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

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Chapter 4:
Morrow Island Distribution System Calibration

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4 Morrow Island Distribution System Calibration

4.1 Introduction

In fall 2002, the Morrow Island Distribution System (MIDS) intake gate was replaced with a new combination gate (flap and screw combination). The 48-inch diameter high-density polyethylene pipes are significantly smoother than the previous corrugated, asphalt-coated pipes. The physical impact of this change was studied by conducting a field study in February 2003. This study was then used to calibrate the MIDS intake gate coefficient used in DSM2 by running a series of sensitivity runs using different MIDS intake coefficients. The study also provided insight on the tidal volume exchange between Goodyear Slough and the MIDS intake.

4.2 Background

Located west of the Sacramento-San Joaquin Delta, the Suisun Marsh lies near the DSM2 downstream tidal boundary at Martinez. The marsh is a vital wintering and nesting area for the waterfowl of the Pacific Flyway, representing approximately 12% of California's remaining wetland habitat. The majority of the wetland property in the marsh is privately owned and managed as waterfowl clubs. MIDS is responsible for maintaining one of these wetland habitats on Morrow Island.

MIDS functions by allowing less saline water to enter the distribution system from Goodyear Slough to the west, and then travel eastward by gravity flow through one of two ditches to the wetlands on the east side of Morrow Island. Water can exit the system from an outfall gate at the end of each of the two ditches. The flap gates on all of the MIDS culverts reduce the reverse flow through the system when the tide is flooding.

In DSM2, MIDS is represented by a series of gates with non-zero flow coefficients in one direction only, thus permitting flow to travel from Goodyear Slough to the west and through the two channels to the two outfall culverts in the east. The previous flow coefficient for the MIDS intake culvert was based on early DSM2 calibrations. When DWR replaced the MIDS intake structure, the Suisun Marsh Planning Branch of DWR's Division of Environmental Services developed a hydrodynamic study that was used to calibrate the DSM2 representation of the new culvert.

4.3 Location and Setup of Flow Study

MIDS is connected to Goodyear Slough through three 48-inch pipes. There is a large berm in Goodyear Slough to the west of the MIDS culverts. When operating, the tidal flap gates on the east side of the MIDS intake culverts prevent flow from leaving the MIDS ditch. The location of the MIDS is shown in Figure 4.1.

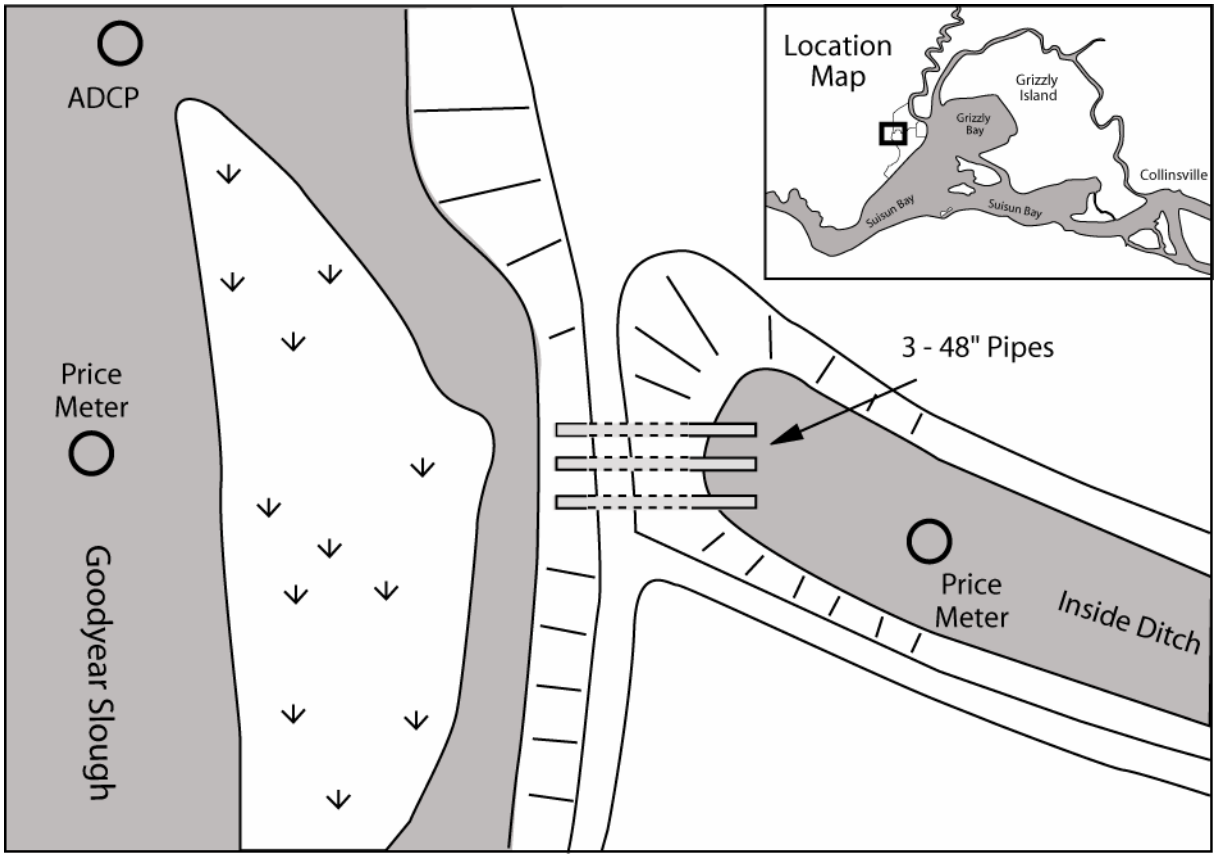

Figure 4.1: Morrow Island Distribution System Intake and Goodyear Slough.

Three flow monitoring devices were used to collect flow and stage data on either side of the new MIDS intake on February 19 and 26, 2003. During the neap tide on February 19, 2003, flow and stage data was sampled every 15 minutes beginning with the low-high tide and continuing through the high-high tide. A week later during the spring tide on February 26, data was sampled from the high-high through to the low-low tide.

As shown in Figure 4.1, two Price current meters were placed on either side of the MIDS intake pipes. An acoustic doppler current profiler (ADCP) was placed in Goodyear Slough north of the MIDS intakes. During the study period, the flap gates were tied fully open on the MIDS side to the east. The screw gates on the western side of the culvert (i.e., in Goodyear Slough) were only partially opened, allowing for an effective opening 18 inches in diameter.

4.4 Data and Analysis

Goodyear Slough flow data (collected by DWR's Central District staff) and stage data (collected by DWR's Delta Field Division) were compared with three DSM2 simulations. The current DSM2 flow coefficients for the MIDS intake pipes simulate one-way flap gates where flow can enter the MIDS from west to east (the assumed downstream direction for the MIDS in DSM2), but cannot reverse direction and move from east to west. A different flow coefficient was used

in each DSM2 run, as shown in Table 4.1. The results of these runs are shown along with the field observations in Figures 4.2 to 4.6.

Table 4.1: DSM2 Sensitivity Runs and MIDS Downstream Flow Coefficients.

Run	Downstream Flow Coefficient	Notes
1	0.5	Current DSM2 Coefficient
2	0.7	
3	0.2	

Figure 4.2 compares modeled and observed flow at the MIDS intake on February 19, 2003, for the three modeled flow coefficients from Table 4.1. The DSM2 results best matched the field observations when the MIDS downstream flow coefficient was set to 0.2 (i.e., run 3).

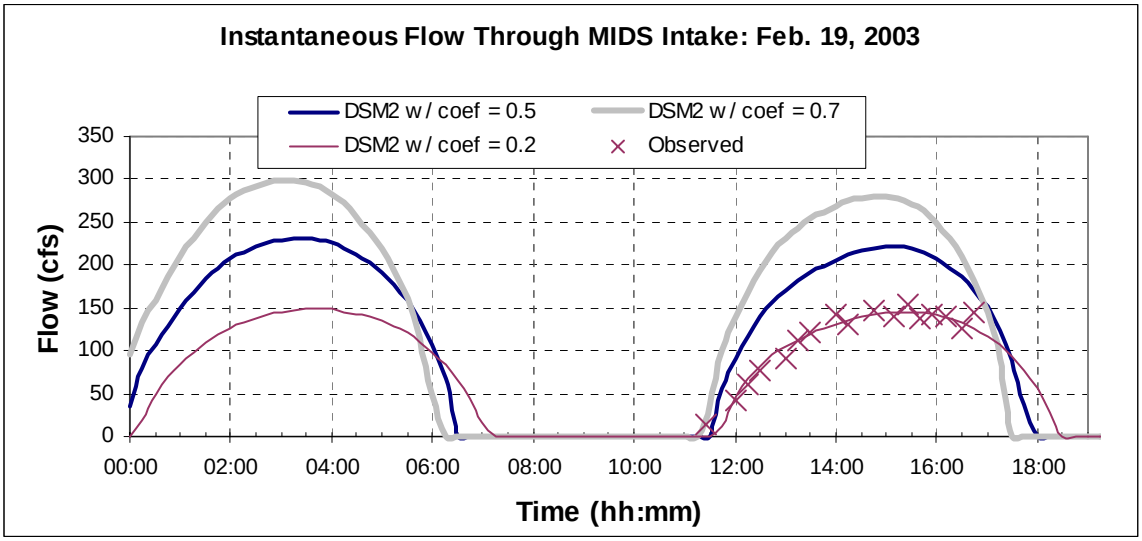

Figure 4.2: DSM2 and Observed Flow Through MIDS Intake on February 19, 2003.

A comparison of DSM2 and observed flow from February 19, 2003, to the north and south of the MIDS intake in Goodyear Slough shows how sensitive the new MIDS flow coefficient is to changes in the intake system (Figure 4.3). In this figure, negative flows in Goodyear Slough represent flow heading out towards Martinez (south). When the flow coefficient of 0.2 is used for the MIDS intake, DSM2 captured the magnitude of the tide ebbing back to sea. When the tide began to flood again at 18:30, the flap gate in the MIDS intake prevented flow from leaving the MIDS system, thus the flow north and south of the MIDS intake on Goodyear Slough was identical. No other changes were made to the geometry surrounding the MIDS intake or Goodyear Slough.

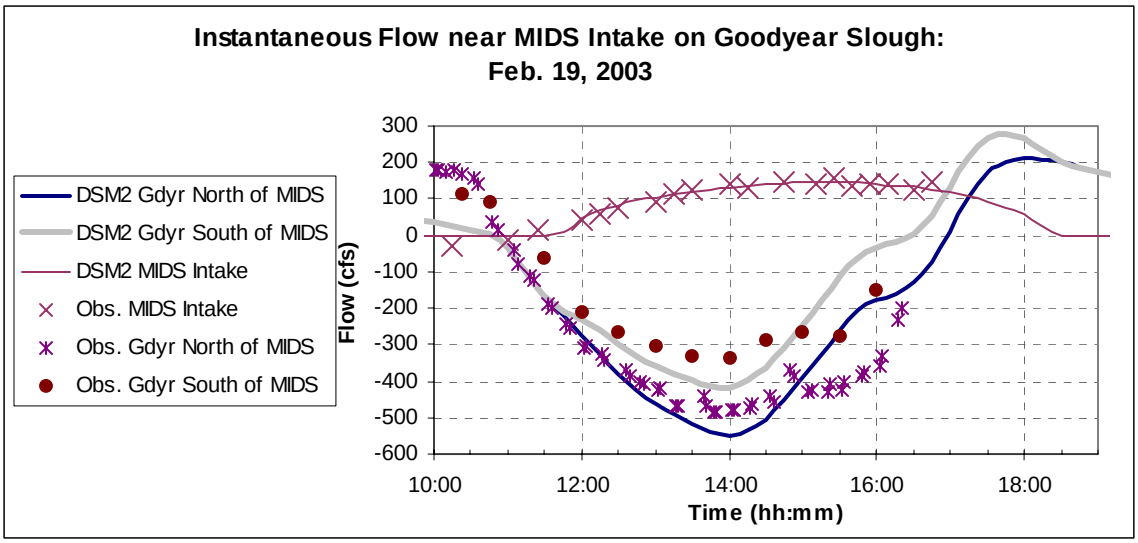

Figure 4.3: DSM2 and Observed Flow in Goodyear Slough near MIDS Intake on February 19, 2003.

Field measurements of the flow inside the MIDS intake and to the north and south of the intake on Goodyear Slough were taken a week later during the spring tide. These measurements were then compared with the new 0.2 flow coefficient used in DSM2 (Figure 4.4). While DSM2 accurately simulates the flow through the MIDS intake, the model underestimates the flow moving back and forth in Goodyear Slough by several hundred cfs. Though it is not shown, this underestimation of the flow magnitude in Goodyear Slough was the same in the runs where different MIDS intake flow coefficients were used. However, the 0.2 flow coefficient still represented the best fit of flow passing through the MIDS intake.

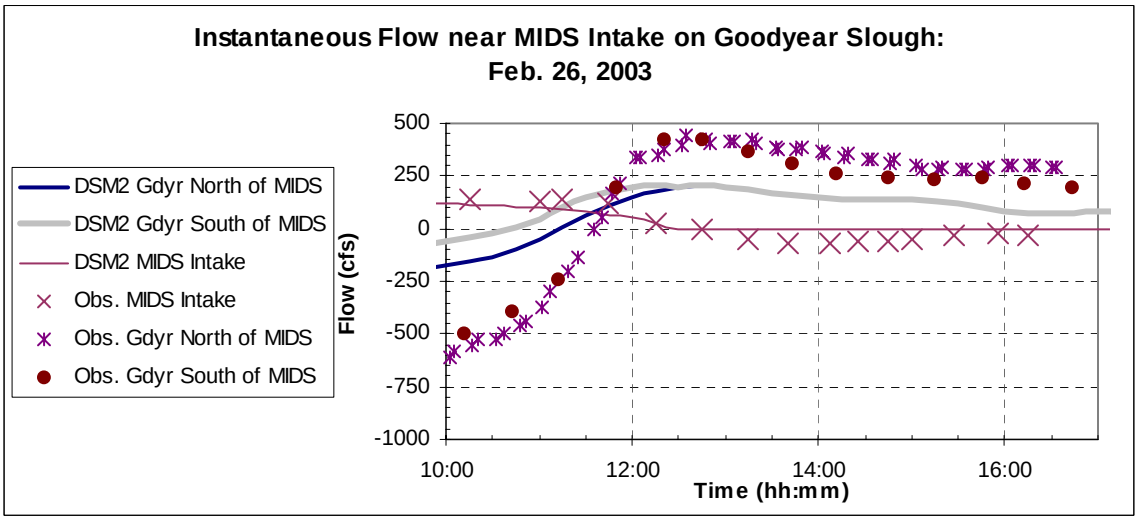

Figure 4.4: DSM2 and Observed Flow in Goodyear Slough near MIDS Intake on February 26, 2003.

Figures 4.5 and 4.6 illustrate the DSM2 and observed stage outside and inside the MIDS for both February 19 and February 26 respectively. The modeled and observed stage in Goodyear Slough to the west of the MIDS intake matched well on both days. However, the modeled stage inside the MIDS lags the field data by about 15 minutes for both days. The observed stage data east of the MIDS intake were flat prior to 8:00 AM because the intake flap gates were not yet tied open.

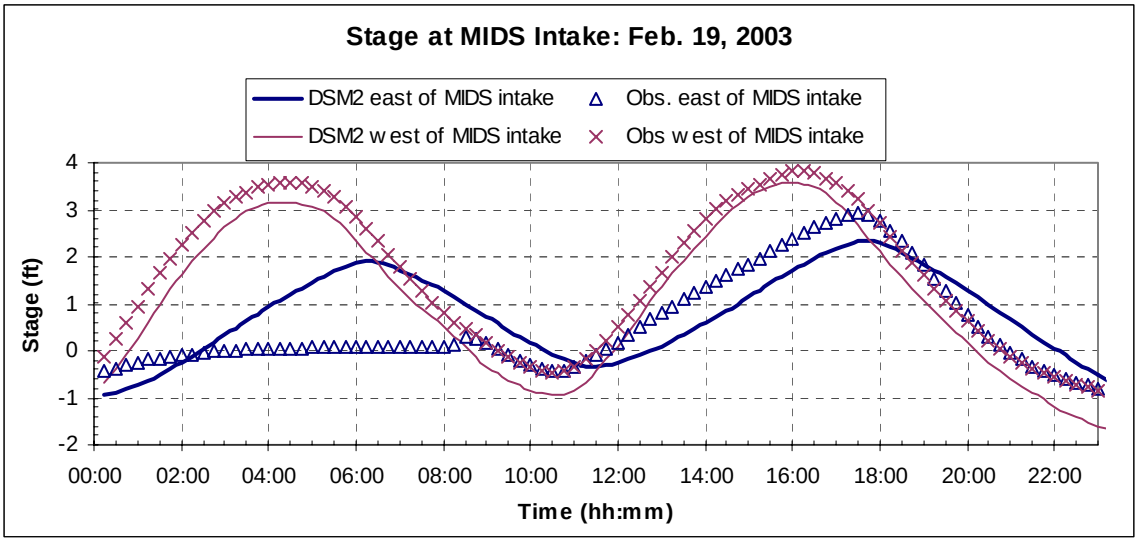

Figure 4.5: Stage at MIDS Intake on February 19, 2003 (Neap Tide).

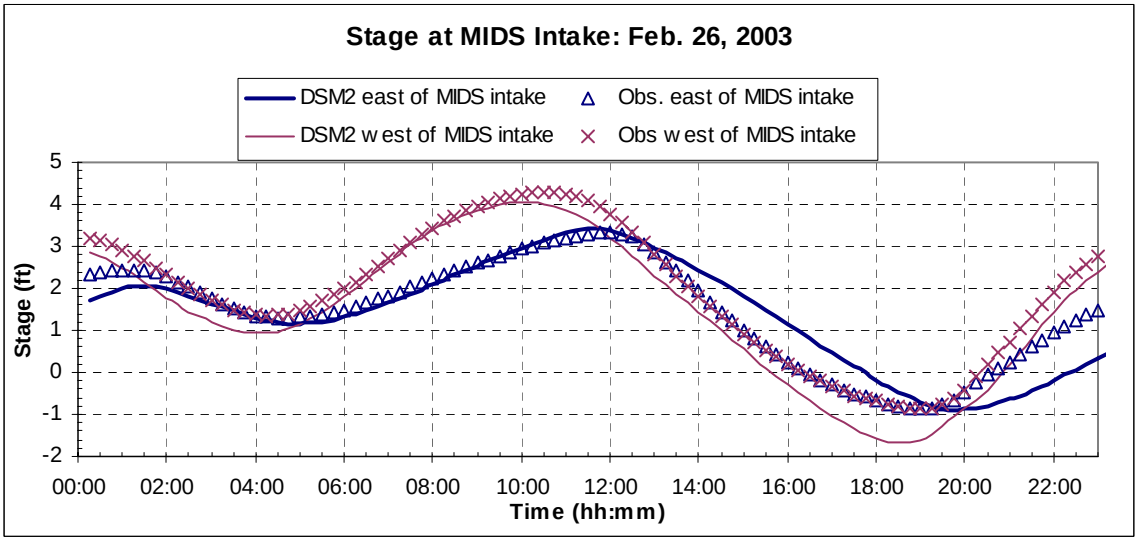

Figure 4.6: Stage at MIDS Intake on February 26, 2003 (Spring Tide).

4.5 Conclusions and Recommendations

- Because the 0.2 flow coefficient used in the DSM2 sensitivity runs fit the observed data better than the 0.5 flow coefficient used in the current calibrated version of DSM2, it is recommended that future DSM2 simulations use 0.2 as the flow coefficient for the MIDS intake.

- Modeled stage in Goodyear Slough matched both the amplitude and phase of the observed stage, while the modeled stage inside the MIDS lags the observed stage by about 15 minutes.

- Modeled flow in Goodyear Slough underestimated the observed tidal flow to the north and south of the MIDS intake during the spring tide; however, the modeled flow inside the MIDS matched the amplitude and phase of observed flow.

4.6 Websites

Additional information on the Suisun Marsh Program and Morrow Island Distribution System can be found at:
http://iep.water.ca.gov/suisun/dataReports/