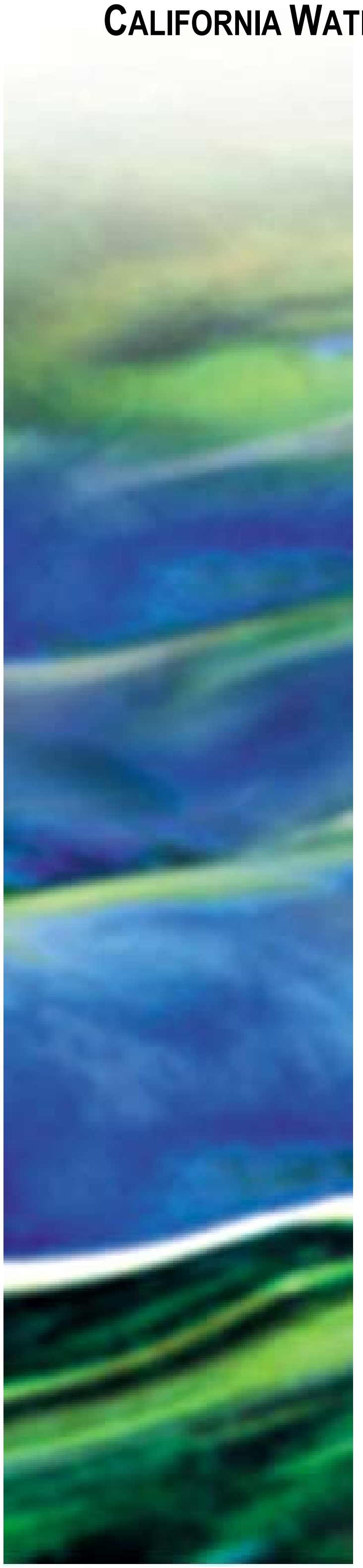
Exhibit DWR-1035

SUPPLEMENTAL INFORMATION REGARDING IN-CHANNEL VELOCITIES FOR THE CALIFORNIA WATERFIX, OPERATIONAL SCENARIO H3+ VERSUS PREVIOUSLY ASSESSED OPERATIONAL SCENARIOS H3 AND H4



Prepared for:

CALIFORNIA DEPARTMENT OF WATER RESOURCES

Prepared by:

ROBERTSON - BRYAN, INC.
Solutions for Progress

November 2017

1 QUALIFICATIONS

My name is Dr. Michael Bryan. I am a Principal Scientist and Managing Partner at Robertson-Bryan, Inc. (RBI). I received a Bachelor of Science degree in Fisheries Biology from the University of Wisconsin-Stevens Point in 1986, a Master of Science degree in Fisheries Biology from Iowa State University in 1989, and a Doctor of Philosophy degree in Toxicology and Fisheries Biology from Iowa State University in 1993.

I have 23 years of experience assessing impacts of water resource projects on water quality and aquatic biological resources in California. My expertise includes assessing measured and modeled data developed to characterize the environmental effects of projects in order to determine impacts to beneficial uses of waters throughout northern California, with a focus on Central Valley water bodies from Shasta Reservoir to the Sacramento-San Joaquin Delta (Delta). I have worked closely with the Central Valley Regional Water Quality Control Board over the past two decades to assist in developing and adopting eight new water quality objectives for the Water Quality Control Plan for the Sacramento River Basin and the San Joaquin River Basin (Basin Plan). For the California WaterFix (CWF), I led a team of scientists and engineers at RBI in the preparation of the Water Quality Chapter of the Bay Delta Conservation Plan (BDCP) Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS), BDCP/CWF Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement (RDEIR/SDEIS), and Final EIR/EIS.

My responsibilities at RBI include serving as the Firm's Managing Partner and technical lead for the practice areas of water quality, fisheries biology, and California Environmental Quality Act/National Environmental Policy Act documentation. Prior to my work at RBI, I was employed by Surface Water Resources, Inc., where I used modeling output from hydrologic models (e.g., PROSIM and CALSIM), temperature models (e.g., Bureau of Reclamation's [Reclamation] lower Sacramento River and lower American River temperature models), and salmon early life stage mortality models (e.g., Reclamation's mortality models for the lower Sacramento and American rivers) along with other studies and monitoring data to assess the potential impacts of water diversion and reservoir and dam re-operation projects on water quality and fish resources in the State Water Project and Central Valley Project reservoirs, rivers and Delta. My expertise also includes designing and implementing field and modeling studies to evaluate the impacts of wastewater treatment plant discharges on receiving water beneficial uses. A copy of my statement of qualifications was submitted in Part 1 of this Proceeding as Exhibit DWR-33.

2 PURPOSE AND ORGANIZATION OF REPORT

This technical report has been prepared in support of my testimony for Part 2 of the hearing (Exhibit DWR-1017) to demonstrate that the CWF Alternative 4A, operational scenario H3+ (CWF H3+) would result in probability distributions for in-channel velocities in the lower Sacramento River at river mile (RM) 58 and at nine locations within the Delta (Figure 1) that are similar to those modeled to occur for these same locations for CWF operational scenarios H3 and H4, as documented previously in my Part 1 Testimony (Exhibits DWR-651, DWR-653). This has been done by simply plotting the modeled probability distribution of velocities for the same locations, presented previously in Exhibit DWR-651 (Sacramento River) and Exhibit DWR-653 (Delta), for the following operational scenarios: No Action Alternative (NAA), H3 and H4, the Biological Assessment (BA) H3+, and CWF H3+. The discussions below focus on the modeled CWF H3+ velocities compared to H3 and H4 velocities that were presented in Part 1 of my testimony, because CWF H3+ is the project adopted by DWR. The BA H3+ scenario is included in the figures herein as an additional point of reference.

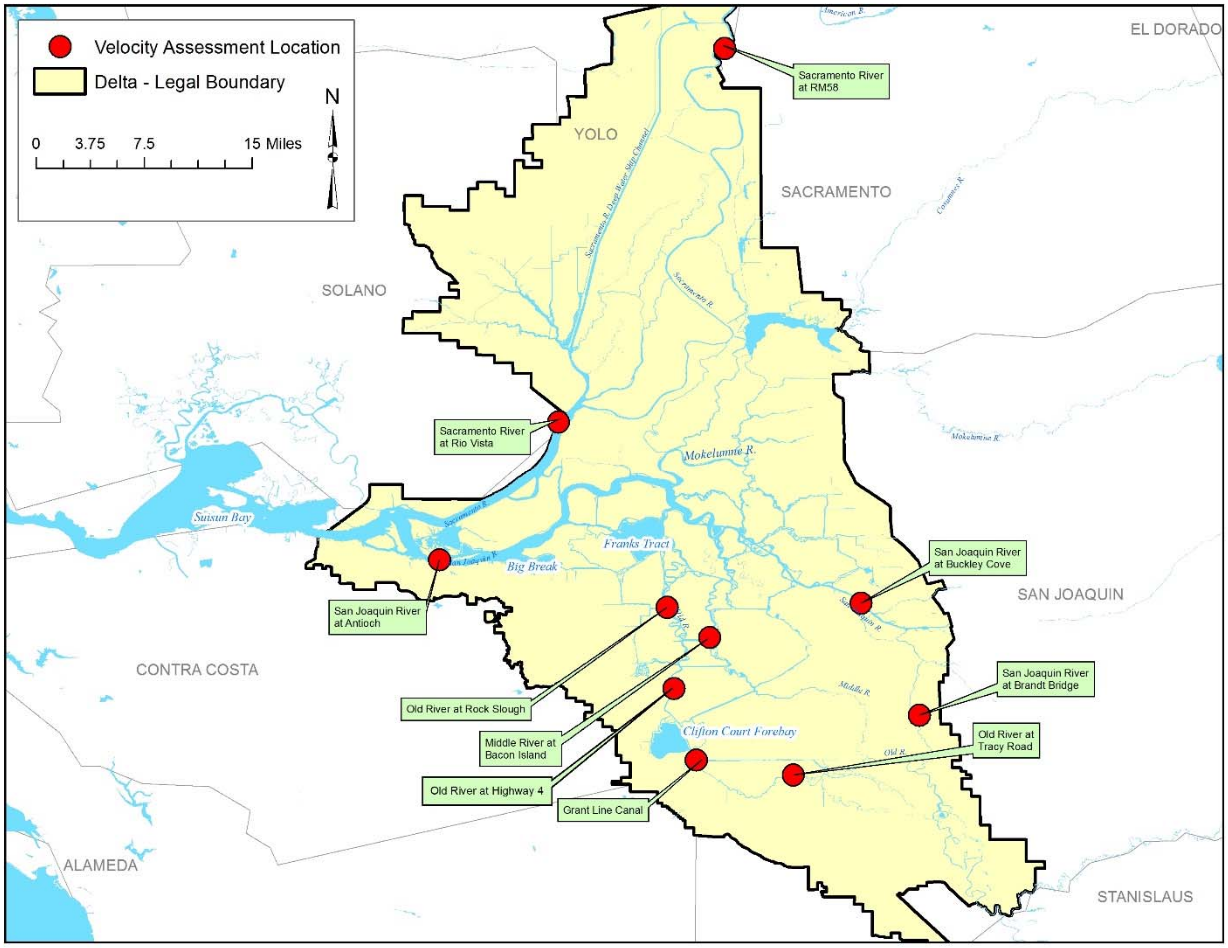


Figure 1. Locations (red circles) in the Sacramento-San Joaquin River Delta where in-channel flow velocities were modeled for the No Action Alternative (NAA) and operational scenarios H3, H4, BA H3+ and CWF H3+.

2.1 LOWER SACRAMENTO RIVER

The probability distributions of in-channel daily maximum velocities modeled for the lower Sacramento River at RM 58 for the months May through October are shown in even numbered Figures 2–12 for the NAA and operational scenarios H3, H4, BA H3+ and CWF H3+. As shown in even numbered Figures 2–12, the frequency with which any given lower Sacramento River daily maximum velocity would be exceeded at RM 58 for CWF H3+ would be within the range of exceedance frequencies modeled for operational scenarios H3 and H4, or would be somewhat greater (occur more frequently) than that modeled for scenarios H3 and H4. The only exception to this is the month of May, as shown in Figure 2, where daily maximum river velocities between about 1.3 ft/s and 2.0 ft/s would occur less frequently than under operational scenario H4 and daily maximum river velocities between about 1.4 ft/s and 2.0 ft/s would occur less frequently than under operational scenario H3. In May, the frequency with which daily maximum channel velocities would exceed about 2.0 ft/s would be the same for the CWF H3+, H3, and H4 operational scenarios. Also, in May, the frequency with which any given daily maximum velocity would be exceeded for the CWF H3+ would be similar to or slightly greater (occur more frequently) than that modeled for the NAA.

These same findings also hold true for absolute values of velocities in the lower Sacramento River at RM 58, modeled on a 15-minute time-step (Figures 3–13, odd numbered figures). The frequency with which any given lower Sacramento River absolute velocity was modeled to be exceeded at RM 58 for CWF H3+ would be within the range of exceedance frequencies for operational scenarios H3 and H4, or would occur at somewhat greater frequencies. The only exception to this is the month of May, as shown in Figure 3, where absolute velocities between about 1.0 ft/s and 2.0 ft/s would occur less frequently for the CWF H3+ than for H4. Similarly, river velocities between about 1.4 ft/s and 2.0 ft/s would occur less frequently for the CWF H3+ than for H3. It is important to note that in May, the frequency with which any given absolute channel velocity would be exceeded for the CWF H3+ at RM 58 would be similar to or greater than that modeled to occur for the NAA.

For the months of June–October, the frequency with which any given daily maximum or absolute velocity would be exceeded for CWF H3+ would be within the range of exceedance frequencies modeled for operational scenarios H3 and H4, or would be somewhat greater than that modeled for the H3 and H4.

Based on these findings, it can be concluded that all technical assessment findings and conclusions reached in Exhibit DWR-651 with regards to how in-channel velocities in the lower Sacramento River at RM 58 for the CWF (Alternative 4A, operational scenarios H3 and H4) would affect cyanobacteria blooms, and particularly *Microcystis* blooms in the river near this location, relative to that which would occur for the NAA, also apply to the CWF H3+.

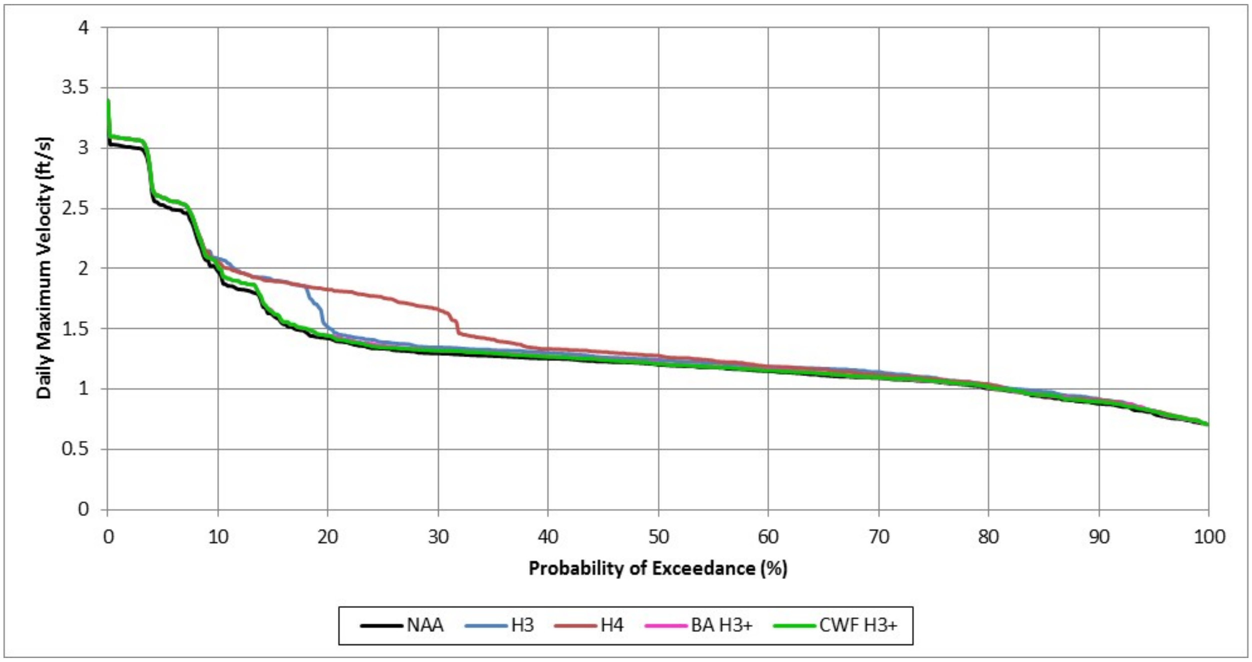


Figure 2. Probability of exceedance of daily maximum velocities in the lower Sacramento River at RM 58 for May of the 1976–1991 period of record modeled.

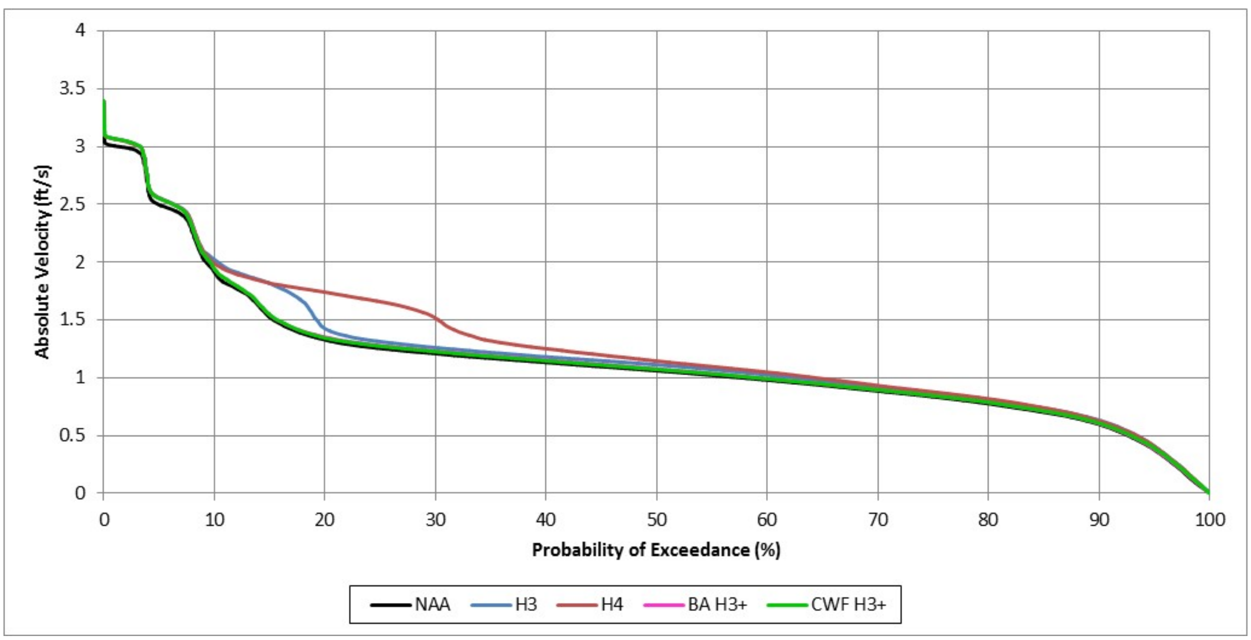


Figure 3. Probability of exceedance of absolute values of daily velocities, on a 15-minute time-step, in the lower Sacramento River at RM 58 for May of the 1976–1991 period of record modeled.

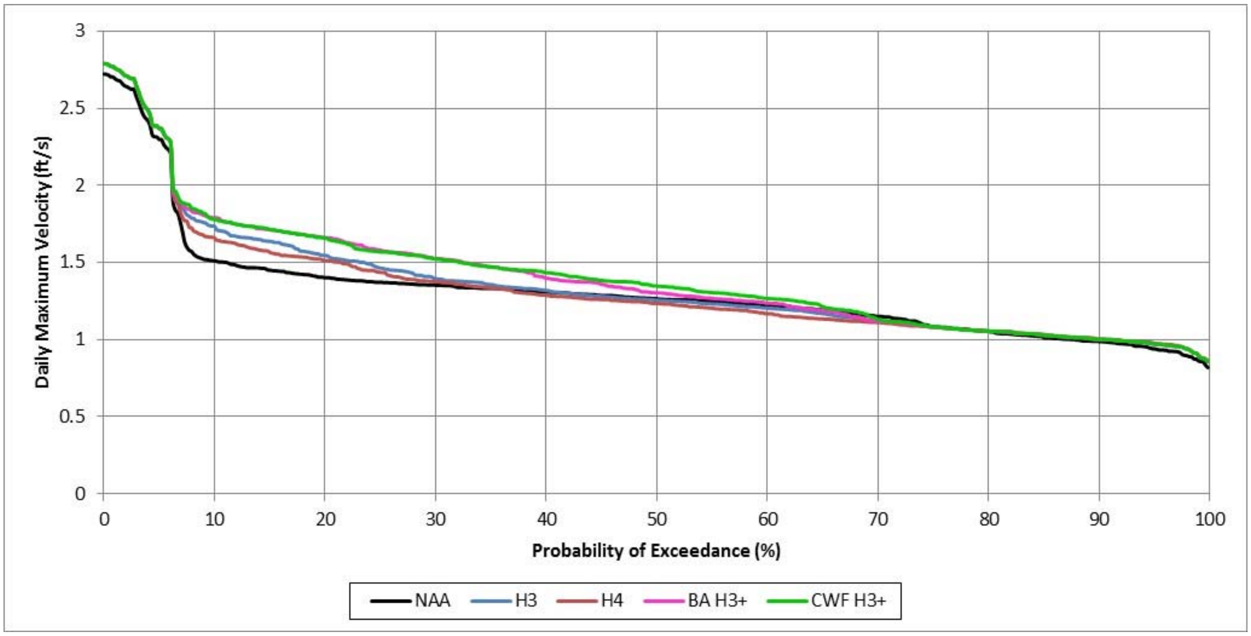


Figure 4. Probability of exceedance of daily maximum velocities in the lower Sacramento River at RM 58 for June of the 1976–1991 period of record modeled.

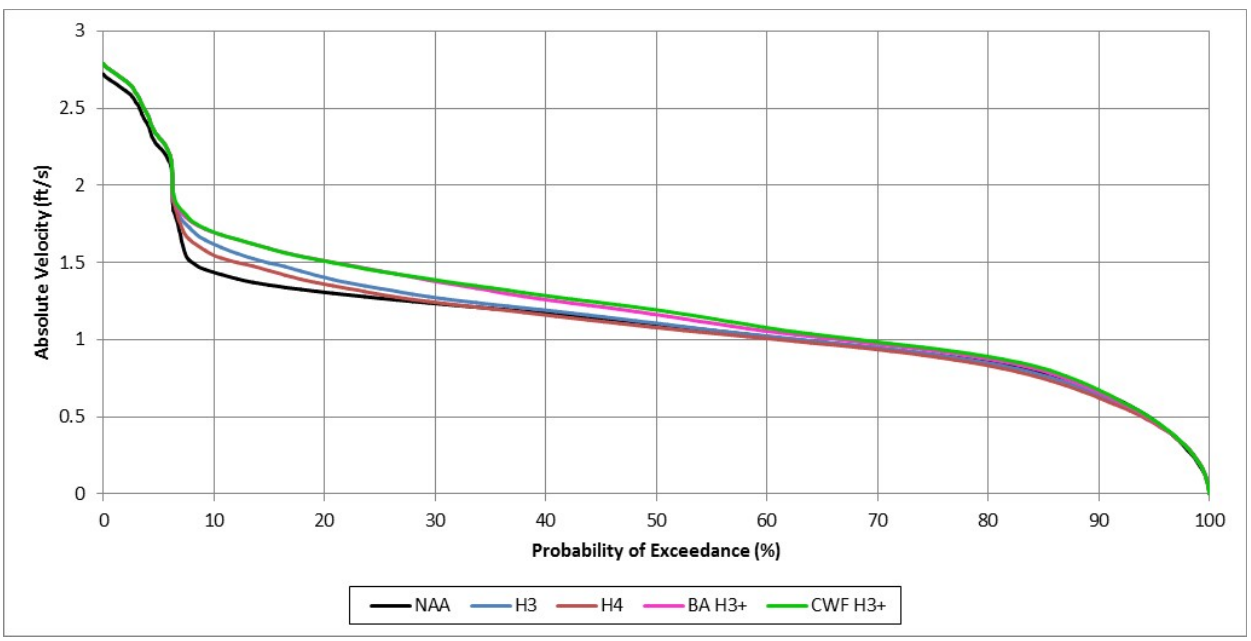


Figure 5. Probability of exceedance of absolute values of daily velocities, on a 15-minute time-step, in the lower Sacramento River at RM 58 for June of the 1976–1991 period of record modeled.

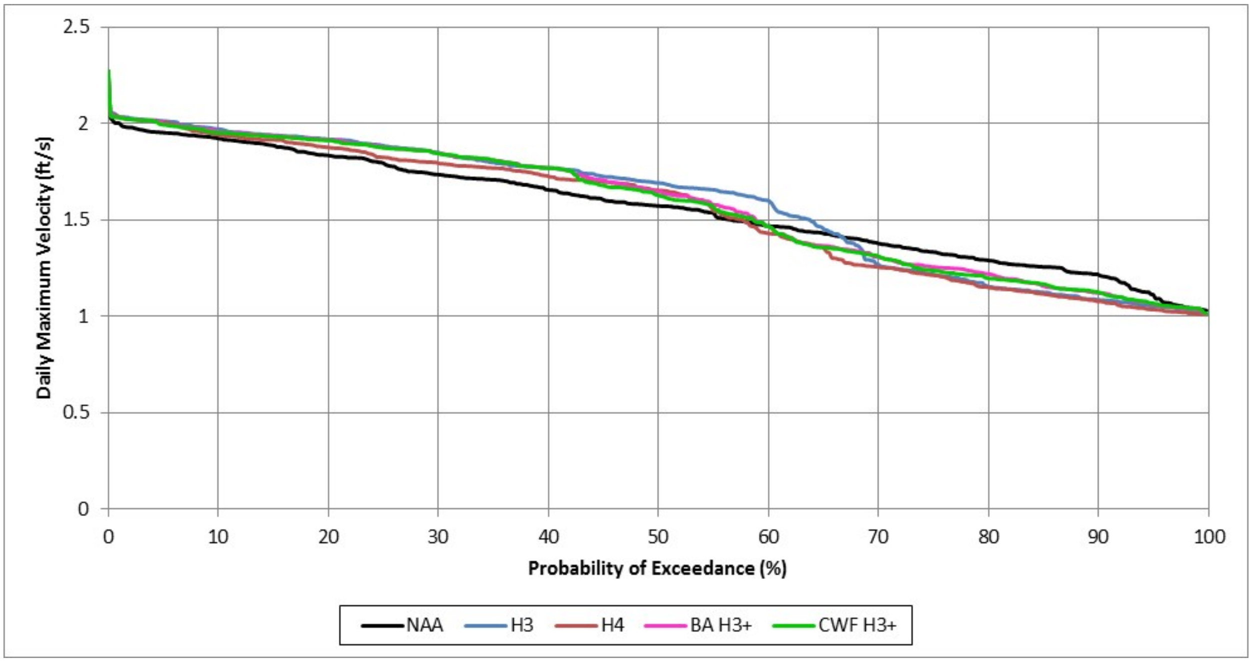


Figure 6. Probability of exceedance of daily maximum velocities in the lower Sacramento River at RM 58 for July of the 1976–1991 period of record modeled.

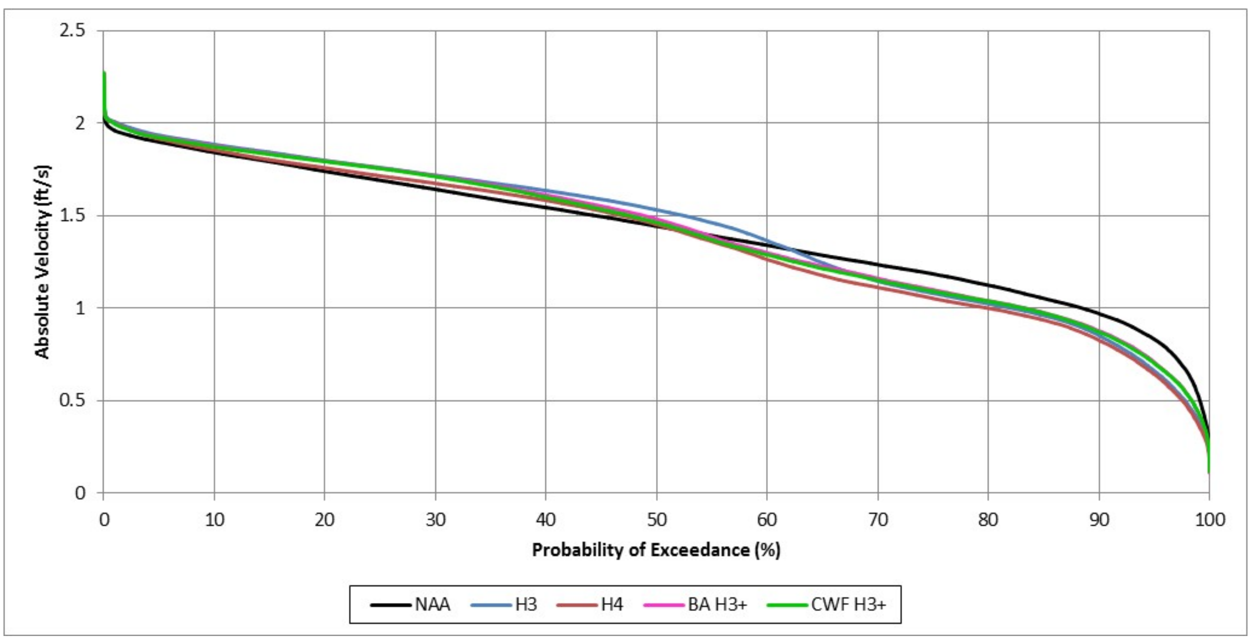


Figure 7. Probability of exceedance of absolute values of daily velocities, on a 15-minute time-step, in the lower Sacramento River at RM 58 for July of the 1976–1991 period of record modeled.

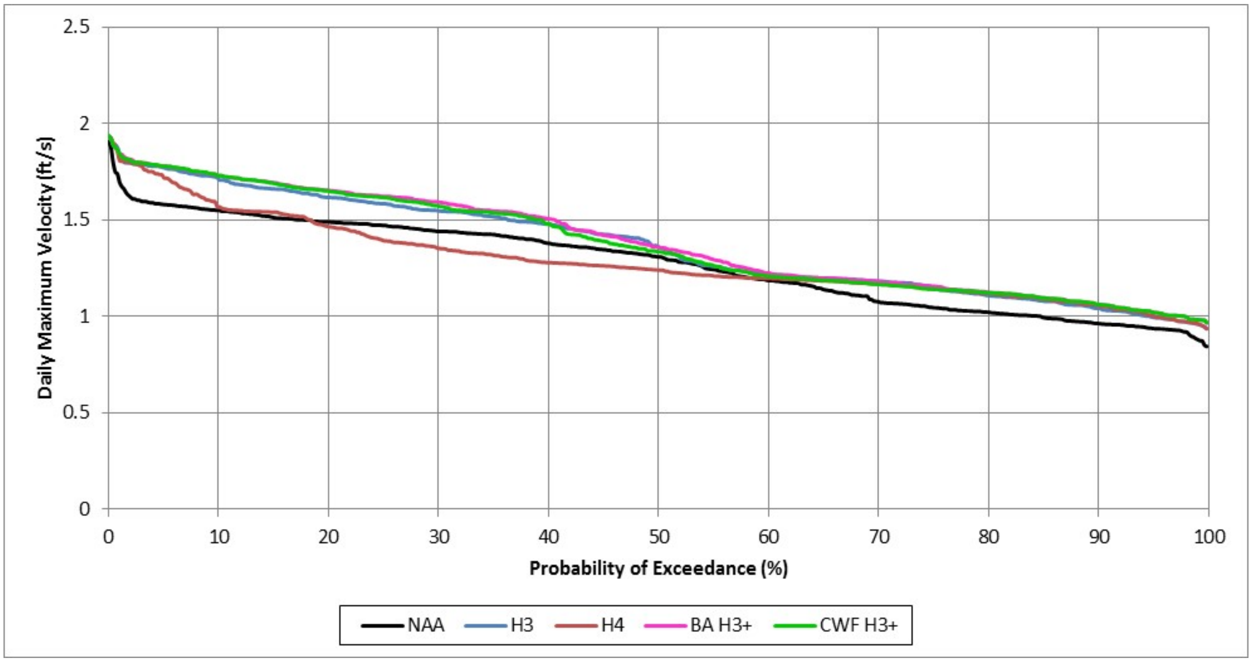


Figure 8. Probability of exceedance of daily maximum velocities in the lower Sacramento River at RM 58 for August of the 1976–1991 period of record modeled.

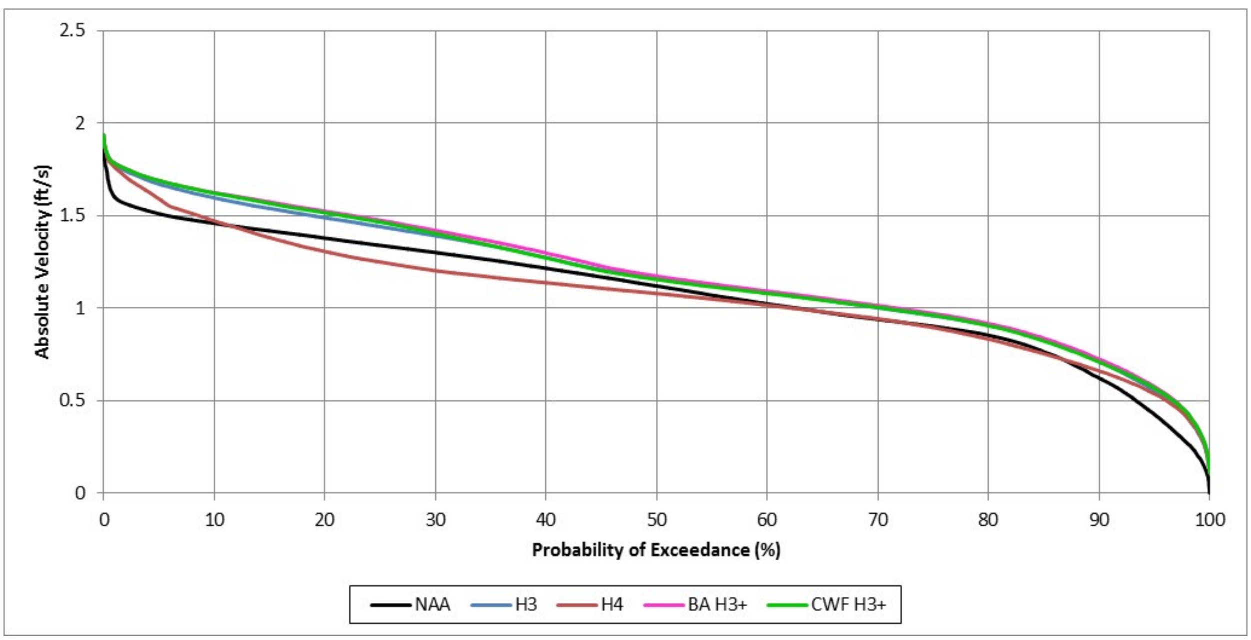


Figure 9. Probability of exceedance of absolute values of daily velocities, on a 15-minute time-step, in the lower Sacramento River at RM 58 for August of the 1976–1991 period of record modeled.

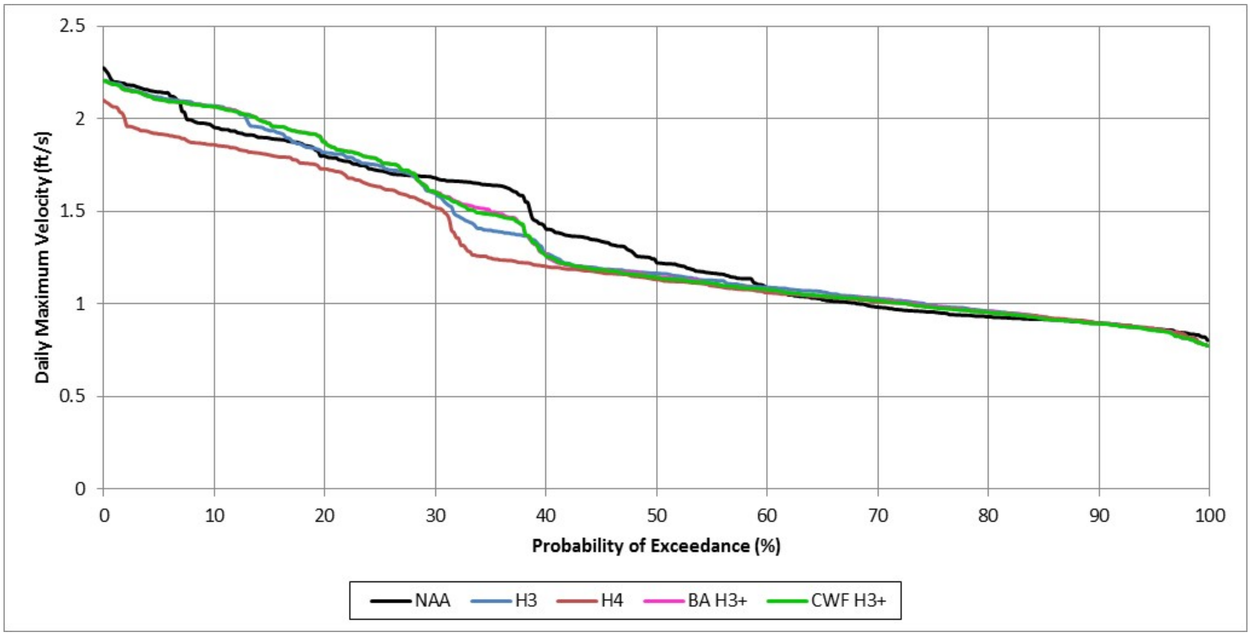


Figure 10. Probability of exceedance of daily maximum velocities in the lower Sacramento River at RM 58 for September of the 1976–1991 period of record modeled.

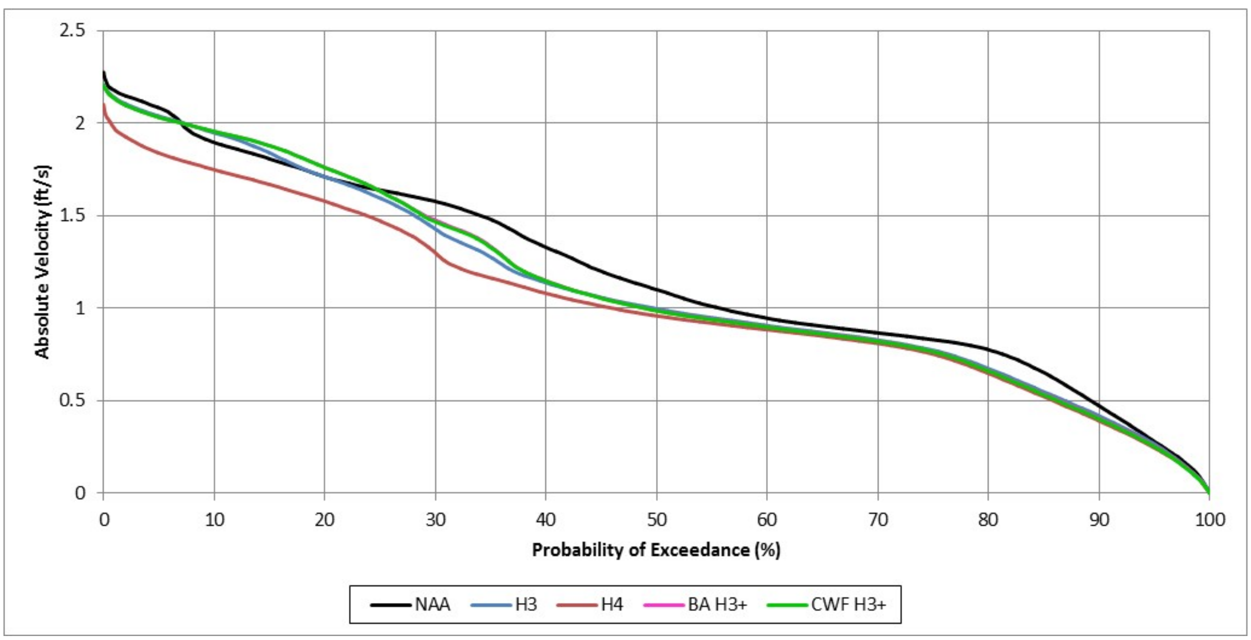


Figure 11. Probability of exceedance of absolute values of daily velocities, on a 15-minute time-step, in the lower Sacramento River at RM 58 for September of the 1976–1991 period of record modeled.

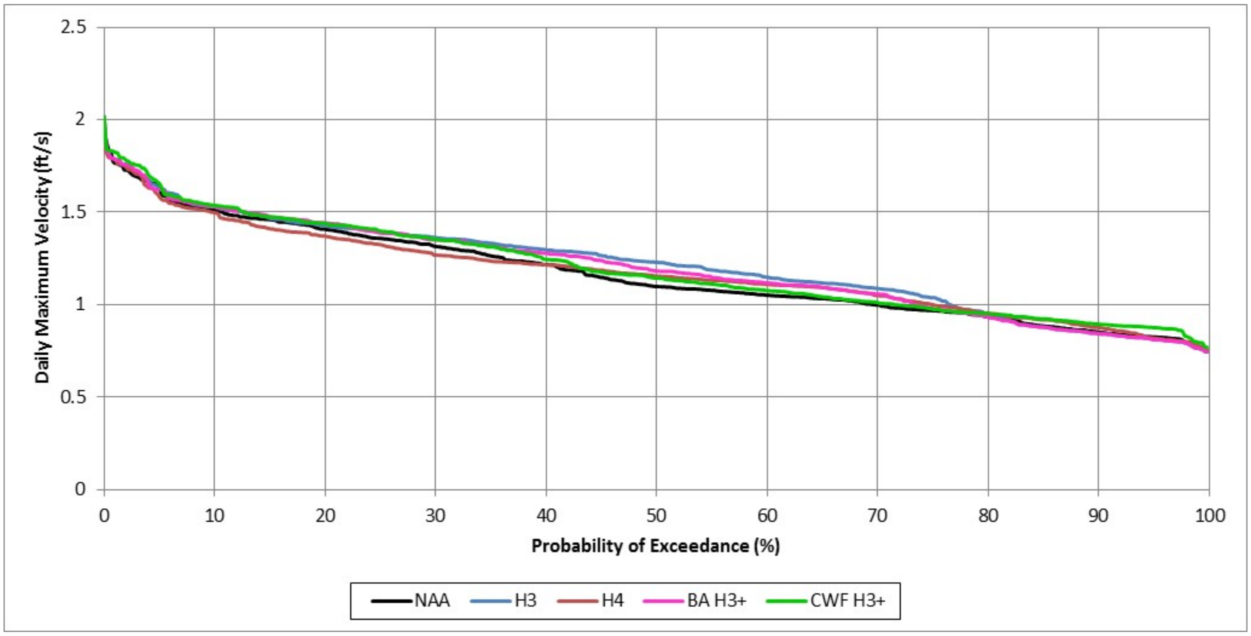


Figure 12. Probability of exceedance of daily maximum velocities in the lower Sacramento River at RM 58 for October of the 1976–1991 period of record modeled.

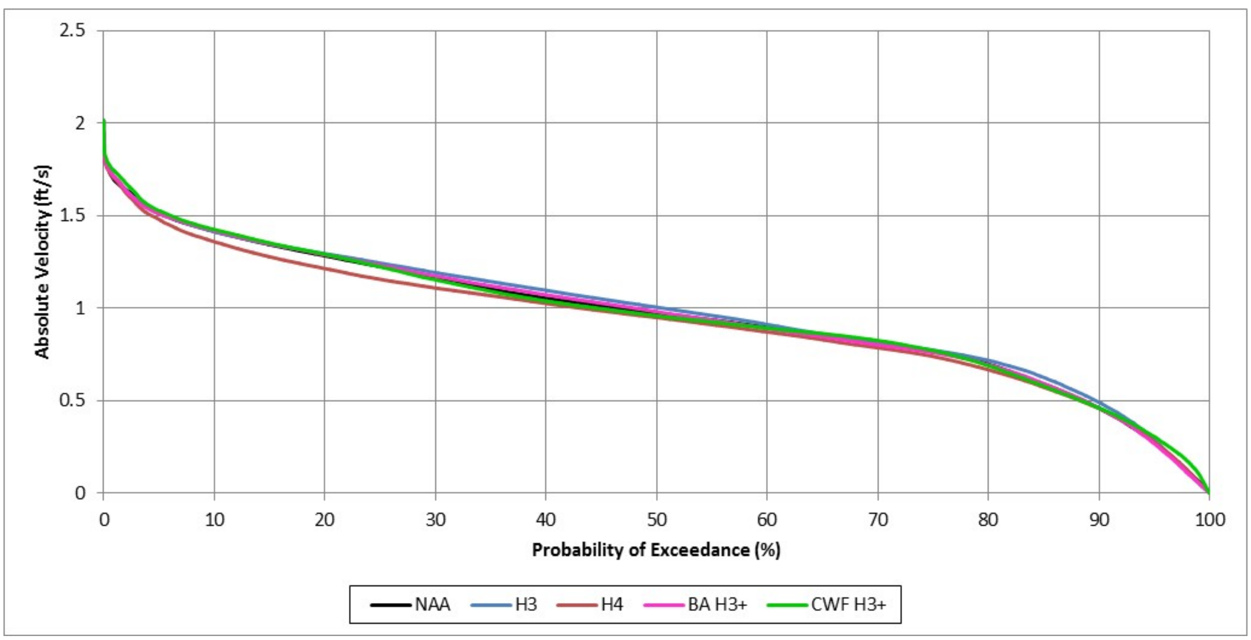


Figure 13. Probability of exceedance of absolute values of daily velocities, on a 15-minute time-step, in the lower Sacramento River at RM 58 for October of the 1976–1991 period of record modeled.

2.2 SACRAMENTO-SAN JOAQUIN RIVER DELTA

The probability distributions of in-channel daily maximum velocities (modeled for the 1976–1991 period of record) (Figures 14–30, even numbered figures) for nine locations within the Delta are presented below. Each of these figures presents the probability distributions of daily maximum in-channel velocities for the NAA and operational scenarios H3, H4, BA H3+ and CWF H3+. The frequency with which any given daily maximum channel velocity at the nine locations assessed was modeled to be exceeded for CWF H3+ would be within the range of exceedance frequencies modeled for operational scenarios H3 and H4. In no case would the frequency with which a defined daily maximum river velocity be exceeded for the CWF H3+ be substantially less than that which would occur for exceedance of the same daily maximum velocity for the CWF under operational scenarios H3 and H4.

These same findings also hold true for absolute values of velocities at the same nine Delta locations, modeled on a 15-minute time-step (Figures 15–31, odd numbered figures). The frequency with which any given absolute velocity at the nine locations assessed was modeled to be exceeded for CWF H3+ would be within the range of exceedance frequencies modeled for operational scenarios H3 and H4. In no case would the frequency with which a defined absolute river velocity would be exceeded for CWF H3+ be substantially less than that which would occur for the same velocity under operational scenarios H3 and H4.

From these findings, it can be concluded that CWF H3+ would result in Delta channel velocities that would be within the same range of velocities previously presented in Exhibit DWR-653, and assessed with regards to effects on cyanobacteria blooms within the Delta, with an emphasis on *Microcystis* blooms, relative to blooms that would occur in the Delta under the in-channel velocities modeled to occur for the NAA. As such, all technical assessment findings and conclusions reached in Exhibit DWR-653 with regards to how in-channel velocities in the Delta for the CWF (Alternative 4A, operational scenarios H3 and H4) would affect cyanobacteria blooms, and particularly *Microcystis* blooms, relative to that which would occur for the NAA, also apply to CWF H3+.

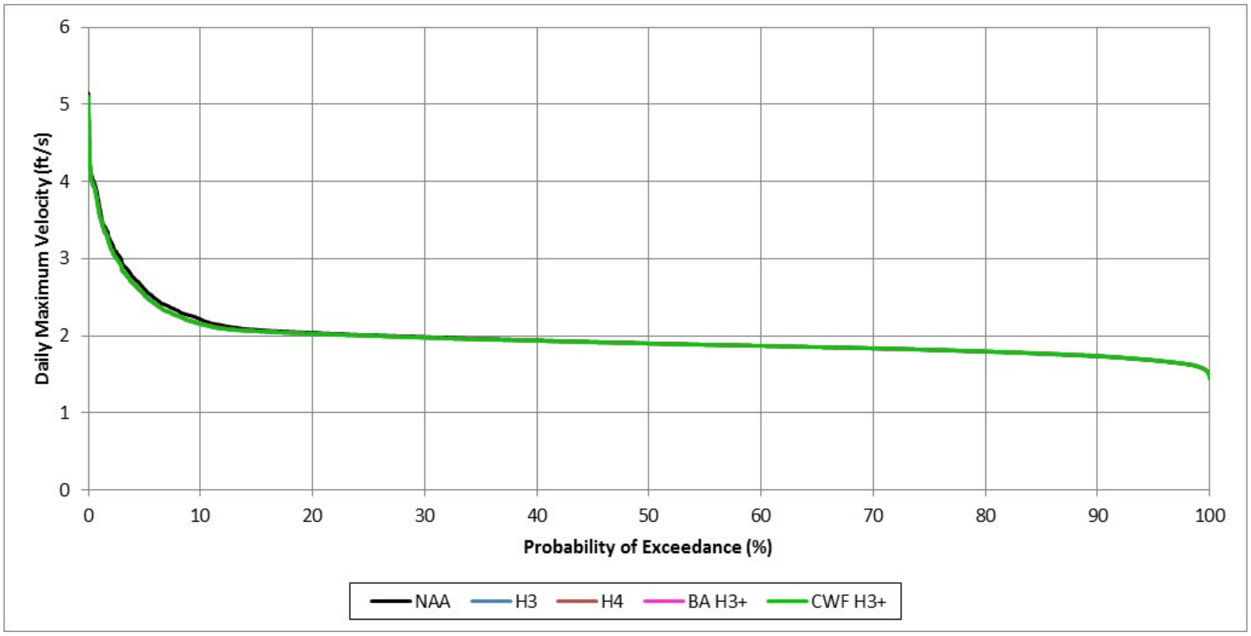


Figure 14. Probability of exceedance of daily maximum velocity in the lower Sacramento River at Rio Vista for the 1976–1991 period of record modeled.

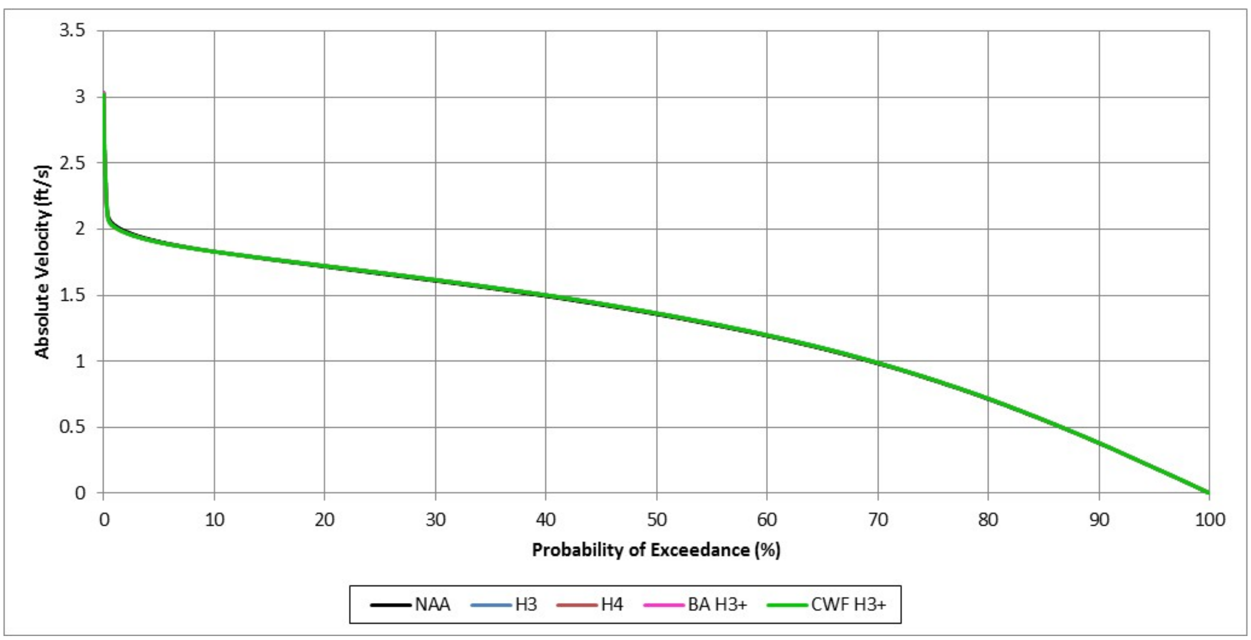


Figure 15. Probability of exceedance of absolute values of daily velocities, on a 15-minute time-step, in the Sacramento River at Rio Vista during the months of June through November for the 1976–1991 period of record modeled.

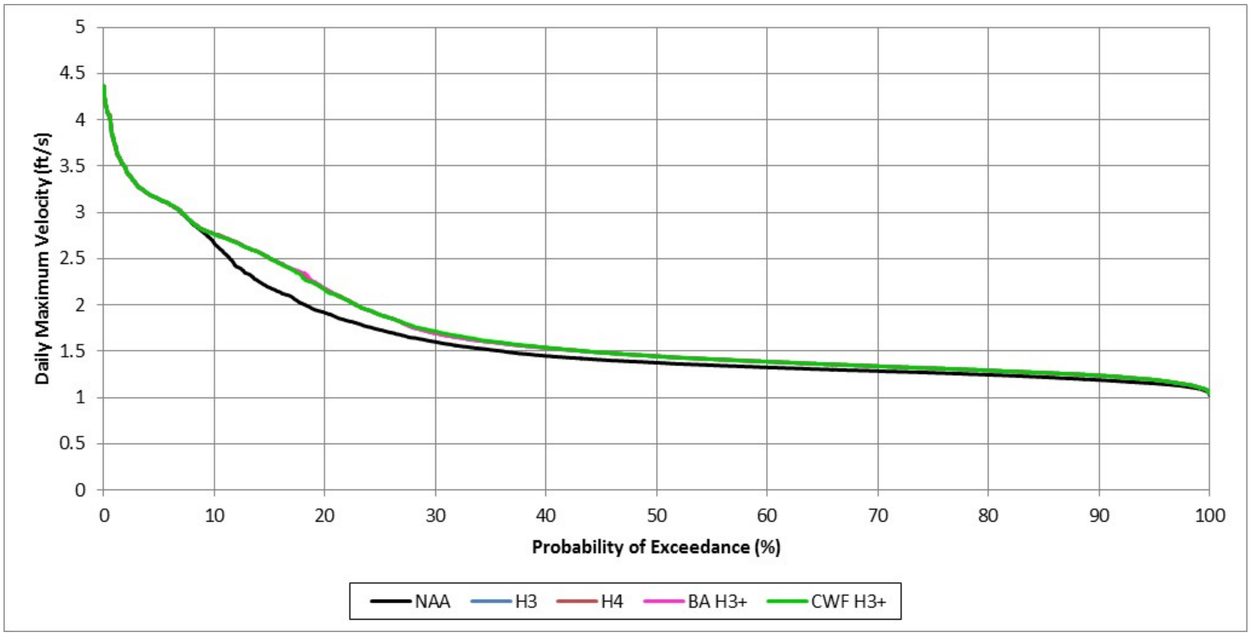


Figure 16. Probability of exceedance of daily maximum velocity in the San Joaquin River at Brandt Bridge for the 1976–1991 period of record modeled.

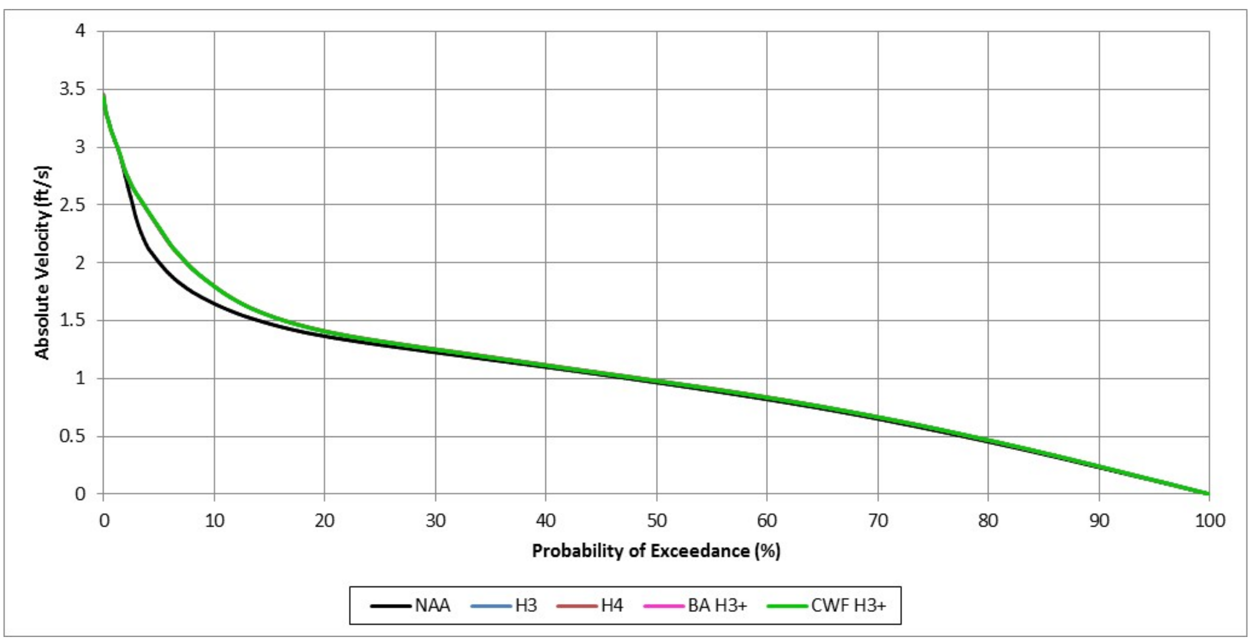


Figure 17. Probability of exceedance of absolute values of daily velocities, on a 15-minute time-step, in the San Joaquin River at Brandt Bridge during the months of June through November for the 1976–1991 period of record modeled.

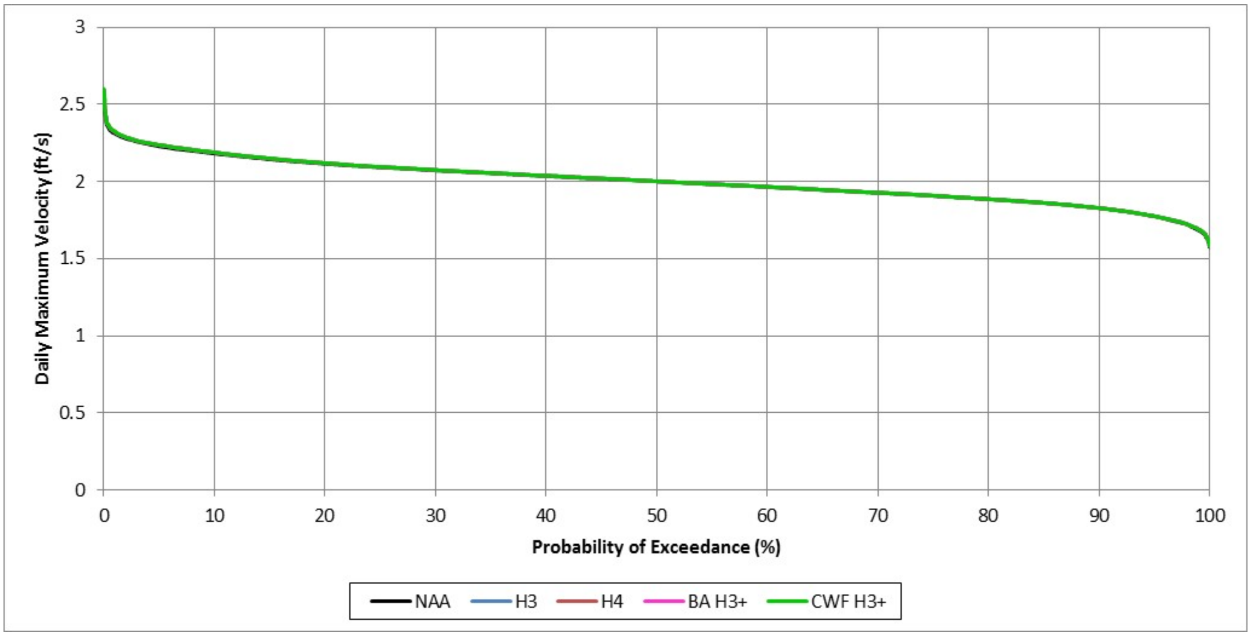


Figure 18. Probability of exceedance of daily maximum velocity in the San Joaquin River at Antioch for the 1976–1991 period of record modeled.

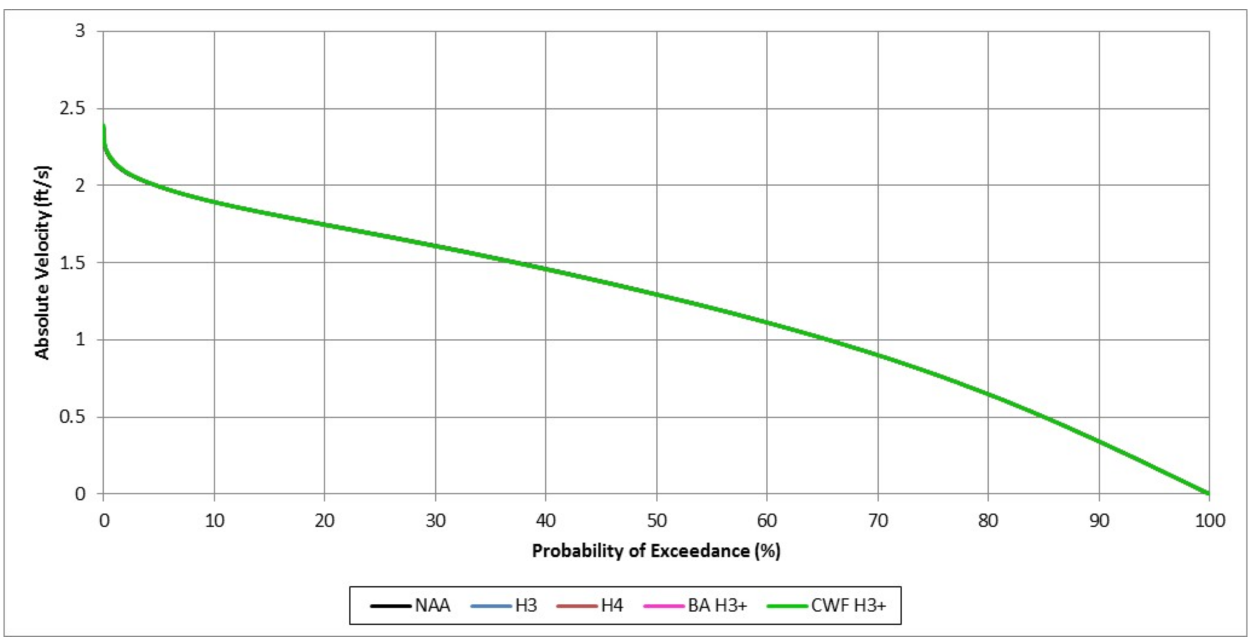


Figure 19. Probability of exceedance of absolute values of daily velocities, on a 15-minute time-step, in the San Joaquin River at Antioch during the months of June through November for the 1976–1991 period of record modeled.

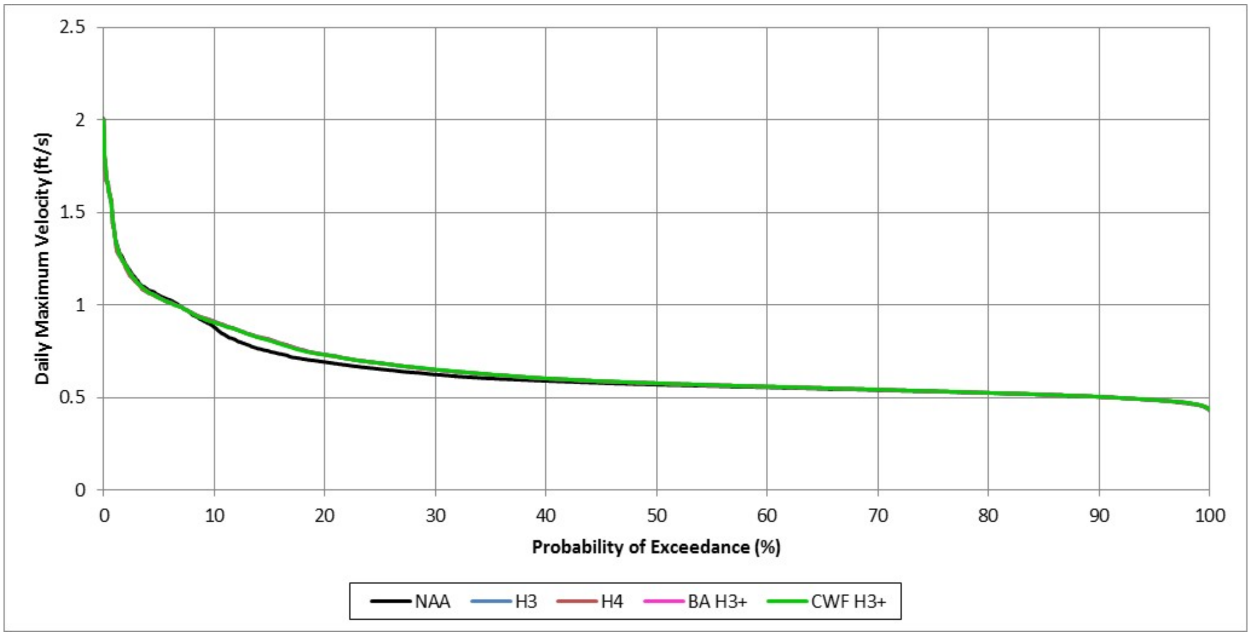


Figure 20. Probability of exceedance of daily maximum velocity in the San Joaquin River at Buckley Cove for the 1976–1991 period of record modeled.

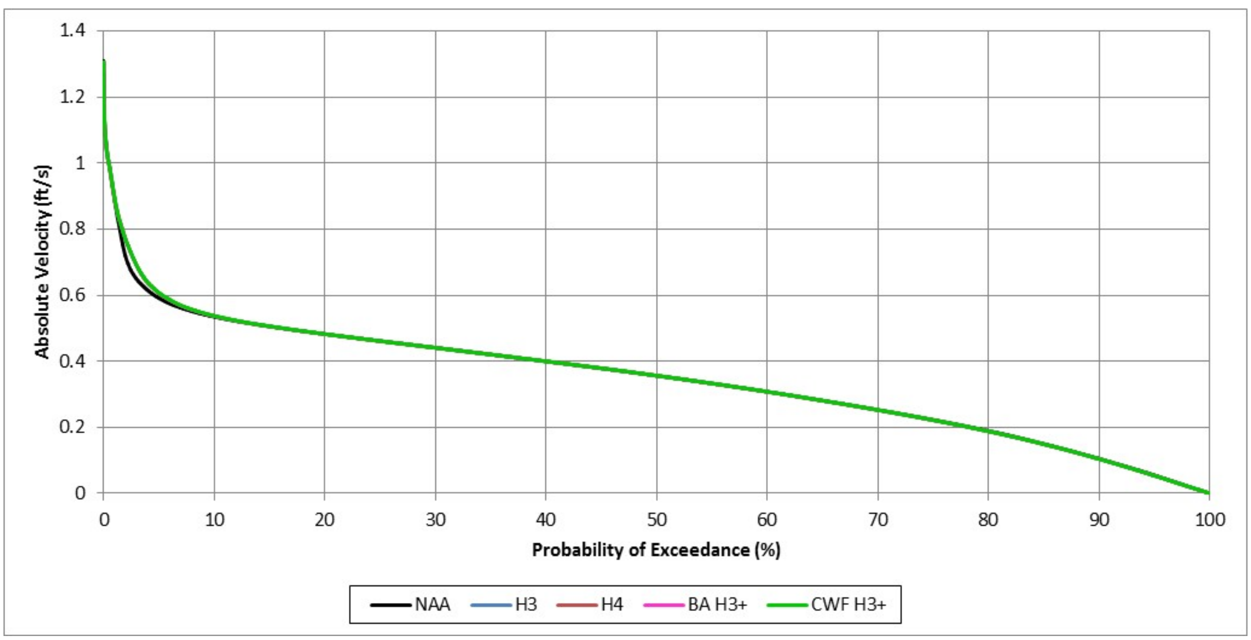


Figure 21. Probability of exceedance of absolute values of daily velocities, on a 15-minute time-step, in the San Joaquin River at Buckley Cove during the months of June through November for the 1976–1991 period of record modeled.

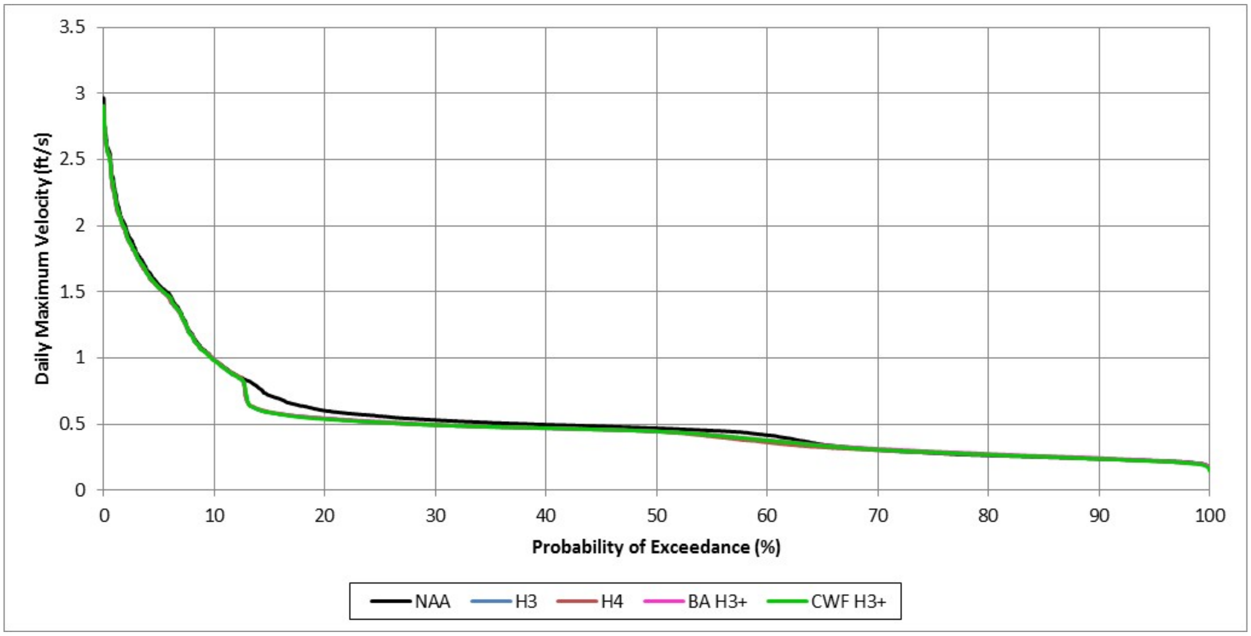


Figure 22. Probability of exceedance of daily maximum velocity in Old River at Tracy Road for the 1976–1991 period of record modeled.

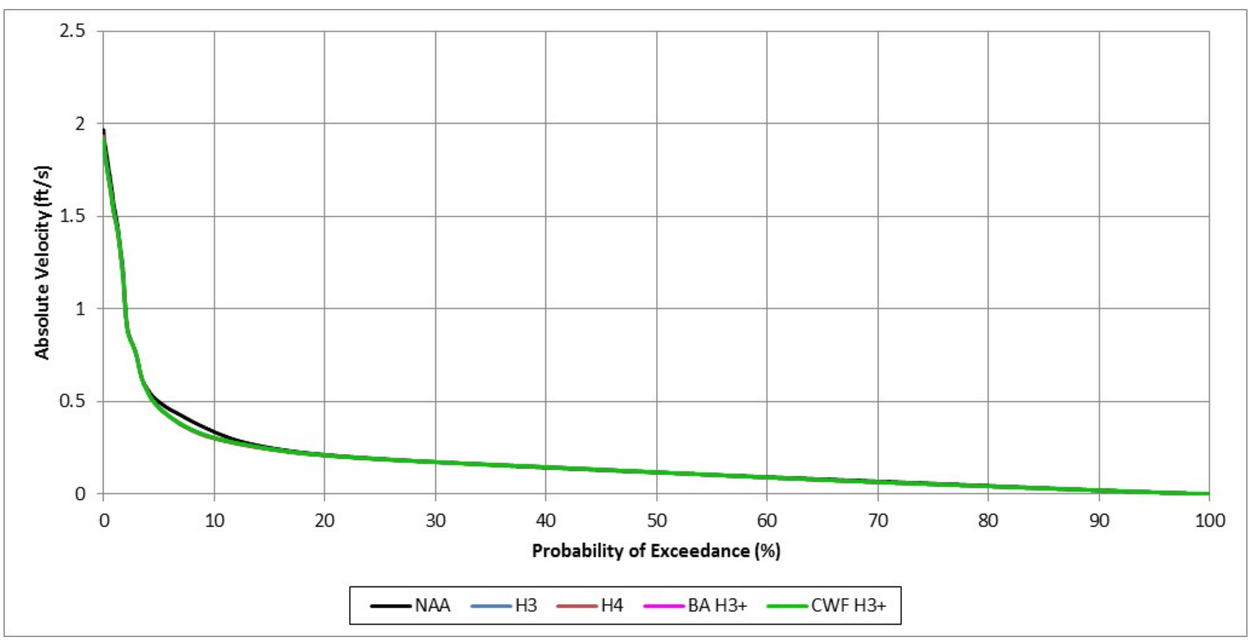


Figure 23. Probability of exceedance of absolute values of daily velocities, on a 15-minute time-step, in Old River at Tracy Road during the months of June through November for the 1976–1991 period of record modeled.

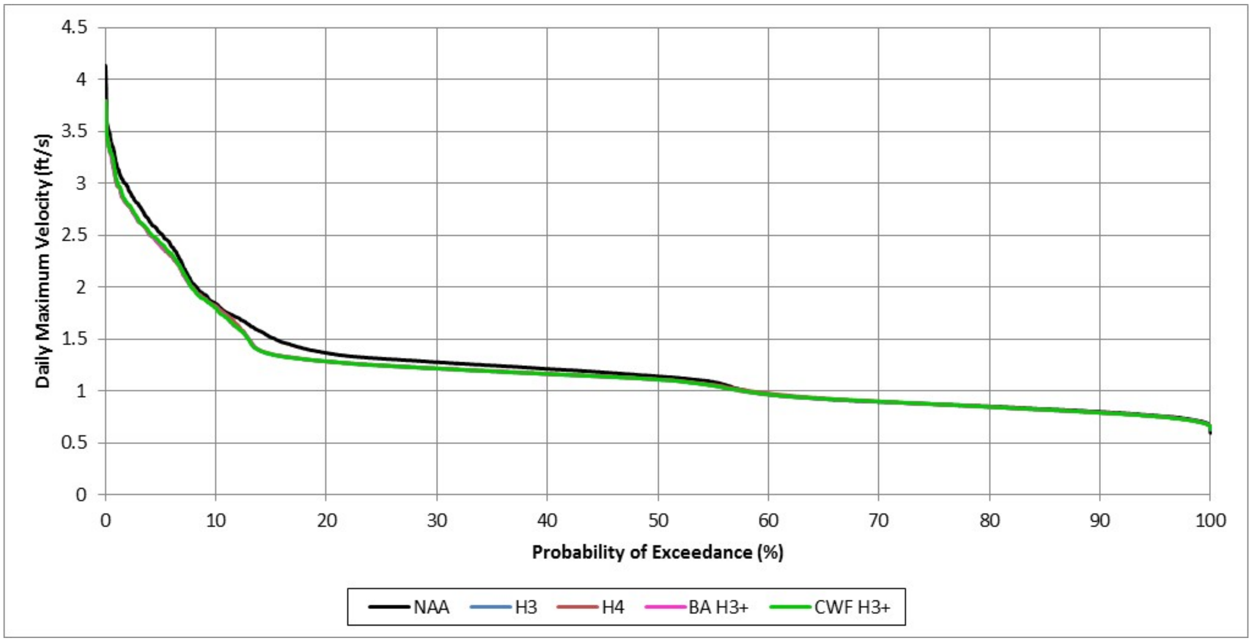


Figure 24. Probability of exceedance of daily maximum velocity in Grant Line Canal for the 1976–1991 period of record modeled.

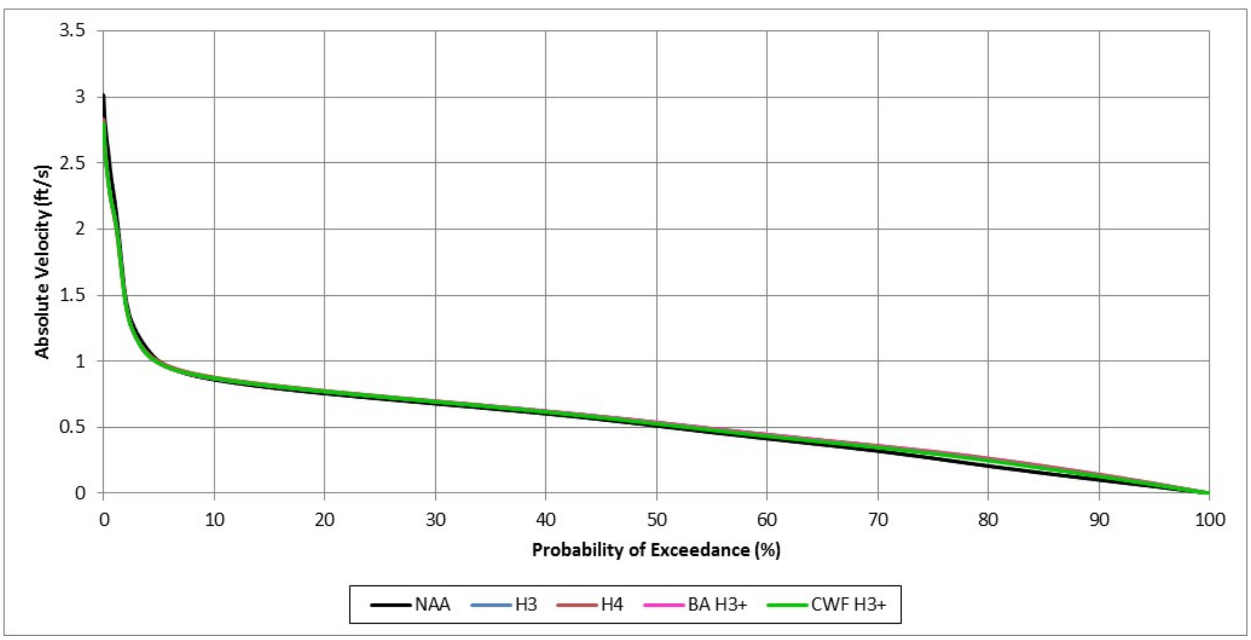


Figure 25. Probability of exceedance of absolute values of daily velocities, on a 15-minute time-step, in Grant Line Canal during the months of June through November for the 1976–1991 period of record modeled.

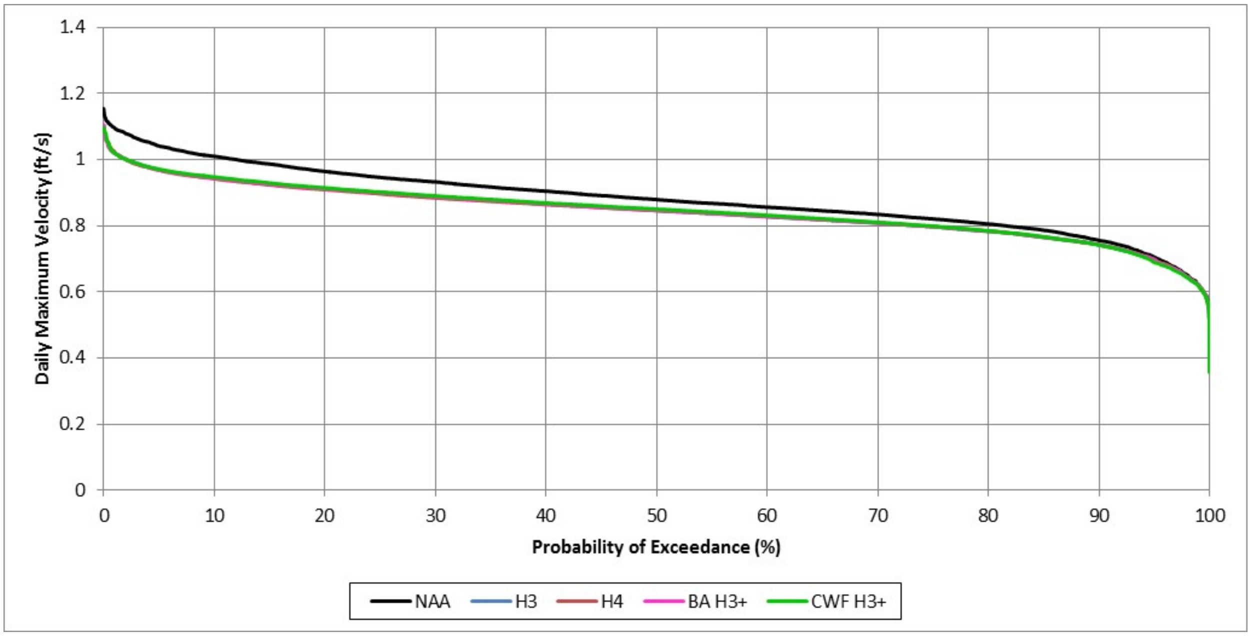


Figure 26. Probability of exceedance of daily maximum velocity in Middle River at Bacon Island for the 1976–1991 period of record modeled.

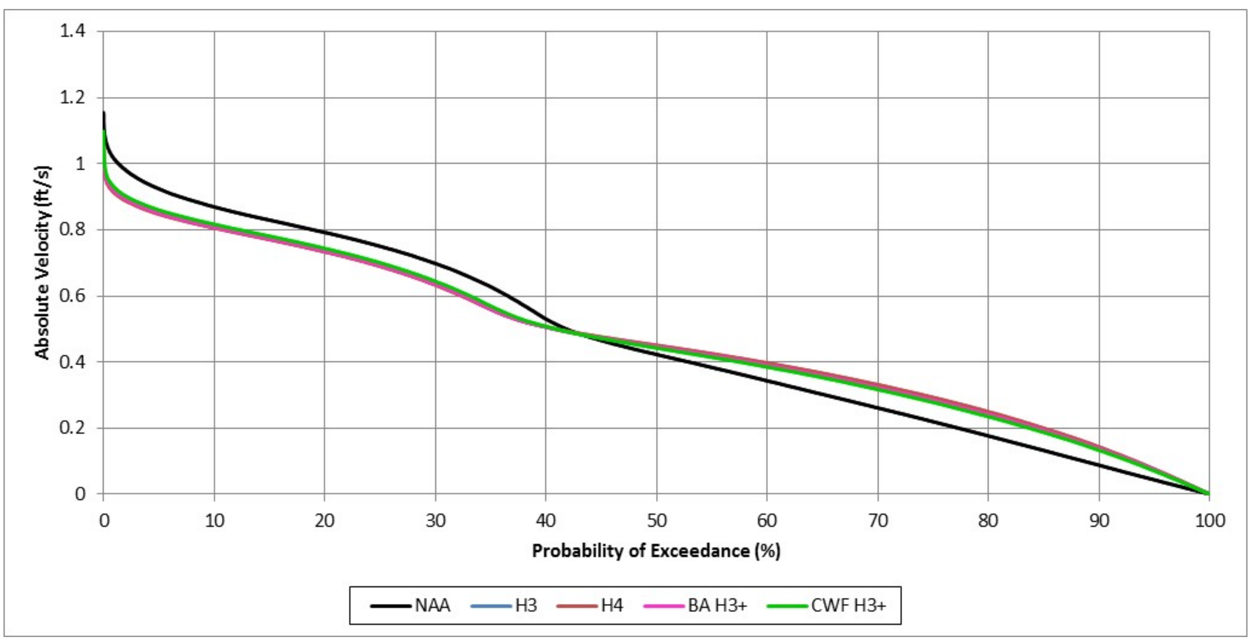


Figure 27. Probability of exceedance of absolute values of daily velocities, on a 15-minute time-step, in Middle River at Bacon Island during the months of June through November for the 1976–1991 period of record modeled.

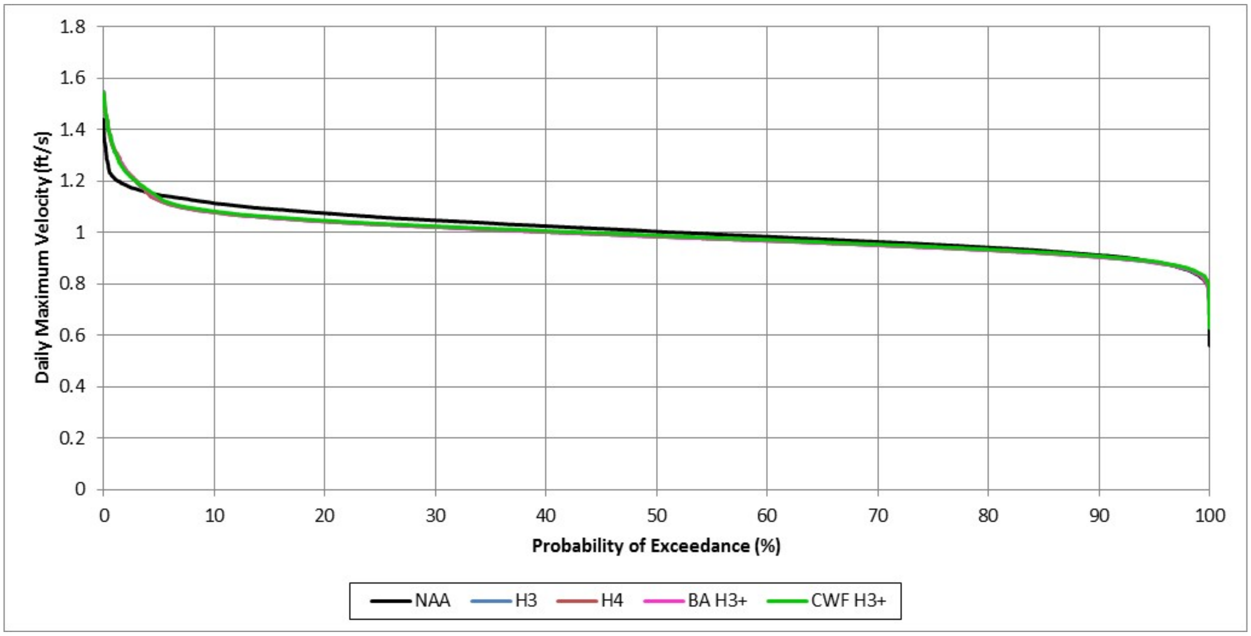


Figure 28. Probability of exceedance of daily maximum velocity in Old River at Rock Slough for the 1976–1991 period of record modeled.

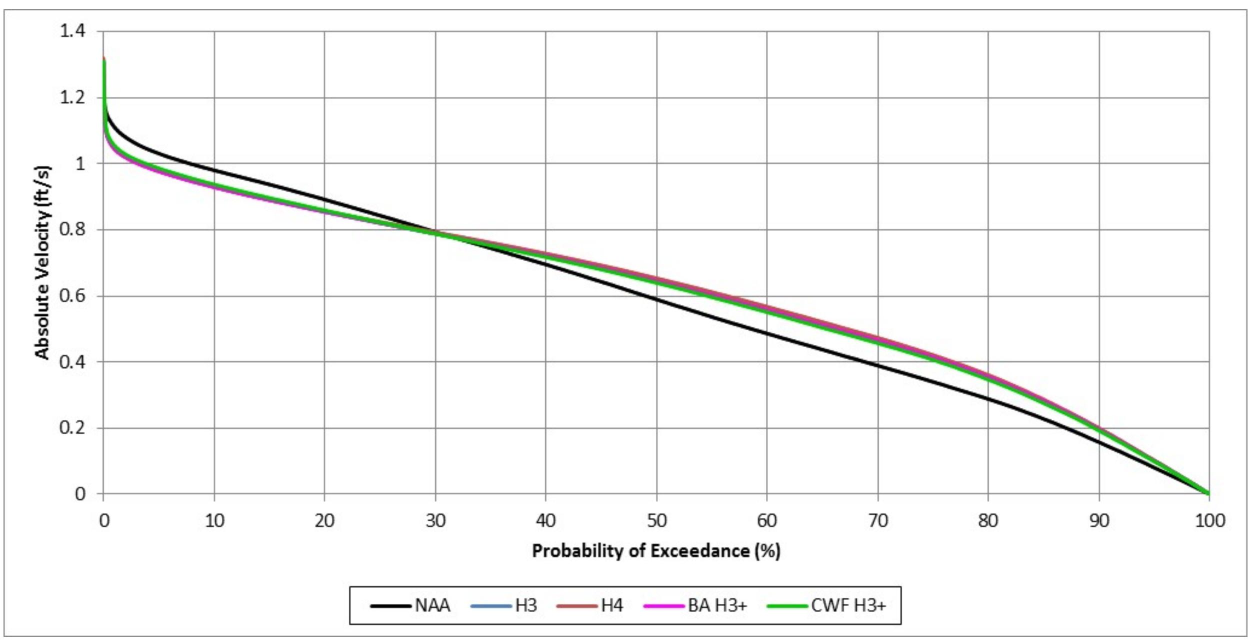


Figure 29. Probability of exceedance of absolute values of daily velocities, on a 15-minute time-step, in Old River at Rock Slough during the months of June through November for the 1976–1991 period of record modeled.

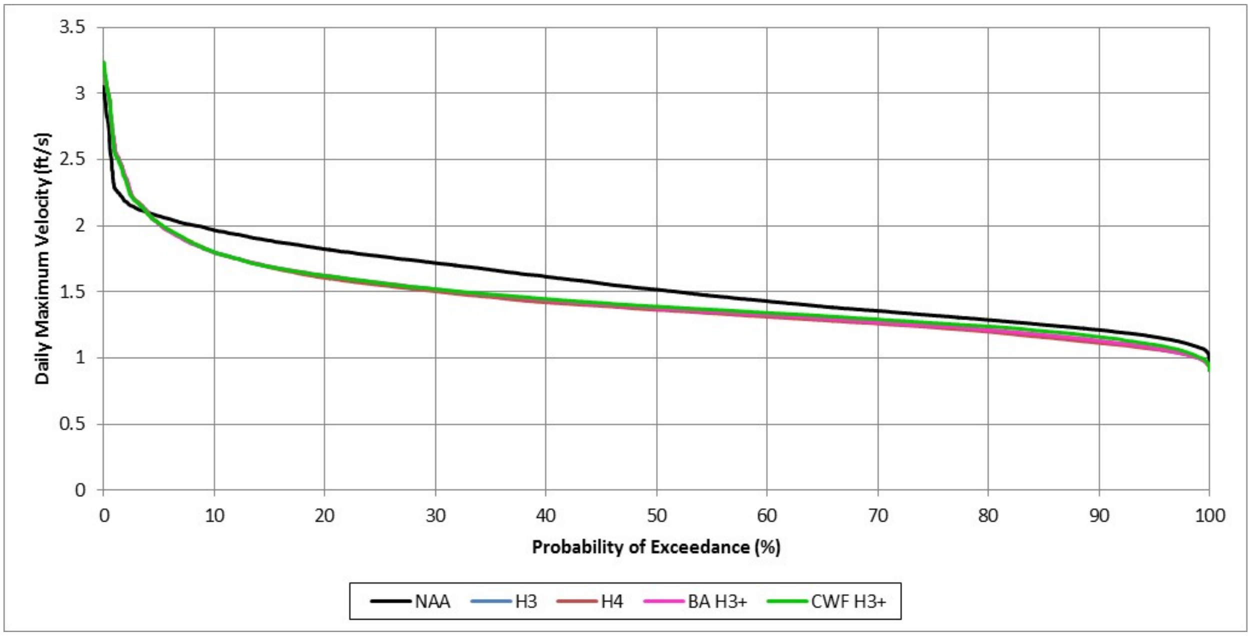


Figure 30. Probability of exceedance of daily maximum velocity in Old River at Highway 4 for the 1976–1991 period of record modeled.

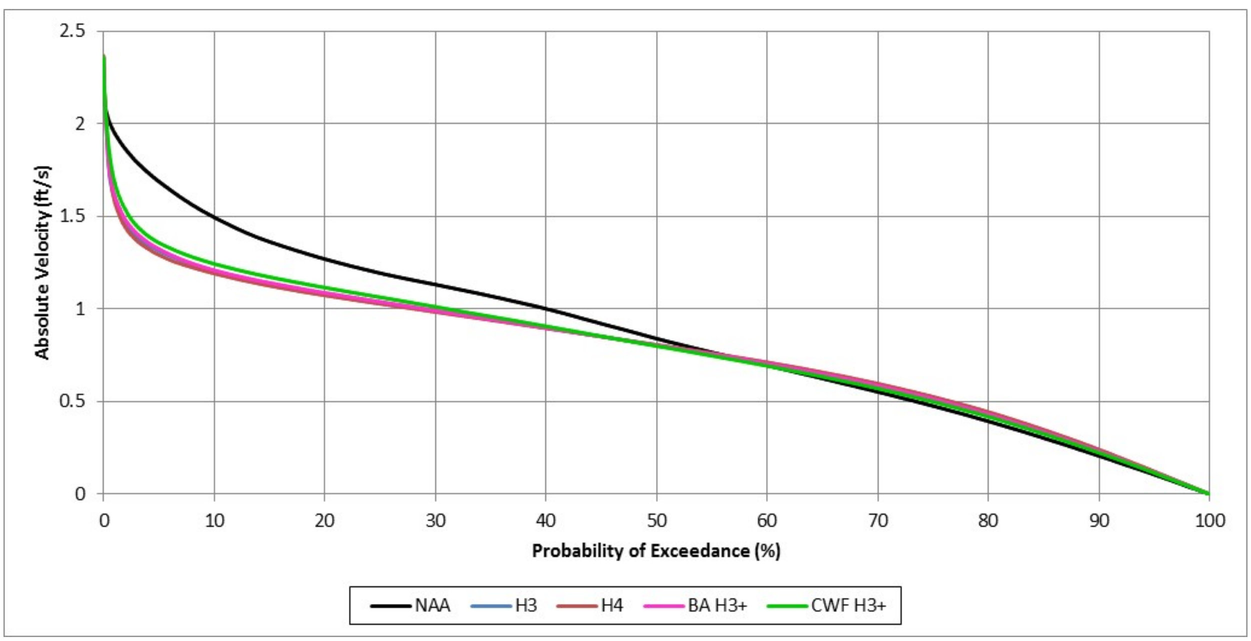


Figure 31. Probability of exceedance of absolute values of daily velocities, on a 15-minute time-step, in Old River at Highway 4 during the months of June through November for the 1976–1991 period of record modeled.