

VII - WATER CONTROL PLAN

7-01 General Objectives

Santa Fe Dam is authorized and constructed to provide flood control protection to the downstream area in the San Gabriel River Valley, and it is an integral part of the overall Los Angeles River Flood Control System. The outflow from the Santa Fe Dam empties into the Whittier Narrows reservoir, which passes flood flows through the San Gabriel River channel and the Rio Hondo concrete channel. The regulation plan for Santa Fe Dam calls for consideration of the operation status of Whittier Narrows reservoir in the determination of the release from Santa Fe Dam.

The reservoir lands behind Santa Fe Dam, when not used for storing floodwaters, are utilized in part for other purposes such as recreation and groundwater recharge. The picnic areas, recreation lakes, and concession stands are used by the public during the dry periods of the year. During flood control operations, these facilities are inundated with minimal damage to their structural integrities.

7-02 Major Constraints

No major physical or regulation constraints exist at the project. Notable changes, however, have taken place or been made over the years, including:

a. Reservoir Storage Space. Reservoir storage space has been reduced by sediment accumulation. Based on the results of the September 1982 reservoir sediment survey (plate 3-3), current reservoir storage space below the spillway crest elevation of 496 ft is 32,109 ac-ft which is 7 percent less than the original reservoir storage space of 34,670 ac-ft. This represents an average sedimentation rate higher than the predicted rate. Fortunately, some

of the accumulated sediment has been removed from the reservoir bottom and more sediment will likely be removed by sand and gravel contractors in the future. The available storage as of the 1982 survey is still adequate to control the SPF. Using the 1982 area-capacity curve, the SPF maximum WSE is 495.09 ft using the regulation schedule in Exhibit A (operation of Santa Fe Dam in tandem with Whittier Narrows Dam), with maximum storage of 31,500 ac-ft and outflow of 40,600 ft³/s.

b. Recreation Facilities. When the Santa Fe Dam water surface elevation rises above the top of the debris pool (WSE 456), recreation facilities (see table 2-1) in the reservoir will begin to flood. This does not constitute a regulation constraint, but when sufficient forecast information is available and the water surface elevation on the Rio Hondo side of the Whittier Narrows Dam is below 201.6 ft., an effort is made to keep the Santa Fe reservoir water surface elevation at or below elevation 456 ft.

c. Joint Operation with Whittier Narrows Dam. Both the Santa Fe and Whittier Narrows Reservoirs will be operated as a system because independent project regulation would tend to result in greater flood damages below Whittier Narrows Dam during major floods. Since the level of flood protection provided by Santa Fe Dam to its immediate downstream area is higher than the level of flood protection provided by Whittier Narrows Dam, Santa Fe Dam is regulated in tandem with Whittier Narrows Dam in order to maximize their combined flood control capabilities. The logic of the coordinated regulation of the two reservoirs is to keep the "percent full" in each reservoir equal during a flood event, where the percent full is the ratio of the instantaneous reservoir storage divided by the total reservoir storage space in each respective reservoir. For instance, if Whittier Narrows Reservoir were more full than Santa Fe Reservoir and water surface elevation at Whittier Narrows Dam exceeded 201.6 ft., the outflow from the Santa Fe Reservoir would be reduced thereby causing an increase in the storage in Santa Fe Reservoir in

order to achieve a "percent full" equal to that in Whittier Narrows Reservoir, Tandem operation is self-correcting and would result to having the storage levels in both reservoir balanced in accordance with the gate regulation schedule in Exhibit A. The coordination of the flood control operation of Santa Fe and Whittier Narrows Reservoirs will achieve an overall objective of minimizing the chance of spillway flow below Whittier Narrows Dam.

7-03 Overall Plan for Water Control

Santa Fe Dam is operated for flood control on the San Gabriel River and the regulation is coordinated with that of Whittier Narrows Dam. Plate 2-2, which depicts the storage allocations for Santa Fe Reservoir, shows that the entire reservoir storage space below elevation 496 feet (the spillway crest) is devoted to flood control (including debris pool). Spillway surcharge occurs between elevation of 496 and 508.2 feet (the maximum water surface elevation for the revised PMF). Once WSE 496 is reached, flood control is no longer the prime objective. Passing as much water out of the reservoir as is required to assure the safety of the dam becomes the primary regulation concern. The space between elevation 508.2 and 513 feet is freeboard.

The Santa Fe Dam gate operation schedule includes consideration of the reservoir status of Whittier Narrows Dam. This tandem operation schedule can be found in Exhibit A and it is discussed in section 7-05.

There may be instances where a decrease (or increase) in releases may be considered necessary from a systems perspective. These deviations are discussed in section 7-13.

7-04 Standing Instructions to Dam Operator for Water Control

During periods of normal communication, the dam operator will receive operating instructions from the ROC. The Standing Instructions to the Dam Operator for regulation of Santa Fe Dam are given in Exhibit A. In the event that communication with the ROC is lost for a period of six (6) hours, the dam operator should follow the standing instructions in Exhibit A.

7-05 Flood Control

The plan for controlling floods on the San Gabriel River below Santa Fe Dam is presented in this section. The objective of the water control plan is to minimize downstream flood damages. Project releases will be regulated to protect downstream communities and to avoid spillway flow. Releases from Santa Fe Dam will always be regulated so as not to exceed the downstream channel capacity (41,000 ft³/sec) in so far as possible. Santa Fe Dam is regulated as a component of a reservoir system protecting (primarily) the San Gabriel and lower Los Angeles Rivers. Whittier Narrows Dam is located approximately 7 miles downstream of Santa Fe Dam on the San Gabriel River. Regulation of Whittier Narrows Dam to prevent exceedance of downstream channel capacity on the Rio Hondo, San Gabriel River and lower Los Angeles River is its primary flood control operation objective. Accordingly, Santa Fe Dam is operated in conjunction with Whittier Narrows Dam to achieve this flood control objective. Hence, reservoir releases from Santa Fe Dam will be reduced as required to equalize the "stress" (instantaneous percentage of flood control storage space filled) between Whittier Narrows Dam and Santa Fe Dam. Whittier Narrows Dam will be operated based on the capability of the downstream channels to safely convey the combination of reservoir releases and local uncontrolled flood runoff. Releases from Whittier Narrows Dam are not intended to equalize or maintain the balance of water in storage between Whittier Narrows Dam and Santa Fe Dam. In addition, if Whittier Narrows Dam,

is projected to experience spillway flow at any time within a flood event, Santa Fe releases will be reduced as necessary in order to prevent spillway flow at Whittier Narrows Dam. Spillway flow at Santa Fe Dam is far less damaging than spillway flow at Whittier Narrows Dam. Spillway flow from Santa Fe Dam would currently enter a group of large gravel pits located immediately downstream of the Santa Fe Dam spillway.

a. Normal Regulation. When the reservoir WSE is within the debris pool (WSE 421 to WSE 456), releases are made at Santa Fe Dam by keeping one gate open at 0.5 feet (i.e., the standby gate setting).

Once the WSE at Santa Fe Dam reaches 456 feet, and communication between the ROC and Santa Fe Dam tender exists, Santa Fe Dam is operated in tandem with Whittier Narrows Dam in a manner such that Santa Fe Reservoir releases will maintain parity in the "percent full" (flood storage capacity utilized) at the two reservoirs. This is, if the flood control storage at Whittier Narrows Reservoir is 17 percent of its capacity, Santa Fe Dam is operated so as to fill 17 percent of its flood control storage capacity. It should be noted that operation of Santa Fe Dam in tandem with Whittier Narrows Dam starts at WSE 456 ft at Santa Fe Reservoir and WSE 201.6 ft at Whittier Narrows Reservoir. Tandem operation does not apply to the debris pool at Santa Fe Reservoir not to the water conservation pool at Whittier Narrows Reservoir.

If the degree of fullness of Whittier Narrows Reservoir is increasing at a faster rate than that of Santa Fe Reservoir, Santa Fe Dam releases can be decreased (to zero, if desired) in order to minimize the "stress" on Whittier Narrows Dam. Typically, in a single or the first of a series of storms, runoff from the Rio Hondo watershed raises the WSE at Whittier Narrows Reservoir at a faster rate than runoff from the San Gabriel River watershed raises the WSE at Santa Fe Reservoir. Runoff from the Rio Hondo then

typically decreases and the WSE at Whittier Narrows Reservoir declines (as long as the releases from Santa Fe Dam do not change) as the Santa Fe Reservoir WSE rises to its maximum. After a series of Storms have occurred that fill the storage of the San Gabriel River system above Santa Fe Dam, the probability of large flood inflows into the Santa Fe Reservoir increase significantly.

The water control manager at the ROC must monitor these trends of inflow and water surface elevations at Whittier Narrows Dam and Santa Fe Dam so changes in releases from both Whittier Narrows and Santa Fe Dams are made smoothly. Fluctuation of releases (i.e., from increase to decrease or from decrease to increase in a short time interval) should be minimized by monitoring the reservoir inflows, watershed conditions, and WSE trends. The outflow from Morris Dam can usually be used to approximate inflow to Santa Fe Reservoir. The telemetered stream gages located on the Rio Hondo at Garvey Road (gage name HRDG) and Alhambra Wash at Klingerman (ALWK) can indicate the magnitude of inflow to Whittier Narrows Dam from the Rio Hondo. The telemetered stream gage located on San Gabriel River at Peck Road (SGRP) indicates total inflow to the Whittier Narrows Dam from the San Gabriel River, including the inflows from San Jose Creek and Walnut Creek. Limiting the rate consideration if releases from Santa Fe Dam have to be increased. The rate of increase of releases is limited increments of 5,000 ft³/sec per half-hour (i.e., from 2,000 ft³/sec, to 7,000ft³/sec, to 12,000 ft³/sec, and so on, until the required outflow is reached). When reducing releases from Santa Fe Dam, consideration should be given to bank sloughing of the San Gabriel River. However, the flows can be gradually reduced to as little as zero, if required.

The gate regulation schedule of Santa Fe Dam in tandem with Whittier Narrows Dam can be found in Appendix A. The first step (WSE 421 - 456) of the regulation schedule is the standby gate setting at the dam. Operation of

Santa Fe Dam in tandem with Whittier Narrow Dam starts at WSE 456 ft. Procedures for the tandem operation are listed in the gate regulation schedule. The following example illustrates the use of the gate regulation schedule:

ASSUMPTIONS:	
	<p>1) Whittier Narrows Reservoir WSE = 202.0 ft (outflow = approximately 5000ft³/s)</p> <p>2) Previous Whittier Narrows elevation = 201.6ft</p> <p>3) The stream gages at Rio Hondo at Garvey, Alhambra Wash at Klingerman and San Gabriel River at Peck Road indicate total inflow in excess of 6000 ft³/s</p> <p>4) Santa Fe Reservoir WSE = 456.2 ft (outflow = 1000 ft³/s)</p> <p>5) Morris Dam outflow = 1000 ft³/s</p>
ANALYSIS:	
	<p>1) The stream gauges indicate that without any change at Santa Fe Dam, the Whittier Narrows Reservoir WSE would rise (inflow = 6000 + 1000 = 7000 ft³/s, vs outflow = 5000 ft³/s)</p> <p>2) Morris Dam outflow indicates inflow to Santa Fe Dam Reservoir is matched by Santa Fe Dam outflow, so Santa Fe Reservoir WSE would not change</p> <p>3) Follow the procedures for "Operation of Santa Fe Dam (SNFE) in Tandem with Whittier Narrows Dam (WNRH)", as shown on the gate operation schedule:</p> <p style="margin-left: 40px;">*1 <u>Current WSE at SNFE</u>: 456.2 ft</p> <p style="margin-left: 40px;">*2 <u>Concurrent WSE at WNRH</u>: 202.0ft</p> <p style="margin-left: 40px;">*3 "<u>Equivalent SNFE WSE</u>" (from table 1 of the gate regulation schedule): 456.4 ft</p> <p style="margin-left: 40px;">*4 Is <u>current WSE at SNFE</u> greater than "<u>equivalent SNFE WSE</u>"? No.</p> <p style="margin-left: 40px;">*5 Is <u>current WSE at SNFE</u> greater than <u>equivalent SNFE WSE</u>? Yes. Therefore, no release from Santa Fe Dam is required.</p>
ACTION BY WATER CONTROL MANAGER:	
	<p>Cut back Santa Fe Dam outflow (to zero, if desired) because it was determined that Whittier Narrows Reservoir "percent full" would rise faster than Santa Fe Reservoir "percent full" under the current conditions. Once the 2 reservoirs reached the same degree of fullness, follow procedure *6 (from the schedule): "Operate Santa Fe Dam in such a way that the balance in "percent fullness" is maintained".</p>

b. Loss of Communication. In the event that communication between the ROC and Santa Fe Dam tender is lost for a period of six (6) hours, the dam tender should use the gate regulation schedule in Exhibit A in order to determine the required gate setting based on current water surface elevation at Santa Fe Reservoir. In using the gate operation schedule, the dam tender should disregard procedures *2, *3, *5, and *6 listed on the schedule. The

gate operation schedule should be followed until communication with the District office is reestablished.

c. Forecasts. The runoff forecast on which regulation decisions are based, should be developed from the best available precipitation and stream flow information. The ROC is responsible for developing the forecast and for determining its usefulness in making water control decisions. The intent is to consider all appropriate information in implementing the water control plan.

When forecast information clearly indicates that Santa Fe Dam will not experience spillway flow (reservoir water surface elevation will not exceed elevation 496 ft), all 16 gates may be partially or fully closed in order to alleviate downstream emergencies (see Sec. 7-13), to prevent downstream damages, or to add an additional safety factor when the downstream channel is experiencing high flows. When forecast information clearly indicates that Whittier Narrows Dam will experience a spillway flow, all 16 gates at Santa Fe Dam may be partially or fully closed in order to prevent or minimize the possibility of spillway flow at Whittier Narrows Dam.

d. Reservoir Evacuation. Santa Fe Dam should be drained as rapidly as possible, consistent with the achievement of downstream flood control. The objective is to empty the reservoir in preparation for the next flood. Santa Fe Dam releases will be reduced upon reaching the debris pool (WSE 456), so that the Los Angeles County Department of Public Works (LACDPW) can divert the remaining storm runoff to their spreading facilities to enhance water conservation.

e. Channel Observation Teams. Whenever the combination of reservoir releases and local uncontrolled runoff is expected to exceed one-half of the design conveyance capacity (see plate 3-2) on the San Gabriel River, channel

observation teams should be dispatched to observe the hydraulic performance of the channel and to report the current available channel capacity.

7-06 Recreation

Extensive recreational development has taken place in the Santa Fe Reservoir lands in accordance with the PL 89-72 (Federal Water Project Recreation Act). PL 89-72 requires consideration of opportunities for outdoor recreation and fish and wildlife enhancement in planning water resource projects. In addition to the recreational developments in the reservoir area, there is currently more public demand for wider range of recreational pursuits. The existing recreational lake located within the reservoir area provides water oriented recreational facilities. However, no water is impounded by the dam for recreational purposes. Also, the channel of the San Gabriel River downstream of Santa Fe Dam is strictly a flood control channel, and provides no water oriented recreational use. Thus no release are made for recreational purposes.

7-07 Water Quality

Santa Fe Dam has not ungated outlets, and may be operated to contain contaminant spills, unless the WSE exceeds 496 feet (spillway crest). Santa Fe Dam is not operated for water quality objectives.

7-08 Fish and Wildlife

The operation of Santa Fe Dam does not include considerations for fish and wildlife objectives.

7-09 Drought Contingency Plan

Santa Fe Dam does not contain any storage allocation for water supply. However, water conservation and ground water recharge measures at Santa Fe Dam are coordinated with the Los Angeles County Department of Public Works (LACDPW) to the extent consistent with other project purposes. The San Gabriel River downstream of the dam is soft-bottomed, and conservation facilities exist at several spreading grounds (see sec. 3-04). Currently, no reservoir storage is allocated for water conservation. However, as the flood pool recedes below elevation 456 t, releases can be reduced to the intake capacity of the downstream LACDPW spreading facilities if meteorological forecasts and downstream reservoir/channel conditions are favorable.

7-10 Hydroelectric Power

No facilities for the generation of hydroelectric power at Santa Fe Dam exist, nor are any contemplated.

7-11 Navigation

The ephemeral nature of runoff on the San Gabriel River and its steep gradient preclude navigation.

7-12 Other

Maintenance and construction activities in the downstream channel of the San Gabriel River normally occur during the dry season of late spring and summer. During such periods, the 16 Santa FE Dam gates may be closed in order to reduce releases in support of such downstream activities.

7-13 Deviation from Normal Operation

The release plan for Santa Fe Dam is discussed in Section 7-05. However, it is desirable under certain limited circumstances, for the release rate from Santa Fe Dam to be decreased below what is called for. In addition to the prevention of downstream damages, there other possible reasons for deviation from the normal release plan at Santa Fe Dam:

a. Emergencies. In the event of emergencies such as potential drowning, toxic spill, other accident, reservoir releases may be adjusted as appropriate to cooperate with rescue or remedial action efforts to the extent that flood control objectives of the dam are not compromised. In addition, potential structural damage to the downstream channel will be treated as an emergency for which reservoir releases may be reduced. Such emergency action may be taken immediately by the ROC.

b. Unplanned Minor Deviations. Unplanned events that could create a temporary need for minor deviations from the plan include emergency bridge repairs, the restoration of utility lines across the San Gabriel River, and certain unplanned but necessary maintenance and inspection. Santa Fe Dam may be operated to support these activities, provided that flood protection is not jeopardized.

c. Planned Deviations. The same arguments apply to planned construction, maintenance, inspections, etc., as under Section 7-13.b. Such planned activities should be schedule for the dry season, whenever possible. The dry season is normally May through October, although on a rare occasion, a tropical storm with heavy rain and high runoff potential can occur during the late summer or early fall.

7-14 Rate or Release Change

The gates at Santa Fe Dam are hydraulically operated. Up to two gates can be operated at a time, and opened or closed about one foot per minute. The gate can generally be adjusted in as rapid a manner as possible without concern over the rate of change of outflow. Continuous large magnitude fluctuations in reservoir releases could cause instability of channel revetment and should therefore be avoided. If the gate operation requires larger release, the outflow from the dam can be increased by increments of 5,000 ft³/sec per half-hour until the required release is reached.

7-15 Water Control Hydraulic Information

Project hydraulic information has been utilized in the development of the flood control plan. This information has also been used to evaluate and set regulation rules for planned deviations and also facilities regulation of the dam during emergencies and unplanned deviations. Project Hydraulic information used for Santa Fe Dam include:

- a. Outlet Rating Curves (pl. 7-1),
- b. Spillway Discharge Curve (pl. 7-2),
- c. Area-Capacity Curves (pl. 3-3),
- d. Downstream Steam Gauge Rating Curve (pl. 8-4).