Comparison of Flow Trends Associated with Releases from In-Delta Storage Islands

Michael Mierzwa and Aaron Miller: California Department of Water Resources, Bay-Delta Office: Sacramento, CA

Introduction

The California Department of Water Resource's Integrated Storage Investigations (ISI) group used CALSIM II and DSM2 to evaluate changes to the flow patterns in the South Delta associated with releasing water from Bacon Island and Webb Tract (see Figure 1). The goal of the In-Delta Storage project is to use these two islands as storage facilities in order to increase drinking water supply, while maintaining the same environmental standards.

CALSIM II optimized the operation of the State Water Project (SWP) and Central Valley Project (CVP) with and without the two island reservoirs, and then DSM2-HYDRO simulated flow and stage throughout the Delta for both scenarios. Simulated particles were released into the Delta each July when CALSIM II scheduled project releases. DSM2-PTM tracked these particles as they moved in the Delta, allowing the comparison of particle fate presented here.

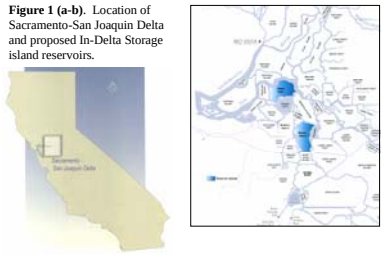

Figure 1 (a-b). Location of Sacramento-San Joaquin Delta and proposed In-Delta Storage island reservoirs.

Methodology

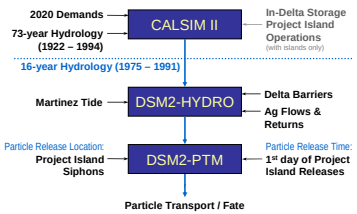

Figure 2. Flow chart illustrating the CALSIM II / DSM2 modeling process.

Two separate CALSIM II / DSM2 simulations were run: (1) a base case without the operations of the project islands, and (2) an alternative where water was diverted to and later released from the project islands. Although CALSIM II optimized the daily operations of the two project islands for 73 years (see Figure 2), DSM2-HYDRO only simulated these operations for the 16-year period starting in October 1975 and ending September 1991.

Table 1. Summary of July release periods from the project islands.

Release Year	Water Year Type	Monthly Ave. Bacon Island Release (cfs)	Monthly Ave. Webb Tract Release (cfs)
1978	Above Normal	1,844	1,617
1979	Below Normal	1,415	1,558
1980	Above Normal	1,844	1,601
1981	Dry	664	283
1982	Wet	1,836	1,613
1984	Wet	873	1,535
1986	Wet	1,837	1,535
1987	Dry	517	0

Hydrodynamics Summary:

- Water released from project islands in July, except in 1987 when it was released in June (see Table 1);
- Three South Delta Barriers were in place every July in both the base and alternative scenarios (see Figure 3);
- Agricultural flows to and from Delta islands based on 2020 demands, but changed in the alternative scenario to account for water use changes associated with the project;
- SWP exports increased to match project island releases.

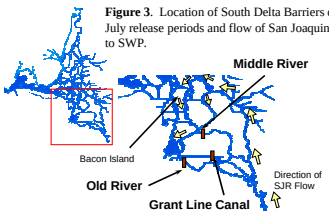

Figure 3. Location of South Delta Barriers during July release periods and flow of San Joaquin River to SWP.

Particle Tracking Summary:

- Particles released at 2 siphons on both Webb Tract and Bacon Island (see Figure 4);
- 200 particles released at each siphon on the 1st of July for each year shown in Table 1;
- Webb Tract and Bacon Island releases tracked independently.

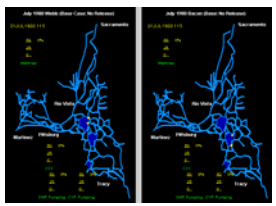

Figure 4. Particle release locations for Webb Tract and Bacon Island as shown in screenshot of July 1980 base scenario particle tracking animations.

Results

For each year shown in Table 1, a total of four independent 31-day simulations were run. Screen shots taken at the end of the DSM2-PTM simulations are shown for the 1980 and 1981 (which represent above normal and dry water years respectively) simulations for the base and alternative scenarios for both Webb Tract and Bacon Island (see Figures 5 and 9). Pie charts (see Figures 6, 7, 10, and 11) show the fate of all of the particles released from either island. Particle fate is show for Martinez (MTZ), Rock Slough (CCC), the State Water Project (SWP), or the Central Valley Project (CVP). The last category (Other) includes both particles that were removed from the Delta along with agricultural diversions and particles that are still present in the Delta. In the case of particles released from Webb Tract, the "Other" category largely consists of particles still in the Delta (as shown by the yellow particles in the Confluence region in the particle tracking animations). The difference in the percentage of particles released from Webb Tract is compared with the percentages of particles released from Bacon Island for the alternative simulation only (see Figures 8 and 12).

July 1980 (Above Normal Water Year) Releases

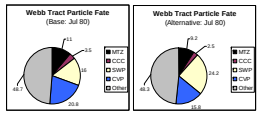

Figure 6 (a-b). Percentage of particles released in July 1980 from Webb Tract that end up leaving the Delta or that still remain in the Delta for both the base and alternative scenarios.

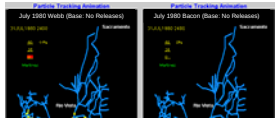

Figure 7 (a-b). Percentage of particles released in July 1980 from Bacon Island that end up leaving the Delta or that still remain in the Delta for both the base and alternative scenarios.

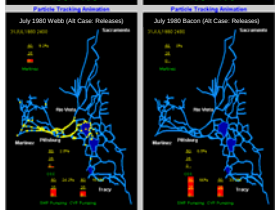

Figure 5. Screen shots of particle tracking animations for particles released in July 1980 from Webb Tract and Bacon Island for both the base and alternative scenarios.

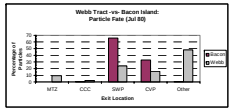

Figure 8. Comparison of exit locations of particles released in July 1980 from Webb Tract and Bacon Island 30 days after initial release.

July 1981 (Dry Water Year) Releases

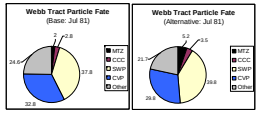

Figure 10 (a-b). Percentage of particles released in July 1981 from Webb Tract that end up leaving the Delta or that still remain in the Delta for both the base and alternative scenarios.

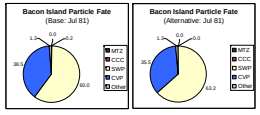

Figure 11 (a-b). Percentage of particles released in July 1981 from Bacon Island that end up leaving the Delta or that still remain in the Delta for both the base and alternative scenarios.

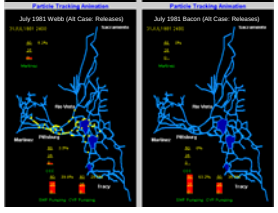

Figure 9. Screen shots of particle tracking animations for particles released in July 1981 from Webb Tract and Bacon Island for both the base and alternative scenarios.

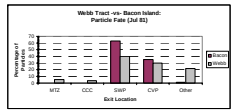

Figure 12. Comparison of exit locations of particles released in July 1981 from Webb Tract and Bacon Island 30 days after initial release.

Summary

The following trends were observed from the particle tracking results of the base and alternative simulations during all 8 releases periods (see Table 1):

- The South Delta Barriers (see Figure 3) change the summer flow patterns, such that water moving towards the SWP and CVP intakes passes near the *Bacon Island* siphons;
- Water year type effected the length of time particles released from *Webb Tract* would remain in the Delta (in dry years, higher SWP pumping rates would bring more *Webb Tract* particles to the SWP);
- Water year type had a more significant impact on the flow trend for *Webb Tract* than amount of water released from the project islands;
- For all water year types, the majority of particles released from Bacon Island end up at the SWP and CVP;
- For all water year types, particles released from *Bacon Island* reached the SWP and CVP intakes in less than a week;
- In wet and above normal water years the ratio between the percentage of particles released from *Bacon Island* reaching the SWP and CVP changed;
- In dry water years the ratio between particles released from *Bacon Island* reaching the SWP and CVP did not change.

Future Directions

The flow trends analyzed by DSM2-PTM are based only on one set of optimized CALSIM II operations for the In-Delta Storage islands, yet there are changes that can be made in CALSIM II, DSM2-HYDRO, and DSM2-PTM to refine this study:

- Develop different release rules in CALSIM II to study sensitivity of timing of project releases on particle fate;
- Remove some or all of the South Delta Barriers to study the importance of their operation on South Delta flow dynamics;
- Increase the particle release period from 1 day to 2 weeks in order to capture Spring-Neap effects.

Acknowledgments

Thanks to Dan Easton for developing the daily CALSIM II model and designing the In-Delta Storage operation rules, Pal Sandhu, Amy Bindra, and Rob Duvall for answering our constant questions about the project islands, Tara Smith and the Delta Modeling Section for developing and maintaining DSM2, and Callie Harrison for encouraging us to start making poster presentations.

Additional Info?

E-mail Contact: Michael Mierzwa, mmierzwa@water.ca.gov

Web Info:

- ISI In-Delta Storage Public Releases: http://calfed.water.ca.gov/DeltaImprovements/InDeltaStorage.shtml
- DSM2-PTM: http://modeling.water.ca.gov/