed this release rate, extreme caution should be used. A dam

safety inspection team should be present at the site to monitor the condition of the outlet works and dam embankment whenever releases greater than 10,000 cfs are made. During recession, the resulting maximum release shall be maintained for as long as necessary in order to safely evacuate the excess reservoir pool as quickly as possible.

4-04. Channel Observation Teams. If it is expected that damaging releases will be made, channel observation teams will be dispatched by OCPF&RD and/or the Corps to observe the hydraulic performance of the channel and report channel conditions to the ROC. The water control manager at the ROC gives instructions and directs the channel observation teams to the channel reaches that need to be observed. As releases from the dam are cut back, the water control manager in the ROC will decide on when to terminate observation of the downstream channel.

4-05. Rate of Release Change. Based upon operational experience, the maximum permissible rate of release changes shown below are followed under normal operating conditions. Since the interim operation plan contained in this manual requires the presence of channel observation teams when critical releases are made from the dam, the permissible rate of release changes can be modified during flood operations, as necessary, depending on the observed condition of the channel. Each gate adjustment should be carefully coordinated with the channel observers.

Table 4-1

Suggested Rate of Release Change
Prado Dam

Current Rate of Release (cfs)	Maximum Rate of Release Change per ½ Hour (cfs)
0 – 300	100
300- 1,000	250
1,000 – 2,500	400
2,500 – 5,000	625
>5,000	750

4-06. Level of Protection. The highest water surface elevation ever recorded at Prado dam was at elevation 528 feet, NGVD in February 1980. During the construction of the new outlet works, a cofferdam with a crest elevation of 525 feet, NGVD will be constructed to provide a 40-year level of protection to the construction area.

4-07 Flood Emergency Action Plan. As stated in Design Memorandum No. 1, Phase II GDM on the Santa Ana River Mainstem including Santiago Creek, Volume 2 - Prado Dam, dated August 1988, in the event an evacuation of the downstream areas becomes necessary, the existing Flood Emergency Plan, dated November 1985, will be followed. This document also covers identification of impending and existing emergencies, notification of other parties about impending or existing emergencies, emergency operations and repairs, and post earthquake response procedures. Downstream areas potentially subject to inundation are identified by a set of inundation maps for the case of dam failure with the reservoir at full capacity. Further details on the Flood Emergency Action Plan are provided in section 5-02.

V. FLOOD NOTIFICATION PLAN

V - FLOOD NOTIFICATION AND COORDINATION PLAN

5-01 **Hydrologic Data Gathering Network**. The current network of hydrologic data gathering facilities established in the Santa Ana River watershed will be utilized to provide real time information during the period of construction. The existing network consists of gages that monitor and collect precipitation, stream flow, and reservoir water surface elevation (WSE) data. Plate 5-01 shows the locations of water surface elevation, and stream, gages pertinent to the operation of Prado Dam. Precipitation gages pertinent to Prado Dam's operation are shown on Plate 5-02. Hydrometeorological data measured at the dam and other gages are transmitted to the Los Angeles District, Corps of Engineers by the Los Angeles Telemetry System (LATS).

The telemetry system is an event-reporting system in which the stations automatically report when a threshold is reached. The current threshold for reporting is every 0.04 inches of rain for rain gages and $\pm$ 0.25 feet for reservoir and stream level gages. Whenever a threshold is exceeded, the station sends a report via an FM radio signal to one of the Southern California radio repeaters located at Pleasants Peak, Mt. Disappointment, or Keller Peak. The receiving repeater then relays the report via microwave transmission to receivers located at the Federal Building in downtown Los Angeles and at the Corps Baseyard in El Monte, California. Data received at the Baseyard is primarily utilized internally by the LATS Central computer. Data received at the Federal Building is transferred to data collection computers at the Los Angeles District Office via a dedicated T1 circuit. The data collection computers then decode the messages and make them available for storage in HECDSS files. Summary reports of telemetry values are updated periodically and are available for viewing via the main menu on the water control data system computer or via the Reservoir Regulation Section Web Page. The locations of the hydrometeorological instrumentation at Prado Dam are shown on Plate 5-01.

The Reservoir Operation Center (ROC) also uses a voice radio communication network to talk to the dam tender at Prado Dam. The dam tender observes precipitation,

the water surface elevation of the reservoir, the water stage elevation at the downstream gage, and gate settings at Prado Dam and reports the observations to the ROC. During flood control operations, staff within the ROC set the reporting intervals for the dam tender to take and report these observations.

5-02. <u>Notification and Coordination Plan.</u> During storm operations, Reservoir Operation Center (ROC) personnel notify all private and public agencies affected by the operation of LAD projects, which includes Prado Dam. These notifications pertain to the possibility of flooding in a basin and anticipated changes in reservoir releases. The notifications facilitate the coordination of reservoir operations with other LAD organizations, and other Federal and local government agencies with water conservation, flood control, and public safety related responsibilities.

The ROC maintains a list of these agencies and organizations, which are contained in an annual LAD publication, entitled "Instructions for Reservoir Operations Center Personnel"(also known as the "Orange Book"), and in an electronic file used for making actual notifications ("Electronic Orange Book"). The ROC also maintains a "Restrictions List" of notifications to be made for temporary conditions. This list contains notifications and individual organizations engaging in temporary activities, such as contractors working in areas that could be affected by reservoir operations. The "Electronic Orange Book" also includes the "Restrictions List" notifications. In preparation for the flood season each year, ROC personnel meet with the different local government, other Corps organizations and other Federal agencies. For Prado Dam, a coordination meeting between the Corps of Engineers, the National Weather Service, the Orange County Department of Public Facilities and Resource Department (OCPFRD), the Orange County Water District (OCWD) and other agencies is held annually at the OCPFRD maintenance yard in the city of Anaheim. Issues that affect the operation of the dam, including the activities of the local agencies are discussed in this meeting.

OCPFRD staff patrols the Santa Ana River during storm events. These staff provide channel observations of the Santa Ana River when requested by the ROC.

Problem areas are reported by the OCPFRD to the ROC. Over the past few years, the Orange County Sanitation District's (OCSD) SARI line has shown signs of stress from the high flows on the Santa Ana River. A study performed recently by OCSD has identified segments of the SARI line that could be exposed and damaged by significant discharge. These segments are shown on Plate 5-03 of this manual.

Due to the increased releases in the plan contained in this document, the changing conditions of the dam, and of the river channel, the implementation of the water control plan will rely on close coordination between the ROC and the local agencies, such as the OCPFRD and OCSD, and the Corps construction field office prior to and during storm events. Known constrictions and necessary notifications and coordination will be included in the "Orange Book", and the "Electronic Orange Book will be updated as necessary. As part of the Reservoir Regulation Section's preparation prior to each flood season, coordination with OCFPRD, OCSD and other agencies will be made to focus on the conditions of the channel and the dam construction. Established procedures in notifications, monitoring and reporting will be modified, if necessary, to take into account changed conditions in the channel and the dam.

5-03. <u>Downstream Evacuation</u>. The current Prado Dam Emergency Action Plan was prepared in November 1985, and it describes the necessary emergency actions to take when conditions at the dam result in a hazard downstream. When warranted, flood-warning notifications will be issued by Los Angeles District personnel to local agencies, emergency officials, and key personnel within the Los Angeles District and South Pacific Division Offices. The notifications list is part of the annually updated "Instructions for Reservoir Operations Center Personnel" (the "Orange Book"), and includes the names and telephone numbers of local emergency officials in the event that an evacuation of downstream areas becomes necessary. Additionally, Corps of Engineers Los Angeles District observation teams may be notified to conduct field observations. Local emergency planning officials will be responsible for developing and implementing evacuation plans. A meeting may be held with local officials and the contractors to provide guidance on how the inundation maps may be used in evacuation planning and to

answer any questions regarding the Emergency Action Plan. A meeting may also be held prior to construction each flood season to define the responsibilities of key personnel. Should severe weather conditions result in the need for emergency action at the construction site, the Resident Engineer will coordinate with the Contracting Officer as to appropriate procedures to follow for the situation. The Contracting Officer, along with the advice of his technical staff will decide on the proper course of action with respect to construction activity.

The Emergency Action Plan document also includes inundation mapping for the areas upstream and downstream of the dam. The downstream inundation maps indicate the areas, which would be flooded under the assumed condition of a dam breach with the reservoir water surface at the current spillway crest elevation of 543.0 feet, NGVD. The downstream inundation maps are annotated with information that includes time of arrival of floodwaters, time of the peak water surface elevation, and the average overbank depth at various distances from the dam. The delineated upstream flooding area is based upon an event that has completely filled the dam to its top of embankment elevation of 566 feet, NGVD. Preparation of the maps does not reflect on the safety or integrity of Prado Dam. These maps have been prepared as part of a national program to prepare similar maps for all Federal Dams. They provide a basis for evaluating existing evacuation plans for the affected areas and development of any further plans which are needed. As stated in the Phase II GDM, the existing maps are sufficient to meet the needs of the Interim Water Control Plan during construction. Mapping of the downstream overflow areas are shown on Plates 5-04 through 5-10, and the upstream inundation map is shown on Plate 5-11.

VI. SUMMARY

VI - SUMMARY

6-01. Summary. The intent of this interim water control plan is to provide guidance for operating Prado Dam during the Prado Dam Embankment and Outlet works Construction project for the purpose of maintaining public safety, while at the same time providing flood control and water conservation benefits and facilitating project construction to the extent possible. The current Prado Dam Water Control Manual, dated September 1994 contains all the pertinent information about the existing Prado Dam and shall be used as the basis of operation for any situation not explicitly covered in this document. This document will be in use until all construction is complete. The interim water control plan contained in this document will be updated as construction progresses and the new project features come on-line, such as the completion of the new outlet works. In addition, if a situation arises where the construction schedule is significantly changed or for any other unforeseen reason, an update to the plan may be made as necessary in order to ensure the most effective operation of the dam. At the completion of the construction project, a preliminary water control plan will be developed and implemented until the final water control manual for the new Prado Dam is finalized.

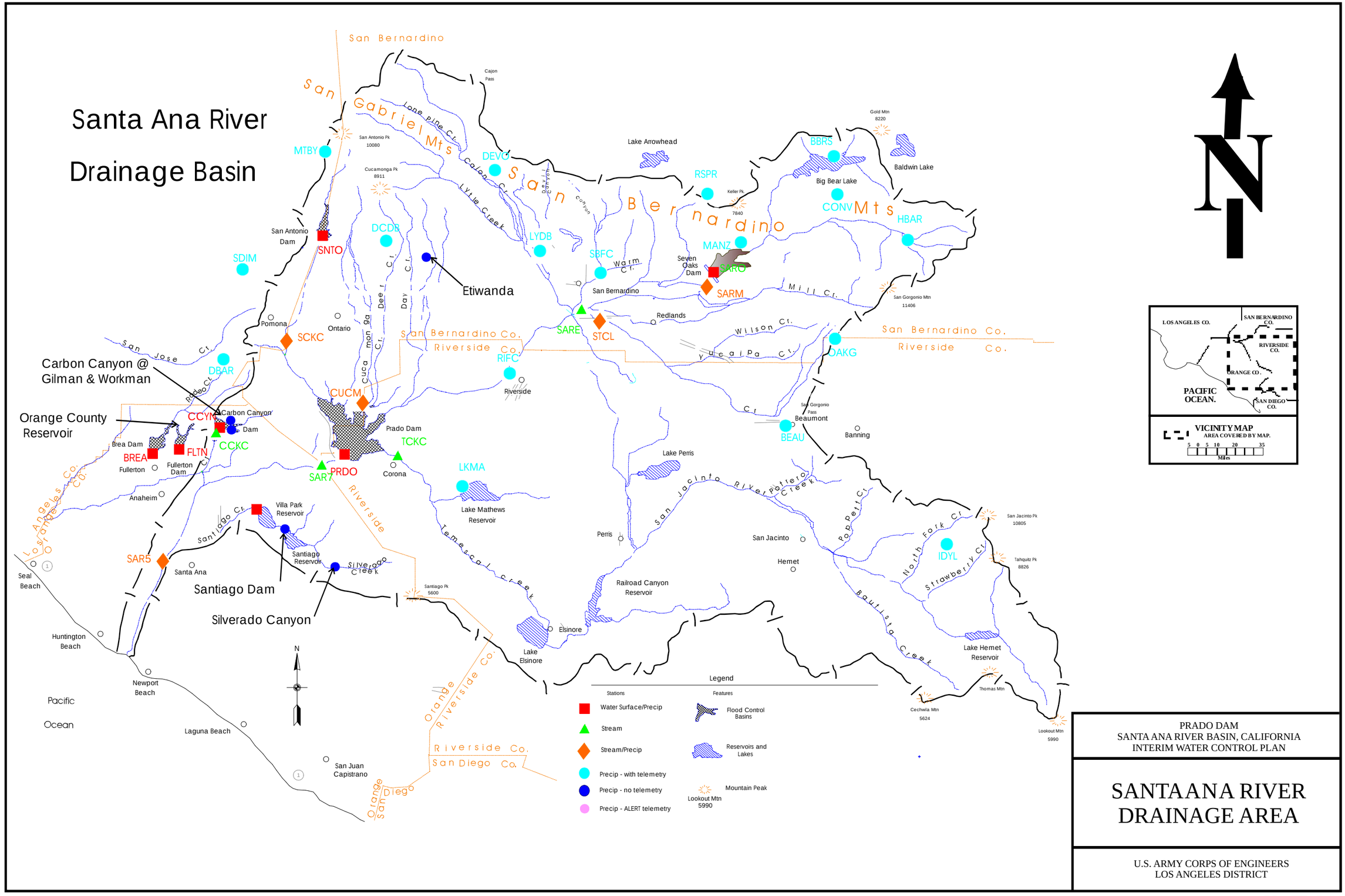
Due to the current condition of the lower Santa Ana River channel and possible overlapping of construction activities at the dam and in the downstream channel, flexibility is incorporated into this interim water control plan, in order to optimize the dam's operation as much as possible. Contractors for the Prado Dam construction, as well as Reach 9 - Santa Ana River Project, or any other project scheduled during the time frame may be required to plan, design, construct, and operate features necessary for operation that are not covered in this interim water control plan. The contractors will also be responsible for ensuring that their project sites maintain sufficient diversion capacity to accommodate releases from Prado Dam and to coordinate available channel discharge capacities with the Corps (Reservoir Regulation Section), as necessary.

The dam will be operated to provide seasonal water conservation benefits during the entire construction period, in accordance with the April 1995 Cooperative Agreement,

which was signed by the US Fish and Wildlife Service, the Orange County Water District and the Corps. Should water conservation operation interfere with the construction activities, coordination among the agencies shall be made in order to arrive at a solution. Public safety will be the primary consideration in resolving conflicting operation objectives.

PLATES

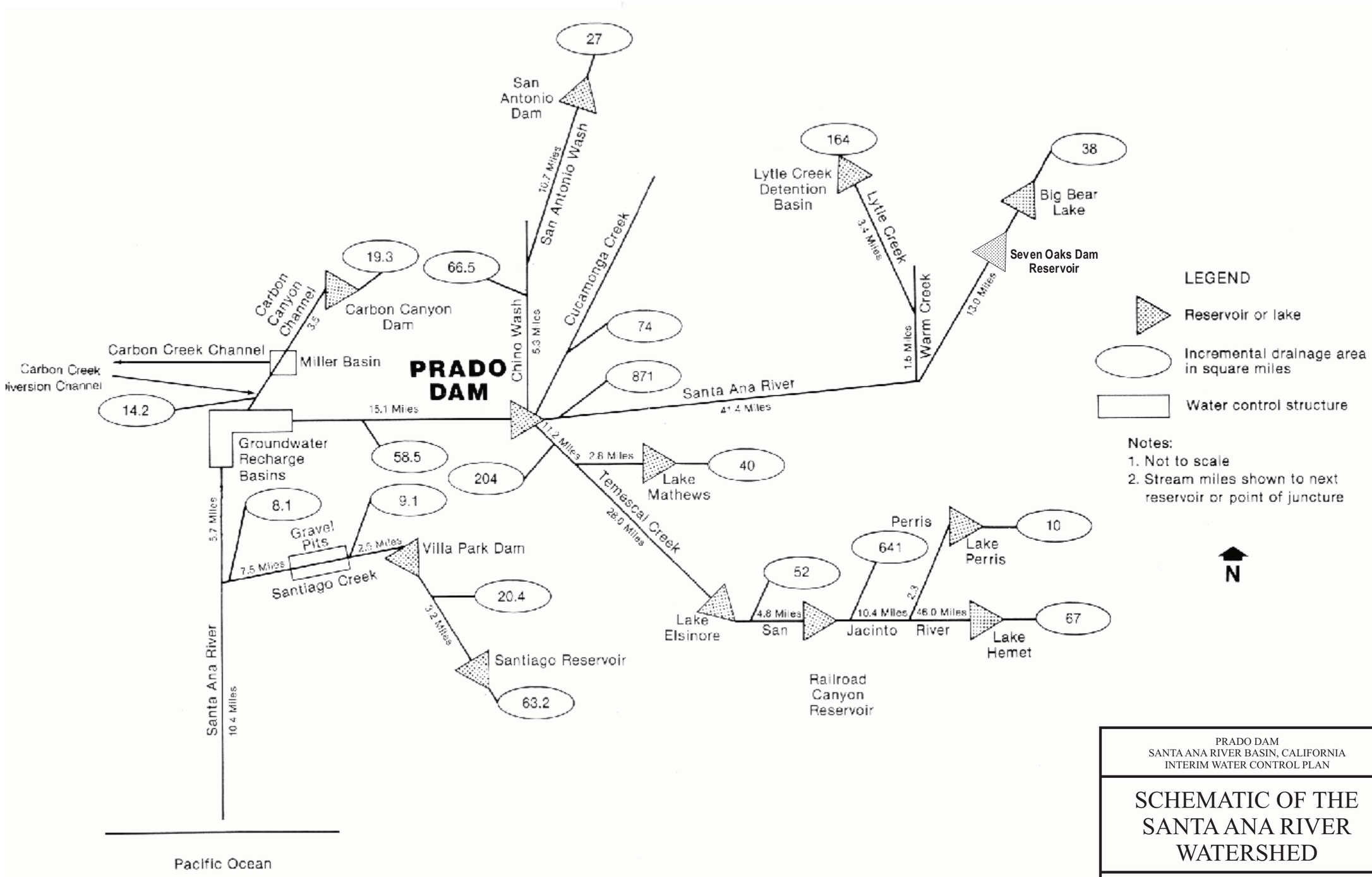
Santa Ana River Drainage Basin



PRADO DAM
SANTA ANA RIVER BASIN, CALIFORNIA
INTERIM WATER CONTROL PLAN

SANTA ANA RIVER DRAINAGE AREA

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



PRADO DAM
SANTA ANA RIVER BASIN, CALIFORNIA
INTERIM WATER CONTROL PLAN

SCHEMATIC OF THE SANTA ANA RIVER WATERSHED

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

The Plate you are attempting to access is not currently available.

For additional information, please contact the Los Angeles District Public Affairs Office at (213) 452-3908.

The Plate you are attempting to access is not currently available.

For additional information, please contact the Los Angeles District Public Affairs Office at (213) 452-3908.

The Plate you are attempting to access is not currently available.

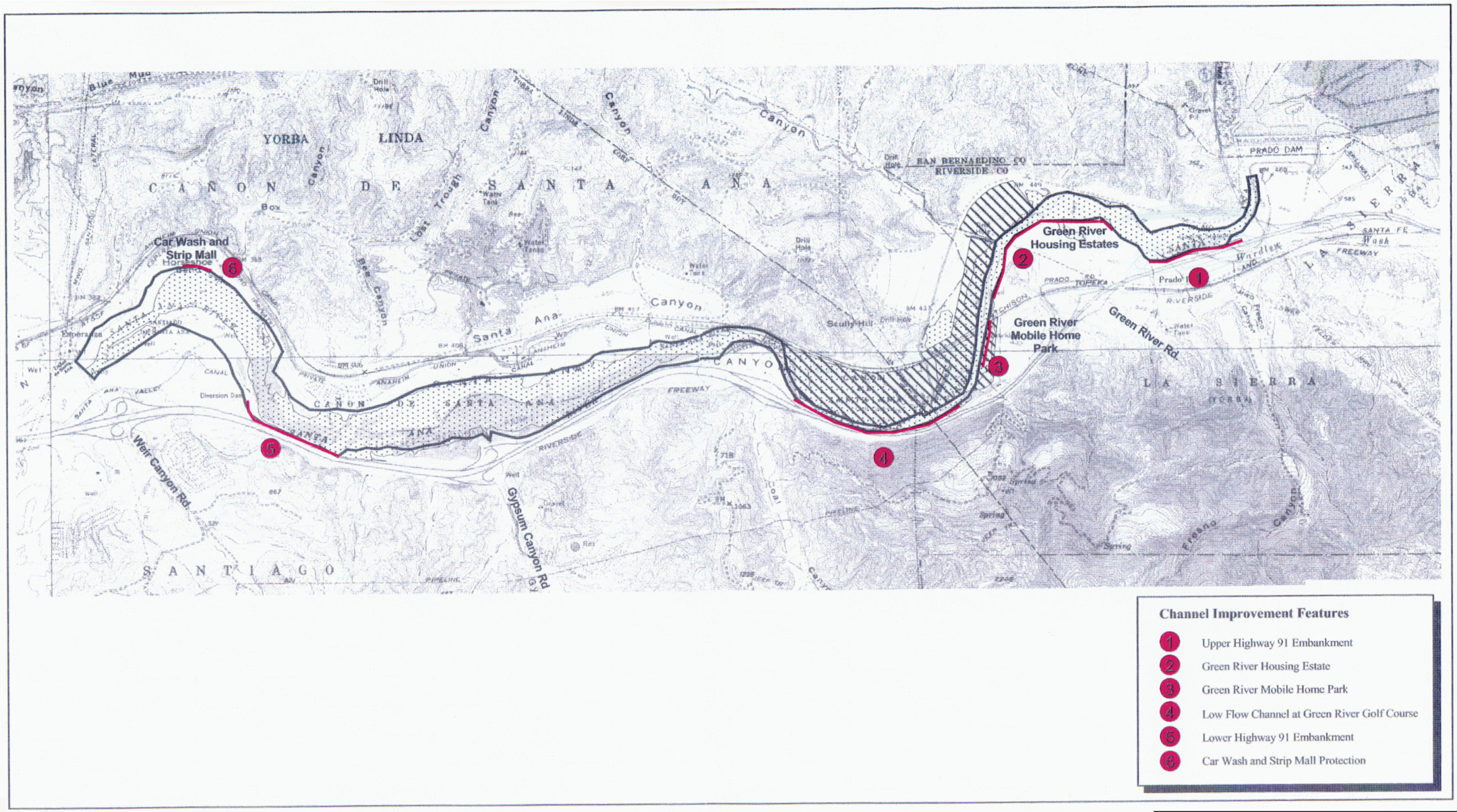
For additional information, please contact the Los Angeles District Public Affairs Office at (213) 452-3908.

The Plate you are attempting to access is not currently available.

For additional information, please contact the Los Angeles District Public Affairs Office at (213) 452-3908.

The Plate you are attempting to access is not currently available.

For additional information, please contact the Los Angeles District Public Affairs Office at (213) 452-3908.



NORTH

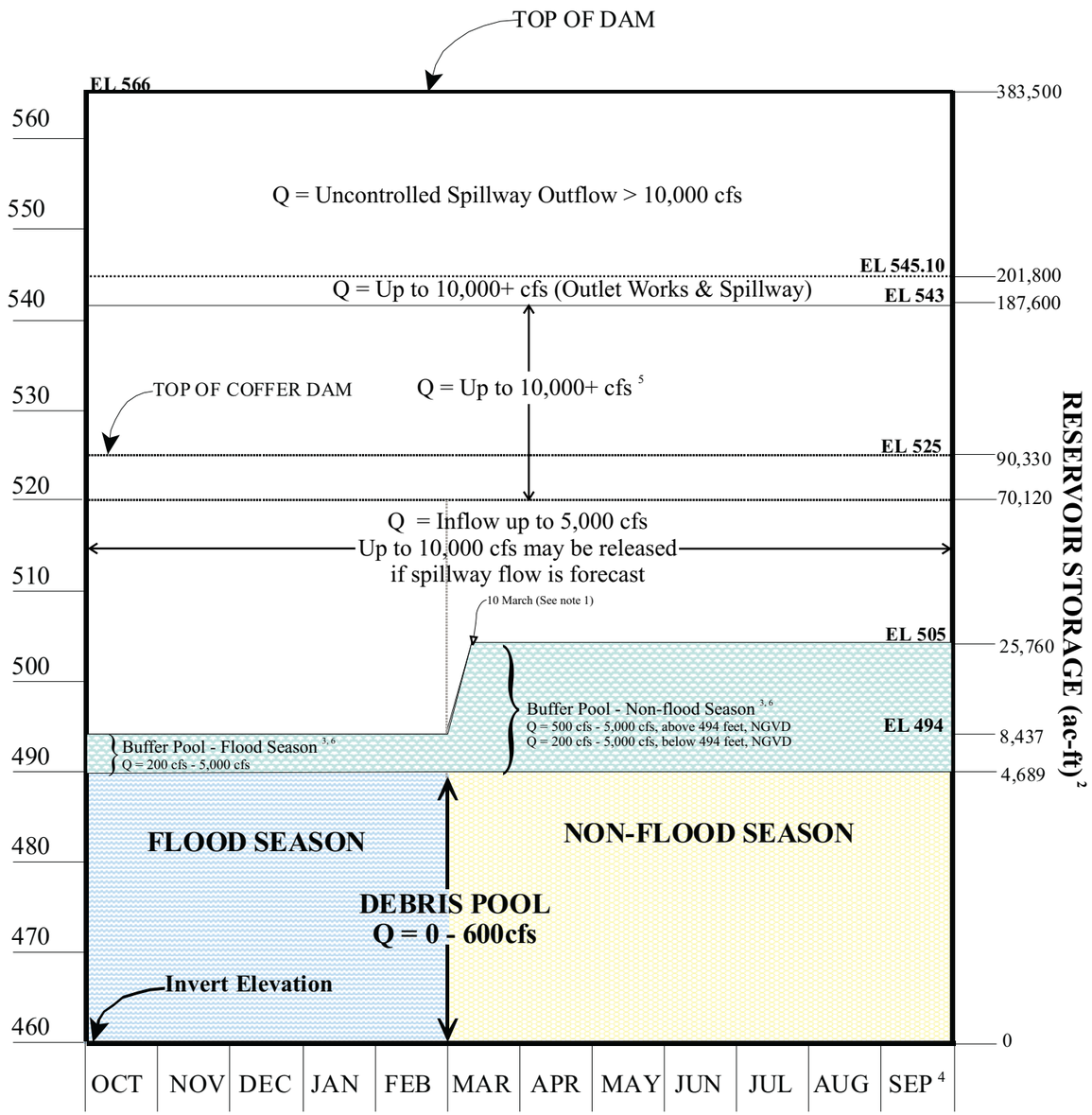
Feet 2600 1300 0 2600

Meters 800 400 0 800

PRADO DAM
SANTA ANA RIVER BASIN, CALIFORNIA
INTERIM WATER CONTROL PLAN

LOWER SANTA ANA RIVER CONSTRUCTION (REACH 9)

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



PRADO DAM Release Ranges - Using Existing Outlet Works

Release Range for the follwing Reservoir Elevations (ft)		Description
460 - 490		A debris pool is allowed to form in order to prevent floating debris from being drawn into the outlet works. Water within the debris pool is released at rates that equal OCWD's capability to recharge the groundwater without waste to the Pacific Ocean. Flow may be shut off to faciliate construction.
Flood Season * 490 - 494	Non-Flood Season ** 490 - 505	Reservoir releases range between 200 cfs and 5,000 cfs. Flood control releases match inflow up to 5,000 cfs year around. Water conservation releases are made equal to OCWD's groundwater recharge capacity subject to minimum releases as specified in section 4-03.
494 - 520	505 - 520	The resulting maximum reservoir release will depend on inflow forecast and downstream conditions. If necessary, a maximum of 10,000 cfs will be released within this elevation range.***
520 - 525		The resulting maximum reservoir release will depend on inflow forecast, observed downstream conditions, and possible damages to the construction site protected by the coffer dam. If safe, the maximum possible discharge may be released within this elevation range.***
525 - 543		The resulting maximum from the previous elevation range shall be maintained until conditions at the dam, downstream channel, or the upstream construction site warrants a change in releases.
543 - 545.10		Flood control release through the outlet works are reduced at the reservoir pool level rises above the spillway crest to as to maintain flow from the spillway plus outlet works at a maximum outflow.
545.10 - 566		All outlet gates are closed at reservoir pool levels above 545.10ft. Uncontrolled spillway discharge only. Under the extremely remote circumstance that the dam embankment were in danger of overtopping, all outlet gates are to be opened fully to mimimize the possibility of dam failure.

Footnotes:

* Flood season is defined to be between 1 Oct and 28 Feb of each year. Within this time period, a release magnitude between 200 cfs and 5,000 cfs is computed based on a real-time forecast of inflow volume so as not to exceed WSE 494 ft. The minimum release will always be equal to OCWD's groundwater recharge capability.

** Non-flood Season is defined to be between 1 March and 30 Sep of each year. Within this time period, a release magnitude between 200 cfs to 5,000 cfs is computed based on a real-time forecast of inflow so as not to exceed WSE 505 ft, except during the month of September, if the reservoir is required to be empty due to maintenance work. Between elevation 494 and 505, an average minimum release of 500 cfs must be made.

***The decision of release magnitude will depend on storm and runoff conditions, as well as conditions of the reservoir and channels in the Santa Ana River watershed, as how the flood control operational objectives of the dam can be met.

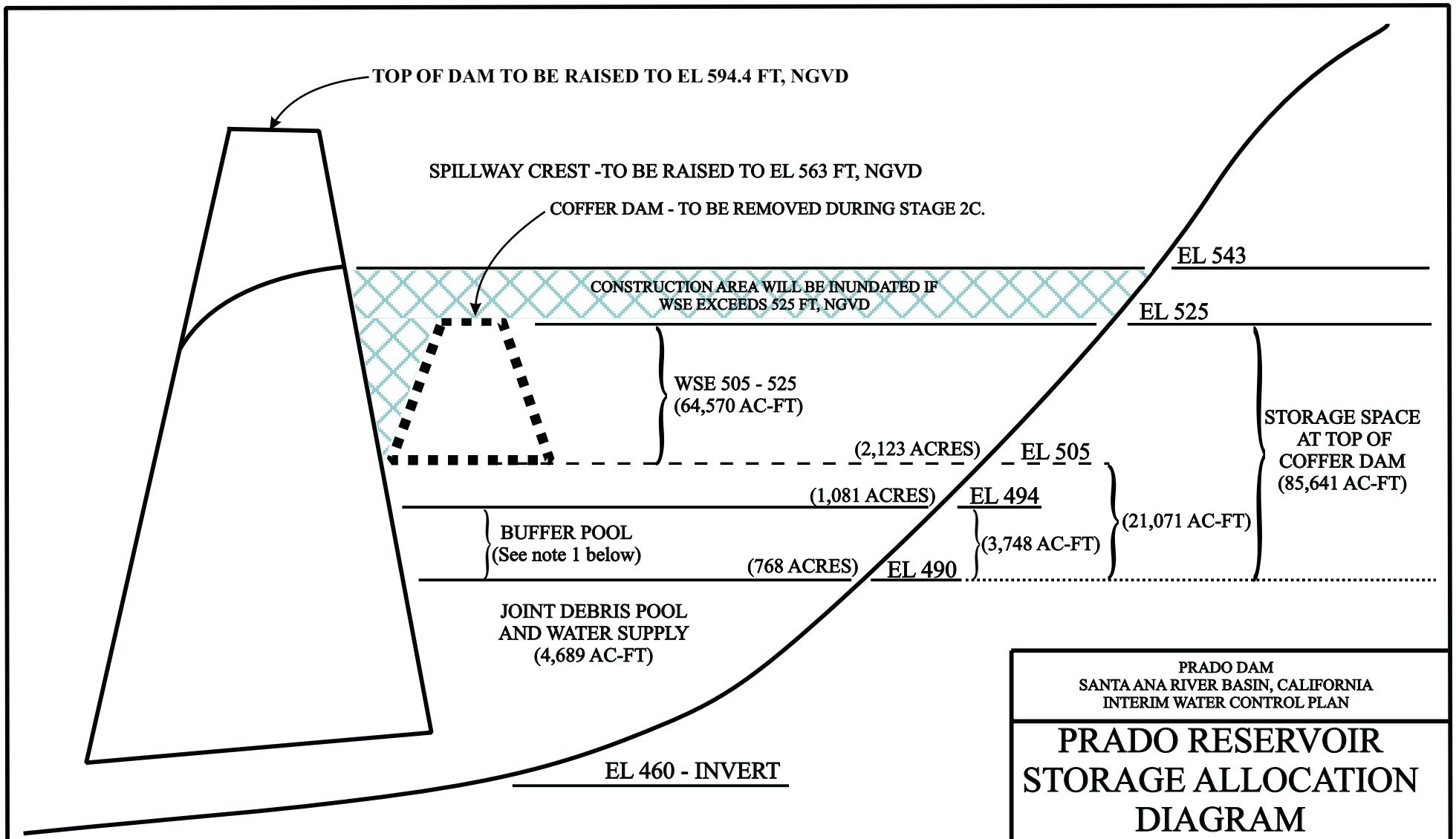
NOTES:

1. Beginning 1 March, the reservoir WSE may be increased at a rate of 1.1 ft/day until WSE 505 ft is reached (by March 10).
2. Reservoir Survey 1988.
3. OCWD's spreading capacity is 200 - 600 cfs during both flood and non-flood seasons; if forecasts indicate WSE 505 ft will be exceeded, match inflow with outflow up to, 5000 cfs.
4. September is designated as maintenance period (i.e., May require reservoir to be empty).
5. Above Elevation 520 ft, releases may be increased to the maximum possible discharge to minimize spilling or to protect the upstream construction, only if dam safety is not compromised and downstream channel conditions allow it. (The maximum capable release within this range is 14,100 cfs to 17,000 cfs.)
6. Releases could be reduced, if necessary, to protect downstream construction activities subject to minimum release requirements (200 cfs during the flood season and 500 cfs during the non-flood season).
7. If releases greater than 10,000 cfs are made, a dam safety team must be on site to evaluate impacts to the dam and outlet works.

PRADO DAM
SANTA ANA RIVER BASIN, CALIFORNIA
INTERIM WATER CONTROL PLAN

WATER CONTROL DIAGRAM PLAN A

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



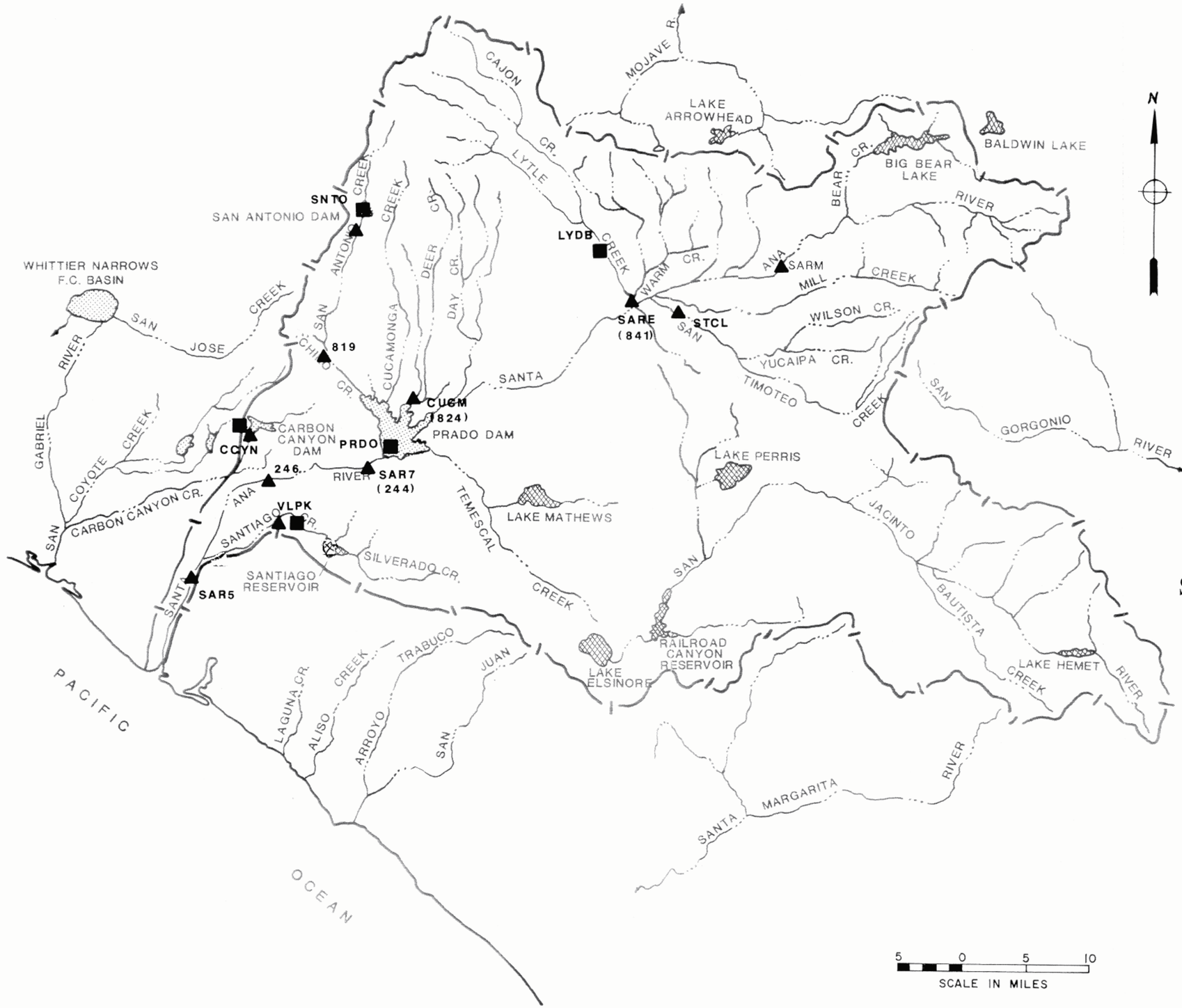
NOTES:
1. BUFFER POOL - EL 494 DURING FLOOD SEASON (1 OCT - 28 FEB)
   - EL 505 DURING NON-FLOOD SEASON (1 MAR - 30 SEP)
2. AREA AND STORAGE FIGUES - BASED ON 1988 RESERVOIR SURVEY.

PRADO DAM
SANTA ANA RIVER BASIN, CALIFORNIA
INTERIM WATER CONTROL PLAN

PRADO RESERVOIR STORAGE ALLOCATION DIAGRAM

(DURING CONSTRUCTION - PLAN A)

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



LEGEND

▲ STREAM GAGE

■ RESERVOIR WATER SURFACE ELEVATION GAGE

SAR5 LOS ANGELES TELEMETRY SYSTEM (LATS) GAGE

819 ALERT SYSTEM GAGE

WATER COURSE

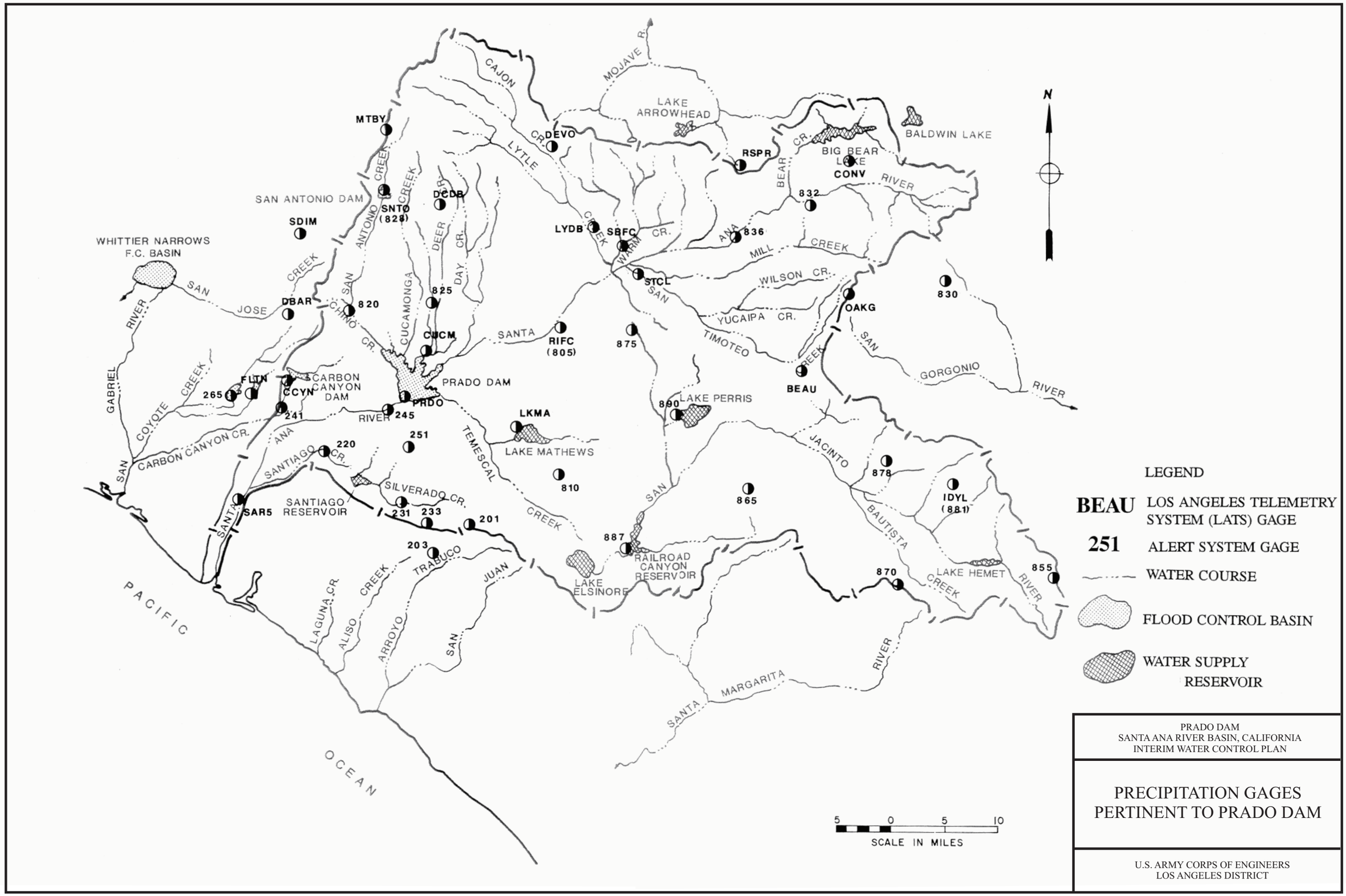
FLOOD CONTROL BASIN

WATER SUPPLY RESERVOIR

PRADO DAM
SANTA ANA RIVER BASIN, CALIFORNIA
INTERIM WATER CONTROL PLAN

ALERT AND LATS
STREAM AND RESERVOIR
GAGING STATIONS

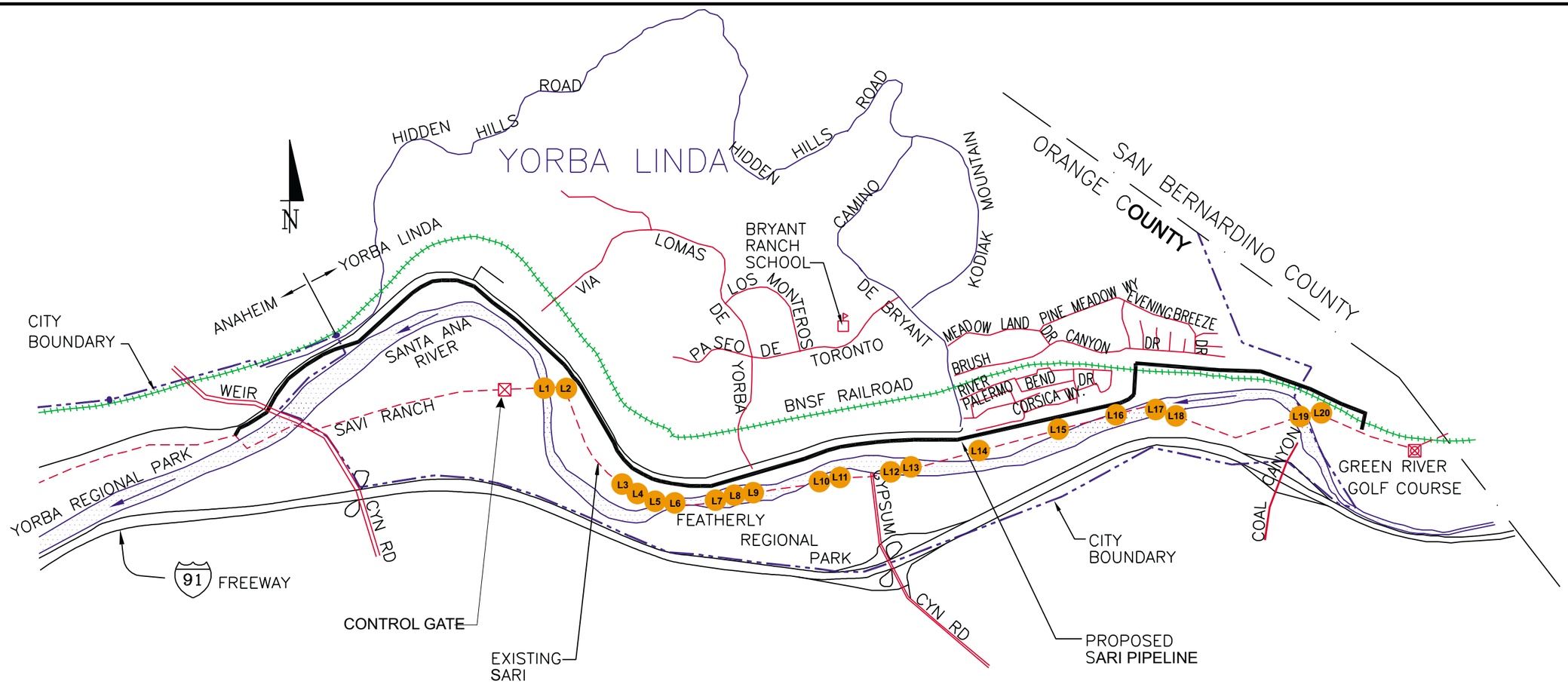
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



PRADO DAM
SANTA ANA RIVER BASIN, CALIFORNIA
INTERIM WATER CONTROL PLAN

PRECIPITATION GAGES PERTINENT TO PRADO DAM

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



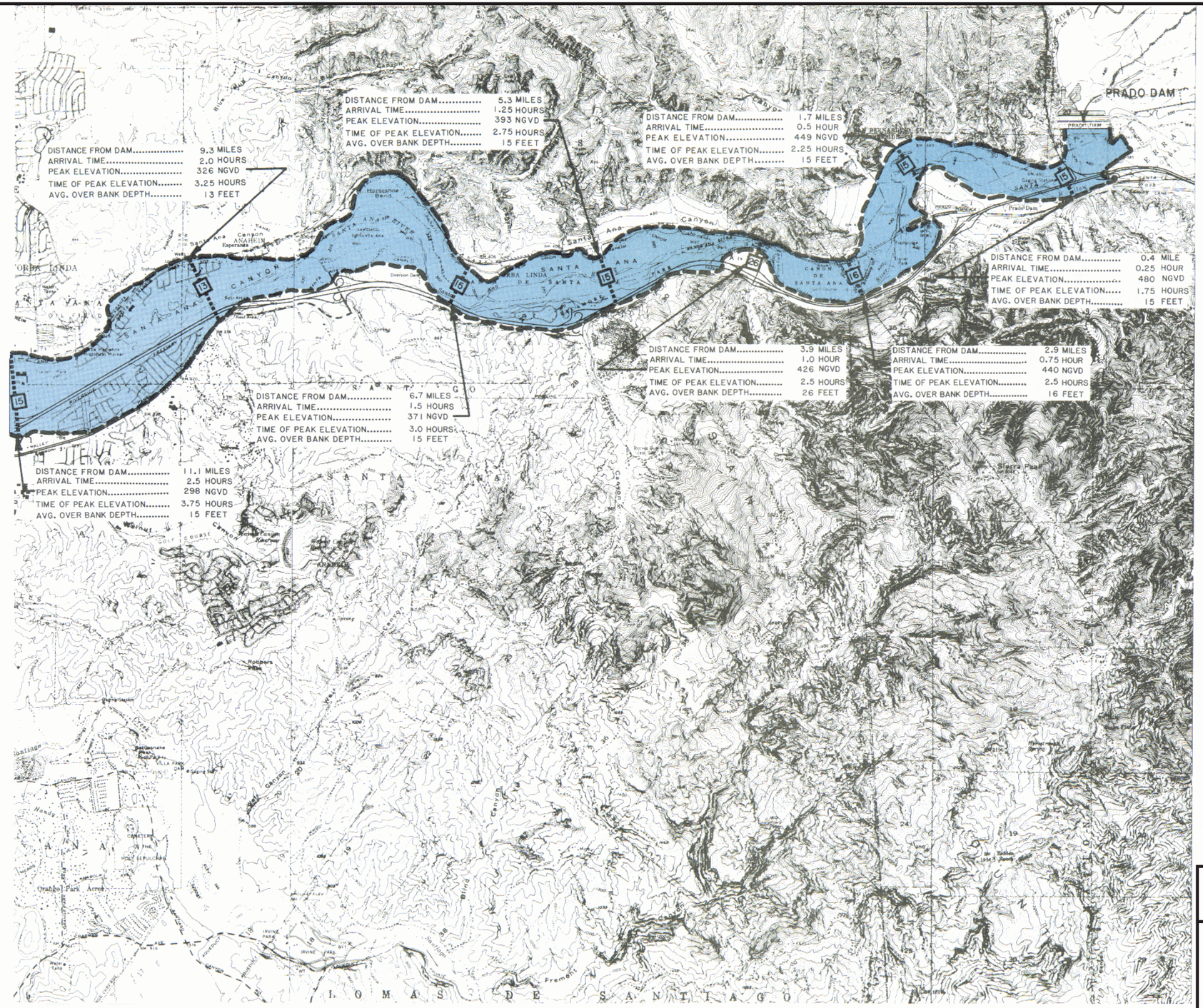
LOCATION	LOCATION OF POTENTIAL SCOUR DISTANCE (MILES) FROM CONTROL GATE AT SAVI RANCH	PIPE DIA (IN)	EXISTING COVER[1] (FT)	ESTIMATED POTENTIAL SCOUR[2] (FT)	COVER AFTER SCOUR[3] (FT)	COMMENTS
L1	0.12	45	6.9	8.6	-1.7	RIVER CROSSING, ENCASED
L2	0.20	45	6.2	5.0	1.2	MANHOLE
L3	0.98	45	3.3	19.4	-16.1	RIVER CROSSING, SCOUR COULD TOTALLY EXPOSE PIPE
L4	1.06	45	4.5	19.4	-14.9	RIVER CROSSING, SCOUR COULD TOTALLY EXPOSE PIPE
L5	1.10	45	18.9	23.0	-4.1	MANHOLE, SCOUR COULD APPROACH MH BASE
L6	1.14	45	7.4	12.9	-5.5	RIVER CROSSING, SCOUR COULD TOTALLY EXPOSE PIPE
L7	1.29	45	18.2	20.0	-1.8	MANHOLE
L8	1.33	45	3.8	13.7	-9.9	RIVER CROSSING, SCOUR COULD TOTALLY EXPOSE PIPE
L9	1.39	45	7.4	13.7	-6.3	RIVER CROSSING, SCOUR COULD TOTALLY EXPOSE PIPE
L10	1.62	45	7.4	9.1	-1.7	RIVER CROSSING
L11	1.66	45	17.7	14.0	3.7	MANHOLE
L12	1.89	45	20.2	23.0	-2.8	MANHOLE
L13	1.93	45	6.4	17.0	-10.6	RIVER CROSSING, SCOUR COULD TOTALLY EXPOSE PIPE
L14	2.11	45	19.3	16.0	3.3	MANHOLE
L15	2.64	42	17.9	17.0	0.9	MANHOLE
L16	2.88	42	18.9	15.0	3.9	MANHOLE
L17	3.03	42	24.1	22.0	2.1	MANHOLE
L18	3.07	42	3.1	7.9	-4.8	ENCASED RIVER CROSSING, SCOUR COULD TOTALLY EXPOSE PIPE
L19	3.63	45	4.4	14.6	-10.2	ENCASED RIVER CROSSING, SCOUR COULD TOTALLY EXPOSE PIPE
L20	3.67	45	17.4	34.0	-16.6	MANHOLE, SCOUR COULD TOTALLY EXPOSE MH BASE

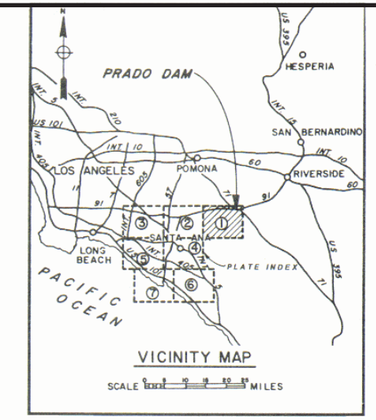
NOTE 1: MEASURED FROM EXISTING GROUND PER 1998 SURVEY COMPARED TO TOP OF EXISTING SARI PIPE AT RIVER CROSSING OR MANHOLE.
NOTE 2: TAKEN FROM AN OCSD PROJECT REPORT FOR SANTA ANA RIVER INTERCEPTOR SEWER PROJECT (CONTRACT NO. 2-14-5R2) DATED NOVEMBER 1996, PREPARED BY BROWN & CALDWELL.
NOTE 3: EXISTING COVER MINUS ESTIMATED POTENTIAL SCOUR.
NOTE 4: DRAWING IS NOT TO SCALE.

PRADO DAM
SANTA ANA RIVER BASIN, CALIFORNIA
INTERIM WATER CONTROL PLAN

SANTA ANA RIVER INTERCEPTOR (SARI LINE) POTENTIAL SCOUR AREAS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT





N

LEGEND

Limit of flood due to dam failure with the pool at spillway crest, elevation 543 feet.

5 Average overbank depth in feet at cross section.

Cross Section

2000 0 2000 4000 6000
SCALE IN FEET

Contour interval 20 and 25 feet
National Geodetic Vertical Datum of 1929

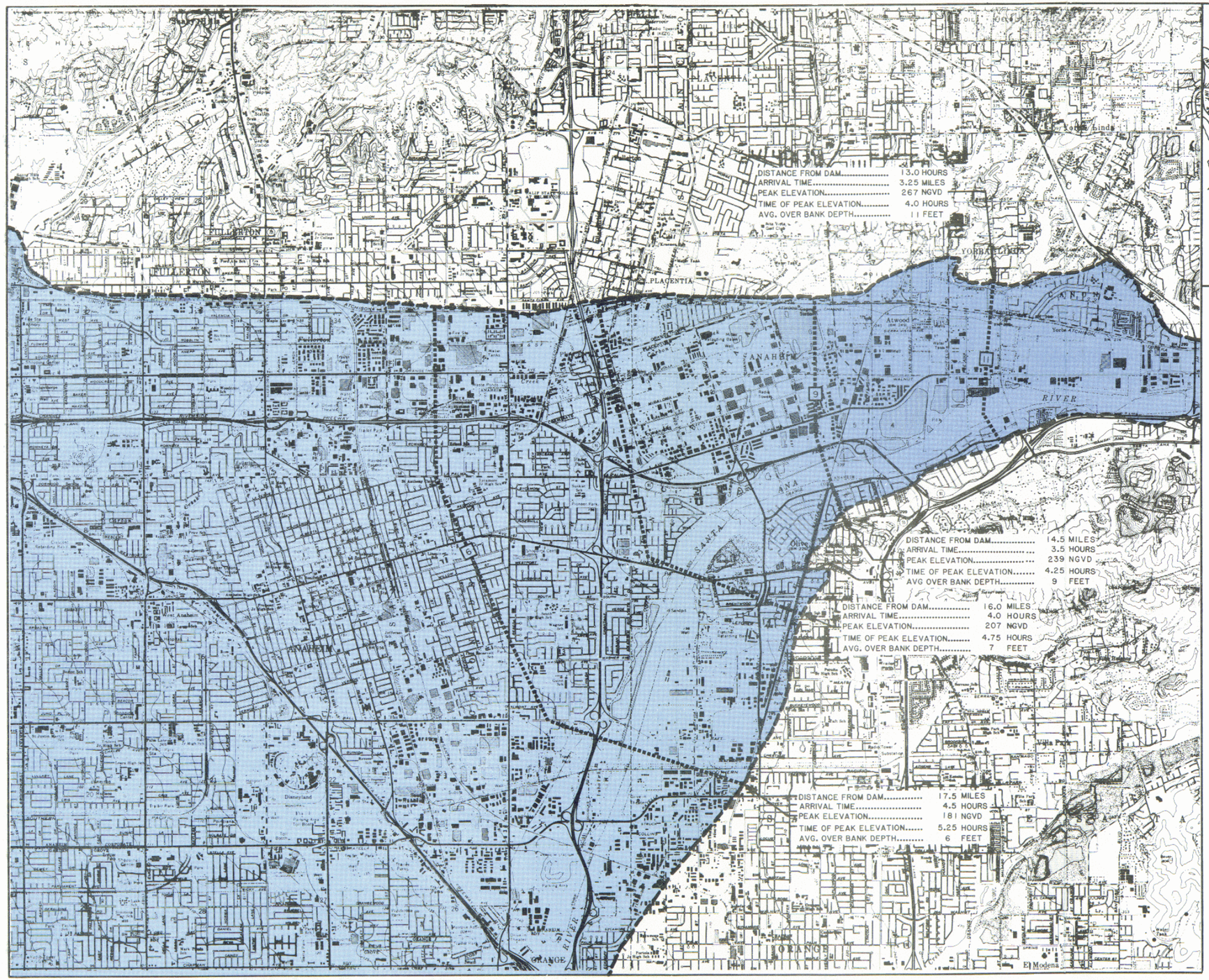
Source of base map: U. S. Geological Survey 7.5 minute series

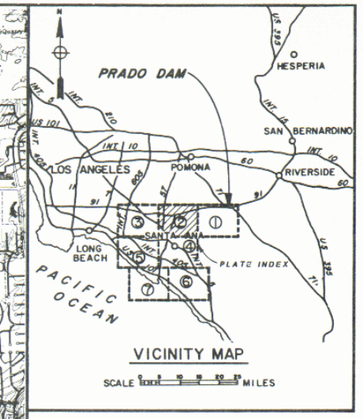
NOTE: The inundated areas shown on this map reflect events of an extremely remote nature. These results are not in any way intended to reflect upon the integrity of the Prado Dam

PRADO DAM
SANTA ANA RIVER BASIN, CALIFORNIA
INTERIM WATER CONTROL PLAN

EMERGENCY ACTION PLAN DOWNSTREAM INUNDATION AREAS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT





N

LEGEND

Limit of flood due to dam failure with the pool at spillway crest, elevation 543 feet.

5 Average overbank depth in feet at cross section.

Cross Section

2000 0 2000 4000 6000
SCALE IN FEET

Contour interval 5 and 20 feet
National Geodetic Vertical Datum of 1929

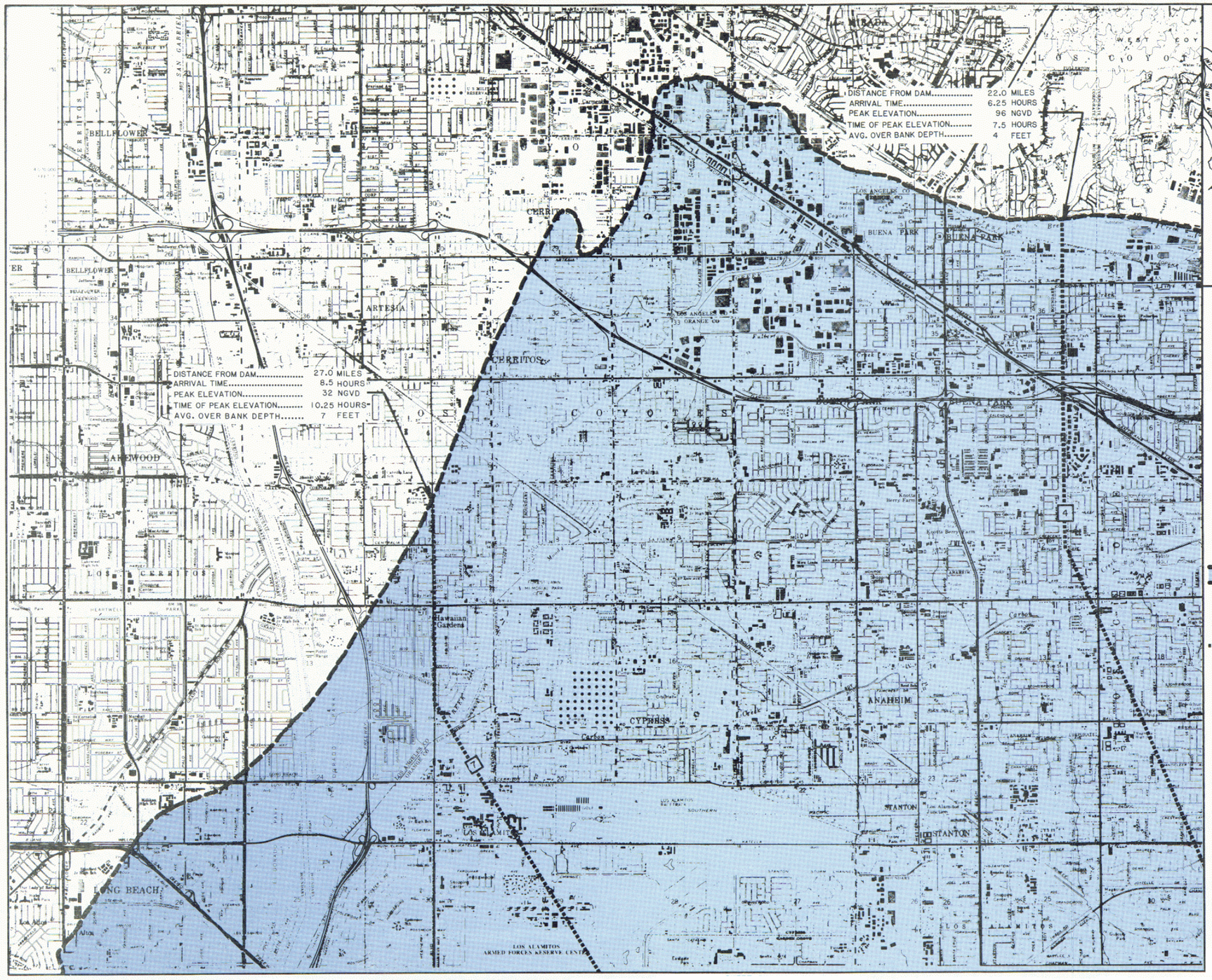
Source of base map: U. S. Geological Survey 7.5 minute series

NOTE: The inundated areas shown on this map reflect events of an extremely remote nature. These results are not in any way intended to reflect upon the integrity of the Prado Dam

PRADO DAM
SANTA ANA RIVER BASIN, CALIFORNIA
INTERIM WATER CONTROL PLAN

EMERGENCY ACTION PLAN DOWNSTREAM INUNDATION AREAS

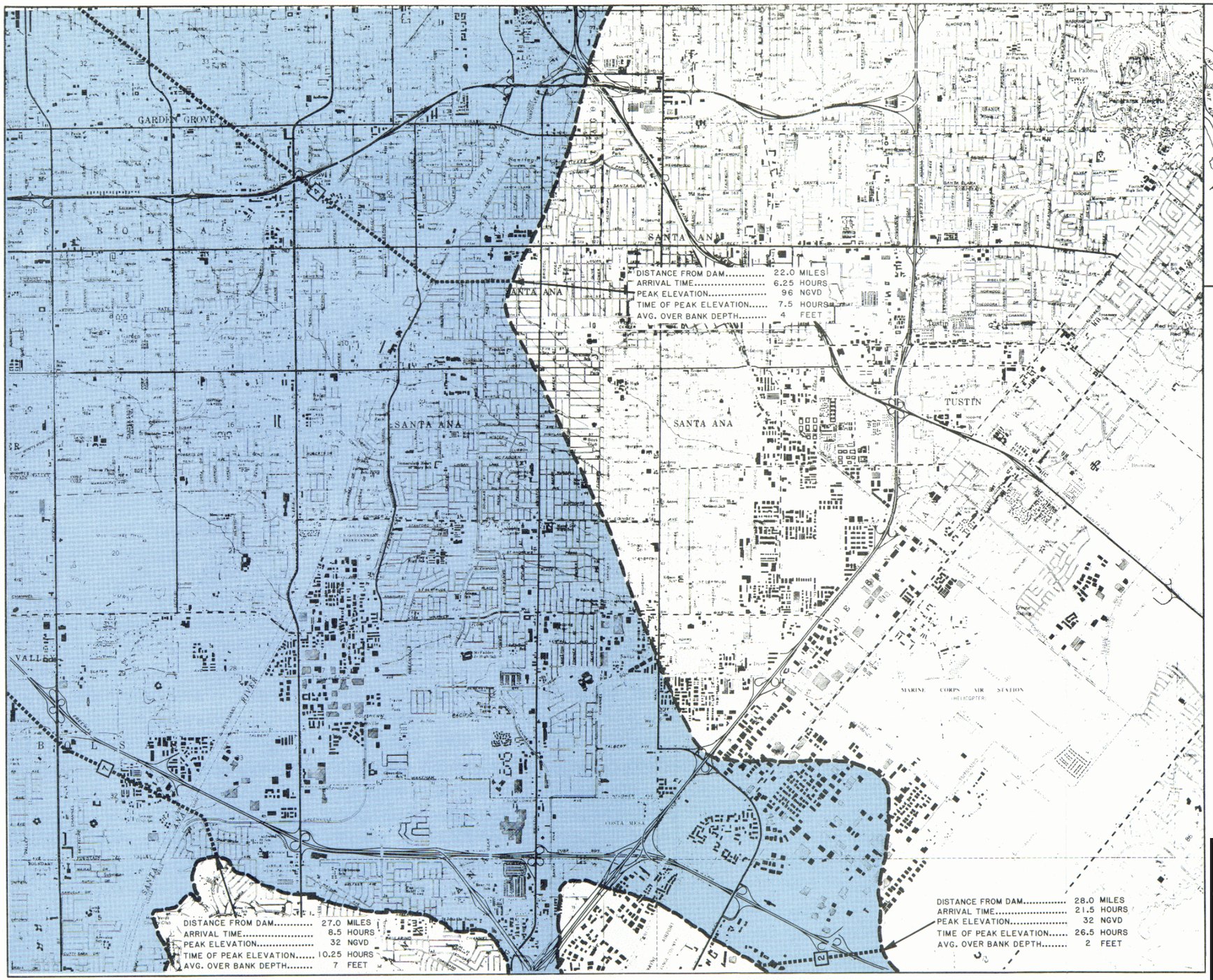
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

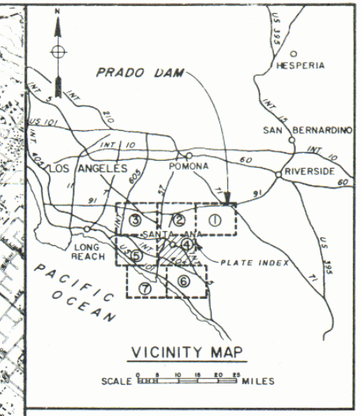


PRADO DAM
SANTA ANA RIVER BASIN, CALIFORNIA
INTERIM WATER CONTROL PLAN

EMERGENCY ACTION PLAN DOWNSTREAM INUNDATION AREAS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELELS DISTRICT





N

LEGEND

Limit of flood due to dam failure with the pool at spillway crest, elevation 543 feet.

5 Average overbank depth in feet at cross section.

Cross Section

2000 0 2000 4000 6000
SCALE IN FEET

Contour interval 5 and 10
National Geodetic Vertical Datum of 1929

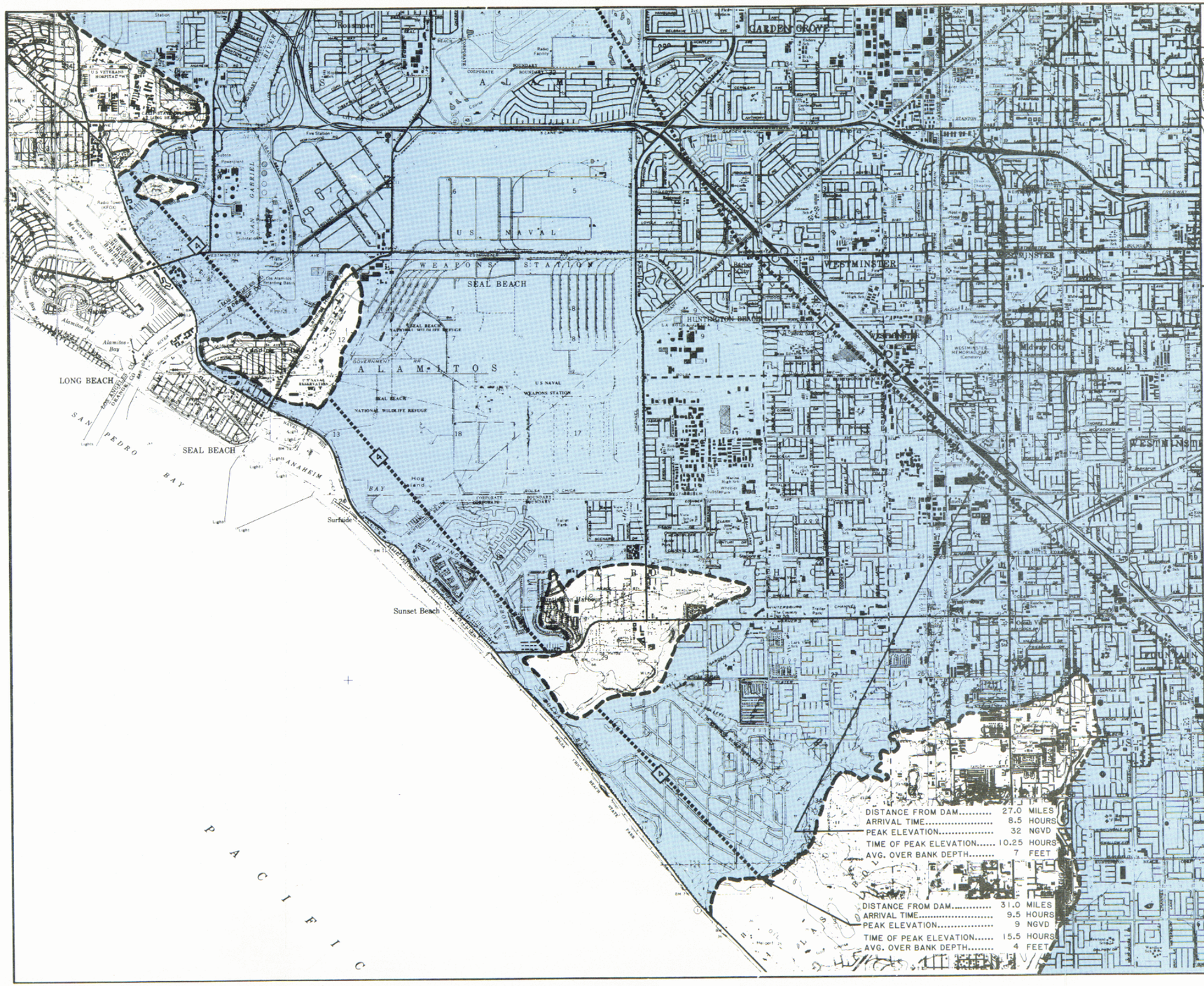
Source of base map: U. S. Geological Survey 7.5 minute series

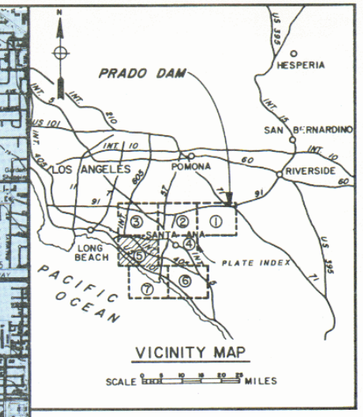
NOTE: The inundated areas shown on this map reflect events of an extremely remote nature. These results are not in any way intended to reflect upon the integrity of the Prado Dam

PRADO DAM
SANTA ANA RIVER BASIN, CALIFORNIA
INTERIM WATER CONTROL PLAN

EMERGENCY ACTION PLAN DOWNSTREAM INUNDATION AREAS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT





N

LEGEND

Limit of flood due to dam failure with the pool at spillway crest, elevation 543 feet.

5 Average overbank depth in feet at cross section.

Cross Section

2000 0 2000 4000 6000
SCALE IN FEET

Contour interval 10 feet.
National Geodetic Vertical Datum of 1929

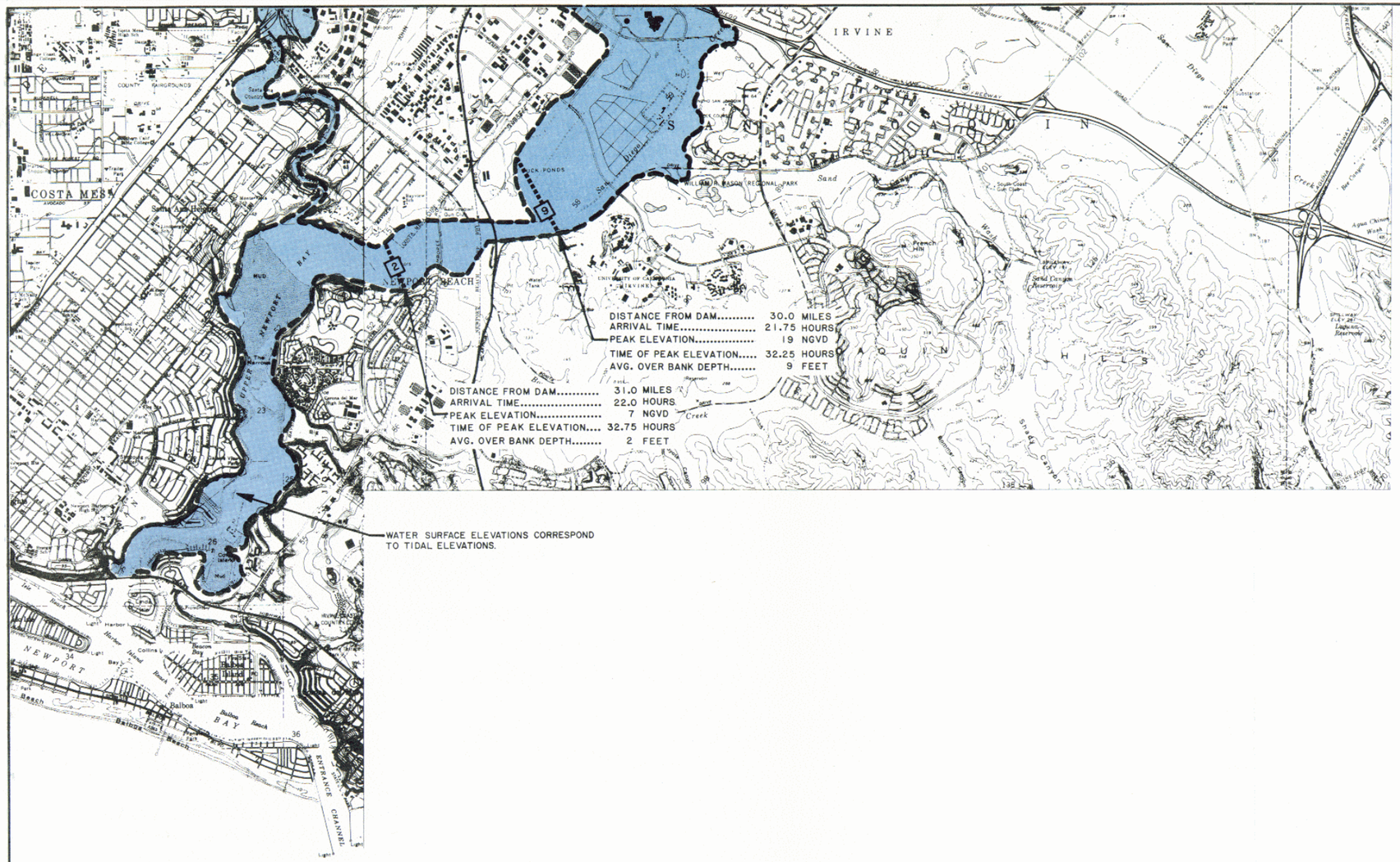
Source of base map: U. S. Geological Survey 7.5 minute series

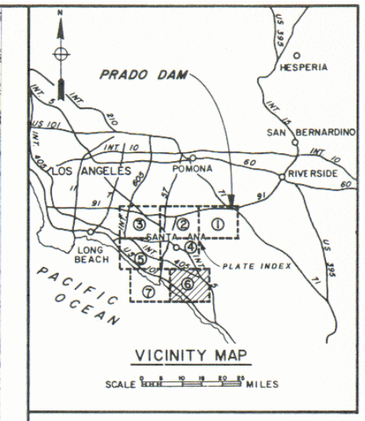
NOTE: The inundated areas shown on this map reflect events of an extremely remote nature. These results are not in any way intended to reflect upon the integrity of the Prado Dam

PRADO DAM
SANTA ANA RIVER BASIN, CALIFORNIA
INTERIM WATER CONTROL PLAN

EMERGENCY ACTION PLAN DOWNSTREAM INUNDATION AREAS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT





N

LEGEND

Limit of flood due to dam failure with the pool at spillway crest, elevation 543 feet.

5 Average overbank depth in feet at cross section.

Cross Section

2000 0 2000 4000 6000
SCALE IN FEET

Contour interval 5 and 10 feet
National Geodetic Vertical Datum of 1929

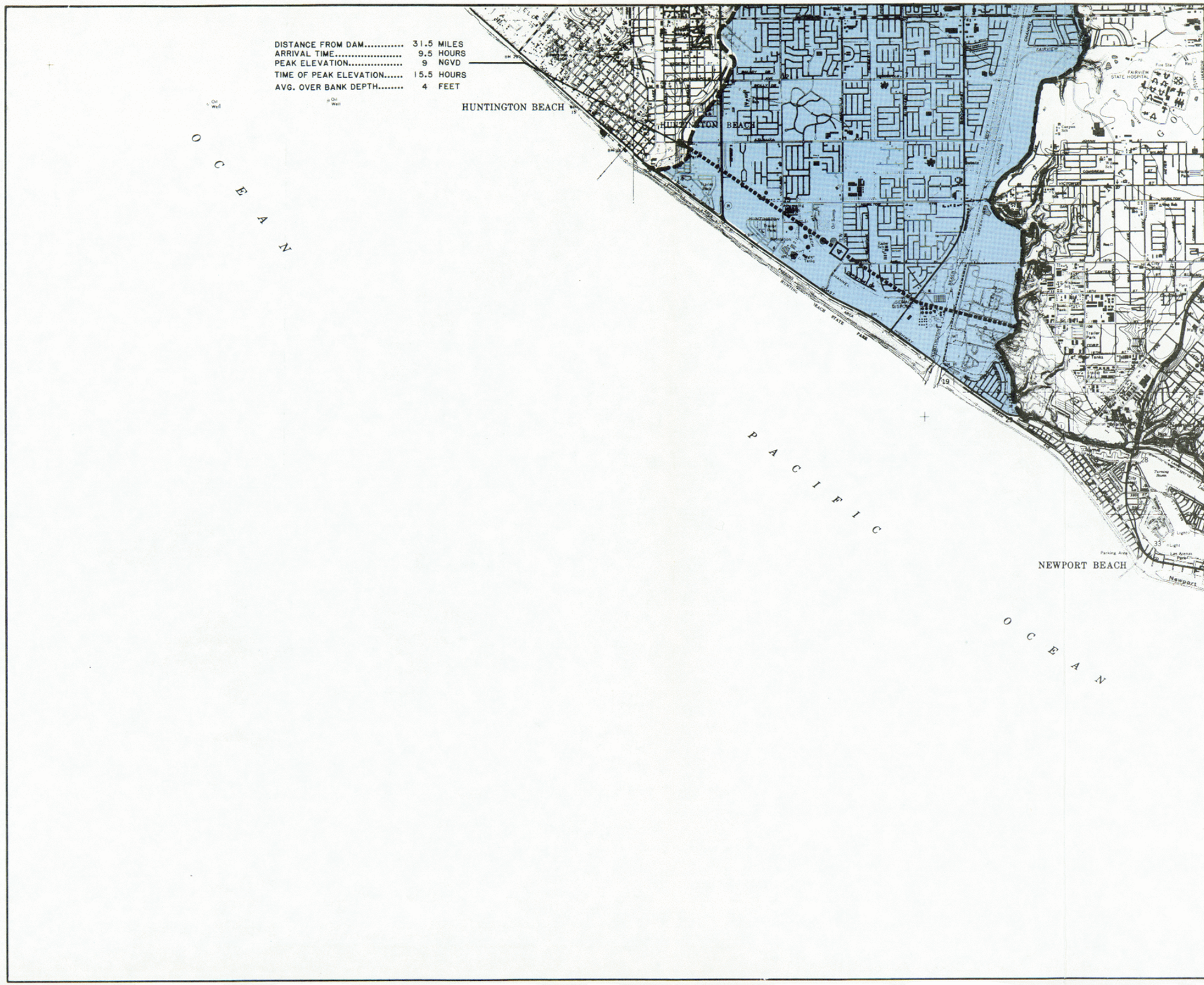
Source of base map: U. S. Geological Survey 7.5 minute series

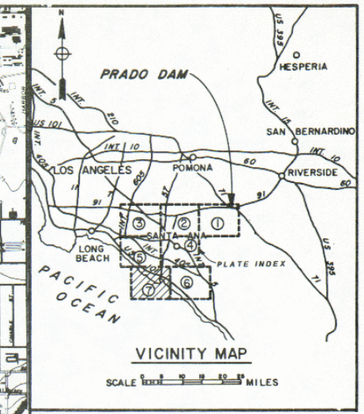
NOTE: The inundated areas shown on this map reflect events of an extremely remote nature. These results are not in any way intended to reflect upon the integrity of the Prado Dam

PRADO DAM
SANTA ANA RIVER BASIN, CALIFORNIA
INTERIM WATER CONTROL PLAN

EMERGENCY ACTION PLAN DOWNSTREAM INUNDATION AREAS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT





N

LEGEND

Limit of flood due to dam failure with the pool at spillway crest, elevation 543 feet.

5 Average overbank depth in feet at cross section.

Cross Section

2000 0 2000 4000 6000
SCALE IN FEET

Contour interval 5 feet
National Geodetic Vertical Datum of 1929

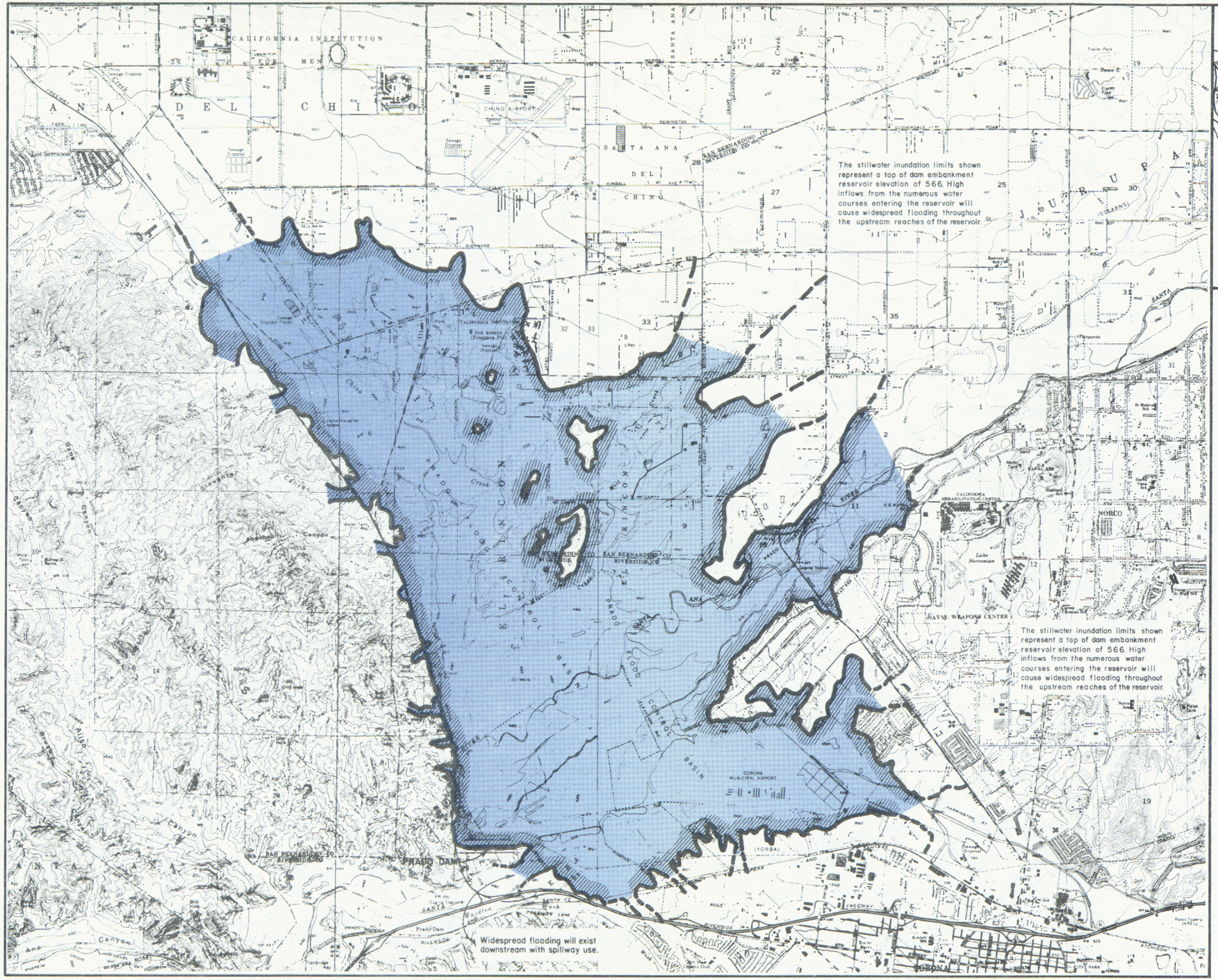
Source of base map: U. S. Geological Survey 7.5 minute series

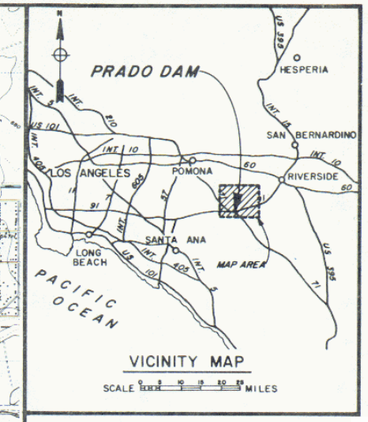
NOTE: The inundated areas shown on this map reflect events of an extremely remote nature. These results are not in any way intended to reflect upon the integrity of the Prado Dam

PRADO DAM
SANTA ANA RIVER BASIN, CALIFORNIA
INTERIM WATER CONTROL PLAN

EMERGENCY ACTION PLAN DOWNSTREAM INUNDATION AREAS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT





N

LEGEND

Limit of reservoir due to pool at top of dam, elev. 566.0 feet NGVD.

2000 0 2000 4000 6000
SCALE IN FEET

Contour interval
National Geodetic Vertical Datum of 1929

Source of base map: U. S. Geological Survey
7.5 minute series

NOTE: The inundated area upstream of the dam, shown on this map, reflects the results of the use of the project under an extremely remote flood condition.

PRADO DAM
SANTA ANA RIVER BASIN, CALIFORNIA
INTERIM WATER CONTROL PLAN

EMERGENCY ACTION PLAN DOWNSTREAM INUNDATION AREAS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT