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

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Chapter 1
Initial Investigation of Inflatable Barrier in South Delta

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1.1 Background

The agricultural rock barriers constructed in the South Delta (Figure 1-1), under the Temporary Barriers Program of the California Department of Water Resources, Bay-Delta Office (BDO), are installed to provide increased water levels and improved circulation patterns in the South Delta area.

BDO is investigating the feasibility of using inflatable barriers (i.e., rubber-bladder barriers) instead of the current rock barriers. The potential benefits of the inflatable barriers are lower cost and ease of installation.

The Old River at Tracy temporary barrier is used as a modeling case study to investigate the feasibility of an inflatable barrier. To increase water levels and improve water quality, the current rock barrier, under normal operating conditions, allows water to flow from downstream to upstream through the culverts with flap gates (Figure 1-2), and over the top of the weir during flood tide events. The ends of culverts, with the flap gates, are on the upstream side of the barrier. On the other hand, the inflatable barrier under consideration will not allow overtopping.

For the inflatable barrier to work in generally the same way as the rock barrier, it has to allow the same flood tide volume of water to flow upstream of the barrier by using only culverts, as opposed to the current configuration, which uses both culverts and overtopping of the weir. If the inflatable barrier does not allow the same flood tide of water to flow upstream of the barrier by using the current amount of culverts, then additional culverts may have to be installed to match that flow.

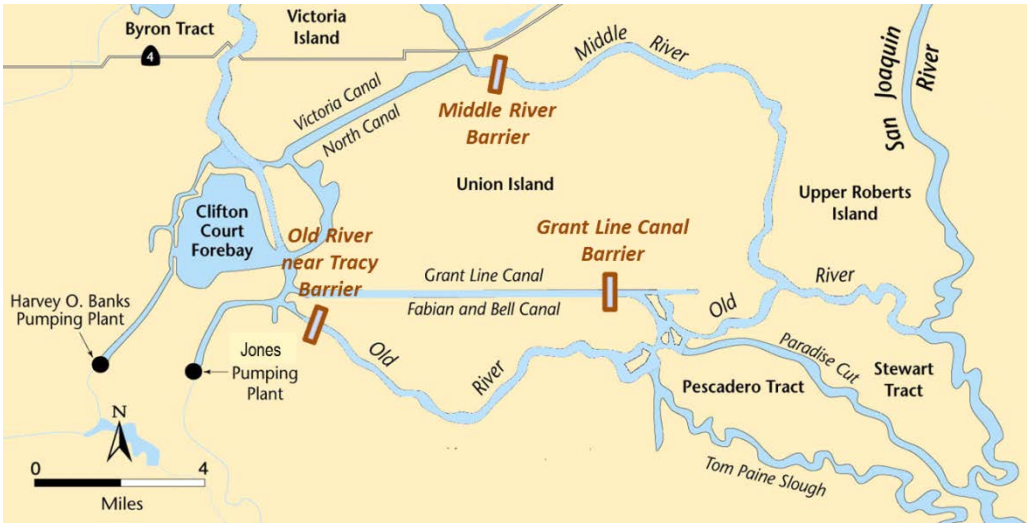

Figure 1-1 Agricultural Temporary Barriers in the South Delta

Figure 1-2 The Culverts with Flap Gates at the Old River Tracy Barrier

1.2 Purpose

The purpose of this preliminary investigation is to evaluate what percentage of the flood tide flows through the culverts, as opposed to the flow that overtops the weir.

1.3 Modeling Assumptions

The Delta Simulation Model II (DSM2) is a one-dimensional mathematical model for dynamic simulation of hydrodynamics, water quality, and particle tracking in a network of riverine or estuarine channels. DSM2 consists of three modules: HYDRO, QUAL, and PTM. DSM2-HYDRO is used for this investigation. The simulation period is January 1999–December 2011 and includes various types of hydrologic conditions and historical water project operations. Specifically, the culverts of the Old River at Tracy temporary barrier are assumed to be tidally operated. This means that, during flood tide conditions, the pressure of the flood tide forces water against the flap gates on the culverts, and this pressure opens the flap gates on the upstream side to enable water to flow into the channel upstream of the barrier.

DSM2-HYDRO assumes the flap gates of the culverts open immediately when the flood tide is flowing from downstream to upstream side of the barrier. In other words, there is no explicit assumption regarding what hydraulic conditions (e.g., water-level difference) need to be considered in order to open the flap gates under flood tide conditions. In addition, DSM2-HYDRO has not been calibrated to assess how accurately the model estimates flows over the top of the weir and through the culverts because the field data is not available.

1.4 Preliminary Modeling Results and Findings

This investigation focuses on discovering the percentage of water flowing over the top of the weir and through the culverts under flood tide conditions. The hourly flow modeling results are post-processed and summarized for this analysis.

Figure 1-3 shows the numerical range of the water amount flowing over the top of weir and through the culverts during flood tide events and the associated exceedance probabilities. It appears that the flow range of water over the top of weir has a larger range than the flow through the culverts. Note that when interpreting the two exceedance probability curves, for a certain probability value, the flow over

the top of weir and through the culverts does not represent that these two flows occur at the same time. For example, for a 50-percent exceedance probability, the flows over the top of weir and through the culverts are about 250 cubic feet per second (cfs) and 410 cfs, respectively, but these two flows actually occur at different times.

Figure 1-4 is a stacked-column plot showing the portion of water flowing over the top of weir and through the culverts in terms of the percentage of total water flowing from downstream to upstream of the barrier. The results show that about 67.7 percent of the time, the amount of water flowing through the culverts is greater than the water flowing over the top of the weir. Furthermore, the results show that total water flowing from downstream to upstream, in general about 37.6 percent of the total water amount, flows over the top of the weir, and about 62.4 percent of the total water amount flows through the culverts.

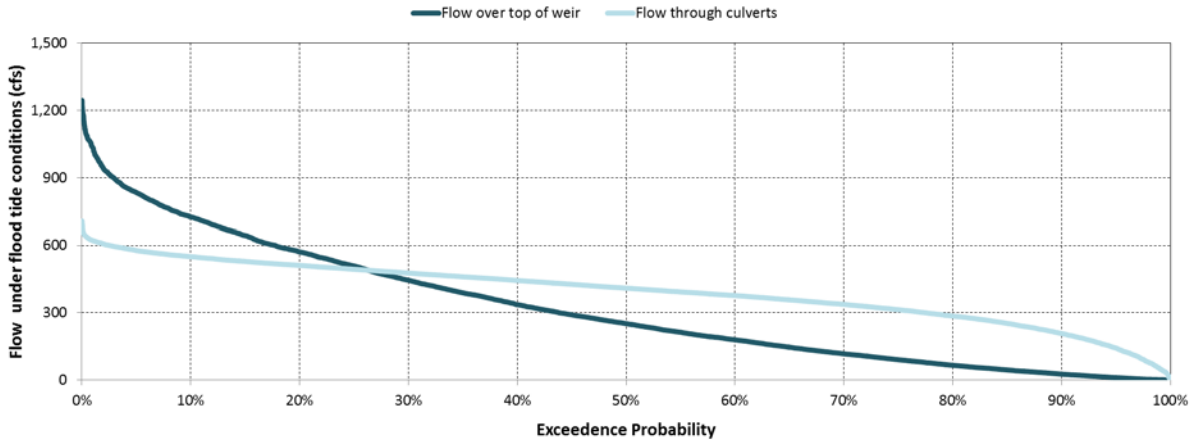

Figure 1-3 Exceedance Probabilities of Flow Over the Top of the Weir and Through the Culverts Under Flood Tide Conditions

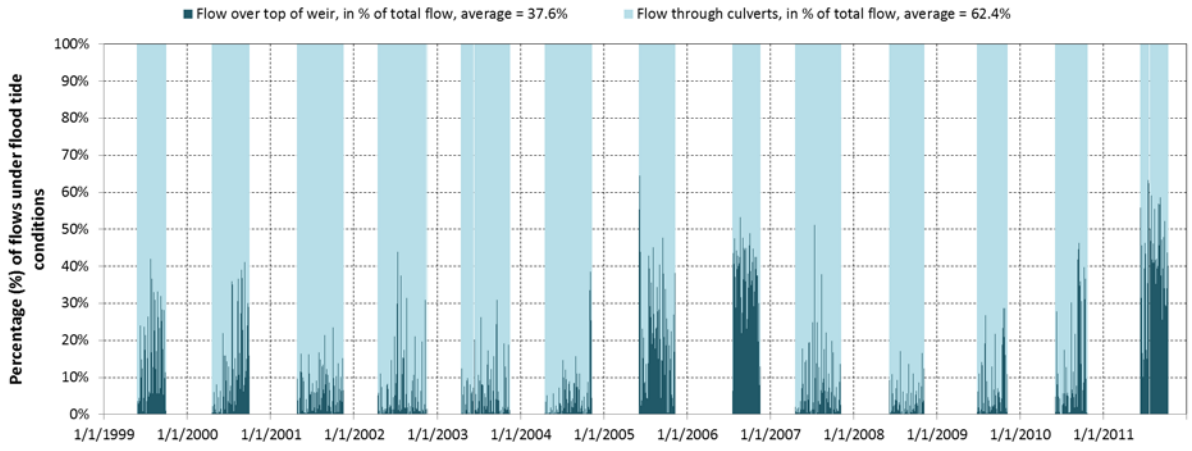

Figure 1-4 Flows Over the Top of the Weir and Through the Culverts in Terms of Total Flow Amount Under Flood Tide Conditions

1.5 Next Steps

As previously mentioned, the key assumption of this analysis is that the flap gates open immediately when the flood tide is flowing from downstream to upstream. Along these lines, the hydraulic conditions

that need to be considered to open the flap gates are not considered in this study. In addition, DSM2-HYDRO has not been calibrated to evaluate the accuracy of estimating the flow over the top of the weir and through the culverts. The modeling results shown in this investigation are very preliminary and need to be further analyzed to determine the next steps (e.g., design and operation purposes) for assessment of the feasibility of using inflatable barriers. Although it is preliminary, the study gives a better idea of the amount of water moving over the weir and through the culverts, and will be used to inform any further analysis. In the past, design of the rock barriers, including the weir heights and number of culverts, has been based on modeling and observation of water levels and flow circulation. If needed, future analysis could also focus on designing the inflatable barriers to meet specified criteria, as this relates to the balance between low water levels and circulation patterns.