Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh

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Chapter 8:
Priority 3 Clifton Court Forebay Gate Operations for Extended Planning Studies

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8 Priority 3 Clifton Court Forebay Gate Operations for Extended Planning Studies

8.1 Introduction

The CALFED Common Assumptions Modeling Team is using the Delta Simulation Model Version 2 (DSM2) model to simulate Delta conditions over 82-year planning studies. In order to conduct these studies, the existing Forebay intake operation under Priority 3 for 16-year planning studies needs to be extended. A time series of Clifton Court Forebay intake gate operation for use in DSM2 planning simulations has been constructed to account for operation of the intake gates under the "Priority 3" criteria. This operation is based on the channel stage immediately outside the Forebay and is intended to reduce impacts of State Water Project diversions on local water levels.

8.2 Background

The Clifton Court Forebay intake structure is composed of 5 control gates (Figures 8.1 and 8.2). At times the gates are operated separately to provide better control of inflow. Normally, however, the gates can be considered to operate in unison (Le, 2004). Typically the gates are opened and closed several times a day to reduce any impacts on levels in the south Delta due to State Water Project (SWP) exports at Banks Pumping Plant.

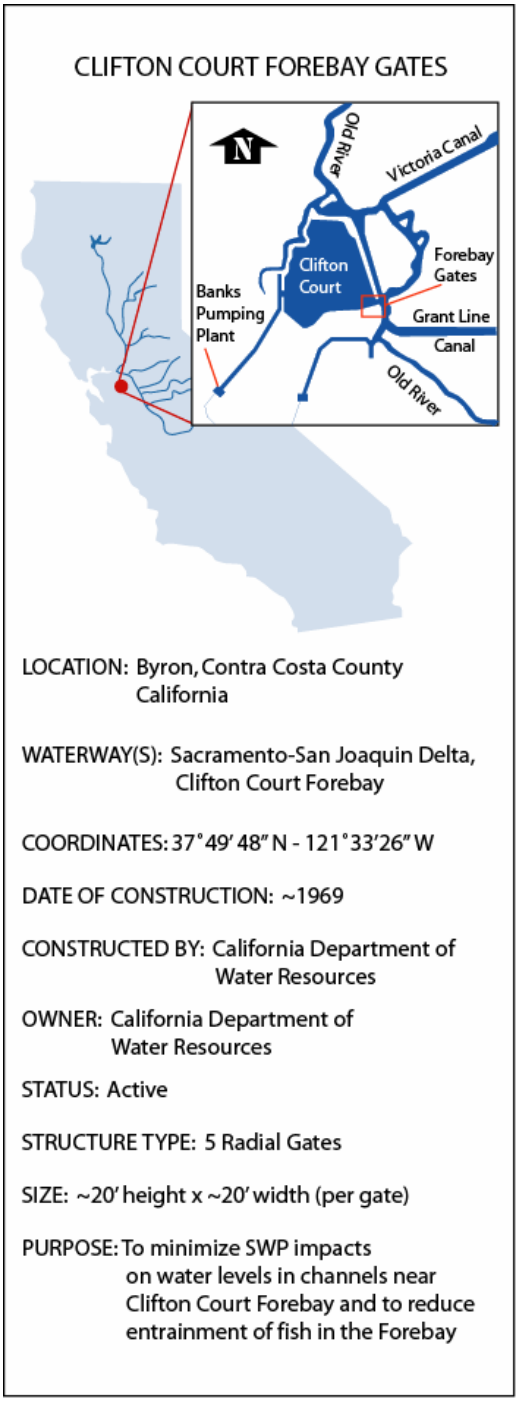

Figure 8.1: View of the Forebay gates from across Old River on Coney Island.
(photograph taken by Mike Burns)

Figure 8.2: Aerial view of the Clifton Court Forebay inlet.

The criteria for the gate operation is defined in the 1989 "STANDING OPERATING ORDER PC 200.7-A" (O&M, 1989). Operation of the Clifton Court Forebay intake gates by what is commonly termed "Priority 3" is such that:

> "Intake gates open 1 hour after the low-low tide; close 2 hours after the high-low tide; reopen 1 hour before the high-high tide; and close 2 hours before the low-low tide."

For a spring tide, the intake gate operation schedule is as shown in Figure 8.3.

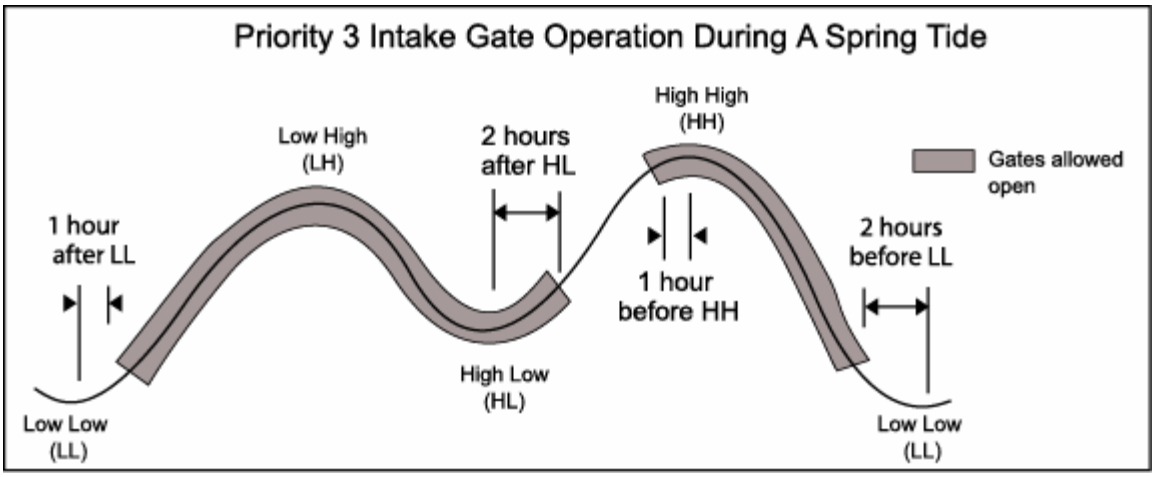

Figure 8.3: Priority 3 Clifton Court Forebay gate operation during spring tide.

Because DWR Operations and Maintenance (O&M) operating guidelines assume a synchronized gate operation and in order to simplify the modeling of the gates, DSM2 treats the five gates as a single device. It is desirable that DSM2 planning simulations assume an intake gate operation according to the Priority 3 operating guidelines in order to simulate more realistic water levels in the south Delta.

8.3 General Methodology

Developing forebay intake gate operation timing involves three steps: simulating channel stage levels adjacent to the forebay; determining the times of higher-high (HH), lower-low (LL), lower-high (LH), and higher-low (HL) water levels; and establishing the gate timing according to Priority 3 criteria. Because the intake gate timing is based on the water levels outside the forebay intake gates, a preliminary base planning simulation is first run to generate a 15-minute time series of stage just outside the intake gates. Constructing the gate operation time series then is done through an analysis of this preliminary stage time series using a Jython script which identifies the times of the HH, LL, LH, and HL values. Based on these times and the Priority 3 criteria, the script constructs an irregular time series of timing of the intake gates' operation. The time series for a Priority 3 gate operation for an 82-year planning simulation is then converted to DSS format for use by DSM2. Figure 8.4 shows an example of the stage just outside the forebay gate as simulated by DSM2 and the generated intake gate operation criteria under Priority 3.

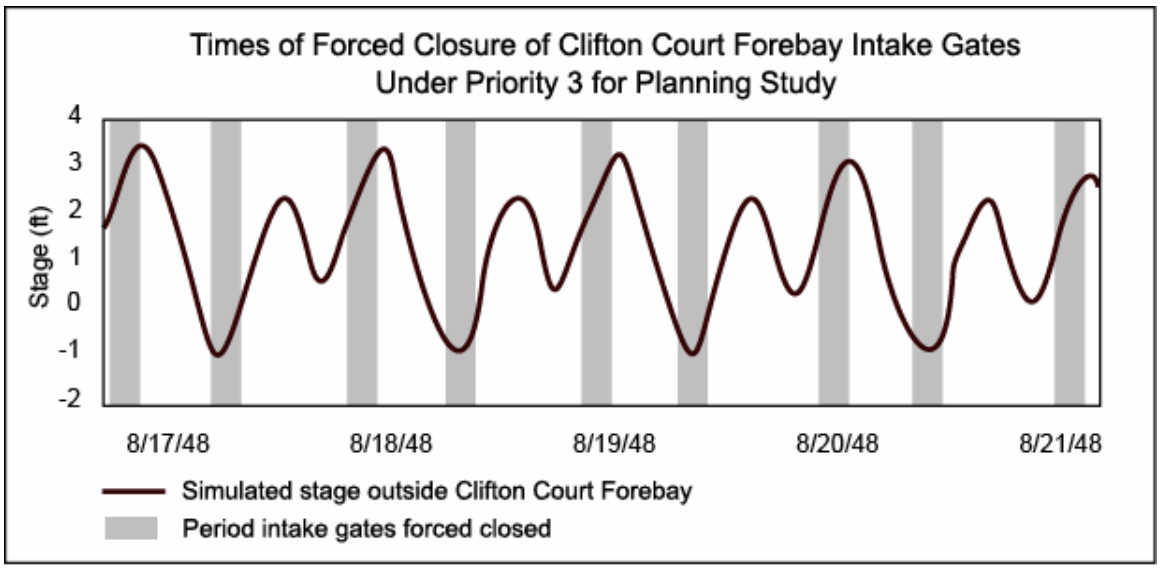

Figure 8.4: Example of Clifton Court Forebay gate timing for a planning study under a Priority 3 criteria.

8.4 Impact of Priority 3 Forebay Intake Gate Operation on DSM2-Generated Water Levels

In this section, water levels under Priority 3 are compared to levels under what has been called 'Priority 4'operation of the intake gates in order to demonstrate the effect on south Delta water levels of strategically restricting flow into the forebay. Priority 4 operation allows water to flow into Clifton Court Forebay any time the water level inside the forebay is lower than the level outside. However, water inside the forebay is never allowed to flow back out. Under Priority 4 much of the water diversion into the forebay occurs during each rising tide. As shown in Figure 8.3, under Priority 3 the intake gates are kept closed on the rising tide before the high-high tide. This allows the tide to better propagate upstream. The south Delta rock barriers, when installed, do suppress some of the upstream movement of tidal energy. For a comparison of the two intake operations, water levels are presented at three locations in the Delta: outside the Clifton Court Forebay intake gate, outside Tom Paine Slough, and inside Tom Paine Slough (Figure 8.5).

The water levels in the south Delta under Priority 3 and 4 for March through September of 1991 from a planning study are shown in Figure 8.6. In 1991 the Grant Line Canal barrier was assumed installed from May 16 to October 1, the Middle River barrier and the Old River near DMC barrier were assumed installed from April 15 to October 1, and the head of Old River barrier was assumed installed from April 14 to May 16 and from September 17 to November 30. The relatively large differences in daily maximum stage (up to one foot) just outside the forebay in July occurred during high SWP and Central Valley Project (CVP) pumping. This shows the potential effectiveness of Priority 3 under high pumping. However, for this same time period, the difference in daily maximum stage outside of Tom Paine Slough, which is upstream of the Old River barrier, is much smaller. This indicates that the barriers reduce the benefits to maximum water levels.

Under high pumping but without the barriers installed, as in March, the difference in maximum water levels under the two intake gate operations is large all along Old River from near the forebay intake to near the mouth of Tom Paine Slough.

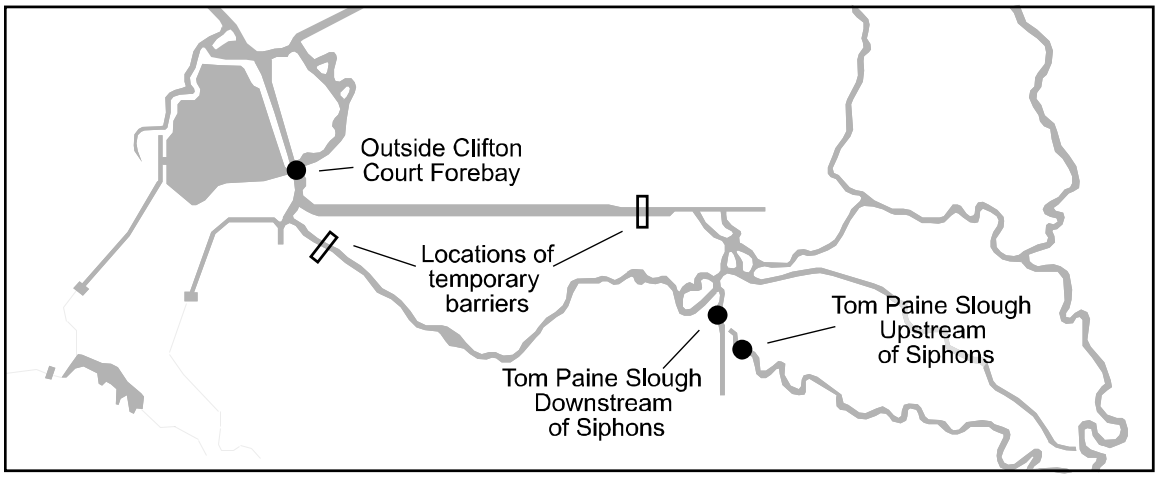

Figure 8.5: Locations water levels are presented to show the impact of operating Clifton Court Forebay intake gates according to Priority 3.

Figures 8.7, 8.8, and 8.9 compare water levels at the three sites over an extended planning simulation of 1975 through 1989. Thirty-day running averages of daily maximum and minimum levels show that the patterns in water levels discussed above are persistent. Operating Clifton Court Forebay intake gates according to Priority 3, as established by the methodology presented in this chapter, significantly affects the maximum water levels near the forebay, but this effect diminishes upstream approaching the siphons on Tom Paine Slough. To show the impact of Priority 3 intake gate operation on the movement of water upstream of Clifton Court Forebay, tidal flows can also be examined.

The impact of operating under Priority 3 can also be seen in the south Delta flows. Figure 8.10 shows the 30-day running average of daily maximum and minimum flows in Old River just upstream of the temporary barrier site near the DMC intake. Positive flows are flows in the downstream direction while negative flows are upstream flows associated with an incoming tide. Diverting water into Clifton Court Forebay under Priority 3 as compared to Priority 4 doesn't significantly change downstream flows, but causes higher peak upstream flows. This is consistent with the goal of Priority 3 preserving the momentum of incoming tides which results in increased movement of water upstream Old River.

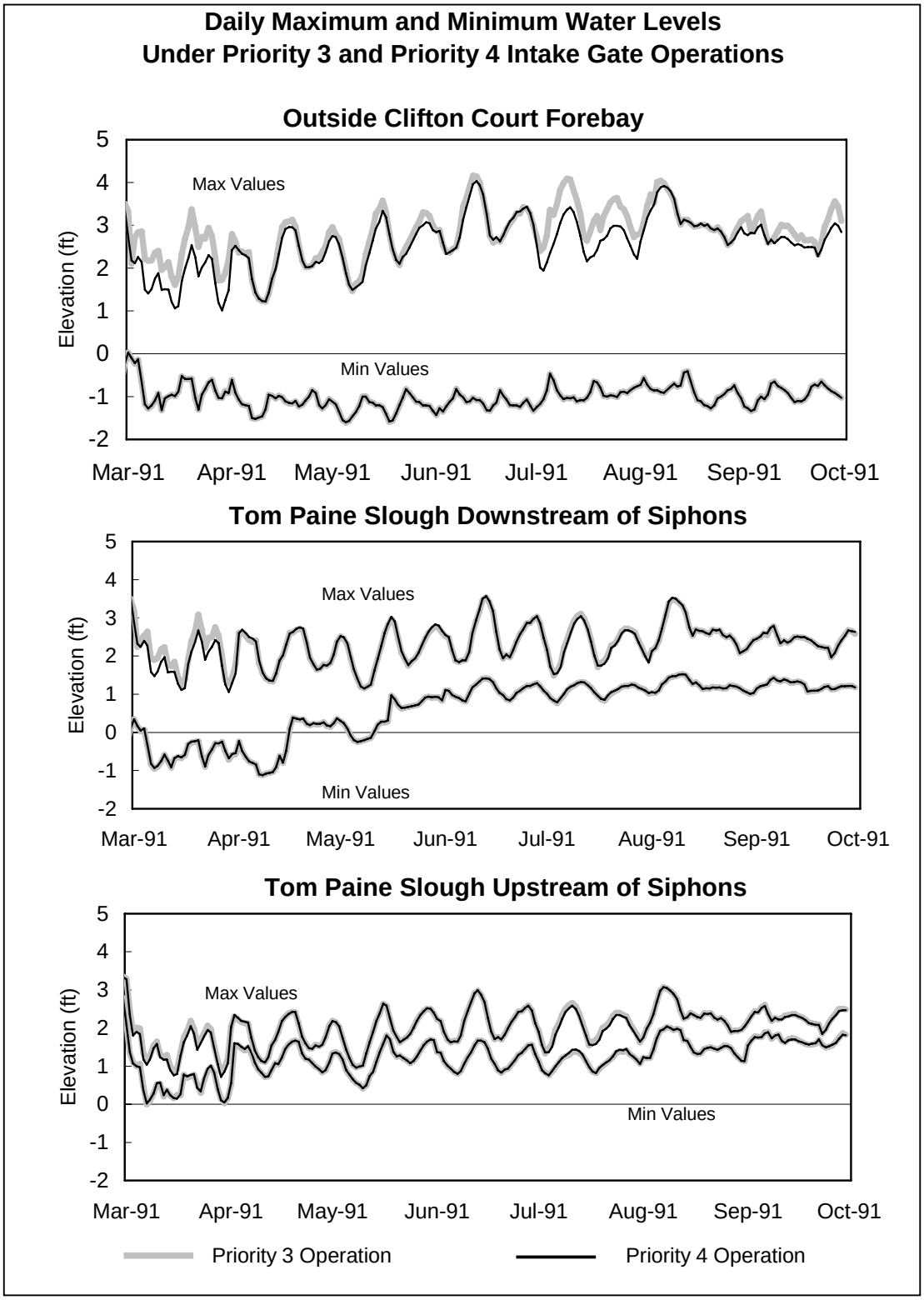

Figure 8.6: Water levels at three locations in the south Delta under Priority 3 and Priority 4 forebay intake gate operation, 1991 planning conditions.

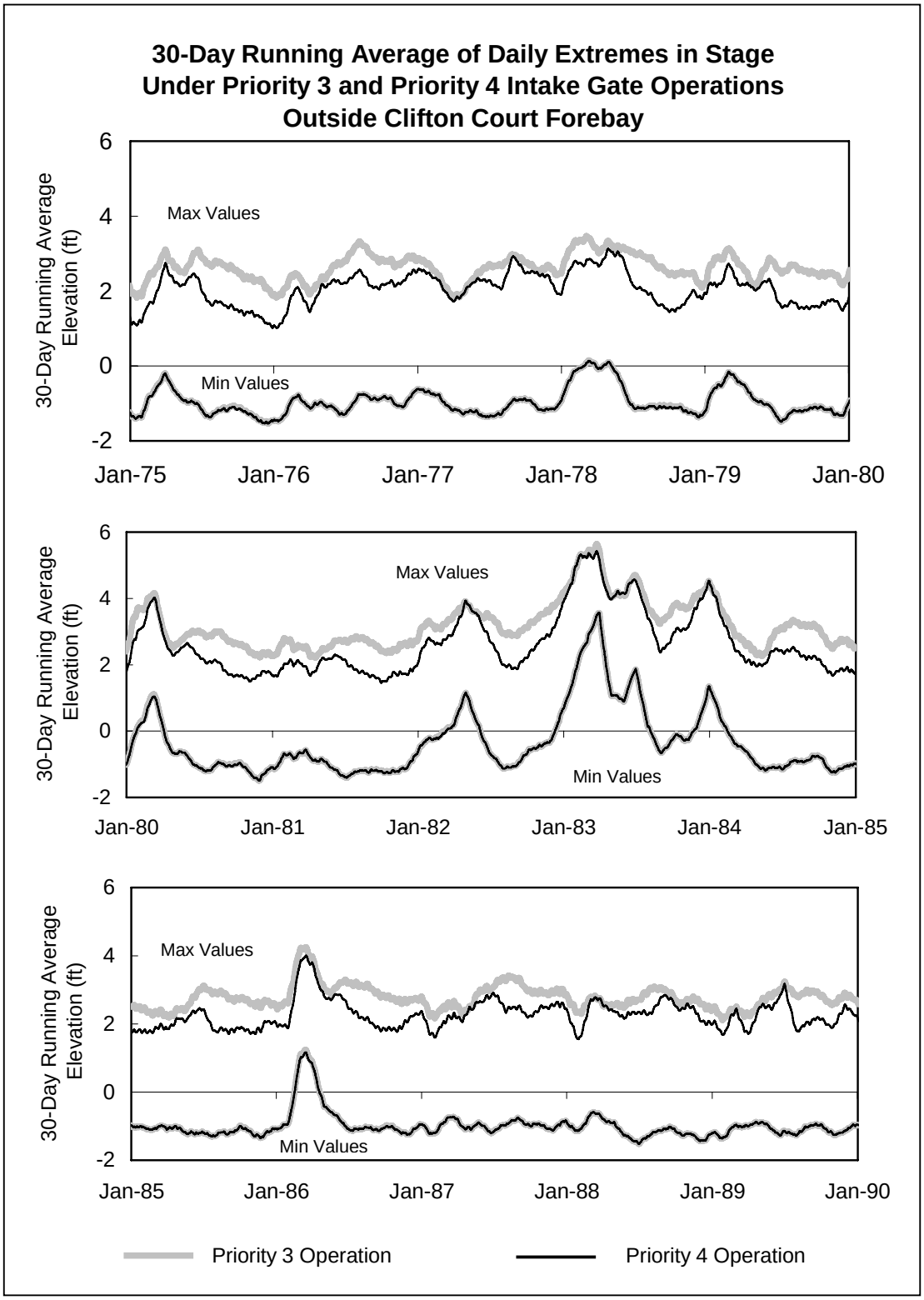

Figure 8.7: Outside Clifton Court Forebay 30-Day running average daily of minimum and maximum water levels under Priority 3 and Priority 4 Clifton Court Forebay intake gate operations.

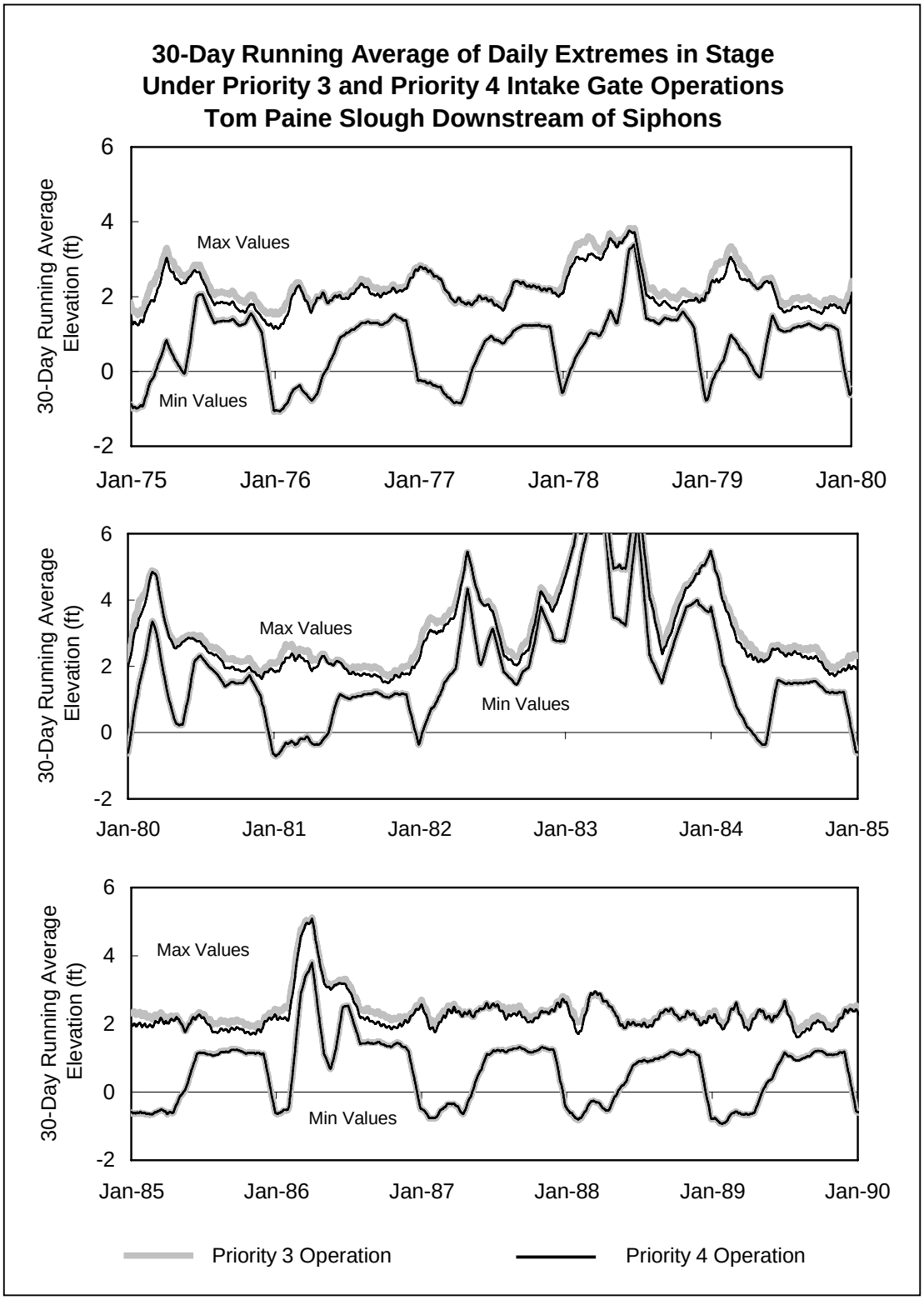

Figure 8.8: Outside Tom Paine Slough 30-Day running average daily of minimum and maximum water levels under Priority 3 and Priority 4 Clifton Court Forebay intake gate operations.

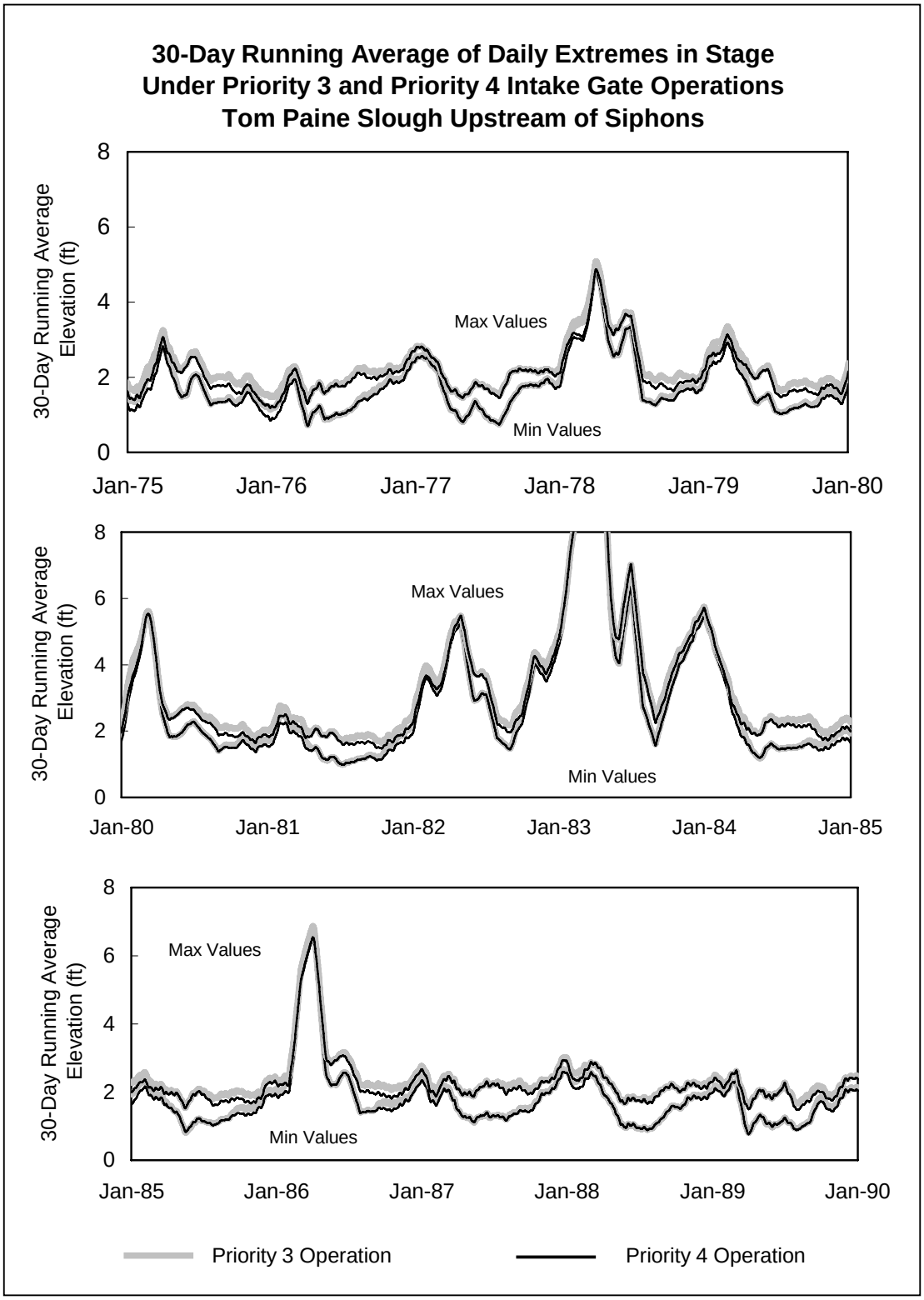

Figure 8.9: Inside Tom Paine Slough 30-Day running average daily of minimum and maximum water levels under Priority 3 and Priority 4 Clifton Court Forebay intake gate operations.

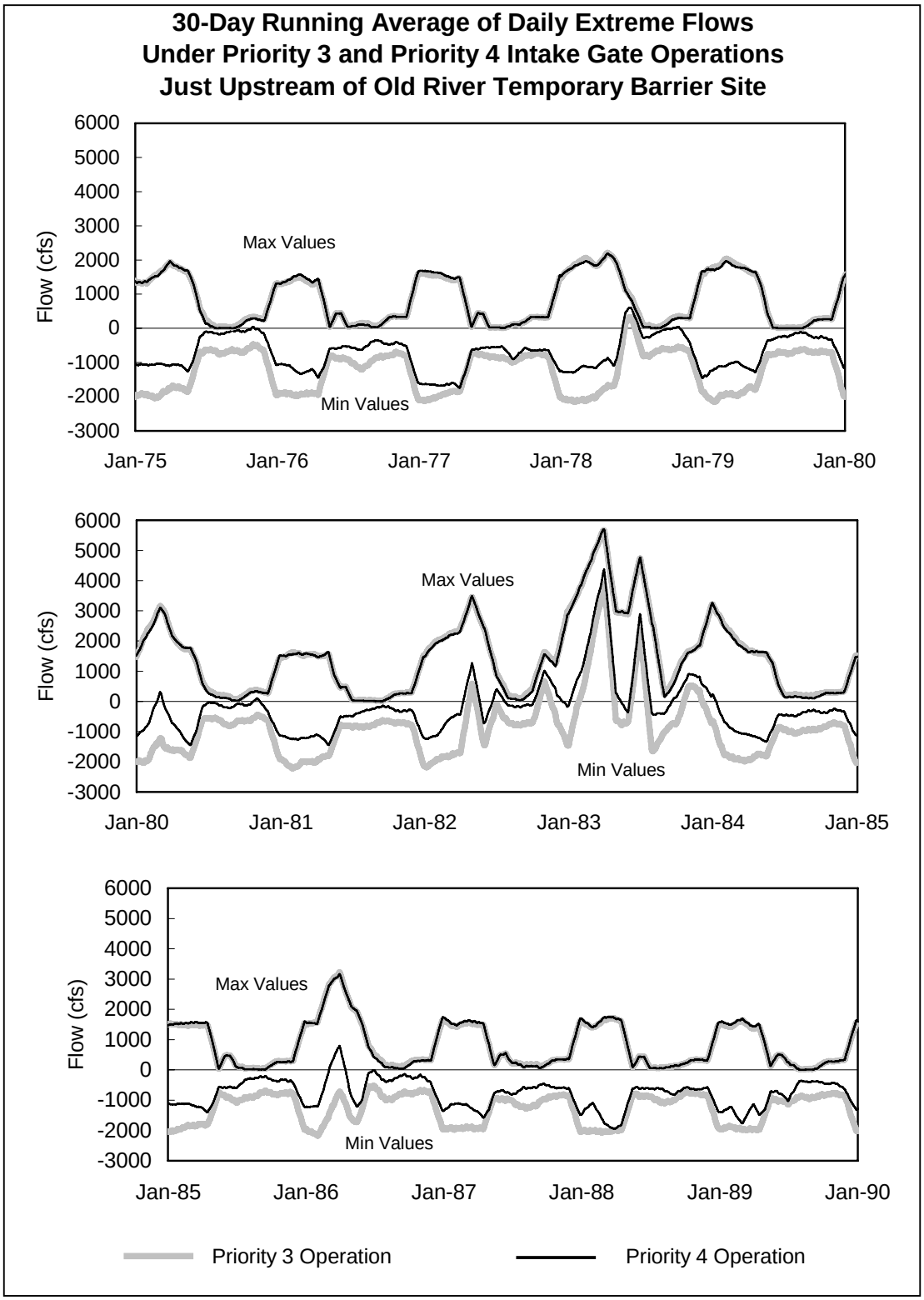

Figure 8.10: Just upstream of Old River temporary barrier 30-day running average daily of minimum and maximum flows under Priority 3 and Priority 4 Clifton Court Forebay intake gate operations.

8.5 References

Le, K. (2004). "Chap. 12: Calculating Clifton Court Forebay Inflow." *Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh. 22nd Annual Progress Report to the State Water Resources Control Board.* Bay-Delta Office, California Department of Water Resources. Sacramento, CA. http://modeling.water.ca.gov/delta/reports/annrpt/2004/2004Ch12.pdf

O&M (1989). *Standing Operating Order PC 200.7-A.* Division of Operation and Maintenance, California Department of Water Resources. Sacramento, CA.