Appendix 6B

Biological Modeling Methods and Selected Results

Appendix 6B
Biological Modeling Methods and Selected Results

The information contained in this appendix supports the quantitative assessment of impacts presented in Chapter 6, "Aquatic Biological Resources." Specifically, this appendix presents the following information.

- Descriptions of the quantitative methods used in the impact analyses within Chapter 6.
- Detailed results from some of the quantitative methods where these results are not presented in Chapter 6.

Chapter 6 cross-references this appendix for detailed methods supporting results presented in Chapter 6 as well as information contained in the results tables and figures presented in this appendix to make determinations regarding the potential for the Proposed Project to result in significant impacts on fish and aquatic resources in the study area. Due to the length and complexity of this information, and in an effort to maintain the readability of Chapter 6, this information is presented in an appendix.

6B.1 Salvage-Density Method

6B.1.1 Methods

The steps in the salvage-density method were as follows.

- Export data were downloaded from https://apps.wildlife.ca.gov/Salvage.[1]
- Water years (WY) 2009–2022 were included, as these water years were complete and representative of recent salvage patterns, and the water year type was known (California Department of Water Resources 2021a).
- Juvenile salmonids with clipped and unclipped adipose fins were included, as together they represent hatchery-origin and wild fish that are all part of the Evolutionarily Significant Unit.
  - For winter-run and spring-run Chinook Salmon, only genetically identified fish were included (based on WYs 2010–2022 for winter-run and 2017–2022 for spring-run; Reece pers. comm.)
- Daily salvage (or loss for juvenile salmonids) density (fish per thousand acre-feet of water exported) was calculated for the State Water Project (SWP) south Delta export facility.
- The daily salvage or loss density values for each month and water year type were multiplied by the CalSim 3-modeled exports (1922–2021) for the modeled scenarios. Note that there were no Above Normal years in 2010–2022, so for Above Normal years the monthly pattern for Wet years was used, and only percentage difference was reported in the results.

[1] This website included salvage density for all species and loss (i.e., salvage extrapolated to loss by accounting for factors such as pre-screen mortality from predation) density for salmonids; the latter was used for salmonids in this analysis, with the exception of winter-run and spring-run Chinook Salmon, for which a different procedure was used as described in the text.

The loss-density method gives outputs in terms of numbers of fish salvaged (or lost), but these outputs are not predictions of future entrainment but rather differences in SWP exports between alternatives weighted by historical loss density of fish.

6B.1.2 Results

Overall annual mean results by water year type are presented and discussed in Chapter 6. Table 6B-1 through Table 6B-19 show mean results by water year type and month.

Table 6B-1. Mean Number of Genetically Identified Winter-run Chinook Salmon Juveniles Lost (Fish Per Year) at the State Water Project South Delta Export Facility for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Month, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on the Salvage-Density Method

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Jan	7	7 (-2%)
Wet	Feb	197	199 (1%)
Wet	Mar	539	551 (2%)
Wet	Apr	58	61 (5%)
Wet	May	1	1 (49%)
Wet	Jun	0	0 (0%)
Wet	Jul	0	0 (0%)
Wet	Aug	0	0 (0%)
Wet	Sep	0	0 (0%)
Wet	Oct	0	0 (0%)
Wet	Nov	0	0 (0%)
Wet	Dec	4	4 (-1%)
Above Normal	Jan	N/A	(-2%)
Above Normal	Feb	N/A	(-9%)
Above Normal	Mar	N/A	(-13%)
Above Normal	Apr	N/A	(100%)
Above Normal	May	N/A	(73%)
Above Normal	Jun	N/A	(0%)
Above Normal	Jul	N/A	(0%)
Above Normal	Aug	N/A	(0%)
Above Normal	Sep	N/A	(0%)
Above Normal	Oct	N/A	(0%)
Above Normal	Nov	N/A	(0%)
Above Normal	Dec	N/A	(1%)
Below Normal	Jan	10	9 (-4%)
Below Normal	Feb	134	127 (-5%)
Below Normal	Mar	424	331 (-22%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Below Normal	Apr	4	6 (61%)
Below Normal	May	0	0 (0%)
Below Normal	Jun	0	0 (0%)
Below Normal	Jul	0	0 (0%)
Below Normal	Aug	0	0 (0%)
Below Normal	Sep	0	0 (0%)
Below Normal	Oct	0	0 (0%)
Below Normal	Nov	0	0 (0%)
Below Normal	Dec	0	0 (0%)
Dry	Jan	0	0 (0%)
Dry	Feb	0	0 (0%)
Dry	Mar	95	84 (-12%)
Dry	Apr	7	8 (7%)
Dry	May	0	0 (0%)
Dry	Jun	0	0 (0%)
Dry	Jul	0	0 (0%)
Dry	Aug	0	0 (0%)
Dry	Sep	0	0 (0%)
Dry	Oct	0	0 (0%)
Dry	Nov	0	0 (0%)
Dry	Dec	0	0 (0%)
Critically Dry	Jan	0	0 (0%)
Critically Dry	Feb	0	0 (0%)
Critically Dry	Mar	4	4 (1%)
Critically Dry	Apr	6	7 (21%)
Critically Dry	May	0	0 (0%)
Critically Dry	Jun	0	0 (0%)
Critically Dry	Jul	0	0 (0%)
Critically Dry	Aug	0	0 (0%)
Critically Dry	Sep	0	0 (0%)
Critically Dry	Oct	0	0 (0%)
Critically Dry	Nov	0	0 (0%)
Critically Dry	Dec	0	0 (0%)

Note: N/A indicates there were no Above Normal years in the historical record for the 2010–2022 period used to provide loss density data for the analysis; for Above Normal years, the Wet year pattern was used, with only the percentage difference shown. Absolute and percentage values are rounded; as a result, differences between absolutes and differences between percentages may not always appear consistent.

Table 6B-2. Mean Number of Genetically Identified Spring-run Chinook Salmon Juveniles Lost (Fish Per Year) at the State Water Project South Delta Export Facility for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Month, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on the Salvage-Density Method

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Jan	2	2 (-2%)
Wet	Feb	5	5 (1%)
Wet	Mar	9	9 (2%)
Wet	Apr	0	0 (0%)
Wet	May	51	76 (49%)
Wet	Jun	0	0 (0%)
Wet	Jul	0	0 (0%)
Wet	Aug	0	0 (0%)
Wet	Sep	0	0 (0%)
Wet	Oct	0	0 (0%)
Wet	Nov	0	0 (0%)
Wet	Dec	0	0 (0%)
Above Normal	Jan	N/A	(-2%)
Above Normal	Feb	N/A	(-9%)
Above Normal	Mar	N/A	(-13%)
Above Normal	Apr	N/A	(0%)
Above Normal	May	N/A	(73%)
Above Normal	Jun	N/A	(0%)
Above Normal	Jul	N/A	(0%)
Above Normal	Aug	N/A	(0%)
Above Normal	Sep	N/A	(0%)
Above Normal	Oct	N/A	(0%)
Above Normal	Nov	N/A	(0%)
Above Normal	Dec	N/A	(0%)
Below Normal	Jan	0	0 (0%)
Below Normal	Feb	0	0 (0%)
Below Normal	Mar	23	18 (-22%)
Below Normal	Apr	30	49 (61%)
Below Normal	May	0	0 (0%)
Below Normal	Jun	0	0 (0%)
Below Normal	Jul	0	0 (0%)
Below Normal	Aug	0	0 (0%)
Below Normal	Sep	0	0 (0%)
Below Normal	Oct	0	0 (0%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Below Normal	Nov	0	0 (0%)
Below Normal	Dec	0	0 (0%)
Dry	Jan	0	0 (0%)
Dry	Feb	0	0 (0%)
Dry	Mar	0	0 (0%)
Dry	Apr	23	25 (7%)
Dry	May	0	0 (0%)
Dry	Jun	0	0 (0%)
Dry	Jul	0	0 (0%)
Dry	Aug	0	0 (0%)
Dry	Sep	0	0 (0%)
Dry	Oct	0	0 (0%)
Dry	Nov	0	0 (0%)
Dry	Dec	0	0 (0%)
Critically Dry	Jan	0	0 (0%)
Critically Dry	Feb	0	0 (0%)
Critically Dry	Mar	0	0 (0%)
Critically Dry	Apr	6	7 (21%)
Critically Dry	May	4	5 (41%)
Critically Dry	Jun	0	0 (0%)
Critically Dry	Jul	0	0 (0%)
Critically Dry	Aug	0	0 (0%)
Critically Dry	Sep	0	0 (0%)
Critically Dry	Oct	0	0 (0%)
Critically Dry	Nov	0	0 (0%)
Critically Dry	Dec	0	0 (0%)

Note: N/A indicates there were no Above Normal years in the historical record for the 2017–2022 period used to provide loss density data for the analysis; for Above Normal years, the Wet year pattern was used, with only the percentage difference shown. Absolute and percentage values are rounded; as a result, differences between absolutes and differences between percentages may not always appear consistent.

Table 6B-3. Mean Number of Fall-run Chinook Salmon Juveniles Lost (Fish Per Year) at the State Water Project South Delta Export Facility for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Month, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on the Salvage-Density Method

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Jan	1,068	1,047 (-2%)
Wet	Feb	2,930	2,960 (1%)
Wet	Mar	352	361 (2%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Apr	456	481 (5%)
Wet	May	9,084	13,530 (49%)
Wet	Jun	8,358	8,139 (-3%)
Wet	Jul	11	11 (0%)
Wet	Aug	0	0 (0%)
Wet	Sep	0	0 (0%)
Wet	Oct	0	0 (0%)
Wet	Nov	0	0 (0%)
Wet	Dec	67	66 (-1%)
Above Normal	Jan	N/A	(-2%)
Above Normal	Feb	N/A	(-9%)
Above Normal	Mar	N/A	(-13%)
Above Normal	Apr	N/A	(100%)
Above Normal	May	N/A	(73%)
Above Normal	Jun	N/A	(-8%)
Above Normal	Jul	N/A	(2%)
Above Normal	Aug	N/A	(0%)
Above Normal	Sep	N/A	(0%)
Above Normal	Oct	N/A	(0%)
Above Normal	Nov	N/A	(0%)
Above Normal	Dec	N/A	(1%)
Below Normal	Jan	0	0 (0%)
Below Normal	Feb	8	8 (-5%)
Below Normal	Mar	94	73 (-22%)
Below Normal	Apr	663	1,069 (61%)
Below Normal	May	2,596	5,427 (109%)
Below Normal	Jun	302	280 (-7%)
Below Normal	Jul	5	5 (-1%)
Below Normal	Aug	0	0 (0%)
Below Normal	Sep	0	0 (0%)
Below Normal	Oct	0	0 (0%)
Below Normal	Nov	0	0 (0%)
Below Normal	Dec	6	6 (4%)
Dry	Jan	0	0 (0%)
Dry	Feb	7	6 (-11%)
Dry	Mar	83	73 (-12%)
Dry	Apr	1,826	1,945 (7%)
Dry	May	1,762	2,544 (44%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Dry	Jun	20	18 (-9%)
Dry	Jul	0	0 (0%)
Dry	Aug	0	0 (0%)
Dry	Sep	0	0 (0%)
Dry	Oct	0	0 (0%)
Dry	Nov	0	0 (0%)
Dry	Dec	356	337 (-5%)
Critically Dry	Jan	0	0 (0%)
Critically Dry	Feb	0	0 (0%)
Critically Dry	Mar	6	6 (1%)
Critically Dry	Apr	249	302 (21%)
Critically Dry	May	280	394 (41%)
Critically Dry	Jun	0	0 (0%)
Critically Dry	Jul	0	0 (0%)
Critically Dry	Aug	0	0 (0%)
Critically Dry	Sep	0	0 (0%)
Critically Dry	Oct	0	0 (0%)
Critically Dry	Nov	0	0 (0%)
Critically Dry	Dec	7	7 (0%)

Note: N/A indicates there were no Above Normal years in the historical record for the 2009–2022 period used to provide loss density data for the analysis; for Above Normal years, the Wet year pattern was used, with only the percentage difference shown. Absolute and percentage values are rounded; as a result, differences between absolutes and differences between percentages may not always appear consistent.

Table 6B-4. Mean Number of Late Fall-run Chinook Salmon Juveniles Lost (Fish Per Year) at the State Water Project South Delta Export Facility for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Month, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on the Salvage-Density Method

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Jan	579	567 (-2%)
Wet	Feb	95	96 (1%)
Wet	Mar	9	9 (2%)
Wet	Apr	0	0 (0%)
Wet	May	0	0 (0%)
Wet	Jun	0	0 (0%)
Wet	Jul	0	0 (0%)
Wet	Aug	0	0 (0%)
Wet	Sep	0	0 (0%)
Wet	Oct	0	0 (0%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Nov	0	0 (0%)
Wet	Dec	728	724 (-1%)
Above Normal	Jan	N/A	(-2%)
Above Normal	Feb	N/A	(-9%)
Above Normal	Mar	N/A	(-13%)
Above Normal	Apr	N/A	(0%)
Above Normal	May	N/A	(0%)
Above Normal	Jun	N/A	(0%)
Above Normal	Jul	N/A	(0%)
Above Normal	Aug	N/A	(0%)
Above Normal	Sep	N/A	(0%)
Above Normal	Oct	N/A	(0%)
Above Normal	Nov	N/A	(0%)
Above Normal	Dec	N/A	(1%)
Below Normal	Jan	169	163 (-4%)
Below Normal	Feb	118	112 (-5%)
Below Normal	Mar	21	16 (-22%)
Below Normal	Apr	0	1 (61%)
Below Normal	May	0	0 (0%)
Below Normal	Jun	0	0 (0%)
Below Normal	Jul	0	0 (0%)
Below Normal	Aug	0	0 (0%)
Below Normal	Sep	0	0 (0%)
Below Normal	Oct	0	0 (0%)
Below Normal	Nov	0	0 (0%)
Below Normal	Dec	104	108 (4%)
Dry	Jan	24	24 (-1%)
Dry	Feb	0	0 (0%)
Dry	Mar	0	0 (0%)
Dry	Apr	0	0 (0%)
Dry	May	0	0 (0%)
Dry	Jun	0	0 (0%)
Dry	Jul	0	0 (0%)
Dry	Aug	0	0 (0%)
Dry	Sep	0	0 (0%)
Dry	Oct	0	0 (0%)
Dry	Nov	0	0 (0%)
Dry	Dec	758	717 (-5%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Critically Dry	Jan	128	115 (-10%)
Critically Dry	Feb	91	86 (-5%)
Critically Dry	Mar	10	10 (1%)
Critically Dry	Apr	16	19 (21%)
Critically Dry	May	0	0 (0%)
Critically Dry	Jun	0	0 (0%)
Critically Dry	Jul	0	0 (0%)
Critically Dry	Aug	0	0 (0%)
Critically Dry	Sep	0	0 (0%)
Critically Dry	Oct	0	0 (0%)
Critically Dry	Nov	0	0 (0%)
Critically Dry	Dec	232	232 (0%)

Note: N/A indicates there were no Above Normal years in the historical record for the 2009–2022 period used to provide loss density data for the analysis; for Above Normal years, the Wet year pattern was used, with only the percentage difference shown. Absolute and percentage values are rounded; as a result, differences between absolutes and differences between percentages may not always appear consistent.

Table 6B-5. Mean Number of Steelhead Lost (Fish Per Year) at the State Water Project South Delta Export Facility for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Month, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on the Salvage-Density Method

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Jan	274	268 (-2%)
Wet	Feb	2,218	2,240 (1%)
Wet	Mar	1,030	1,054 (2%)
Wet	Apr	1,230	1,296 (5%)
Wet	May	445	662 (49%)
Wet	Jun	263	257 (-3%)
Wet	Jul	0	0 (0%)
Wet	Aug	0	0 (0%)
Wet	Sep	6	8 (20%)
Wet	Oct	4	4 (-4%)
Wet	Nov	5	5 (0%)
Wet	Dec	7	7 (-1%)
Above Normal	Jan	N/A	(-2%)
Above Normal	Feb	N/A	(-9%)
Above Normal	Mar	N/A	(-13%)
Above Normal	Apr	N/A	(100%)
Above Normal	May	N/A	(73%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Above Normal	Jun	N/A	(-8%)
Above Normal	Jul	N/A	(0%)
Above Normal	Aug	N/A	(0%)
Above Normal	Sep	N/A	(25%)
Above Normal	Oct	N/A	(-4%)
Above Normal	Nov	N/A	(-2%)
Above Normal	Dec	N/A	(1%)
Below Normal	Jan	287	276 (-4%)
Below Normal	Feb	1,463	1,387 (-5%)
Below Normal	Mar	1,572	1,228 (-22%)
Below Normal	Apr	346	558 (61%)
Below Normal	May	169	353 (109%)
Below Normal	Jun	61	57 (-7%)
Below Normal	Jul	7	7 (-1%)
Below Normal	Aug	0	0 (0%)
Below Normal	Sep	0	0 (0%)
Below Normal	Oct	0	0 (0%)
Below Normal	Nov	0	0 (0%)
Below Normal	Dec	7	7 (4%)
Dry	Jan	92	91 (-1%)
Dry	Feb	321	288 (-11%)
Dry	Mar	936	825 (-12%)
Dry	Apr	514	548 (7%)
Dry	May	144	208 (44%)
Dry	Jun	38	34 (-9%)
Dry	Jul	14	14 (2%)
Dry	Aug	0	0 (0%)
Dry	Sep	0	0 (0%)
Dry	Oct	0	0 (0%)
Dry	Nov	5	5 (0%)
Dry	Dec	23	22 (-5%)
Critically Dry	Jan	68	62 (-10%)
Critically Dry	Feb	224	212 (-5%)
Critically Dry	Mar	214	215 (1%)
Critically Dry	Apr	244	297 (21%)
Critically Dry	May	42	60 (41%)
Critically Dry	Jun	6	6 (-11%)
Critically Dry	Jul	0	0 (0%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Critically Dry	Aug	0	0 (0%)
Critically Dry	Sep	0	0 (0%)
Critically Dry	Oct	0	0 (0%)
Critically Dry	Nov	3	3 (0%)
Critically Dry	Dec	19	19 (0%)

Note: N/A indicates there were no Above Normal years in the historical record for the 2009–2022 period used to provide loss density data for the analysis; for Above Normal years, the Wet year pattern was used, with only the percentage difference shown. Absolute and percentage values are rounded; as a result, differences between absolutes and differences between percentages may not always appear consistent.

Table 6B-6. Mean Number of Green Sturgeon Salvaged (Fish Per Year) at the State Water Project South Delta Export Facility for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Month, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on the Salvage-Density Method

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Jan	0	0 (0%)
Wet	Feb	0	0 (0%)
Wet	Mar	1	1 (2%)
Wet	Apr	0	0 (0%)
Wet	May	0	0 (0%)
Wet	Jun	0	0 (0%)
Wet	Jul	0	0 (0%)
Wet	Aug	0	0 (0%)
Wet	Sep	0	0 (0%)
Wet	Oct	0	0 (0%)
Wet	Nov	0	0 (0%)
Wet	Dec	0	0 (0%)
Above Normal	Jan	N/A	(0%)
Above Normal	Feb	N/A	(0%)
Above Normal	Mar	N/A	(-13%)
Above Normal	Apr	N/A	(0%)
Above Normal	May	N/A	(0%)
Above Normal	Jun	N/A	(0%)
Above Normal	Jul	N/A	(0%)
Above Normal	Aug	N/A	(0%)
Above Normal	Sep	N/A	(0%)
Above Normal	Oct	N/A	(0%)
Above Normal	Nov	N/A	(0%)
Above Normal	Dec	N/A	(0%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Below Normal	Jan	1	1 (-4%)
Below Normal	Feb	0	0 (0%)
Below Normal	Mar	0	0 (0%)
Below Normal	Apr	0	0 (0%)
Below Normal	May	0	0 (0%)
Below Normal	Jun	0	0 (0%)
Below Normal	Jul	0	0 (0%)
Below Normal	Aug	0	0 (0%)
Below Normal	Sep	0	0 (0%)
Below Normal	Oct	0	0 (0%)
Below Normal	Nov	0	0 (0%)
Below Normal	Dec	0	0 (0%)
Dry	Jan	0	0 (0%)
Dry	Feb	0	0 (0%)
Dry	Mar	0	0 (0%)
Dry	Apr	0	0 (0%)
Dry	May	0	0 (0%)
Dry	Jun	0	0 (0%)
Dry	Jul	0	0 (0%)
Dry	Aug	0	0 (0%)
Dry	Sep	0	0 (0%)
Dry	Oct	0	0 (0%)
Dry	Nov	0	0 (0%)
Dry	Dec	0	0 (0%)
Critically Dry	Jan	0	0 (0%)
Critically Dry	Feb	0	0 (0%)
Critically Dry	Mar	0	0 (0%)
Critically Dry	Apr	0	0 (0%)
Critically Dry	May	0	0 (0%)
Critically Dry	Jun	0	0 (0%)
Critically Dry	Jul	0	0 (0%)
Critically Dry	Aug	0	0 (0%)
Critically Dry	Sep	0	0 (0%)
Critically Dry	Oct	0	0 (0%)
Critically Dry	Nov	0	0 (0%)
Critically Dry	Dec	0	0 (0%)

Note: N/A indicates there were no Above Normal years in the historical record for the 2009–2022 period used to provide salvage density data for the analysis; for Above Normal years, the Wet year pattern was used, with only the percentage difference shown. Absolute and percentage values are rounded; as a result, differences between absolutes and differences between percentages may not always appear consistent.

Table 6B-7. Mean Number of White Sturgeon Salvaged (Fish Per Year) at the State Water Project South Delta Export Facility for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Month, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on the Salvage-Density Method

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Jan	5	5 (-2%)
Wet	Feb	1	1 (1%)
Wet	Mar	3	3 (2%)
Wet	Apr	0	0 (0%)
Wet	May	1	2 (49%)
Wet	Jun	3	3 (-3%)
Wet	Jul	4	4 (0%)
Wet	Aug	3	3 (5%)
Wet	Sep	0	0 (0%)
Wet	Oct	0	0 (0%)
Wet	Nov	0	0 (0%)
Wet	Dec	0	0 (-1%)
Above Normal	Jan	N/A	(-2%)
Above Normal	Feb	N/A	(-9%)
Above Normal	Mar	N/A	(-13%)
Above Normal	Apr	N/A	(0%)
Above Normal	May	N/A	(73%)
Above Normal	Jun	N/A	(-8%)
Above Normal	Jul	N/A	(2%)
Above Normal	Aug	N/A	(3%)
Above Normal	Sep	N/A	(0%)
Above Normal	Oct	N/A	(0%)
Above Normal	Nov	N/A	(0%)
Above Normal	Dec	N/A	(1%)
Below Normal	Jan	0	0 (0%)
Below Normal	Feb	0	0 (0%)
Below Normal	Mar	1	1 (-22%)
Below Normal	Apr	0	0 (61%)
Below Normal	May	0	0 (0%)
Below Normal	Jun	5	4 (-7%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Below Normal	Jul	0	0 (0%)
Below Normal	Aug	0	0 (0%)
Below Normal	Sep	0	0 (0%)
Below Normal	Oct	0	0 (0%)
Below Normal	Nov	2	2 (0%)
Below Normal	Dec	3	3 (4%)
Dry	Jan	2	2 (-1%)
Dry	Feb	0	0 (0%)
Dry	Mar	0	0 (0%)
Dry	Apr	0	0 (0%)
Dry	May	1	2 (44%)
Dry	Jun	0	0 (0%)
Dry	Jul	0	0 (0%)
Dry	Aug	0	0 (0%)
Dry	Sep	0	0 (0%)
Dry	Oct	0	0 (0%)
Dry	Nov	0	0 (0%)
Dry	Dec	0	0 (0%)
Critically Dry	Jan	0	0 (0%)
Critically Dry	Feb	0	0 (0%)
Critically Dry	Mar	0	0 (0%)
Critically Dry	Apr	0	0 (0%)
Critically Dry	May	0	0 (0%)
Critically Dry	Jun	0	0 (0%)
Critically Dry	Jul	0	0 (0%)
Critically Dry	Aug	0	0 (0%)
Critically Dry	Sep	0	0 (0%)
Critically Dry	Oct	0	0 (0%)
Critically Dry	Nov	0	0 (0%)
Critically Dry	Dec	0	0 (0%)

Note: N/A indicates there were no Above Normal years in the historical record for the 2009–2022 period used to provide salvage density data for the analysis; for Above Normal years, the Wet year pattern was used, with only the percentage difference shown. Absolute and percentage values are rounded; as a result, differences between absolutes and differences between percentages may not always appear consistent.

Table 6B-8. Mean Number of Unidentified Lamprey Salvaged (Fish Per Year) at the State Water Project South Delta Export Facility for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Month, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on the Salvage-Density Method

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Jan	553	542 (-2%)
Wet	Feb	117	119 (1%)
Wet	Mar	20	21 (2%)
Wet	Apr	7	7 (5%)
Wet	May	22	33 (49%)
Wet	Jun	102	99 (-3%)
Wet	Jul	23	23 (0%)
Wet	Aug	8	9 (5%)
Wet	Sep	0	0 (0%)
Wet	Oct	0	0 (0%)
Wet	Nov	0	0 (0%)
Wet	Dec	10	10 (-1%)
Above Normal	Jan	N/A	(-2%)
Above Normal	Feb	N/A	(-9%)
Above Normal	Mar	N/A	(-13%)
Above Normal	Apr	N/A	(100%)
Above Normal	May	N/A	(73%)
Above Normal	Jun	N/A	(-8%)
Above Normal	Jul	N/A	(2%)
Above Normal	Aug	N/A	(3%)
Above Normal	Sep	N/A	(0%)
Above Normal	Oct	N/A	(0%)
Above Normal	Nov	N/A	(0%)
Above Normal	Dec	N/A	(1%)
Below Normal	Jan	54	52 (-4%)
Below Normal	Feb	1	1 (-5%)
Below Normal	Mar	29	22 (-22%)
Below Normal	Apr	4	7 (61%)
Below Normal	May	5	11 (109%)
Below Normal	Jun	55	51 (-7%)
Below Normal	Jul	18	18 (-1%)
Below Normal	Aug	0	0 (0%)
Below Normal	Sep	0	0 (0%)
Below Normal	Oct	0	0 (0%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Below Normal	Nov	0	0 (0%)
Below Normal	Dec	0	0 (0%)
Dry	Jan	0	0 (0%)
Dry	Feb	14	12 (-11%)
Dry	Mar	25	22 (-12%)
Dry	Apr	32	35 (7%)
Dry	May	5	7 (44%)
Dry	Jun	5	4 (-9%)
Dry	Jul	6	6 (2%)
Dry	Aug	0	0 (0%)
Dry	Sep	0	0 (0%)
Dry	Oct	0	0 (0%)
Dry	Nov	0	0 (0%)
Dry	Dec	33	31 (-5%)
Critically Dry	Jan	5	4 (-10%)
Critically Dry	Feb	23	22 (-5%)
Critically Dry	Mar	22	22 (1%)
Critically Dry	Apr	33	41 (21%)
Critically Dry	May	35	49 (41%)
Critically Dry	Jun	5	4 (-11%)
Critically Dry	Jul	1	1 (-8%)
Critically Dry	Aug	0	0 (7%)
Critically Dry	Sep	0	0 (0%)
Critically Dry	Oct	0	0 (0%)
Critically Dry	Nov	0	0 (0%)
Critically Dry	Dec	2	2 (0%)

Note: N/A indicates there were no Above Normal years in the historical record for the 2009–2022 period used to provide salvage density data for the analysis; for Above Normal years, the Wet year pattern was used, with only the percentage difference shown. Absolute and percentage values are rounded; as a result, differences between absolutes and differences between percentages may not always appear consistent.

Table 6B-9. Mean Number of Sacramento Hitch Salvaged (Fish Per Year) at the State Water Project South Delta Export Facility for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Month, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on the Salvage-Density Method

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Jan	0	0 (0%)
Wet	Feb	0	0 (0%)
Wet	Mar	0	0 (0%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Apr	1	1 (5%)
Wet	May	0	0 (0%)
Wet	Jun	0	0 (0%)
Wet	Jul	0	0 (0%)
Wet	Aug	0	0 (0%)
Wet	Sep	0	0 (0%)
Wet	Oct	0	0 (0%)
Wet	Nov	0	0 (0%)
Wet	Dec	0	0 (0%)
Above Normal	Jan	N/A	(0%)
Above Normal	Feb	N/A	(0%)
Above Normal	Mar	N/A	(0%)
Above Normal	Apr	N/A	(100%)
Above Normal	May	N/A	(0%)
Above Normal	Jun	N/A	(0%)
Above Normal	Jul	N/A	(0%)
Above Normal	Aug	N/A	(0%)
Above Normal	Sep	N/A	(0%)
Above Normal	Oct	N/A	(0%)
Above Normal	Nov	N/A	(0%)
Above Normal	Dec	N/A	(0%)
Below Normal	Jan	0	0 (0%)
Below Normal	Feb	0	0 (0%)
Below Normal	Mar	0	0 (-22%)
Below Normal	Apr	0	0 (0%)
Below Normal	May	0	0 (0%)
Below Normal	Jun	1	1 (-7%)
Below Normal	Jul	0	0 (0%)
Below Normal	Aug	4	4 (-1%)
Below Normal	Sep	0	0 (0%)
Below Normal	Oct	0	0 (0%)
Below Normal	Nov	2	2 (0%)
Below Normal	Dec	0	0 (0%)
Dry	Jan	0	0 (0%)
Dry	Feb	0	0 (0%)
Dry	Mar	0	0 (0%)
Dry	Apr	0	0 (0%)
Dry	May	0	0 (0%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Dry	Jun	0	0 (0%)
Dry	Jul	0	0 (0%)
Dry	Aug	0	0 (0%)
Dry	Sep	0	0 (0%)
Dry	Oct	1	1 (1%)
Dry	Nov	0	0 (0%)
Dry	Dec	0	0 (0%)
Critically Dry	Jan	0	0 (0%)
Critically Dry	Feb	0	0 (0%)
Critically Dry	Mar	0	0 (0%)
Critically Dry	Apr	0	0 (0%)
Critically Dry	May	0	0 (0%)
Critically Dry	Jun	0	0 (0%)
Critically Dry	Jul	0	0 (0%)
Critically Dry	Aug	0	0 (0%)
Critically Dry	Sep	0	0 (0%)
Critically Dry	Oct	0	0 (0%)
Critically Dry	Nov	0	0 (0%)
Critically Dry	Dec	0	0 (0%)

Note: N/A indicates there were no Above Normal years in the historical record for the 2009–2022 period used to provide salvage density data for the analysis; for Above Normal years, the Wet year pattern was used, with only the percentage difference shown. Absolute and percentage values are rounded; as a result, differences between absolutes and differences between percentages may not always appear consistent.

Table 6B-10. Mean Number of Hardhead Salvaged (Fish Per Year) at the State Water Project South Delta Export Facility for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Month, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on the Salvage-Density Method

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Jan	0	0 (0%)
Wet	Feb	0	0 (0%)
Wet	Mar	0	0 (0%)
Wet	Apr	1	1 (5%)
Wet	May	0	0 (0%)
Wet	Jun	0	0 (0%)
Wet	Jul	0	0 (0%)
Wet	Aug	0	0 (0%)
Wet	Sep	0	0 (0%)
Wet	Oct	0	0 (0%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Nov	0	0 (0%)
Wet	Dec	0	0 (0%)
Above Normal	Jan	N/A	(0%)
Above Normal	Feb	N/A	(0%)
Above Normal	Mar	N/A	(0%)
Above Normal	Apr	N/A	(100%)
Above Normal	May	N/A	(0%)
Above Normal	Jun	N/A	(0%)
Above Normal	Jul	N/A	(0%)
Above Normal	Aug	N/A	(0%)
Above Normal	Sep	N/A	(0%)
Above Normal	Oct	N/A	(0%)
Above Normal	Nov	N/A	(0%)
Above Normal	Dec	N/A	(0%)
Below Normal	Jan	0	0 (0%)
Below Normal	Feb	0	0 (0%)
Below Normal	Mar	0	0 (0%)
Below Normal	Apr	0	0 (0%)
Below Normal	May	0	0 (0%)
Below Normal	Jun	0	0 (0%)
Below Normal	Jul	0	0 (0%)
Below Normal	Aug	0	0 (0%)
Below Normal	Sep	0	0 (0%)
Below Normal	Oct	0	0 (0%)
Below Normal	Nov	0	0 (0%)
Below Normal	Dec	0	0 (0%)
Dry	Jan	0	0 (0%)
Dry	Feb	0	0 (0%)
Dry	Mar	0	0 (0%)
Dry	Apr	0	0 (0%)
Dry	May	0	0 (0%)
Dry	Jun	0	0 (0%)
Dry	Jul	0	0 (0%)
Dry	Aug	0	0 (0%)
Dry	Sep	0	0 (0%)
Dry	Oct	0	0 (0%)
Dry	Nov	0	0 (0%)
Dry	Dec	0	0 (0%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Critically Dry	Jan	0	0 (0%)
Critically Dry	Feb	0	0 (0%)
Critically Dry	Mar	0	0 (0%)
Critically Dry	Apr	0	0 (0%)
Critically Dry	May	0	0 (0%)
Critically Dry	Jun	0	0 (0%)
Critically Dry	Jul	0	0 (0%)
Critically Dry	Aug	0	0 (0%)
Critically Dry	Sep	2	2 (1%)
Critically Dry	Oct	0	0 (0%)
Critically Dry	Nov	0	0 (0%)
Critically Dry	Dec	0	0 (0%)

Note: N/A indicates there were no Above Normal years in the historical record for the 2009–2022 period used to provide salvage density data for the analysis; for Above Normal years, the Wet year pattern was used, with only the percentage difference shown. Absolute and percentage values are rounded; as a result, differences between absolutes and differences between percentages may not always appear consistent.

Table 6B-11. Mean Number of Central California Roach Salvaged (Fish Per Year) at the State Water Project South Delta Export Facility for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Month, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on the Salvage-Density Method

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Jan	0	0 (0%)
Wet	Feb	0	0 (0%)
Wet	Mar	0	0 (0%)
Wet	Apr	0	0 (0%)
Wet	May	0	0 (0%)
Wet	Jun	0	0 (0%)
Wet	Jul	0	0 (0%)
Wet	Aug	0	0 (0%)
Wet	Sep	0	0 (0%)
Wet	Oct	0	0 (0%)
Wet	Nov	0	0 (0%)
Wet	Dec	0	0 (0%)
Above Normal	Jan	N/A	(0%)
Above Normal	Feb	N/A	(0%)
Above Normal	Mar	N/A	(0%)
Above Normal	Apr	N/A	(0%)
Above Normal	May	N/A	(0%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Above Normal	Jun	N/A	(0%)
Above Normal	Jul	N/A	(0%)
Above Normal	Aug	N/A	(0%)
Above Normal	Sep	N/A	(0%)
Above Normal	Oct	N/A	(0%)
Above Normal	Nov	N/A	(0%)
Above Normal	Dec	N/A	(0%)
Below Normal	Jan	0	0 (0%)
Below Normal	Feb	0	0 (0%)
Below Normal	Mar	0	0 (0%)
Below Normal	Apr	0	0 (0%)
Below Normal	May	0	0 (0%)
Below Normal	Jun	0	0 (0%)
Below Normal	Jul	0	0 (0%)
Below Normal	Aug	0	0 (0%)
Below Normal	Sep	0	0 (0%)
Below Normal	Oct	0	0 (0%)
Below Normal	Nov	0	0 (0%)
Below Normal	Dec	0	0 (0%)
Dry	Jan	0	0 (0%)
Dry	Feb	0	0 (0%)
Dry	Mar	0	0 (0%)
Dry	Apr	0	0 (0%)
Dry	May	0	0 (0%)
Dry	Jun	0	0 (0%)
Dry	Jul	0	0 (0%)
Dry	Aug	0	0 (0%)
Dry	Sep	0	0 (0%)
Dry	Oct	0	0 (0%)
Dry	Nov	0	0 (0%)
Dry	Dec	0	0 (0%)
Critically Dry	Jan	0	0 (0%)
Critically Dry	Feb	0	0 (-5%)
Critically Dry	Mar	0	0 (0%)
Critically Dry	Apr	0	0 (0%)
Critically Dry	May	0	0 (0%)
Critically Dry	Jun	0	0 (0%)
Critically Dry	Jul	0	0 (0%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Critically Dry	Aug	0	0 (0%)
Critically Dry	Sep	0	0 (0%)
Critically Dry	Oct	0	0 (0%)
Critically Dry	Nov	0	0 (0%)
Critically Dry	Dec	0	0 (0%)

Note: N/A indicates there were no Above Normal years in the historical record for the 2009–2022 period used to provide salvage density data for the analysis; for Above Normal years, the Wet year pattern was used, with only the percentage difference shown. Absolute and percentage values are rounded; as a result, differences between absolutes and differences between percentages may not always appear consistent.

Table 6B-12. Mean Number of Sacramento Splittail Salvaged (Fish Per Year) at the State Water Project South Delta Export Facility for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Month, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on the Salvage-Density Method

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Jan	482	472 (-2%)
Wet	Feb	725	732 (1%)
Wet	Mar	269	275 (2%)
Wet	Apr	1,928	2,031 (5%)
Wet	May	425,050	633,055 (49%)
Wet	Jun	163,050	158,767 (-3%)
Wet	Jul	52,915	53,060 (0%)
Wet	Aug	5,310	5,565 (5%)
Wet	Sep	222	268 (20%)
Wet	Oct	11	11 (-4%)
Wet	Nov	9	9 (0%)
Wet	Dec	52	52 (-1%)
Above Normal	Jan	N/A	(-2%)
Above Normal	Feb	N/A	(-9%)
Above Normal	Mar	N/A	(-13%)
Above Normal	Apr	N/A	(100%)
Above Normal	May	N/A	(73%)
Above Normal	Jun	N/A	(-8%)
Above Normal	Jul	N/A	(2%)
Above Normal	Aug	N/A	(3%)
Above Normal	Sep	N/A	(25%)
Above Normal	Oct	N/A	(-4%)
Above Normal	Nov	N/A	(-2%)
Above Normal	Dec	N/A	(1%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Below Normal	Jan	37	36 (-4%)
Below Normal	Feb	92	87 (-5%)
Below Normal	Mar	141	110 (-22%)
Below Normal	Apr	62	100 (61%)
Below Normal	May	305	638 (109%)
Below Normal	Jun	3,810	3,534 (-7%)
Below Normal	Jul	1,017	1,006 (-1%)
Below Normal	Aug	46	45 (-1%)
Below Normal	Sep	11	11 (-4%)
Below Normal	Oct	149	146 (-2%)
Below Normal	Nov	698	699 (0%)
Below Normal	Dec	71	74 (4%)
Dry	Jan	2	2 (-1%)
Dry	Feb	31	28 (-11%)
Dry	Mar	122	107 (-12%)
Dry	Apr	146	156 (7%)
Dry	May	95	137 (44%)
Dry	Jun	85	77 (-9%)
Dry	Jul	41	42 (2%)
Dry	Aug	1	1 (0%)
Dry	Sep	5	4 (-3%)
Dry	Oct	1	1 (1%)
Dry	Nov	26	26 (0%)
Dry	Dec	14	13 (-5%)
Critically Dry	Jan	36	32 (-10%)
Critically Dry	Feb	63	60 (-5%)
Critically Dry	Mar	14	14 (1%)
Critically Dry	Apr	8	10 (21%)
Critically Dry	May	6	8 (41%)
Critically Dry	Jun	28	25 (-11%)
Critically Dry	Jul	2	2 (-8%)
Critically Dry	Aug	1	1 (7%)
Critically Dry	Sep	0	0 (0%)
Critically Dry	Oct	6	6 (-1%)
Critically Dry	Nov	12	12 (0%)
Critically Dry	Dec	69	69 (0%)

Note: N/A indicates there were no Above Normal years in the historical record for the 2009–2022 period used to provide salvage density data for the analysis; for Above Normal years, the Wet year pattern was used, with only the percentage difference shown. Absolute and percentage values are rounded; as a result, differences between absolutes and differences between percentages may not always appear consistent.

Table 6B-13. Mean Number of Starry Flounder Salvaged (Fish Per Year) at the State Water Project South Delta Export Facility for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Month, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on the Salvage-Density Method

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Jan	2	2 (-2%)
Wet	Feb	1	1 (1%)
Wet	Mar	10	10 (2%)
Wet	Apr	8	8 (5%)
Wet	May	10	16 (49%)
Wet	Jun	21	20 (-3%)
Wet	Jul	14	14 (0%)
Wet	Aug	0	0 (0%)
Wet	Sep	0	0 (0%)
Wet	Oct	0	0 (0%)
Wet	Nov	0	0 (0%)
Wet	Dec	2	2 (-1%)
Above Normal	Jan	N/A	(-2%)
Above Normal	Feb	N/A	(-9%)
Above Normal	Mar	N/A	(-13%)
Above Normal	Apr	N/A	(100%)
Above Normal	May	N/A	(73%)
Above Normal	Jun	N/A	(-8%)
Above Normal	Jul	N/A	(2%)
Above Normal	Aug	N/A	(0%)
Above Normal	Sep	N/A	(0%)
Above Normal	Oct	N/A	(0%)
Above Normal	Nov	N/A	(0%)
Above Normal	Dec	N/A	(1%)
Below Normal	Jan	0	0 (0%)
Below Normal	Feb	3	3 (-5%)
Below Normal	Mar	1	1 (-22%)
Below Normal	Apr	4	7 (61%)
Below Normal	May	23	48 (109%)
Below Normal	Jun	80	74 (-7%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Below Normal	Jul	4	4 (-1%)
Below Normal	Aug	18	18 (-1%)
Below Normal	Sep	0	0 (-4%)
Below Normal	Oct	0	0 (0%)
Below Normal	Nov	0	0 (0%)
Below Normal	Dec	0	0 (0%)
Dry	Jan	0	0 (0%)
Dry	Feb	0	0 (0%)
Dry	Mar	1	1 (-12%)
Dry	Apr	6	6 (7%)
Dry	May	5	7 (44%)
Dry	Jun	0	0 (0%)
Dry	Jul	3	3 (2%)
Dry	Aug	1	1 (0%)
Dry	Sep	0	0 (0%)
Dry	Oct	0	0 (0%)
Dry	Nov	1	1 (0%)
Dry	Dec	0	0 (0%)
Critically Dry	Jan	0	0 (0%)
Critically Dry	Feb	0	0 (0%)
Critically Dry	Mar	0	0 (0%)
Critically Dry	Apr	0	0 (0%)
Critically Dry	May	0	0 (0%)
Critically Dry	Jun	0	0 (0%)
Critically Dry	Jul	0	0 (0%)
Critically Dry	Aug	0	0 (0%)
Critically Dry	Sep	0	0 (0%)
Critically Dry	Oct	1	1 (-1%)
Critically Dry	Nov	0	0 (0%)
Critically Dry	Dec	0	0 (0%)

Note: N/A indicates there were no Above Normal years in the historical record for the 2009–2022 period used to provide salvage density data for the analysis; for Above Normal years, the Wet year pattern was used, with only the percentage difference shown. Absolute and percentage values are rounded; as a result, differences between absolutes and differences between percentages may not always appear consistent.

Table 6B-14. Mean Number of Striped Bass Salvaged (Fish Per Year) at the State Water Project South Delta Export Facility for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Month, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on the Salvage-Density Method

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Jan	14,110	13,823 (-2%)
Wet	Feb	14,300	14,445 (1%)
Wet	Mar	14,020	14,349 (2%)
Wet	Apr	2,136	2,250 (5%)
Wet	May	883	1,315 (49%)
Wet	Jun	30,972	30,159 (-3%)
Wet	Jul	184,114	184,619 (0%)
Wet	Aug	30,426	31,885 (5%)
Wet	Sep	3,789	4,566 (20%)
Wet	Oct	1,049	1,012 (-4%)
Wet	Nov	21,740	21,754 (0%)
Wet	Dec	16,601	16,497 (-1%)
Above Normal	Jan	N/A	(-2%)
Above Normal	Feb	N/A	(-9%)
Above Normal	Mar	N/A	(-13%)
Above Normal	Apr	N/A	(100%)
Above Normal	May	N/A	(73%)
Above Normal	Jun	N/A	(-8%)
Above Normal	Jul	N/A	(2%)
Above Normal	Aug	N/A	(3%)
Above Normal	Sep	N/A	(25%)
Above Normal	Oct	N/A	(-4%)
Above Normal	Nov	N/A	(-2%)
Above Normal	Dec	N/A	(1%)
Below Normal	Jan	2,367	2,277 (-4%)
Below Normal	Feb	3,734	3,539 (-5%)
Below Normal	Mar	3,714	2,901 (-22%)
Below Normal	Apr	199	321 (61%)
Below Normal	May	19,533	40,836 (109%)
Below Normal	Jun	115,991	107,577 (-7%)
Below Normal	Jul	118,541	117,250 (-1%)
Below Normal	Aug	17,904	17,681 (-1%)
Below Normal	Sep	1,444	1,383 (-4%)
Below Normal	Oct	16,856	16,530 (-2%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Below Normal	Nov	46,557	46,615 (0%)
Below Normal	Dec	10,503	10,887 (4%)
Dry	Jan	8,528	8,438 (-1%)
Dry	Feb	1,588	1,421 (-11%)
Dry	Mar	881	777 (-12%)
Dry	Apr	438	466 (7%)
Dry	May	5,264	7,600 (44%)
Dry	Jun	32,141	29,195 (-9%)
Dry	Jul	22,165	22,603 (2%)
Dry	Aug	697	698 (0%)
Dry	Sep	216	209 (-3%)
Dry	Oct	2,568	2,583 (1%)
Dry	Nov	13,248	13,237 (0%)
Dry	Dec	25,315	23,965 (-5%)
Critically Dry	Jan	2,478	2,234 (-10%)
Critically Dry	Feb	5,123	4,848 (-5%)
Critically Dry	Mar	661	664 (1%)
Critically Dry	Apr	255	310 (21%)
Critically Dry	May	4,153	5,849 (41%)
Critically Dry	Jun	5,281	4,700 (-11%)
Critically Dry	Jul	556	509 (-8%)
Critically Dry	Aug	83	88 (7%)
Critically Dry	Sep	68	69 (1%)
Critically Dry	Oct	4,214	4,191 (-1%)
Critically Dry	Nov	3,992	4,005 (0%)
Critically Dry	Dec	7,064	7,049 (0%)

Note: N/A indicates there were no Above Normal years in the historical record for the 2009–2022 period used to provide salvage density data for the analysis; for Above Normal years, the Wet year pattern was used, with only the percentage difference shown. Absolute and percentage values are rounded; as a result, differences between absolutes and differences between percentages may not always appear consistent.

Table 6B-15. Mean Number of American Shad Salvaged (Fish Per Year) at the State Water Project South Delta Export Facility for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Month, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on the Salvage-Density Method

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Jan	21,276	20,843 (-2%)
Wet	Feb	12,095	12,218 (1%)
Wet	Mar	1,270	1,300 (2%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Apr	280	295 (5%)
Wet	May	2,051	3,055 (49%)
Wet	Jun	16,091	15,668 (-3%)
Wet	Jul	137,936	138,314 (0%)
Wet	Aug	102,769	107,698 (5%)
Wet	Sep	15,920	19,183 (20%)
Wet	Oct	1,039	1,002 (-4%)
Wet	Nov	10,262	10,269 (0%)
Wet	Dec	21,085	20,952 (-1%)
Above Normal	Jan	N/A	(-2%)
Above Normal	Feb	N/A	(-9%)
Above Normal	Mar	N/A	(-13%)
Above Normal	Apr	N/A	(100%)
Above Normal	May	N/A	(73%)
Above Normal	Jun	N/A	(-8%)
Above Normal	Jul	N/A	(2%)
Above Normal	Aug	N/A	(3%)
Above Normal	Sep	N/A	(25%)
Above Normal	Oct	N/A	(-4%)
Above Normal	Nov	N/A	(-2%)
Above Normal	Dec	N/A	(1%)
Below Normal	Jan	7,108	6,839 (-4%)
Below Normal	Feb	3,189	3,022 (-5%)
Below Normal	Mar	455	356 (-22%)
Below Normal	Apr	35	56 (61%)
Below Normal	May	2,028	4,240 (109%)
Below Normal	Jun	5,479	5,081 (-7%)
Below Normal	Jul	81,788	80,897 (-1%)
Below Normal	Aug	62,466	61,689 (-1%)
Below Normal	Sep	8,756	8,386 (-4%)
Below Normal	Oct	30,708	30,115 (-2%)
Below Normal	Nov	32,955	32,996 (0%)
Below Normal	Dec	23,043	23,886 (4%)
Dry	Jan	7,820	7,738 (-1%)
Dry	Feb	1,794	1,605 (-11%)
Dry	Mar	362	319 (-12%)
Dry	Apr	276	294 (7%)
Dry	May	120	173 (44%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Dry	Jun	294	267 (-9%)
Dry	Jul	19,914	20,308 (2%)
Dry	Aug	10,402	10,417 (0%)
Dry	Sep	2,402	2,328 (-3%)
Dry	Oct	3,947	3,970 (1%)
Dry	Nov	20,766	20,749 (0%)
Dry	Dec	39,255	37,163 (-5%)
Critically Dry	Jan	3,782	3,409 (-10%)
Critically Dry	Feb	1,796	1,700 (-5%)
Critically Dry	Mar	304	306 (1%)
Critically Dry	Apr	79	96 (21%)
Critically Dry	May	125	176 (41%)
Critically Dry	Jun	10	9 (-11%)
Critically Dry	Jul	105	96 (-8%)
Critically Dry	Aug	19	20 (7%)
Critically Dry	Sep	7	7 (1%)
Critically Dry	Oct	2,201	2,189 (-1%)
Critically Dry	Nov	5,151	5,168 (0%)
Critically Dry	Dec	4,243	4,234 (0%)

Note: N/A indicates there were no Above Normal years in the historical record for the 2009–2022 period used to provide salvage density data for the analysis; for Above Normal years, the Wet year pattern was used, with only the percentage difference shown. Absolute and percentage values are rounded; as a result, differences between absolutes and differences between percentages may not always appear consistent.

Table 6B-16. Mean Number of Threadfin Shad Salvaged (Fish Per Year) at the State Water Project South Delta Export Facility for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Month, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on the Salvage-Density Method

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Jan	3,027	2,965 (-2%)
Wet	Feb	1,512	1,528 (1%)
Wet	Mar	224	230 (2%)
Wet	Apr	222	234 (5%)
Wet	May	918	1,367 (49%)
Wet	Jun	23,019	22,414 (-3%)
Wet	Jul	222,931	223,541 (0%)
Wet	Aug	221,049	231,651 (5%)
Wet	Sep	28,187	33,964 (20%)
Wet	Oct	8,385	8,088 (-4%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Nov	4,307	4,310 (0%)
Wet	Dec	3,923	3,898 (-1%)
Above Normal	Jan	N/A	(-2%)
Above Normal	Feb	N/A	(-9%)
Above Normal	Mar	N/A	(-13%)
Above Normal	Apr	N/A	(100%)
Above Normal	May	N/A	(73%)
Above Normal	Jun	N/A	(-8%)
Above Normal	Jul	N/A	(2%)
Above Normal	Aug	N/A	(3%)
Above Normal	Sep	N/A	(25%)
Above Normal	Oct	N/A	(-4%)
Above Normal	Nov	N/A	(-2%)
Above Normal	Dec	N/A	(1%)
Below Normal	Jan	381	366 (-4%)
Below Normal	Feb	663	629 (-5%)
Below Normal	Mar	200	156 (-22%)
Below Normal	Apr	37	60 (61%)
Below Normal	May	3,724	7,786 (109%)
Below Normal	Jun	77,218	71,617 (-7%)
Below Normal	Jul	854,954	845,643 (-1%)
Below Normal	Aug	299,889	296,161 (-1%)
Below Normal	Sep	46,812	44,834 (-4%)
Below Normal	Oct	165,453	162,259 (-2%)
Below Normal	Nov	11,655	11,669 (0%)
Below Normal	Dec	3,049	3,161 (4%)
Dry	Jan	2,727	2,698 (-1%)
Dry	Feb	41	37 (-11%)
Dry	Mar	26	23 (-12%)
Dry	Apr	73	78 (7%)
Dry	May	615	887 (44%)
Dry	Jun	44,432	40,359 (-9%)
Dry	Jul	776,432	791,790 (2%)
Dry	Aug	80,733	80,849 (0%)
Dry	Sep	31,672	30,692 (-3%)
Dry	Oct	5,123	5,153 (1%)
Dry	Nov	12,611	12,601 (0%)
Dry	Dec	6,150	5,822 (-5%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Critically Dry	Jan	732	660 (-10%)
Critically Dry	Feb	384	363 (-5%)
Critically Dry	Mar	68	68 (1%)
Critically Dry	Apr	31	38 (21%)
Critically Dry	May	397	559 (41%)
Critically Dry	Jun	8,914	7,934 (-11%)
Critically Dry	Jul	12,597	11,539 (-8%)
Critically Dry	Aug	15,030	16,038 (7%)
Critically Dry	Sep	30,451	30,859 (1%)
Critically Dry	Oct	38,740	38,529 (-1%)
Critically Dry	Nov	47,809	47,967 (0%)
Critically Dry	Dec	4,632	4,622 (0%)

Note: N/A indicates there were no Above Normal years in the historical record for the 2009–2022 period used to provide salvage density data for the analysis; for Above Normal years, the Wet year pattern was used, with only the percentage difference shown. Absolute and percentage values are rounded; as a result, differences between absolutes and differences between percentages may not always appear consistent.

Table 6B-17. Mean Number of Largemouth Bass Salvaged (Fish Per Year) at the State Water Project South Delta Export Facility for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Month, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on the Salvage-Density Method

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Jan	62	61 (-2%)
Wet	Feb	38	38 (1%)
Wet	Mar	23	23 (2%)
Wet	Apr	52	55 (5%)
Wet	May	82	122 (49%)
Wet	Jun	6,298	6,133 (-3%)
Wet	Jul	12,563	12,597 (0%)
Wet	Aug	1,957	2,051 (5%)
Wet	Sep	134	162 (20%)
Wet	Oct	61	59 (-4%)
Wet	Nov	63	63 (0%)
Wet	Dec	44	44 (-1%)
Above Normal	Jan	N/A	(-2%)
Above Normal	Feb	N/A	(-9%)
Above Normal	Mar	N/A	(-13%)
Above Normal	Apr	N/A	(100%)
Above Normal	May	N/A	(73%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Above Normal	Jun	N/A	(-8%)
Above Normal	Jul	N/A	(2%)
Above Normal	Aug	N/A	(3%)
Above Normal	Sep	N/A	(25%)
Above Normal	Oct	N/A	(-4%)
Above Normal	Nov	N/A	(-2%)
Above Normal	Dec	N/A	(1%)
Below Normal	Jan	42	40 (-4%)
Below Normal	Feb	8	8 (-5%)
Below Normal	Mar	11	8 (-22%)
Below Normal	Apr	7	11 (61%)
Below Normal	May	2,980	6,229 (109%)
Below Normal	Jun	2,363	2,192 (-7%)
Below Normal	Jul	9,601	9,496 (-1%)
Below Normal	Aug	994	982 (-1%)
Below Normal	Sep	219	210 (-4%)
Below Normal	Oct	378	370 (-2%)
Below Normal	Nov	164	164 (0%)
Below Normal	Dec	79	82 (4%)
Dry	Jan	34	33 (-1%)
Dry	Feb	13	12 (-11%)
Dry	Mar	6	5 (-12%)
Dry	Apr	13	14 (7%)
Dry	May	1,073	1,549 (44%)
Dry	Jun	3,886	3,529 (-9%)
Dry	Jul	6,867	7,003 (2%)
Dry	Aug	684	685 (0%)
Dry	Sep	136	131 (-3%)
Dry	Oct	848	853 (1%)
Dry	Nov	423	423 (0%)
Dry	Dec	180	170 (-5%)
Critically Dry	Jan	143	129 (-10%)
Critically Dry	Feb	94	89 (-5%)
Critically Dry	Mar	12	12 (1%)
Critically Dry	Apr	17	20 (21%)
Critically Dry	May	210	295 (41%)
Critically Dry	Jun	2,647	2,356 (-11%)
Critically Dry	Jul	6,608	6,054 (-8%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Critically Dry	Aug	1,383	1,476 (7%)
Critically Dry	Sep	228	231 (1%)
Critically Dry	Oct	499	496 (-1%)
Critically Dry	Nov	309	310 (0%)
Critically Dry	Dec	80	80 (0%)

Note: N/A indicates there were no Above Normal years in the historical record for the 2009–2022 period used to provide salvage density data for the analysis; for Above Normal years, the Wet year pattern was used, with only the percentage difference shown. Absolute and percentage values are rounded; as a result, differences between absolutes and differences between percentages may not always appear consistent.

Table 6B-18. Mean Number of Smallmouth Bass Salvaged (Fish Per Year) at the State Water Project South Delta Export Facility for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Month, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on the Salvage-Density Method

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Jan	1	1 (-2%)
Wet	Feb	5	5 (1%)
Wet	Mar	0	0 (0%)
Wet	Apr	0	0 (0%)
Wet	May	0	0 (0%)
Wet	Jun	0	0 (0%)
Wet	Jul	0	0 (0%)
Wet	Aug	0	0 (0%)
Wet	Sep	0	0 (0%)
Wet	Oct	0	0 (0%)
Wet	Nov	0	0 (0%)
Wet	Dec	1	1 (-1%)
Above Normal	Jan	N/A	(-2%)
Above Normal	Feb	N/A	(-9%)
Above Normal	Mar	N/A	(0%)
Above Normal	Apr	N/A	(0%)
Above Normal	May	N/A	(0%)
Above Normal	Jun	N/A	(0%)
Above Normal	Jul	N/A	(0%)
Above Normal	Aug	N/A	(0%)
Above Normal	Sep	N/A	(0%)
Above Normal	Oct	N/A	(0%)
Above Normal	Nov	N/A	(0%)
Above Normal	Dec	N/A	(1%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Below Normal	Jan	0	0 (0%)
Below Normal	Feb	0	0 (0%)
Below Normal	Mar	0	0 (-22%)
Below Normal	Apr	0	0 (0%)
Below Normal	May	0	0 (0%)
Below Normal	Jun	0	0 (0%)
Below Normal	Jul	0	0 (0%)
Below Normal	Aug	0	0 (0%)
Below Normal	Sep	0	0 (0%)
Below Normal	Oct	7	7 (-2%)
Below Normal	Nov	0	0 (0%)
Below Normal	Dec	0	0 (0%)
Dry	Jan	0	0 (0%)
Dry	Feb	0	0 (0%)
Dry	Mar	0	0 (0%)
Dry	Apr	0	0 (0%)
Dry	May	0	0 (0%)
Dry	Jun	0	0 (0%)
Dry	Jul	0	0 (0%)
Dry	Aug	0	0 (0%)
Dry	Sep	0	0 (0%)
Dry	Oct	8	8 (1%)
Dry	Nov	0	0 (0%)
Dry	Dec	0	0 (0%)
Critically Dry	Jan	0	0 (0%)
Critically Dry	Feb	0	0 (0%)
Critically Dry	Mar	0	0 (0%)
Critically Dry	Apr	0	0 (0%)
Critically Dry	May	0	0 (0%)
Critically Dry	Jun	0	0 (0%)
Critically Dry	Jul	0	0 (0%)
Critically Dry	Aug	0	0 (0%)
Critically Dry	Sep	0	0 (0%)
Critically Dry	Oct	0	0 (0%)
Critically Dry	Nov	0	0 (0%)
Critically Dry	Dec	0	0 (0%)

Note: N/A indicates there were no Above Normal years in the historical record for the 2009–2022 period used to provide salvage density data for the analysis; for Above Normal years, the Wet year pattern was used, with only the percentage difference shown. Absolute and percentage values are rounded; as a result, differences between absolutes and differences between percentages may not always appear consistent.

Table 6B-19. Mean Number of Spotted Bass Salvaged (Fish Per Year) at the State Water Project South Delta Export Facility for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Month, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on the Salvage-Density Method

Water Year Type	Month	Baseline Conditions	Proposed Project
Wet	Jan	0	0 (0%)
Wet	Feb	0	0 (0%)
Wet	Mar	0	0 (0%)
Wet	Apr	0	0 (0%)
Wet	May	0	0 (0%)
Wet	Jun	0	0 (0%)
Wet	Jul	0	0 (0%)
Wet	Aug	0	0 (0%)
Wet	Sep	0	0 (0%)
Wet	Oct	0	0 (0%)
Wet	Nov	0	0 (0%)
Wet	Dec	0	0 (0%)
Above Normal	Jan	N/A	(0%)
Above Normal	Feb	N/A	(0%)
Above Normal	Mar	N/A	(0%)
Above Normal	Apr	N/A	(0%)
Above Normal	May	N/A	(0%)
Above Normal	Jun	N/A	(0%)
Above Normal	Jul	N/A	(0%)
Above Normal	Aug	N/A	(0%)
Above Normal	Sep	N/A	(0%)
Above Normal	Oct	N/A	(0%)
Above Normal	Nov	N/A	(0%)
Above Normal	Dec	N/A	(0%)
Below Normal	Jan	0	0 (0%)
Below Normal	Feb	0	0 (0%)
Below Normal	Mar	2	1 (-22%)
Below Normal	Apr	0	0 (0%)
Below Normal	May	0	0 (0%)
Below Normal	Jun	0	0 (0%)

Water Year Type	Month	Baseline Conditions	Proposed Project
Below Normal	Jul	0	0 (0%)
Below Normal	Aug	0	0 (0%)
Below Normal	Sep	0	0 (-4%)
Below Normal	Oct	0	0 (0%)
Below Normal	Nov	0	0 (0%)
Below Normal	Dec	0	0 (0%)
Dry	Jan	0	0 (0%)
Dry	Feb	0	0 (0%)
Dry	Mar	0	0 (0%)
Dry	Apr	0	0 (0%)
Dry	May	0	0 (0%)
Dry	Jun	0	0 (0%)
Dry	Jul	0	0 (0%)
Dry	Aug	0	0 (0%)
Dry	Sep	0	0 (0%)
Dry	Oct	0	0 (0%)
Dry	Nov	0	0 (0%)
Dry	Dec	0	0 (0%)
Critically Dry	Jan	0	0 (0%)
Critically Dry	Feb	0	0 (0%)
Critically Dry	Mar	0	0 (0%)
Critically Dry	Apr	0	0 (0%)
Critically Dry	May	0	0 (0%)
Critically Dry	Jun	0	0 (0%)
Critically Dry	Jul	0	0 (0%)
Critically Dry	Aug	0	0 (0%)
Critically Dry	Sep	0	0 (0%)
Critically Dry	Oct	0	0 (0%)
Critically Dry	Nov	0	0 (0%)
Critically Dry	Dec	0	0 (0%)

Note: N/A indicates there were no Above Normal years in the historical record for the 2009–2022 period used to provide salvage density data for the analysis; for Above Normal years, the Wet year pattern was used, with only the percentage difference shown. Absolute and percentage values are rounded; as a result, differences between absolutes and differences between percentages may not always appear consistent.

6B.2 Juvenile Winter-Run Chinook Salmon Salvage Based on Zeug and Cavallo (2014)

6B.2.1 Methods

An analysis to evaluate differences in salvage at the south Delta export facilities between the modeled scenarios was done following the statistical models of salvage of marked (coded wire tags) hatchery-reared Chinook Salmon published by Zeug and Cavallo (2014). This analysis focused on winter-run Chinook Salmon; spring-run Chinook Salmon were not included because very few marked individuals were salvaged, and the statistical models could not be fit successfully (Zeug and Cavallo 2014). The model was based on marked fish released in 1994–2007 during Freeport flows of 14,600–68,700 cubic feet per second (cfs). Several modifications to the methods of Zeug and Cavallo (2014) were employed to focus on relevant model predictors. First, statistical models of the empirical data were constructed using only releases of winter-run Chinook Salmon raised at the Livingston Stone Hatchery. Second, salvage at the south Delta export facilities from both SWP and Central Valley Project (CVP) facilities was modeled.[2] Some variables were excluded from the statistical models because they were not significant in the original analysis, or they were not relevant in this context. For example, the original analysis used the variable "distance of release from the facilities." However, winter-run Chinook Salmon were only released from a single location, making this predictor irrelevant. Finally, to determine which hydrologic variables were the best predictors of salvage, a model selection exercise was performed using the original data from Zeug and Cavallo (2014). The model selection exercise included five potential hydrologic predictor variables including: Old and Middle River (OMR) flows, inflow-export ratio (I-E), total south Delta exports, San Joaquin River flow, Sacramento River flow, and one biological variable (mean fork length at release). Most of these variables were strongly correlated so models were constructed only with variables that had correlation coefficients <|0.70|. One million individuals were used as the total release size (offset variable) for each candidate model with standardized predictors for both the count and zero-inflation portion of the models. To select the best approximating model, Akaike's Information Criterion (AIC) was calculated for each model. The model with the lowest AIC value was identified as the best approximating model. The AIC value of all other models was subtracted from the value of the best approximating model to calculate the ΔAIC. Any model that had a ΔAIC value ≤2.0 was considered a competing model with the best approximating model.

A single best model of salvage was selected with no other model having a ΔAIC <2.8. This model had three predictor variables for the count model and zero-inflation models including mean fork length of fish at release, Sacramento River flow, and total exports. The final count model indicated that non-zero salvage was greater when fish were released at a larger size (coefficient = 0.709, P <0.001), flow in the Sacramento River was higher (coefficient = 0.155, P = 0.707), and exports were higher (coefficient = 0.350, P = 0.006). For the zero-inflation model, coefficients indicated zero salvage was more likely when fish were released at a smaller size (coefficient = -0.776, P <0.001), Sacramento River flow was higher (coefficient = 0.610, P = 0.140), and exports were lower (coefficient = -0.957, P <0.001).

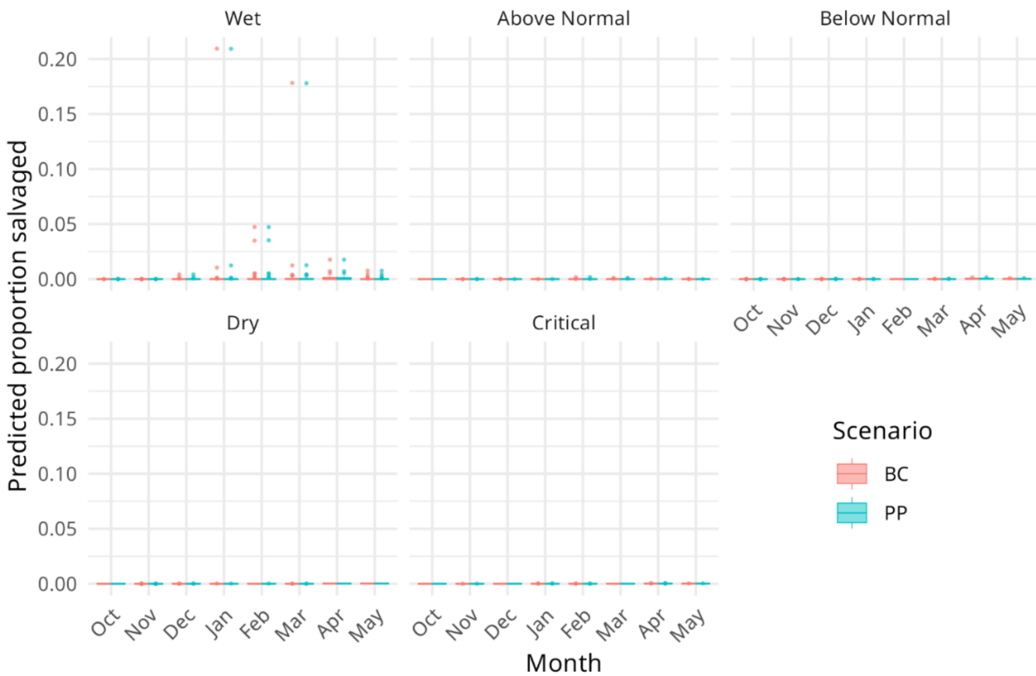
[2] Only the results from the model pertaining to the SWP facilities are reported in this Draft Environmental Impact Report.

To predict salvage under the modeled scenarios, daily flow and export data from the 1922–2021 Delta Simulation Model II (DSM2) output was aggregated into seven-day running means and standardized to the same scale as the empirical data. This was done to mimic the way data were aggregated in the original publication (seven-day means) and the winter-run specific models described above. A seven-day mean was used because an acoustic tagging study revealed that was the approximate mean time Chinook Salmon smolts spent transiting through the Sacramento–San Joaquin Delta (Delta) (Zeug and Cavallo 2014). The total number of fish entering the Delta in a season was then multiplied by the daily entry proportion defined by the same distribution used in the Delta Passage Model (DPM). The log-transformed product of this calculation was used as the offset on each day. The distribution did not weight the result but simply distributed the fish over time.

The values described above (DSM2 data, offset, fish fork length) are used as inputs in the Zero-Inflated Negative Binomial model to predict the mean salvage for each day. The size of fish entering the Delta was set as the midpoint size on the 15th of each month using the Delta length-at-date model. After January, the midpoint value was higher than the observed sizes at release and the model was set to the maximum observed fork length from February–June (95 millimeters [mm]). However, it should be noted that the statistical model uses size at release in the Sacramento River near Redding, CA, and fish are assumed to grow between release and the salvage facilities. The mean daily salvage values were then summarized by month and reported as the proportion of total annual salvage observed in each month. Additionally, the annual predicted proportional salvage in each of the water years was plotted for the modeled scenarios.

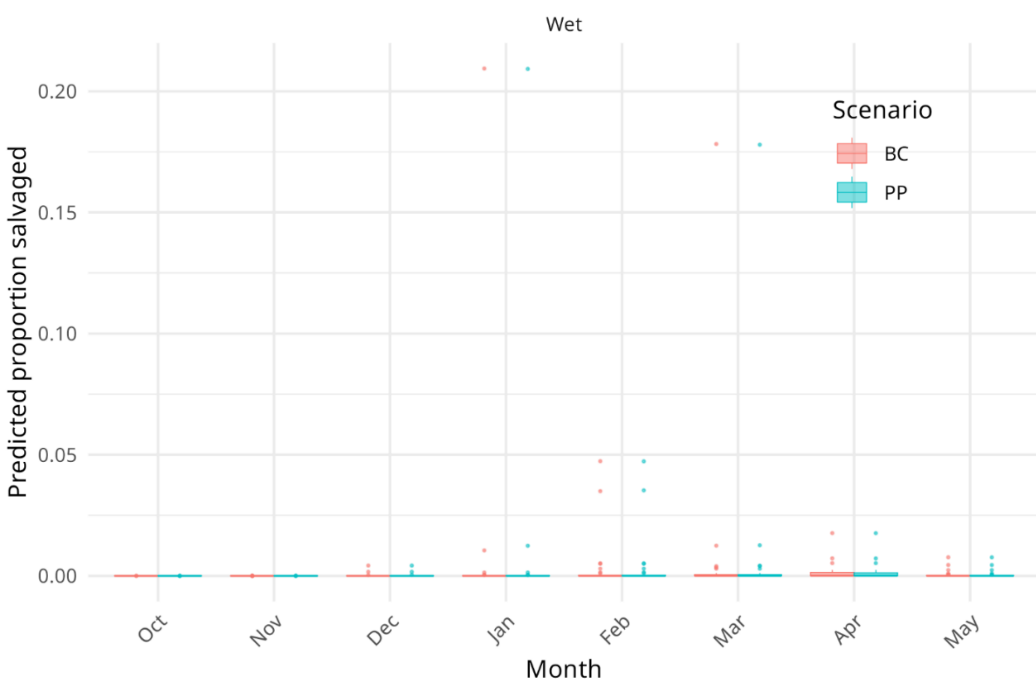
6B.2.2 Results

The main results are presented and discussed in Chapter 6 with graphical summaries broken down by month in Figure 6B-1 through Figure 6B-6 below.



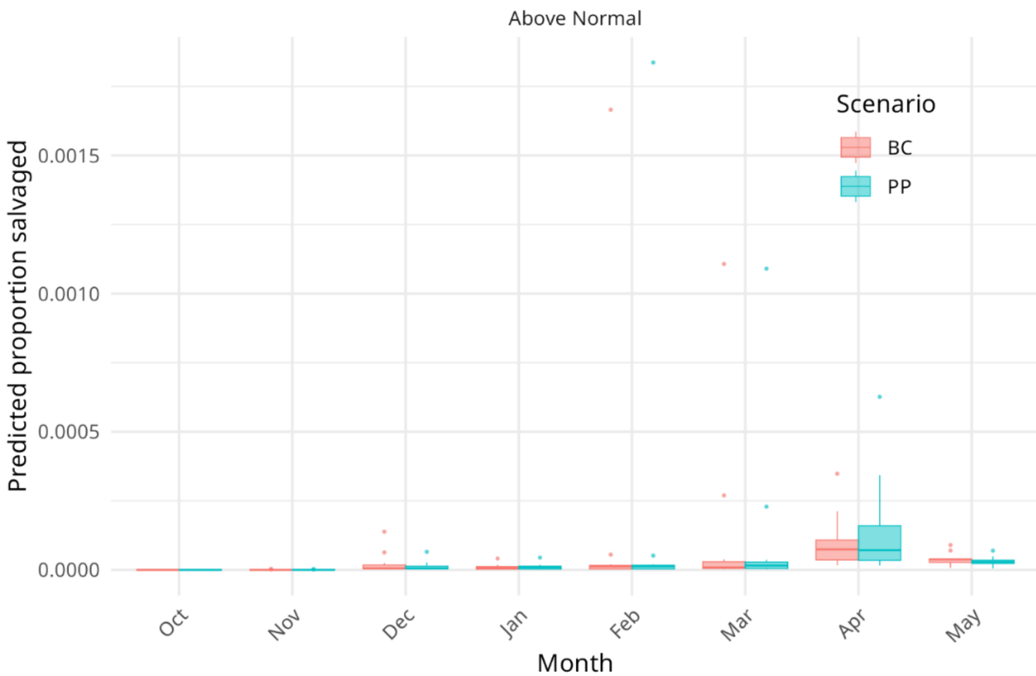
Note: BC = Baseline Conditions; PP = Proposed Project.

Figure 6B-1. Box Plot of Proportional Juvenile Winter-Run Chinook Salmon Salvage at the SWP South Delta Export Facility by Water Year Type and Month for the Analysis Based on Zeug and Cavallo (2014)



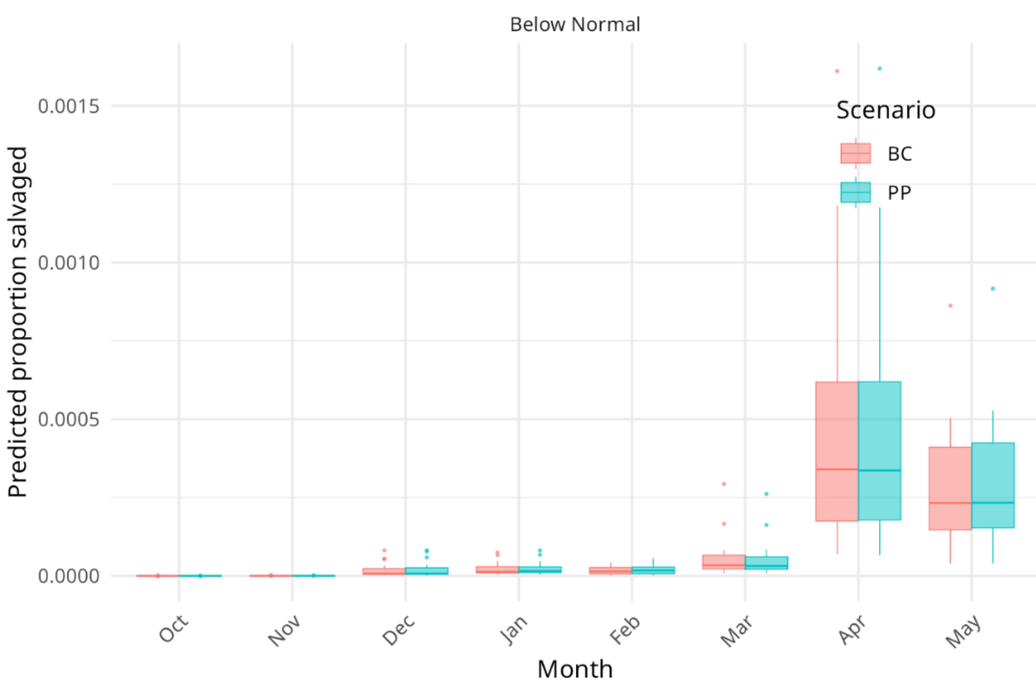
Note: BC = Baseline Conditions; PP = Proposed Project.

Figure 6B-2. Box Plot of Proportional Juvenile Winter-Run Chinook Salmon Salvage at the SWP South Delta Export Facility by Month in Wet Water Years for the Analysis Based on Zeug and Cavallo (2014)



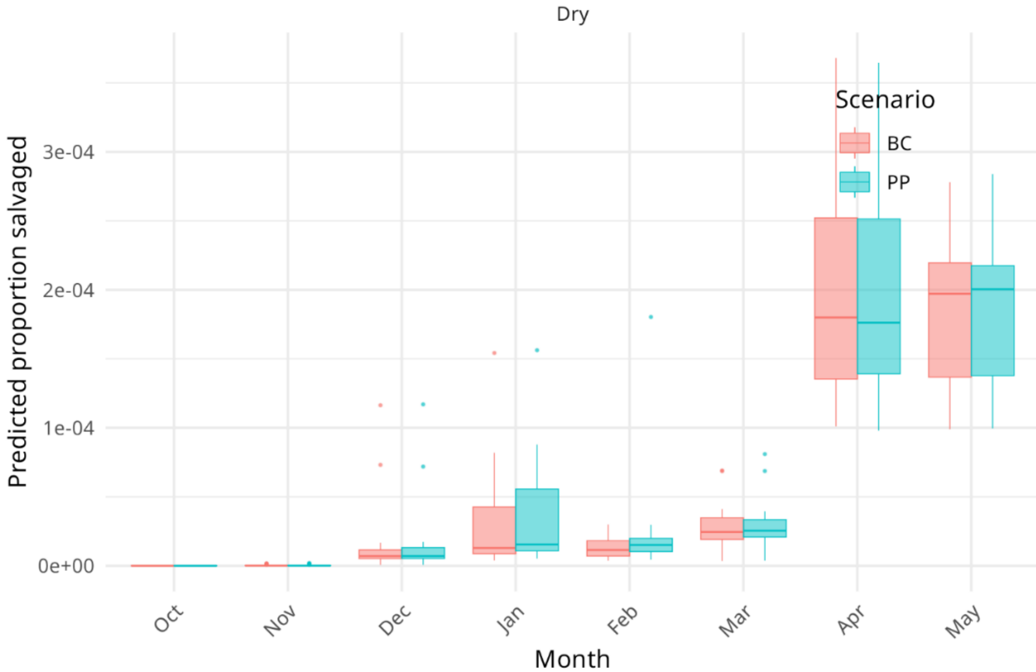
Note: BC = Baseline Conditions; PP = Proposed Project.

Figure 6B-3. Box Plot of Proportional Juvenile Winter-Run Chinook Salmon Salvage at the SWP South Delta Export Facility by Month in Above Normal Water Years for the Analysis Based on Zeug and Cavallo (2014)



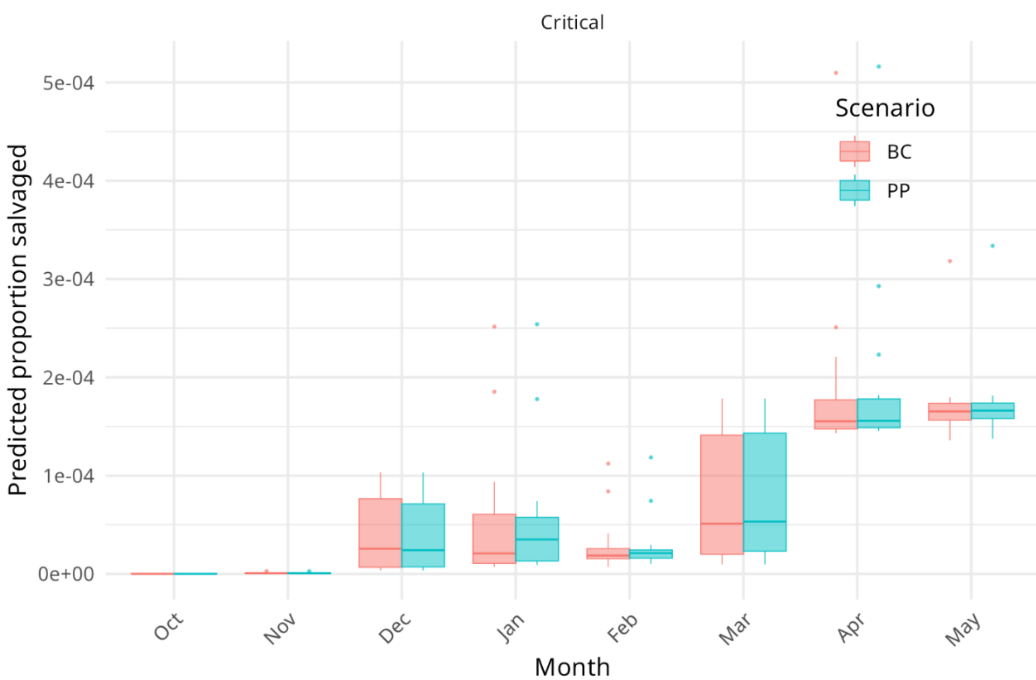
Note: BC = Baseline Conditions; PP = Proposed Project.

Figure 6B-4. Box Plot of Proportional Juvenile Winter-Run Chinook Salmon Salvage at the SWP South Delta Export Facility by Month in Below Normal Water Years for the Analysis Based on Zeug and Cavallo (2014)



Note: BC = Baseline Conditions; PP = Proposed Project.

Figure 6B-5. Box Plot of Proportional Juvenile Winter-Run Chinook Salmon Salvage at the SWP South Delta Export Facility by Month in Dry Water Years for the Analysis Based on Zeug and Cavallo (2014)



Note: BC = Baseline Conditions; PP = Proposed Project.

Figure 6B-6. Box Plot of Proportional Juvenile Winter-Run Chinook Salmon Salvage at the SWP South Delta Export Facility by Month in Critically Dry Water Years for the Analysis Based on Zeug and Cavallo (2014)

6B.3 Hydrodynamic Effects Based on DSM2-HYDRO Data

6B.3.1 Velocity

6B.3.1.1 Methods

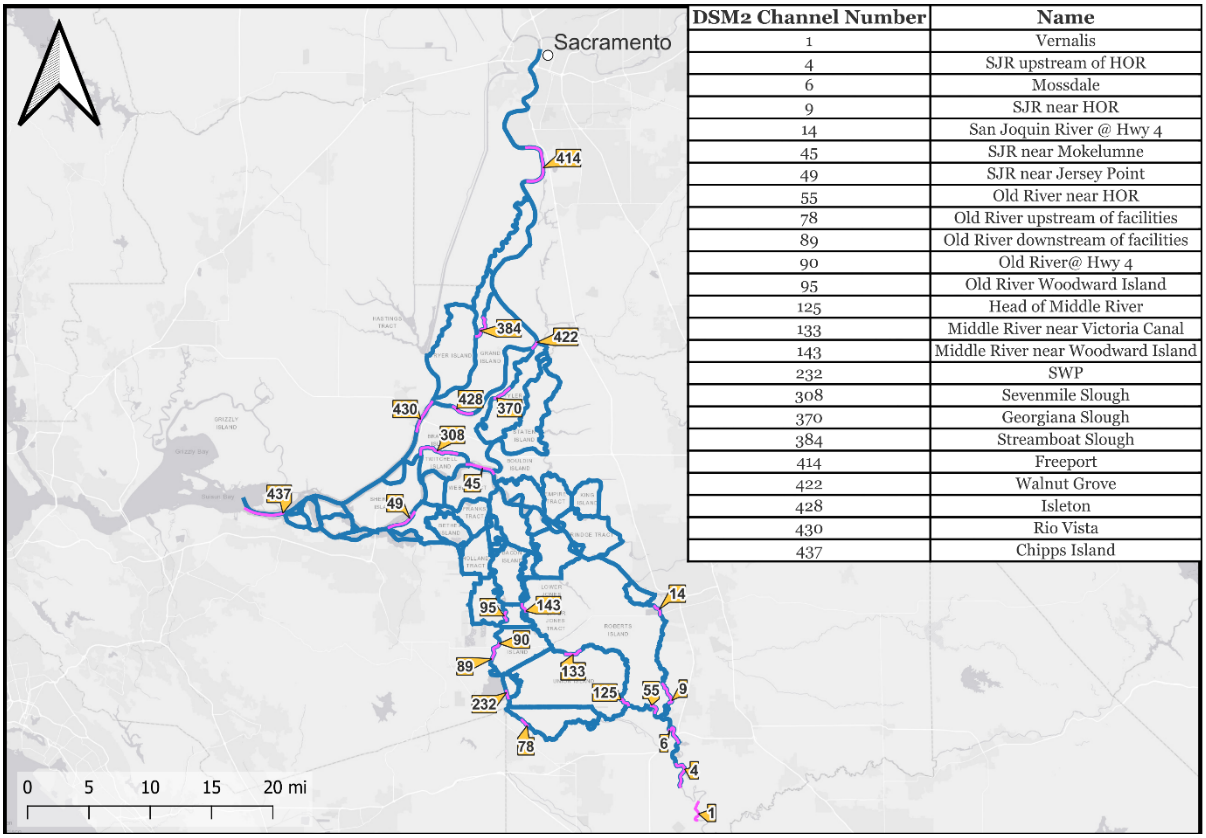
In order to assess the potential for water project operations to influence survival and routing, Delta hydrodynamic conditions were analyzed by creating maps from DSM2-HYDRO modeling. The maps are based on a comparative metric, proportion overlap (more below), to capture channel-level hydrodynamic details as a single number for color-scale mapping of Delta channels.

The objective of the comparative metric is to summarize the water velocity time series for each channel and scenario such the channel-level comparison is captured in a single number. For the proportion overlap metric, kernel density estimates are calculated on each time series. The kernel density estimates represent a non-parametric smoothing of the empirical distribution of time series values. The proportion overlap of two kernel density estimates is calculated with the following steps: (1) calculate the total area under the curve (AUC_t) as the sum of the AUC for each density estimate, (2) calculate the AUC of the overlapping portions (AUC_o) of the two density distributions being compared, and (3) calculate the overlapping proportion of the density distributions as AUC_o/AUC_t. Proportion overlap is naturally bound by zero and one; a value of zero indicates no overlap and a value of one indicates complete overlap. Lower values of proportion overlap identify channels demonstrating larger differences in a scenario comparison.

The proportion overlap metric is best applied over relatively short time periods because seasonal and annual variation in water velocity can overwhelm differences between scenarios. Thus, the proportion overlap for every DSM2 channel for each month in each water year (1922–2021) was calculated. The proportion overlap was calculated based on hourly DSM2 output. Because each month was roughly 30 days, each comparison involved roughly 1,440 DSM2 values (2 scenarios * 24 hours * 30 days) for each channel.

Because the proportion overlap was calculated for each channel in each water year, the proportion overlap values were summarized prior to mapping (i.e., it was not feasible to map proportion overlap for every comparison in every water year). To summarize, the minimum proportion overlap for each channel for each water year type for each comparison was found. The minimum values represent the maximum expected effect of the project alternatives. Note that the year with the minimum proportion overlap for one channel might not be the same year as for another channel.

Velocity summaries in the form of density distribution and mean by water year type, location, and month were also calculated for each of the locations shown in Figure 6B-7.



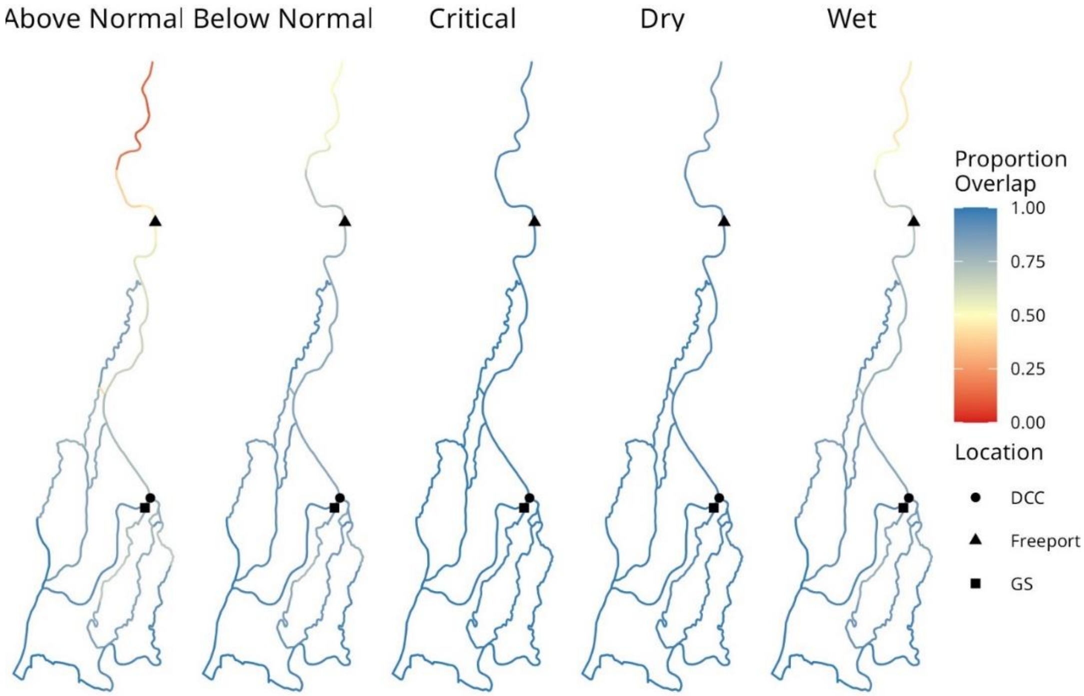
DSM2 Channel Number	Name
1	Vernalis
4	SJR upstream of HOR
6	Mossdale
9	SJR near HOR
14	San Joquin River @ Hwy 4
45	SJR near Mokelumne
49	SJR near Jersey Point
55	Old River near HOR
78	Old River upstream of facilities
89	Old River downstream of facilities
90	Old River@ Hwy 4
95	Old River Woodward Island
125	Head of Middle River
133	Middle River near Victoria Canal
143	Middle River near Woodward Island
232	SWP
308	Sevenmile Slough
370	Georgiana Slough
384	Streamboat Slough
414	Freeport
422	Walnut Grove
428	Isleton
430	Rio Vista
437	Chipps Island

Figure 6B-7. DSM2-HYDRO Output Locations for Which Velocity Was Summarized.

6B.3.1.2 Results

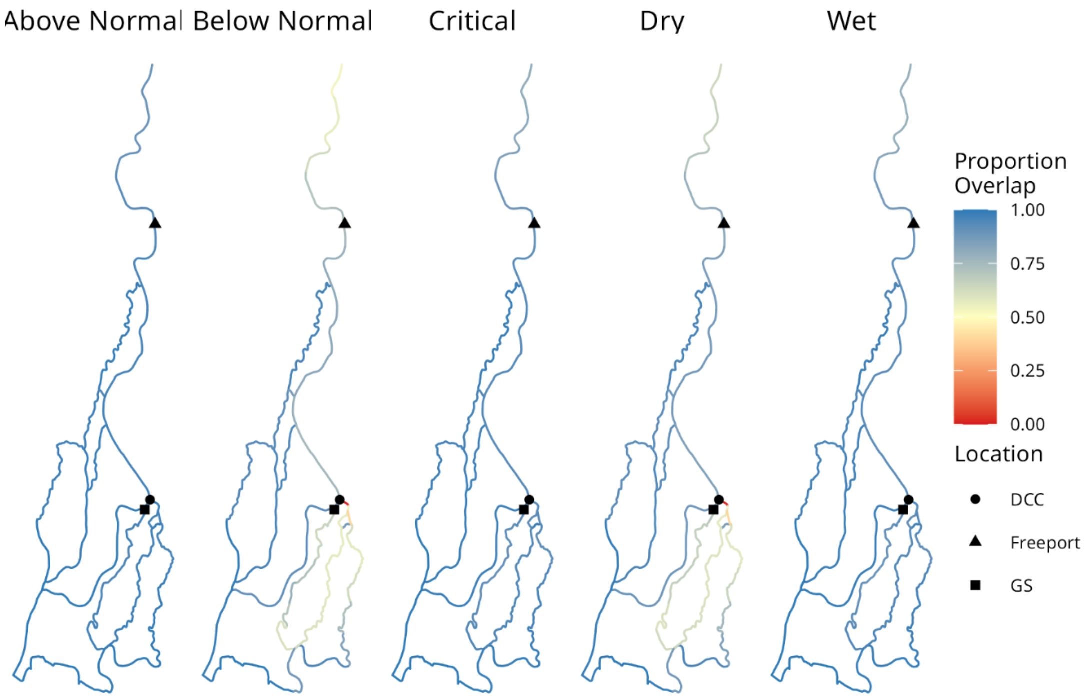
Results of the proportion overlap analysis are presented in Figure 6B-8 through Figure 6B-31 in “Velocity—Proportional Overlap,” and are discussed in Chapter 6. In “Velocity—Density Distribution Figures,” Figure 6B-32 through Figure 6B-71 provide the density distribution of velocity by month and water year type for each location. Table 6B-20 through Table 6B-29 provide mean velocity by water year type and channel for each month.

Velocity—Proportional Overlap



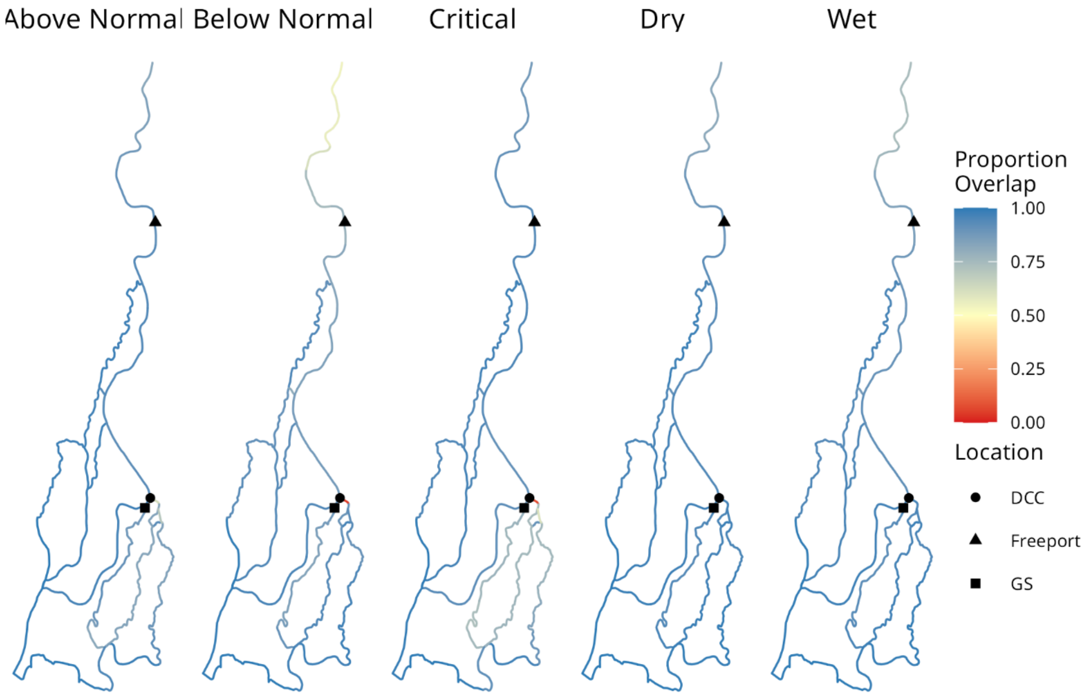
Note: DCC = Delta Cross Channel; GS = Georgiana Slough.

Figure 6B-8. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the North Delta between Existing Conditions and Proposed Project, September



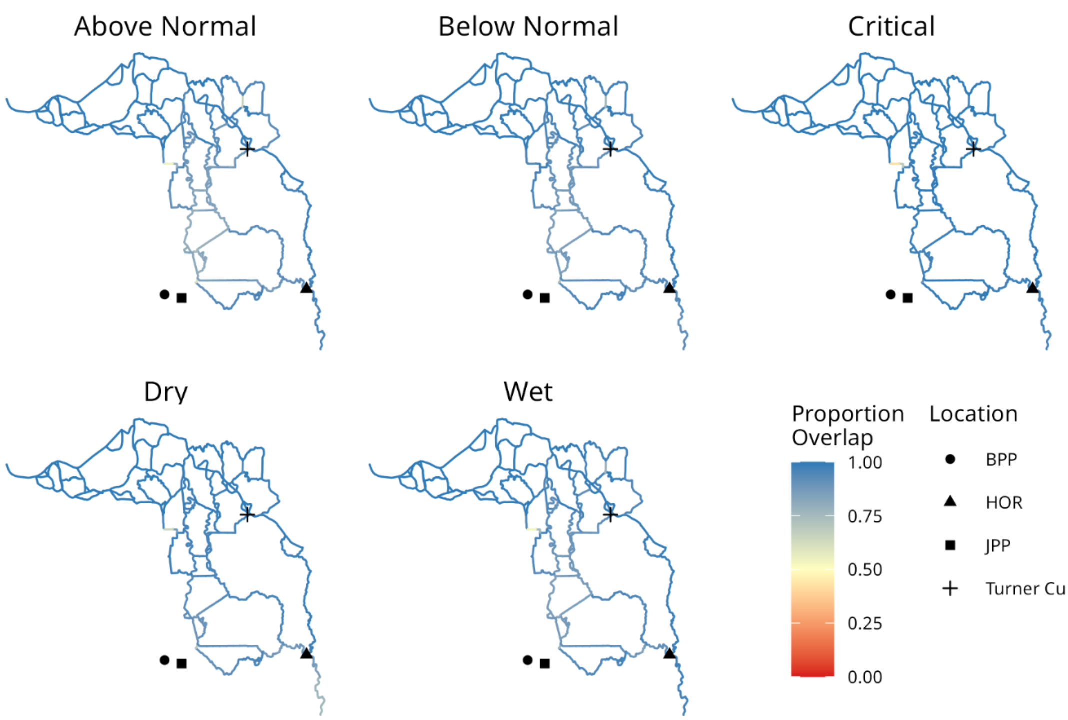
Note: DCC = Delta Cross Channel; GS = Georgiana Slough.

Figure 6B-9. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the North Delta between Existing Conditions and Proposed Project, October



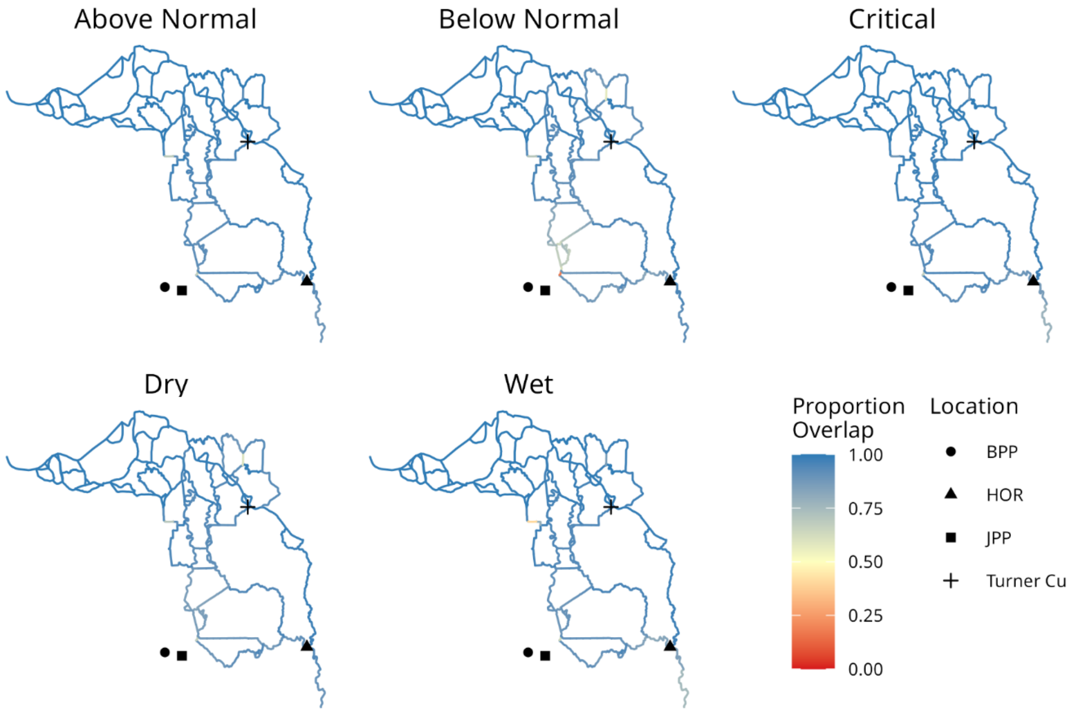
Note: DCC = Delta Cross Channel; GS = Georgiana Slough.

Figure 6B-10. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the North Delta between Existing Conditions and Proposed Project, November



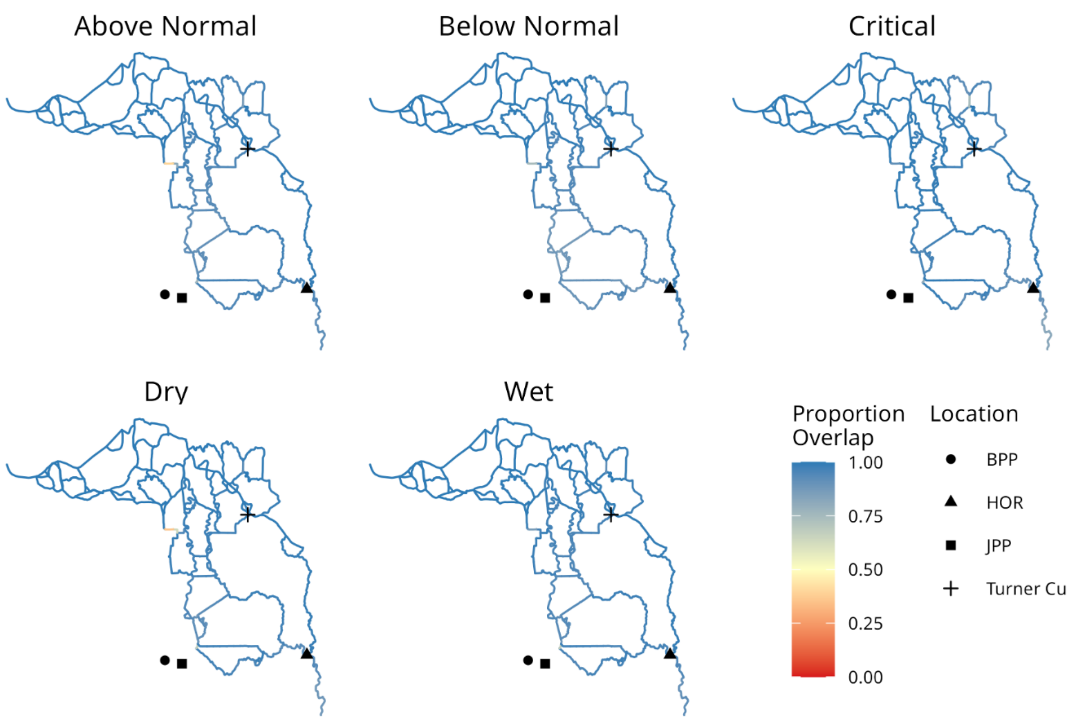
Note: BPP = Banks Pumping Plant; HOR = Head of Old River; JPP = Jones Pumping Plant.

Figure 6B-11. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the South Delta between Existing Conditions and Proposed Project, September



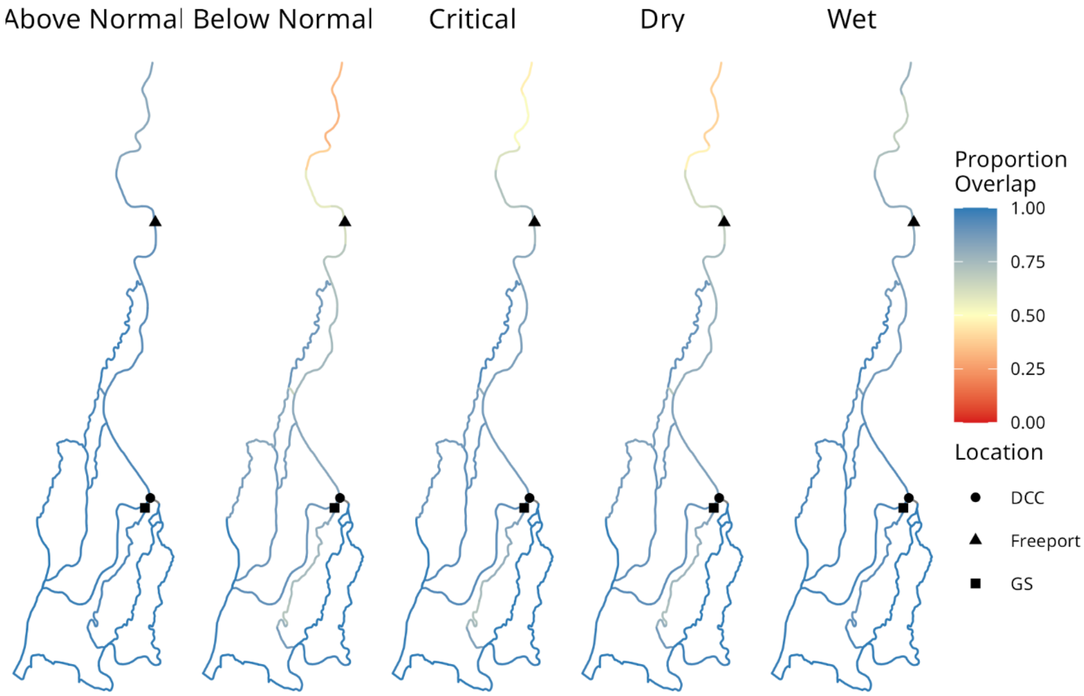
Note: BPP = Banks Pumping Plant; HOR = Head of Old River; JPP = Jones Pumping Plant.

Figure 6B-12. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the South Delta between Existing Conditions and Proposed Project, October



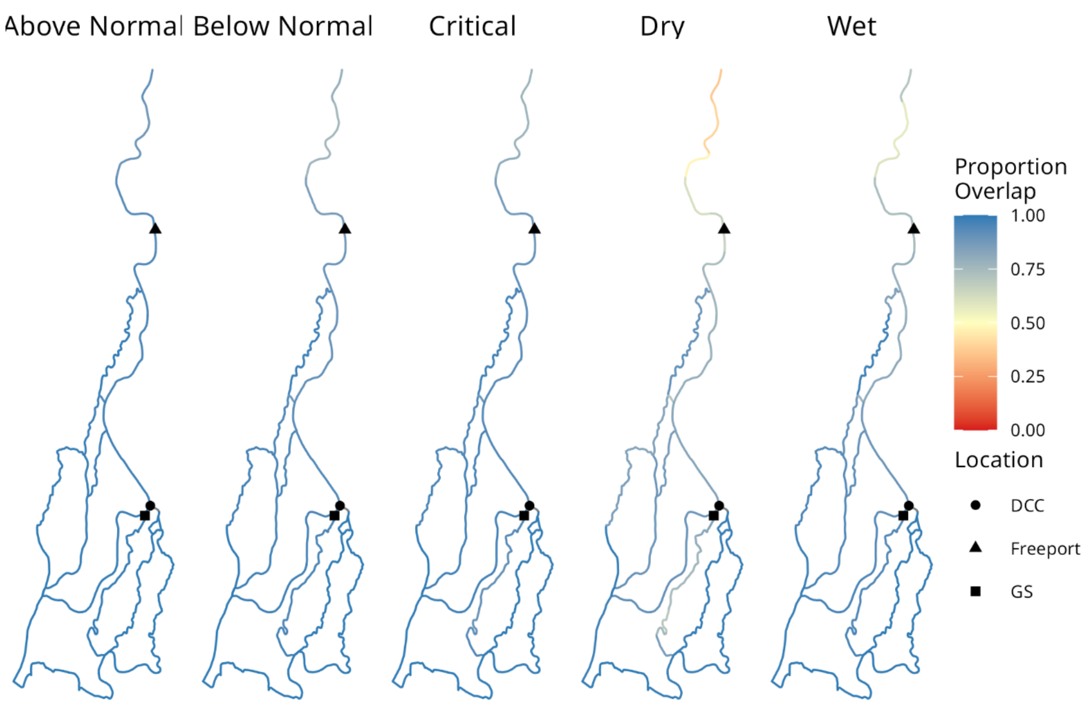
Note: BPP = Banks Pumping Plant; HOR = Head of Old River; JPP = Jones Pumping Plant.

Figure 6B-13. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the South Delta between Existing Conditions and Proposed Project, November



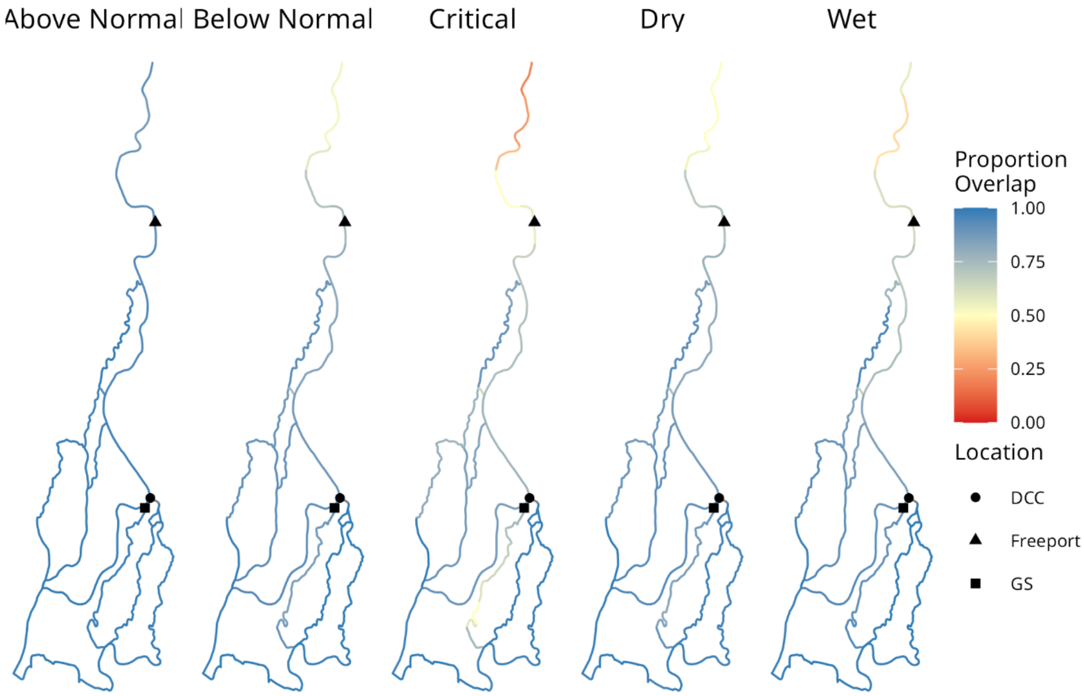
Note: DCC = Delta Cross Channel; GS = Georgiana Slough.

Figure 6B-14. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the North Delta between Existing Conditions and Proposed Project, December



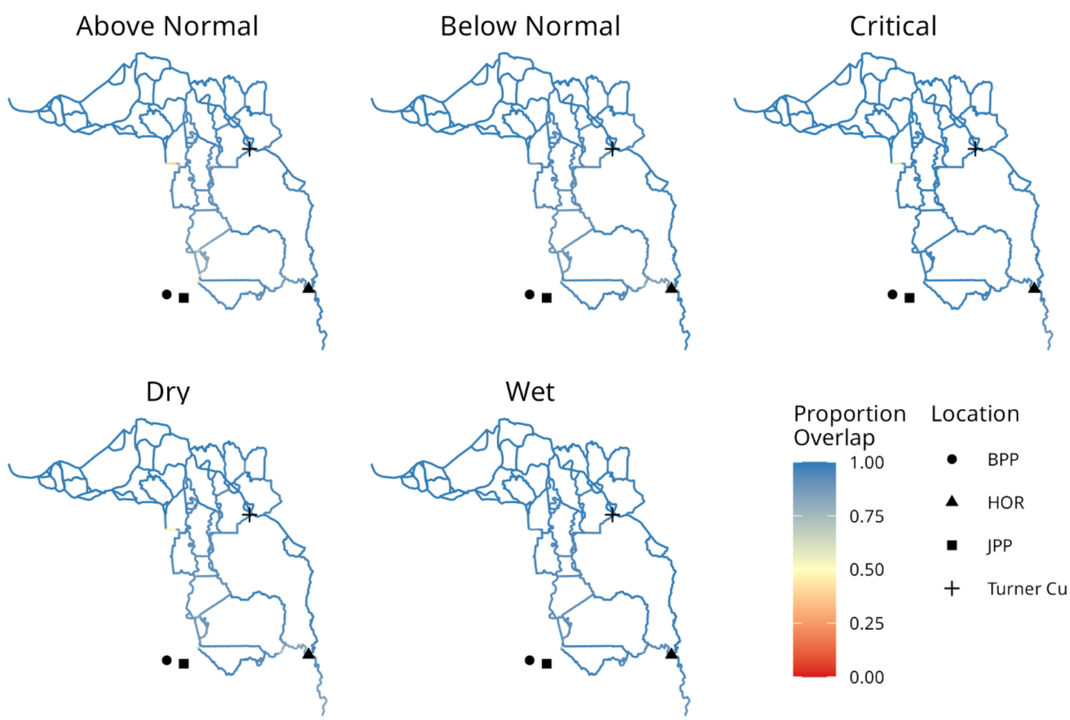
Note: DCC = Delta Cross Channel; GS = Georgiana Slough.

Figure 6B-15. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the North Delta between Existing Conditions and Proposed Project, January



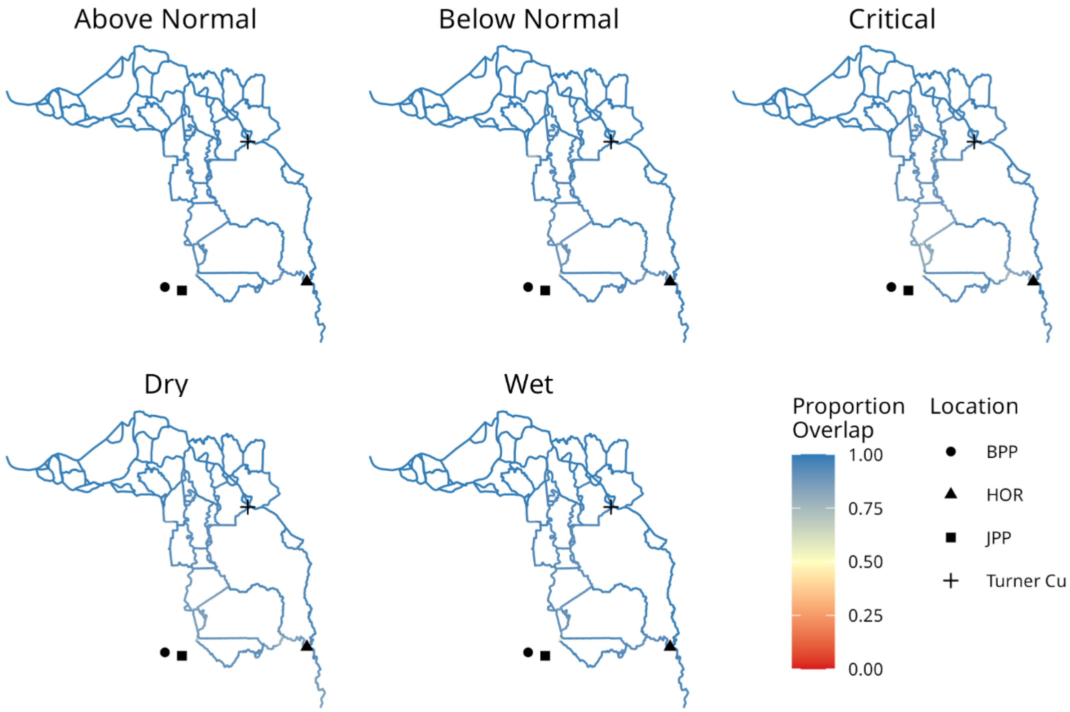
Note: DCC = Delta Cross Channel; GS = Georgiana Slough.

Figure 6B-16. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the North Delta between Existing Conditions and Proposed Project, February



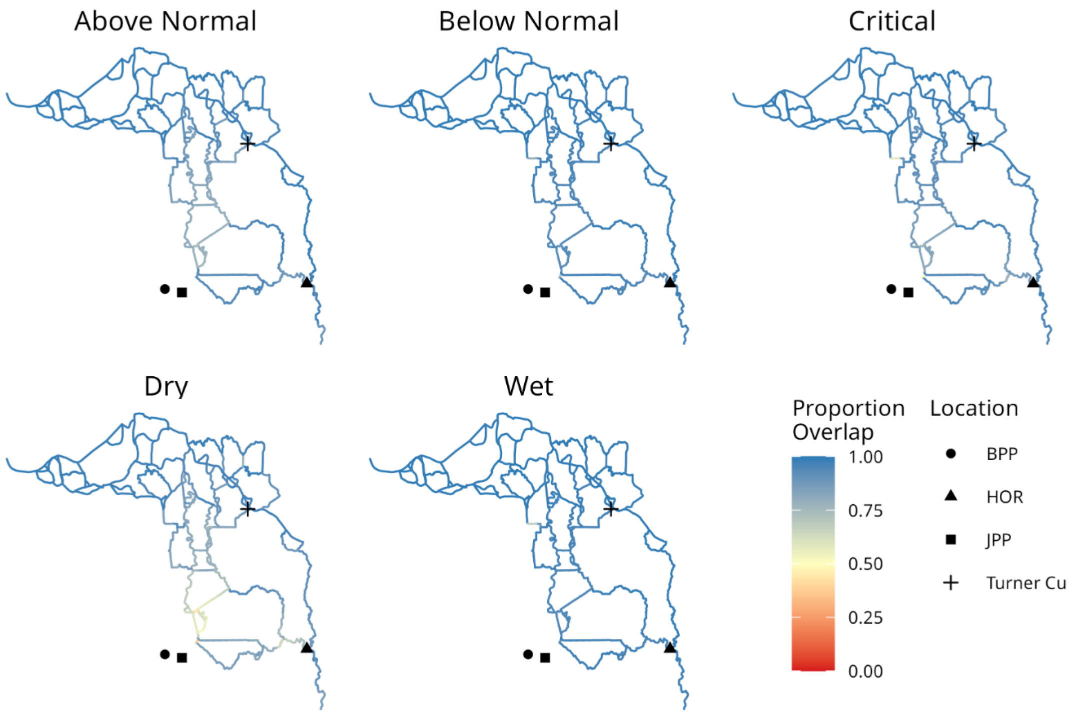
Note: BPP = Banks Pumping Plant; HOR = Head of Old River; JPP = Jones Pumping Plant.

Figure 6B-17. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the South Delta between Existing Conditions and Proposed Project, December



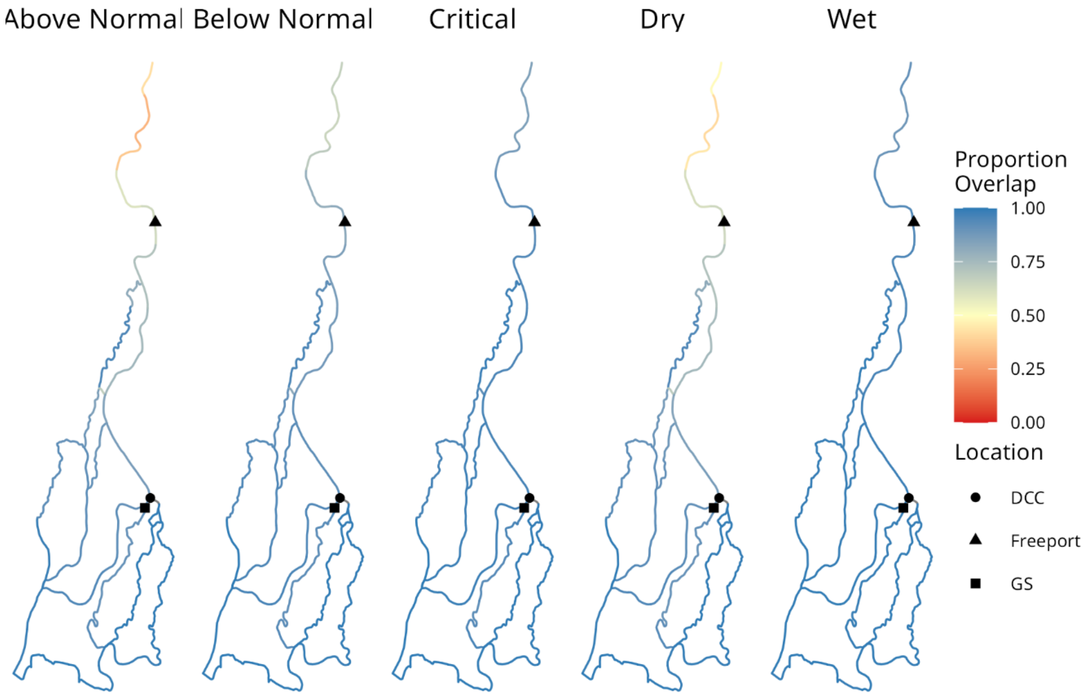
Note: BPP = Banks Pumping Plant; HOR = Head of Old River; JPP = Jones Pumping Plant.

Figure 6B-18. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the South Delta between Existing Conditions and Proposed Project, January



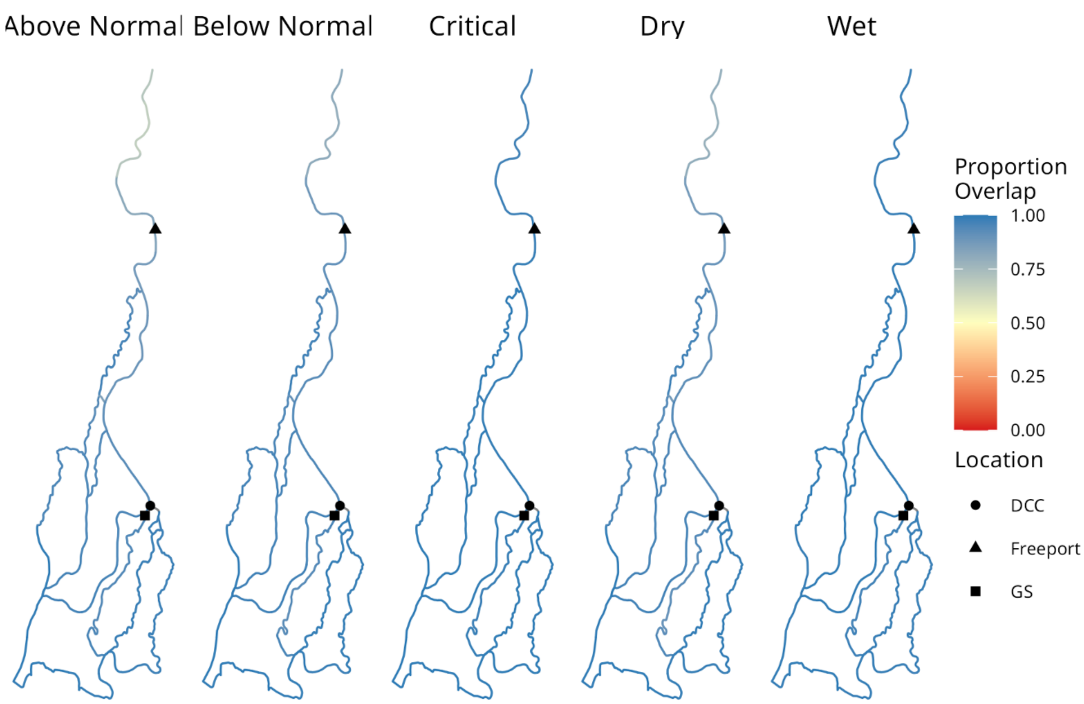
Note: BPP = Banks Pumping Plant; HOR = Head of Old River; JPP = Jones Pumping Plant.

Figure 6B-19. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the South Delta between Existing Conditions and Proposed Project, February



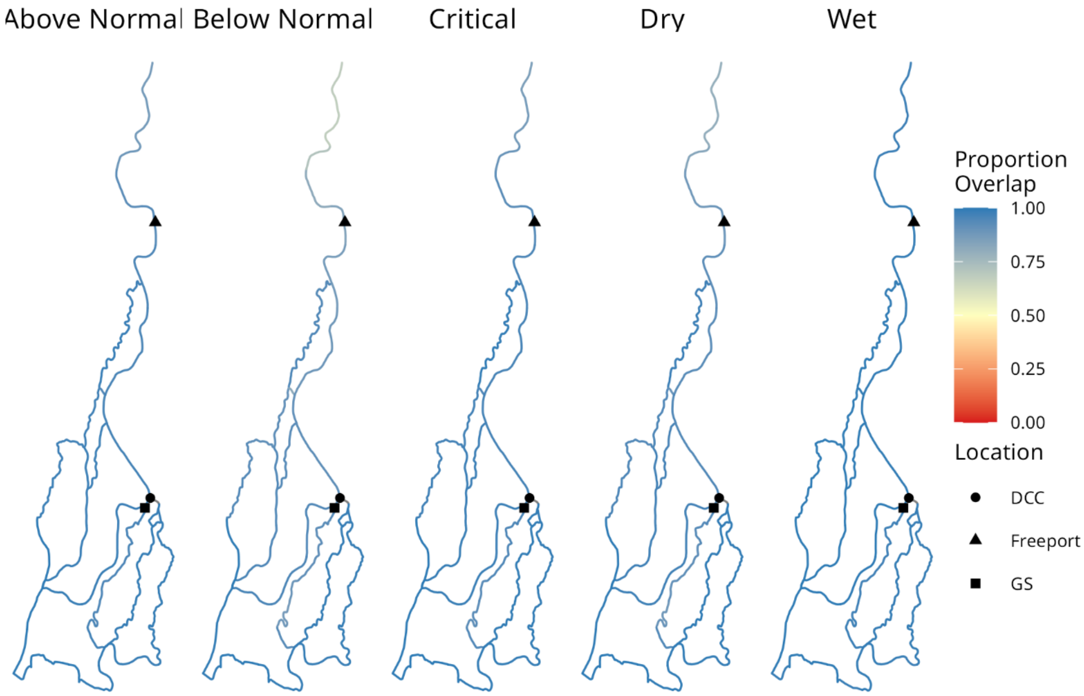
Note: DCC = Delta Cross Channel; GS = Georgiana Slough.

Figure 6B-20. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the North Delta between Existing Conditions and Proposed Project, March



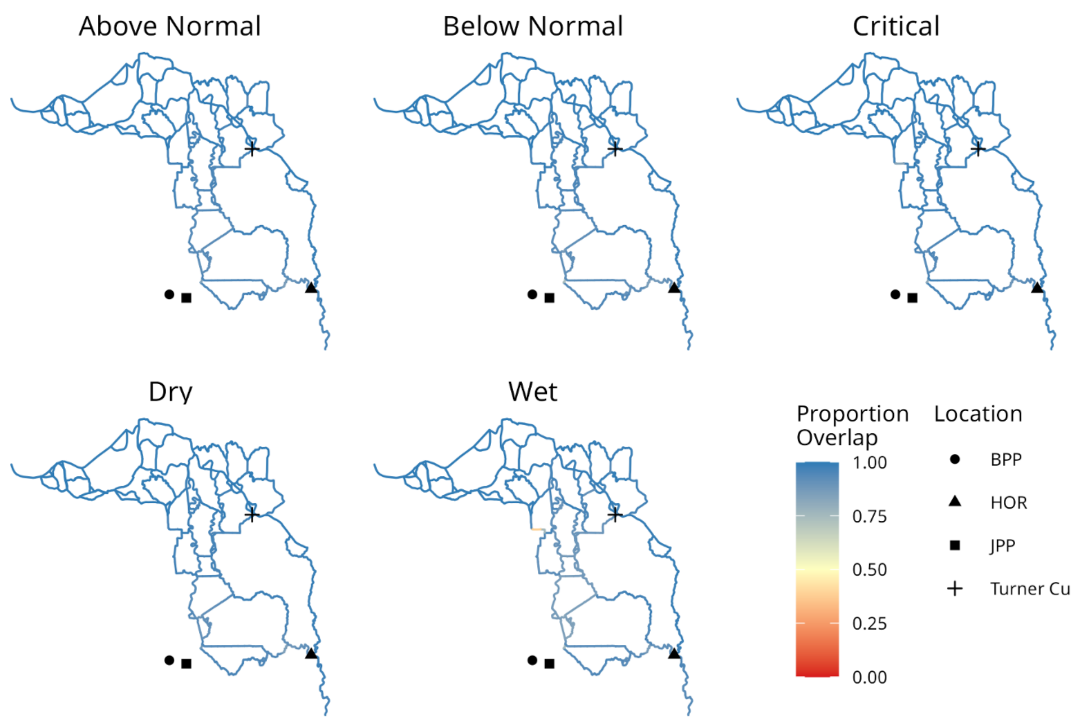
Note: DCC = Delta Cross Channel; GS = Georgiana Slough.

Figure 6B-21. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the North Delta between Existing Conditions and Proposed Project, April



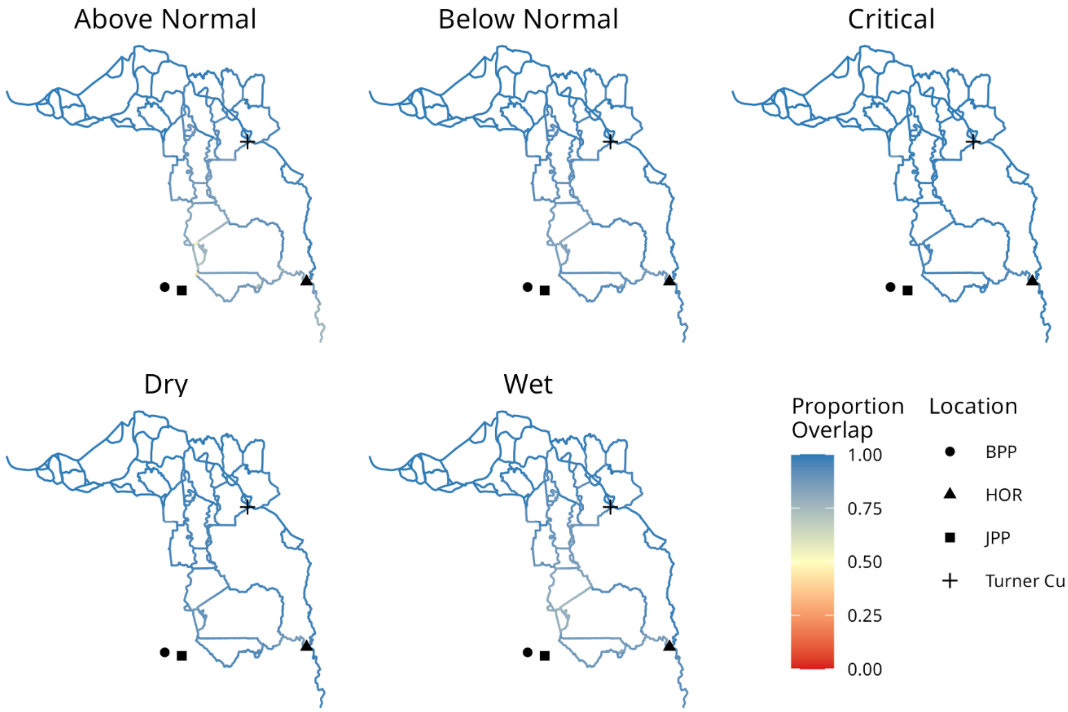
Note: DCC = Delta Cross Channel; GS = Georgiana Slough.

Figure 6B-22. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the North Delta between Existing Conditions and Proposed Project, May



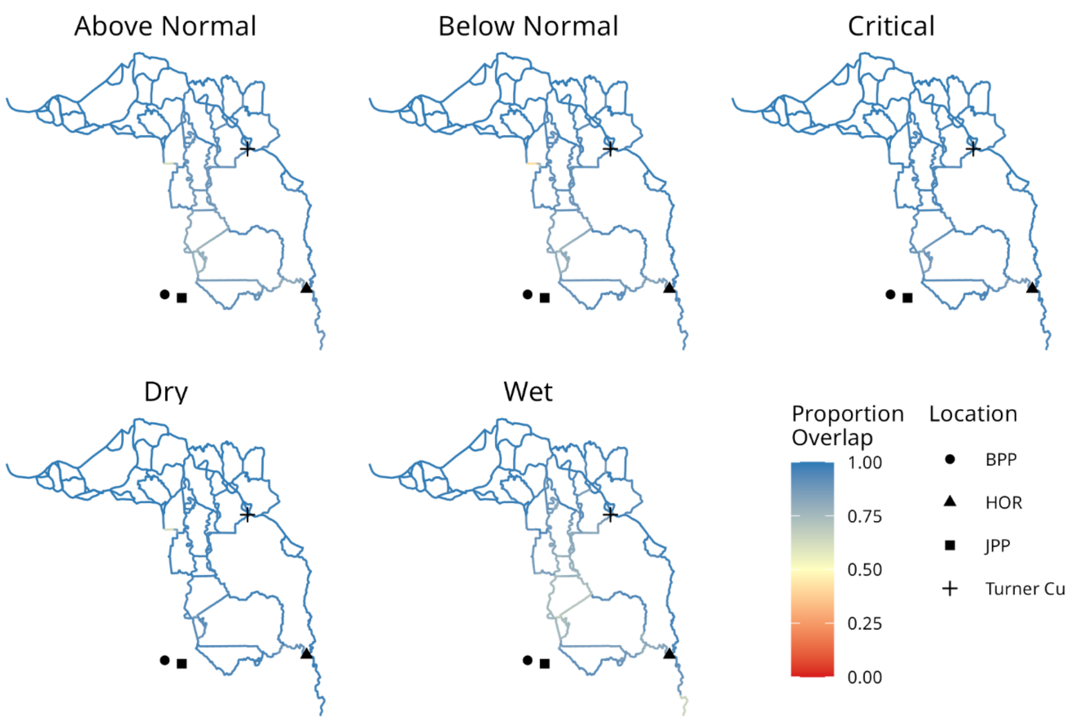
Note: BPP = Banks Pumping Plant; HOR = Head of Old River; JPP = Jones Pumping Plant.

Figure 6B-23. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the South Delta between Existing Conditions and Proposed Project, March



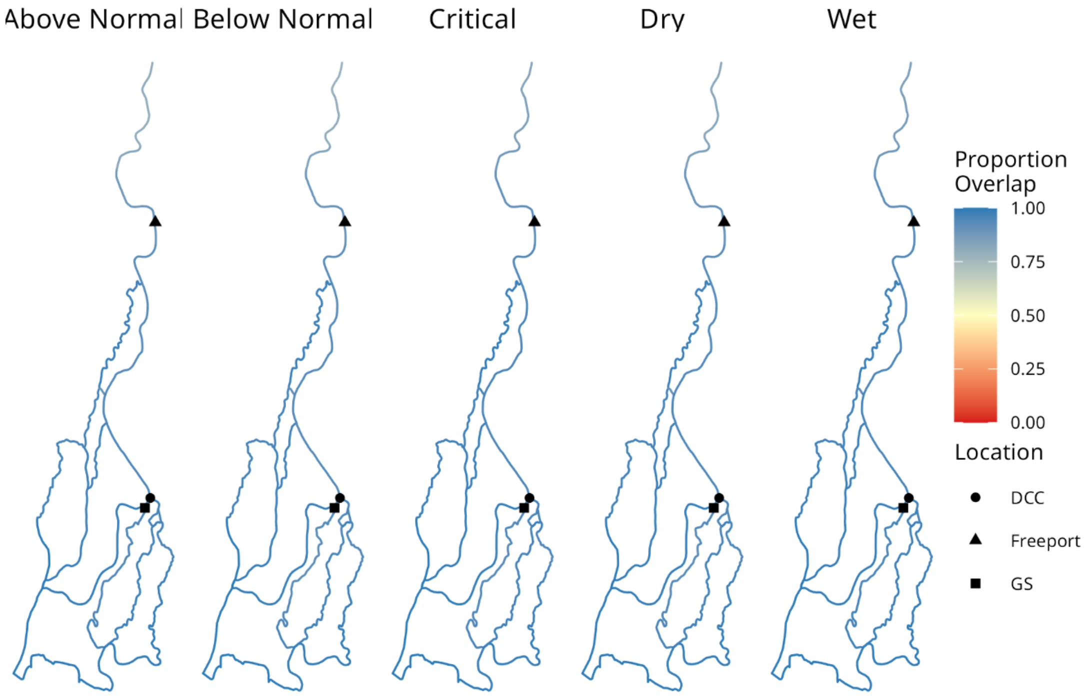
Note: BPP = Banks Pumping Plant; HOR = Head of Old River; JPP = Jones Pumping Plant.

Figure 6B-24. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the South Delta between Existing Conditions and Proposed Project, April



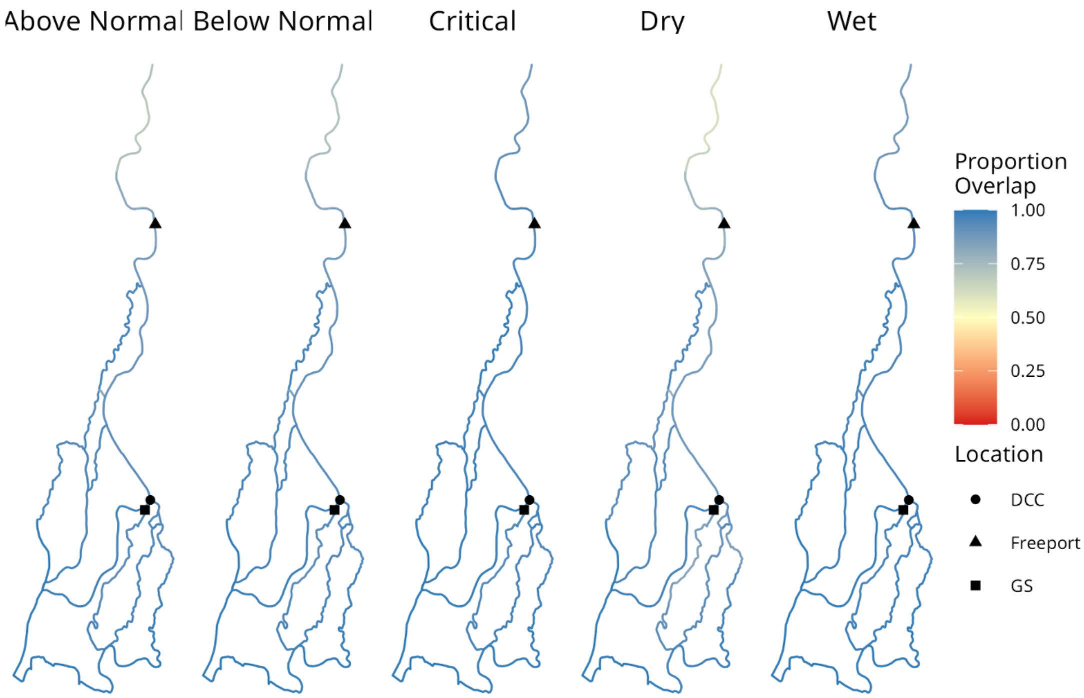
Note: BPP = Banks Pumping Plant; HOR = Head of Old River; JPP = Jones Pumping Plant.

Figure 6B-25. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the South Delta between Existing Conditions and Proposed Project, May



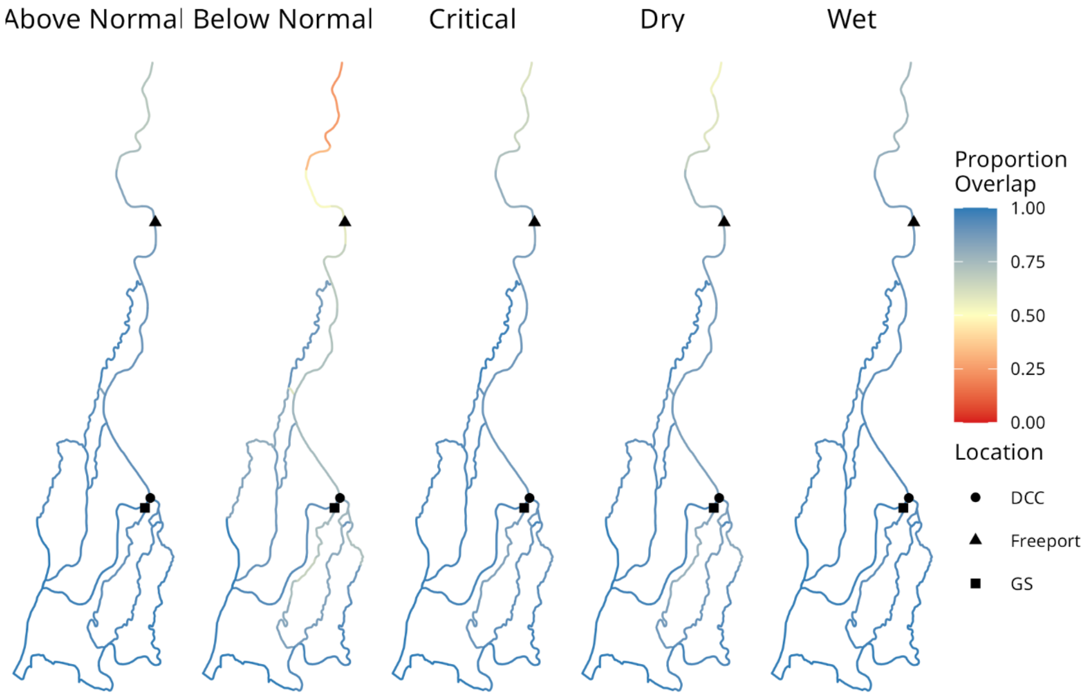
Note: DCC = Delta Cross Channel; GS = Georgiana Slough.

Figure 6B-26. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the North Delta between Existing Conditions and Proposed Project, June



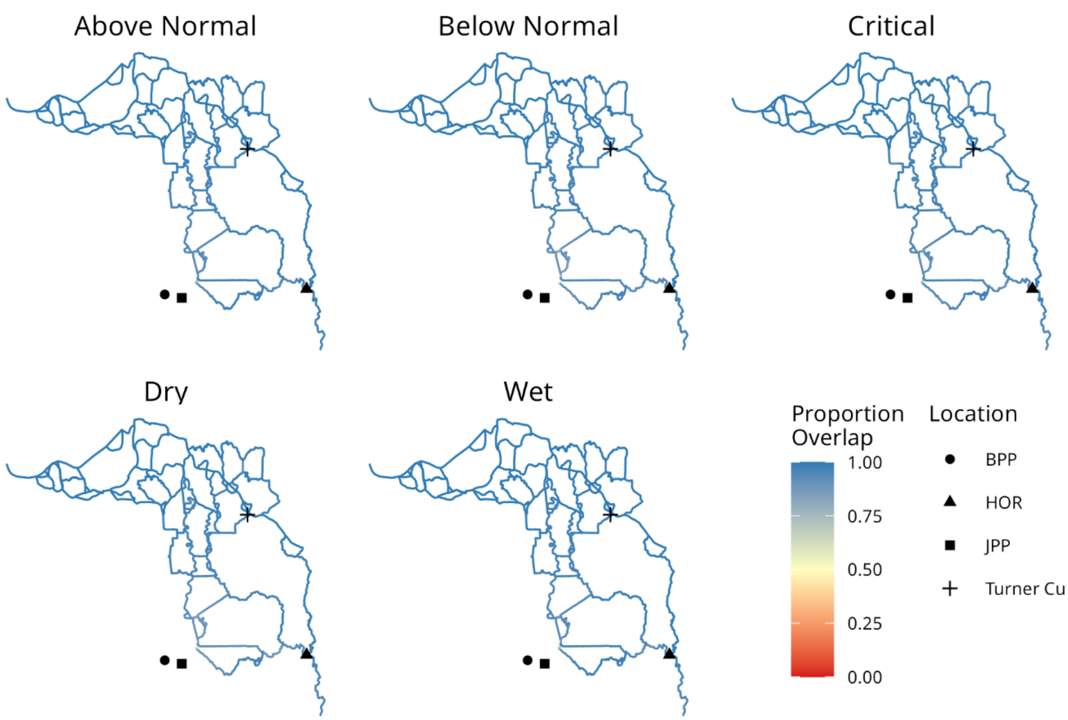
Note: DCC = Delta Cross Channel; GS = Georgiana Slough.

Figure 6B-27. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the North Delta between Existing Conditions and Proposed Project, July



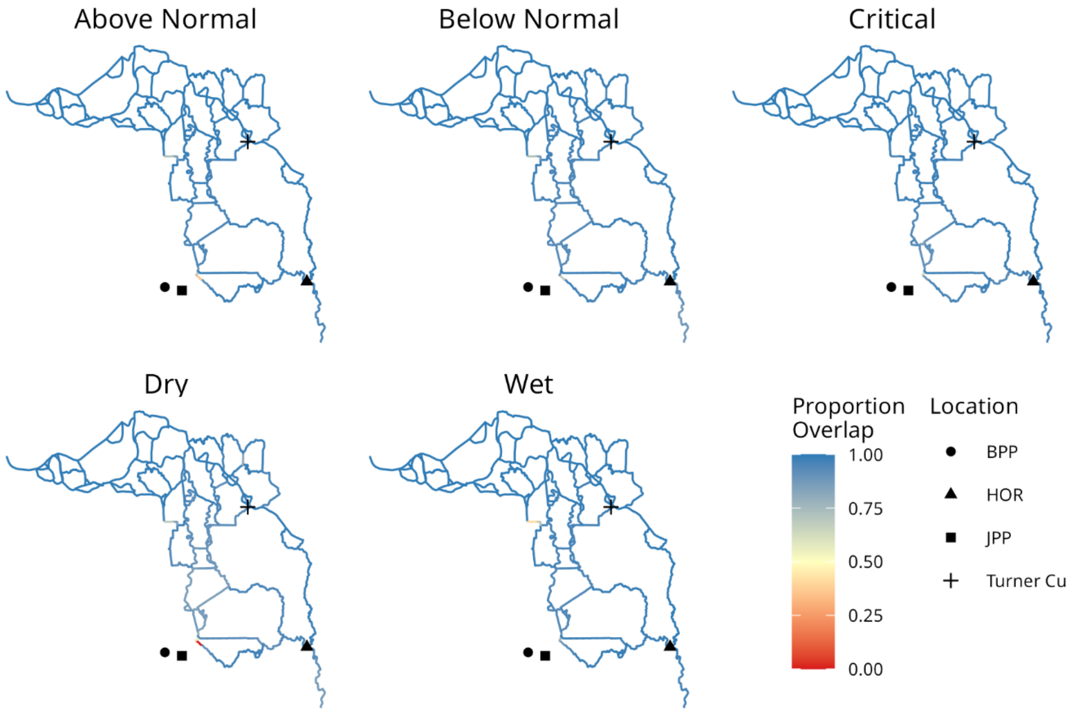
Note: DCC = Delta Cross Channel; GS = Georgiana Slough.

Figure 6B-28. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the North Delta between Existing Conditions and Proposed Project, August



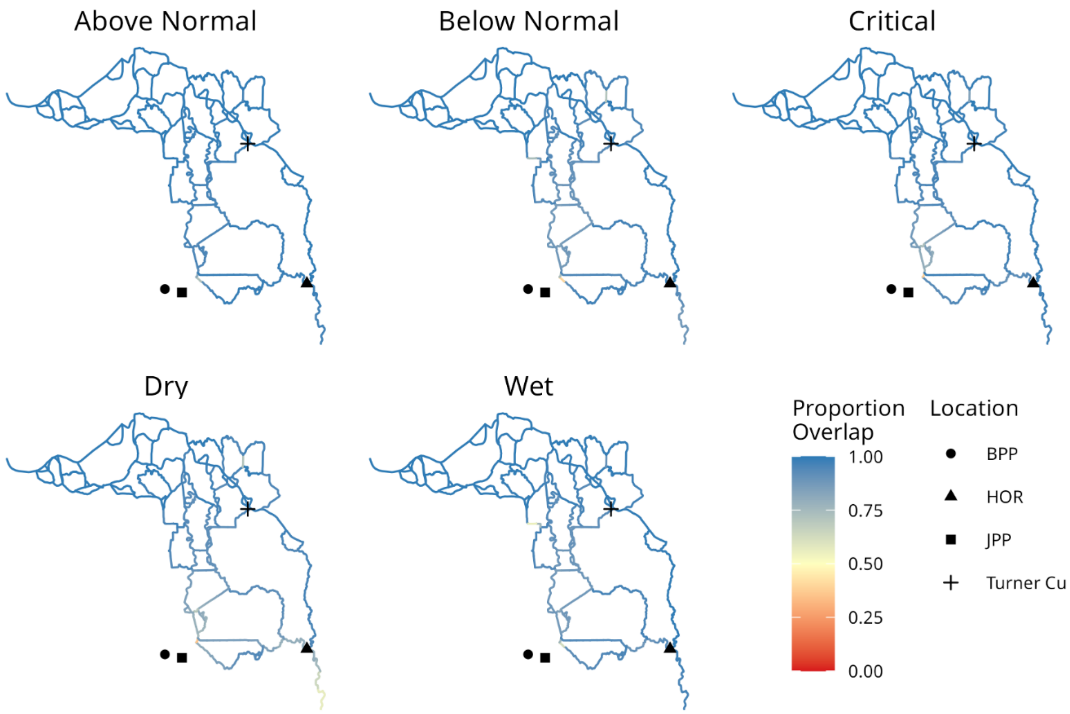
Note: BPP = Banks Pumping Plant; HOR = Head of Old River; JPP = Jones Pumping Plant.

Figure 6B-29. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the South Delta between Existing Conditions and Proposed Project, June



Note: BPP = Banks Pumping Plant; HOR = Head of Old River; JPP = Jones Pumping Plant.

Figure 6B-30. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the South Delta between Existing Conditions and Proposed Project, July

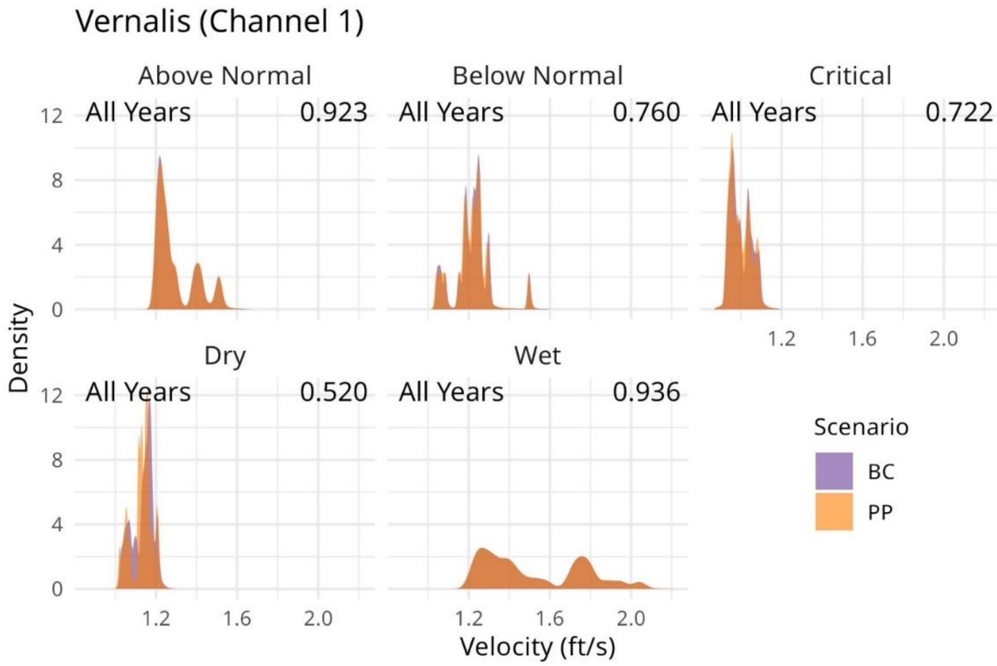


Note: BPP = Banks Pumping Plant; HOR = Head of Old River; JPP = Jones Pumping Plant.

Figure 6B-31. Minimum Proportional Overlap of DSM2-HYDRO Velocity in the South Delta between Existing Conditions and Proposed Project, August

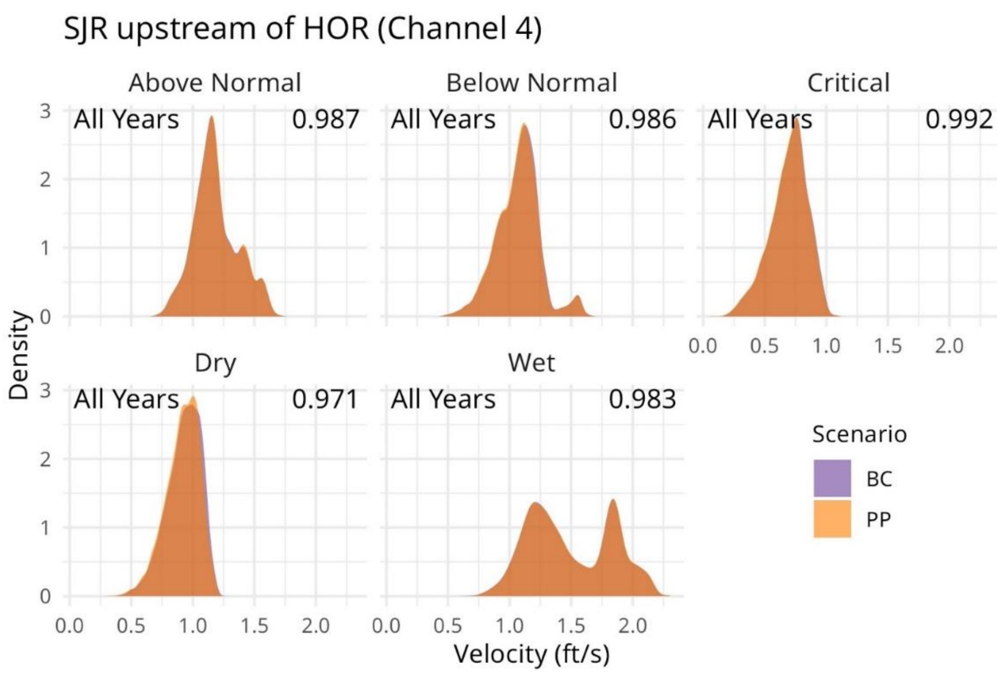
Velocity—Density Distribution Figures

September



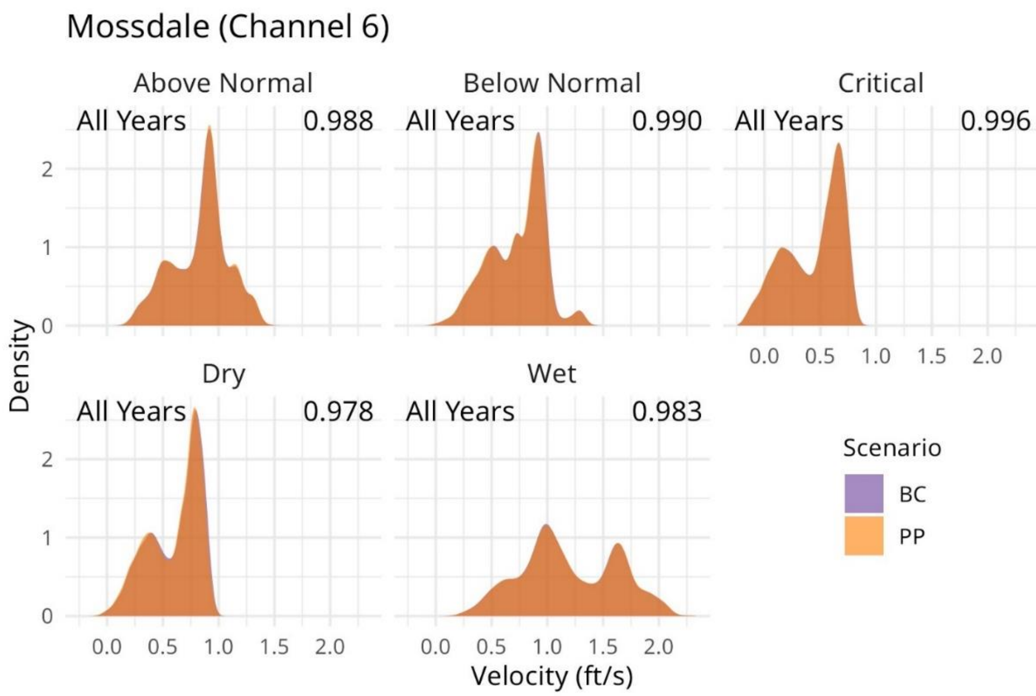
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-32. Velocity Density Distribution for San Joaquin River at Vernalis, September.



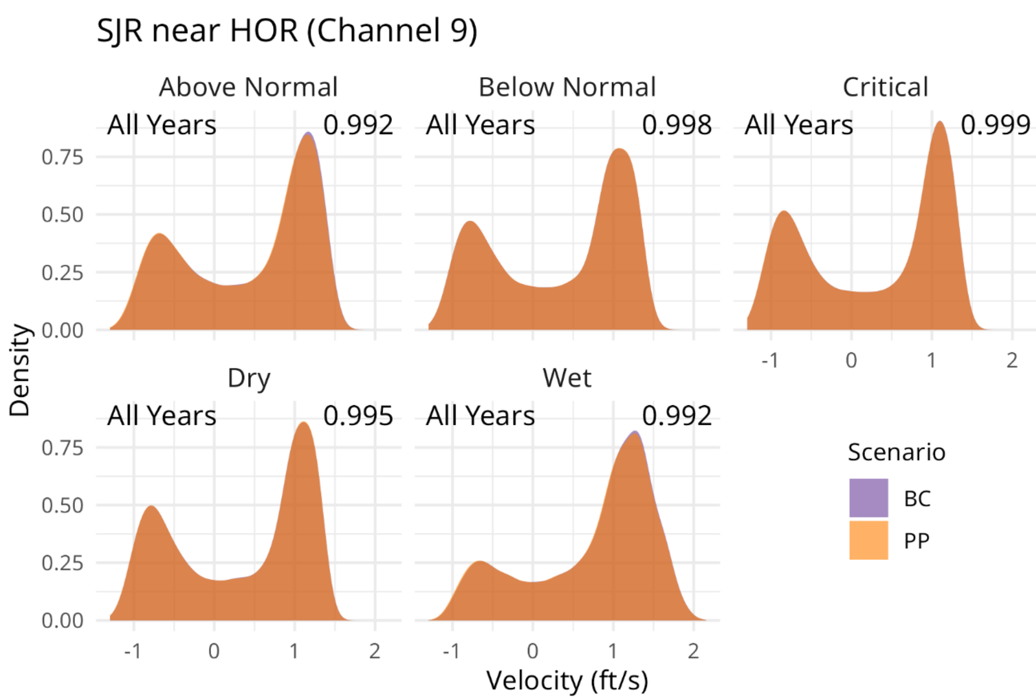
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-33. Velocity Density Distribution for San Joaquin River upstream of Head of Old River, September.



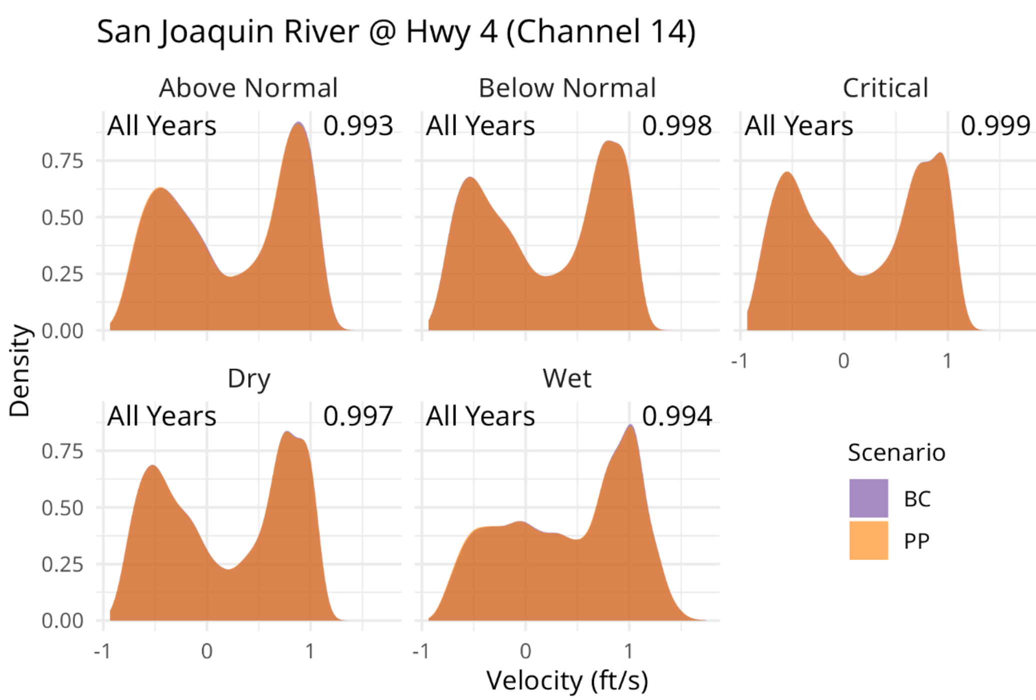
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-34. Velocity Density Distribution for San Joaquin River at Mossdale, September.



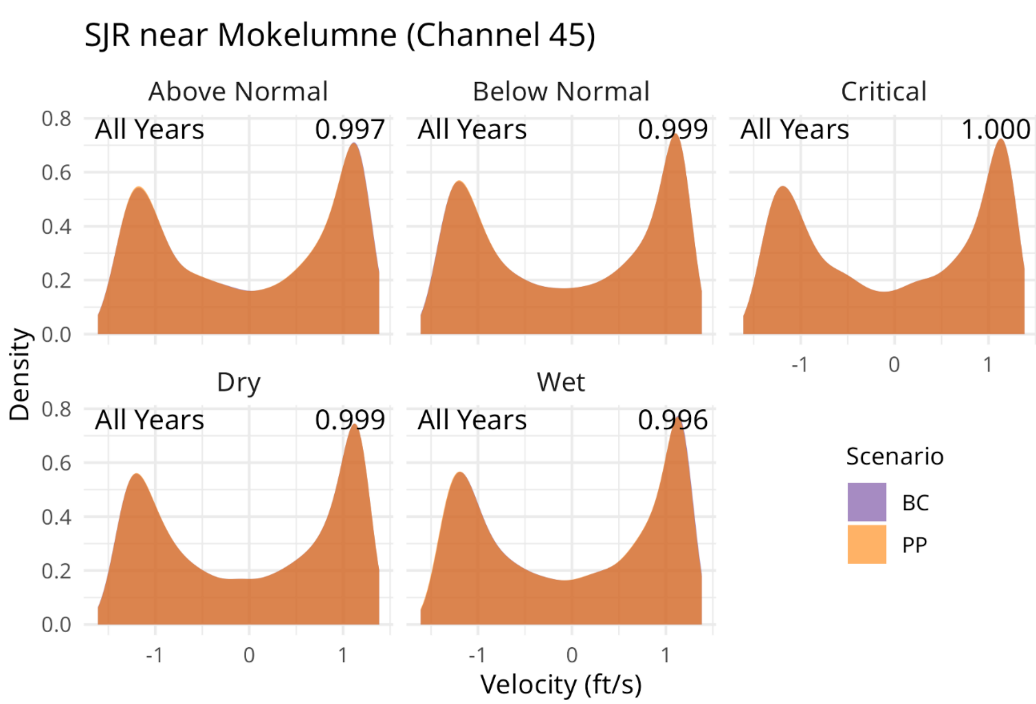
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-35. Velocity Density Distribution for San Joaquin River near Head of Old River, September.



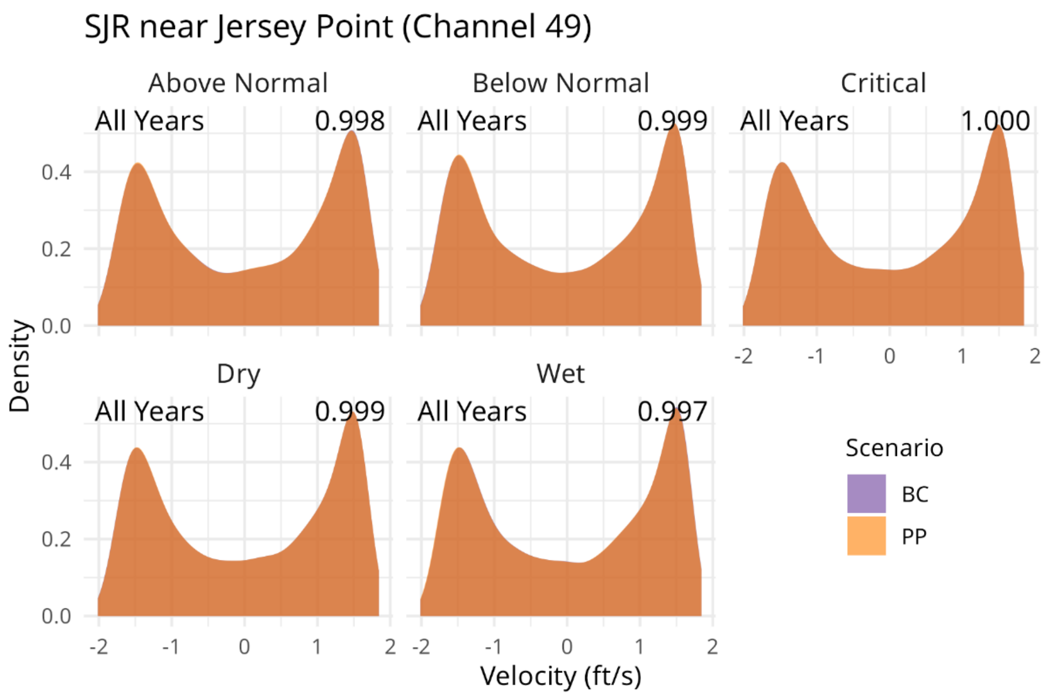
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-36. Velocity Density Distribution for San Joaquin River at Highway 4, September.



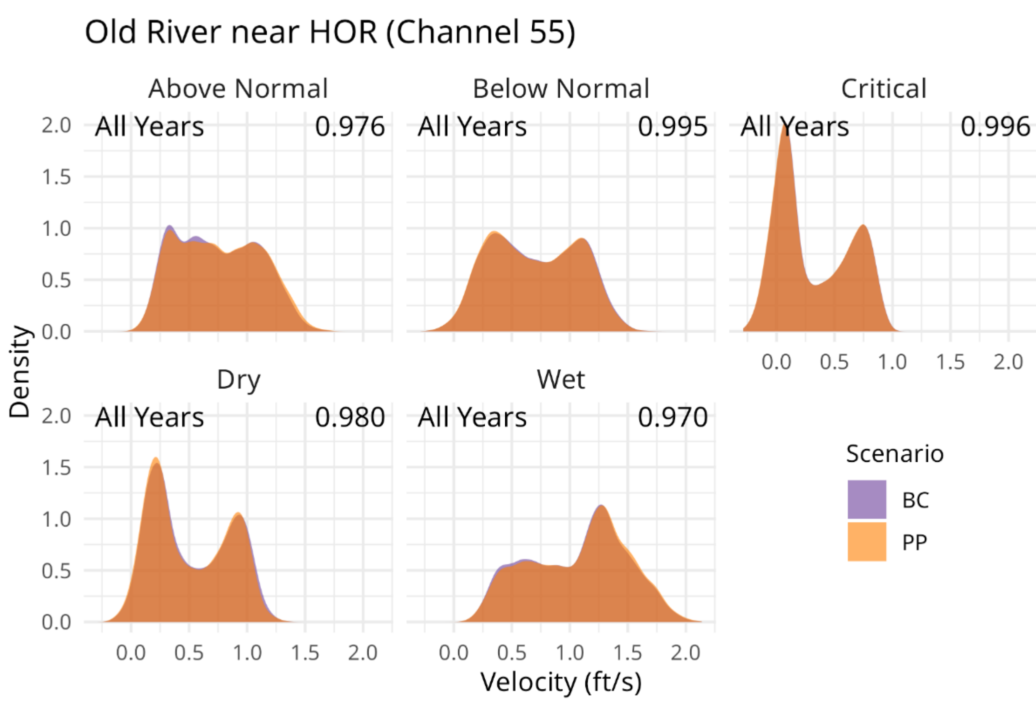
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-37. Velocity Density Distribution for San Joaquin River near Mokelumne River, September.



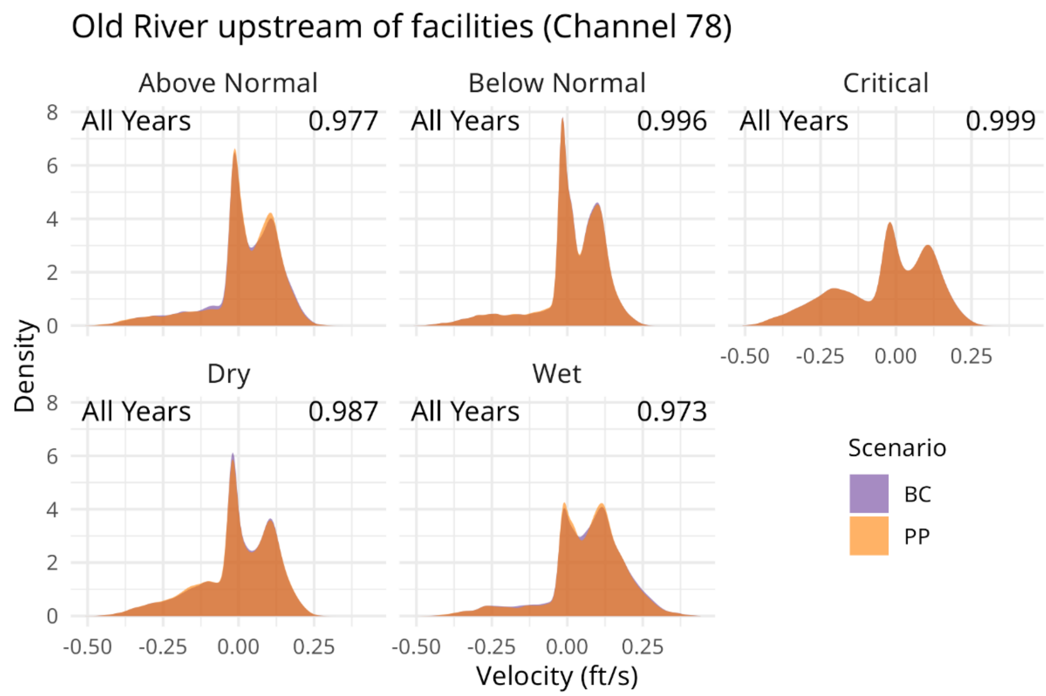
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-38. Velocity Density Distribution for San Joaquin River near Jersey Point, September.



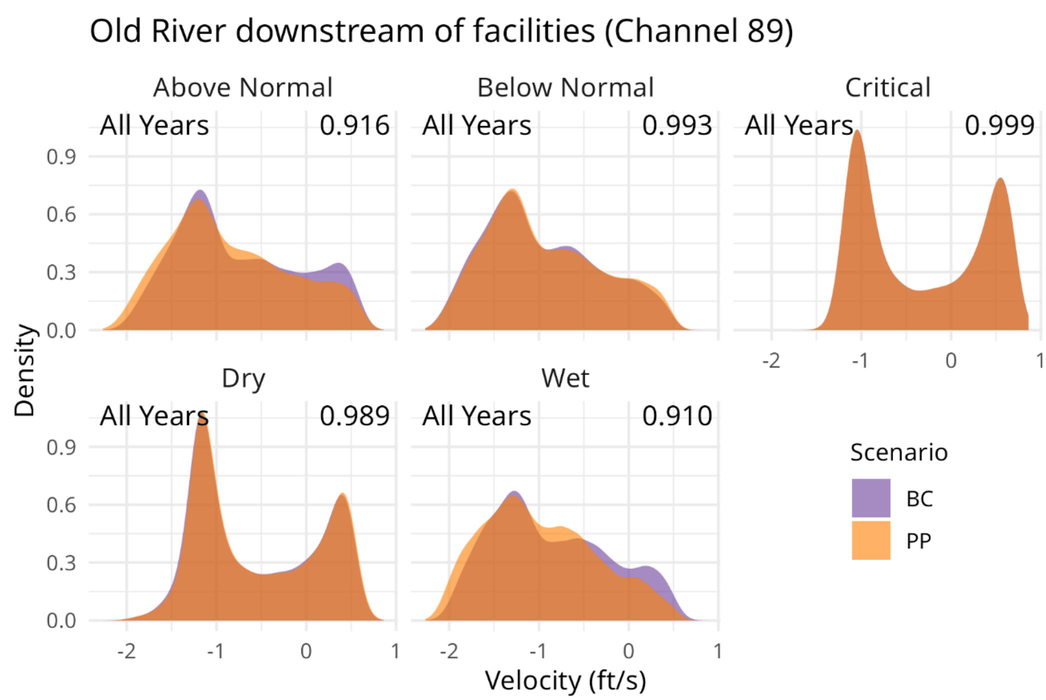
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-39. Velocity Density Distribution for Old River near Head of Old River, September.



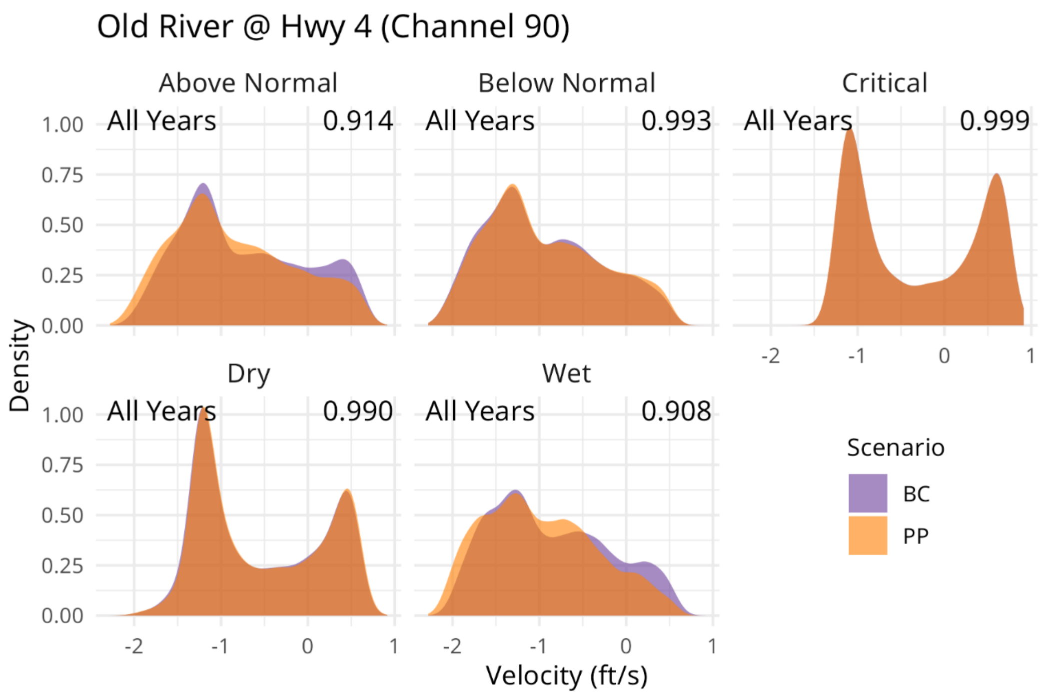
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-40. Velocity Density Distribution for Old River Upstream of the South Delta Export Facilities, September.



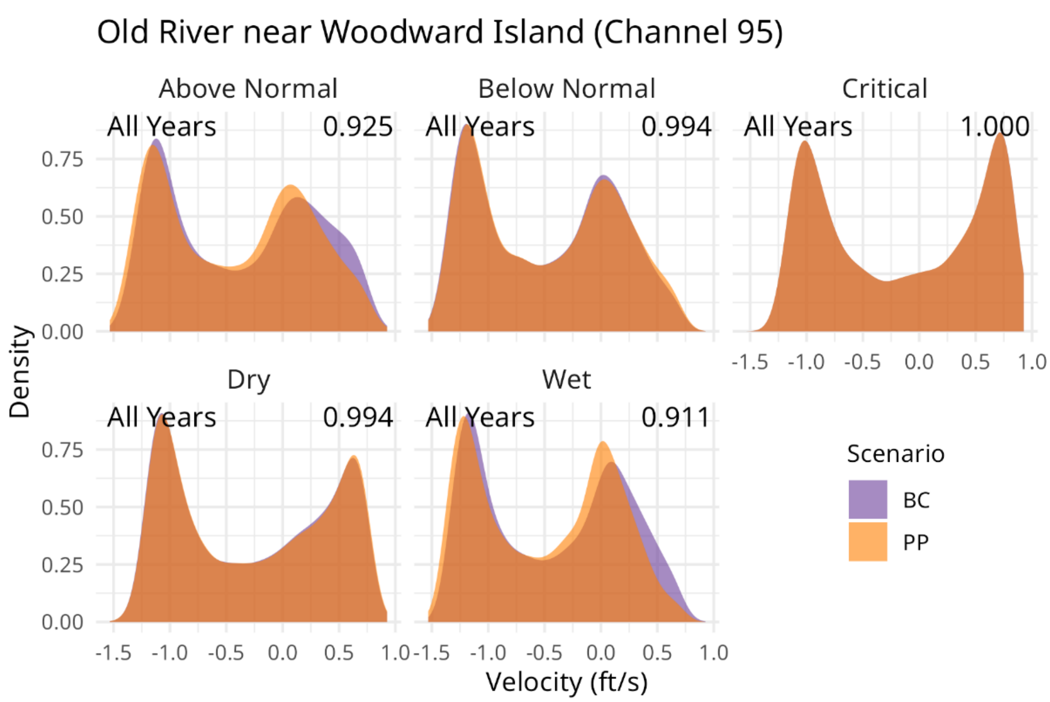
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-41. Velocity Density Distribution for Old River Downstream of the South Delta Export Facilities, September.



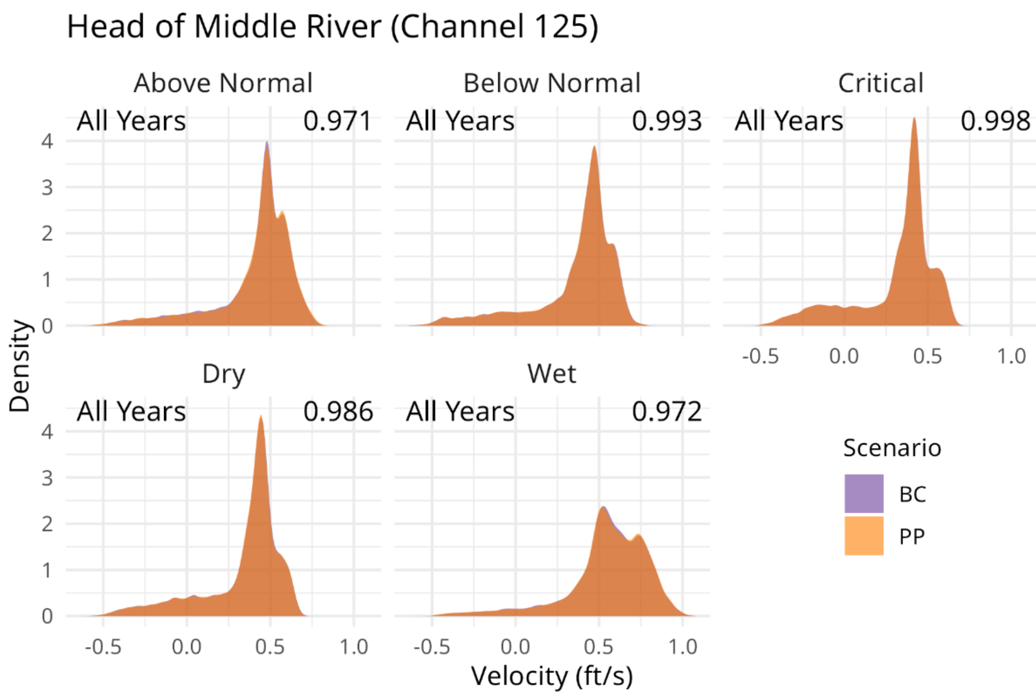
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-42. Velocity Density Distribution for Old River at Highway 4, September.



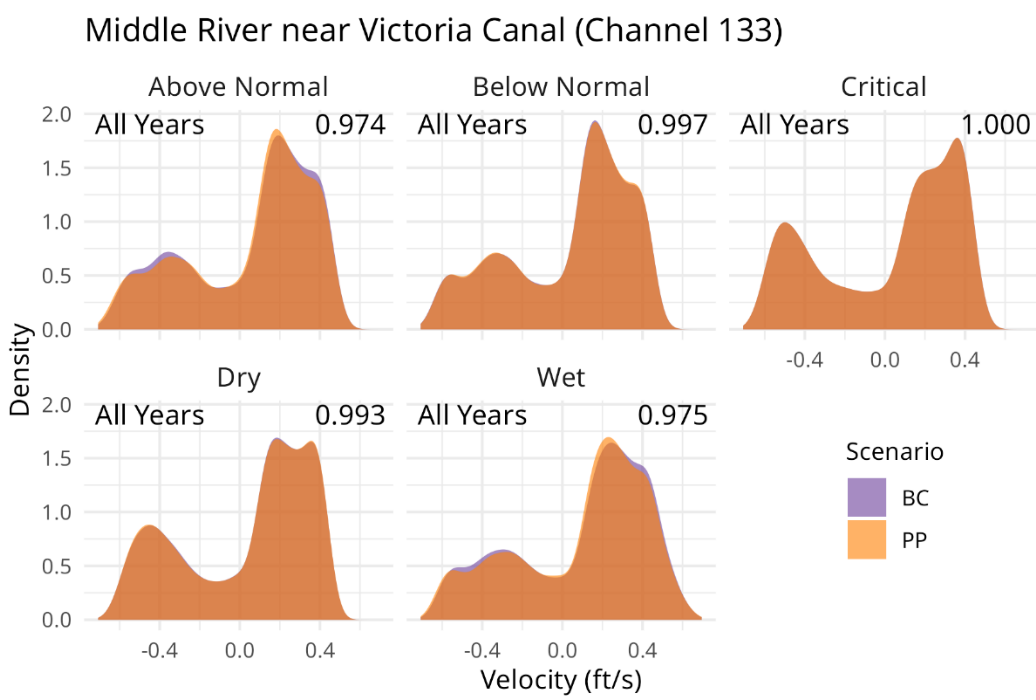
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-43. Velocity Density Distribution for Old River near Woodward Island, September.



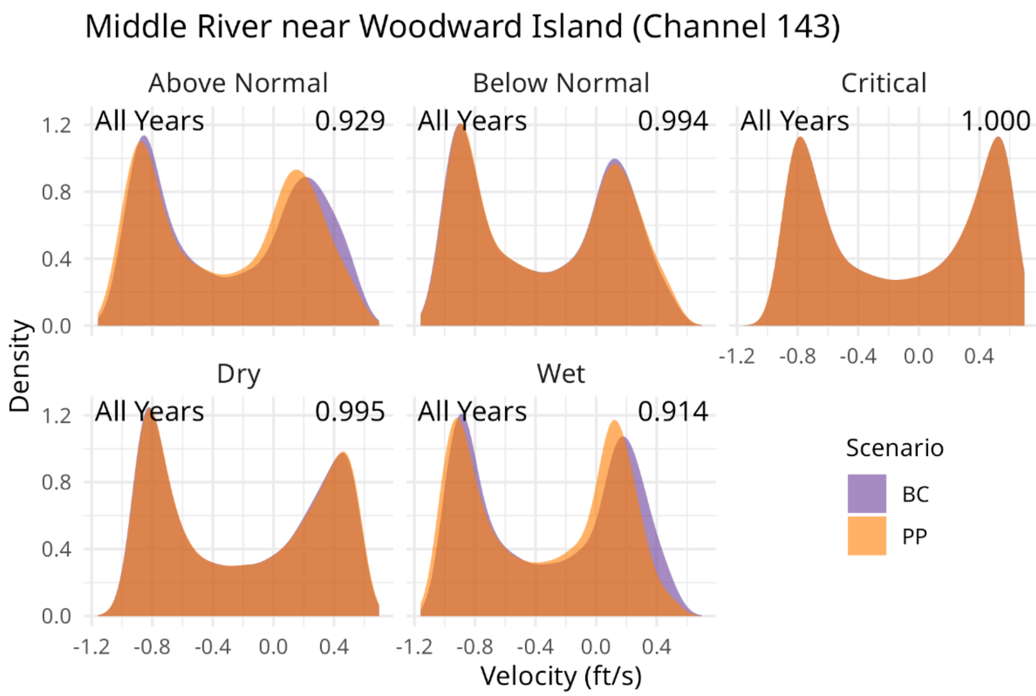
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-44. Velocity Density Distribution for Head of Middle River, September.



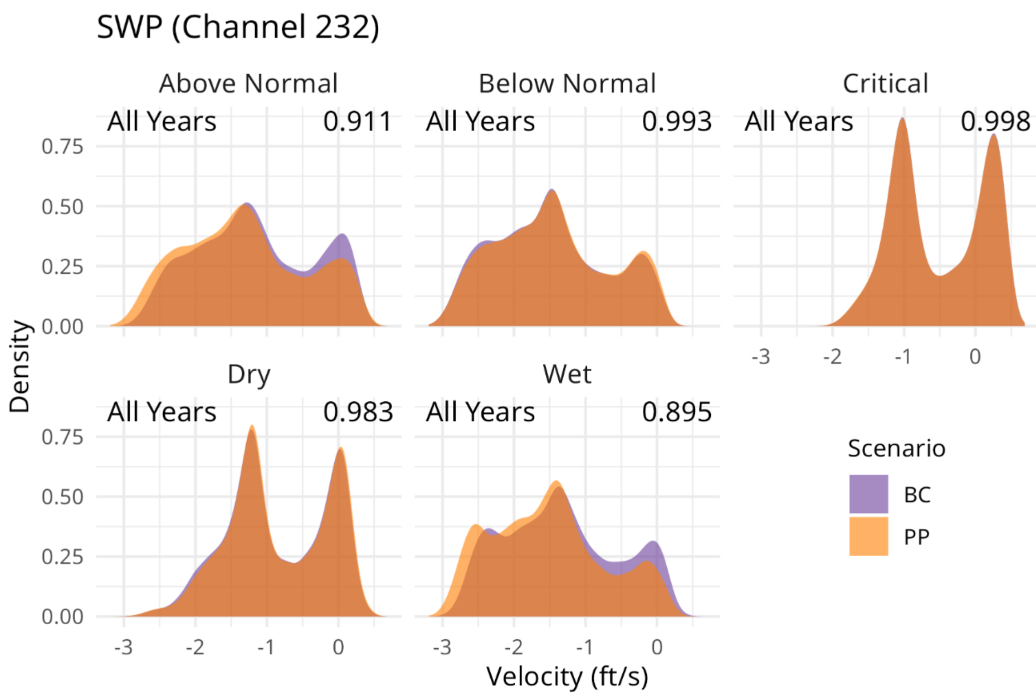
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-45. Velocity Density Distribution for Middle River near Victoria Canal, September.



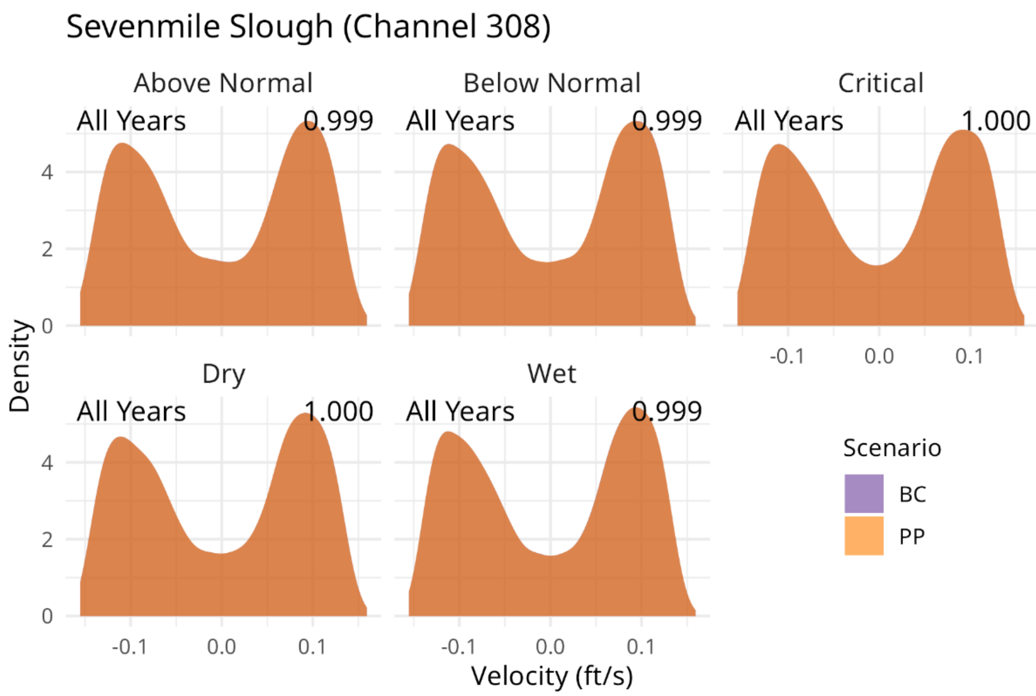
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-46. Velocity Density Distribution for Middle River near Woodward Island, September.



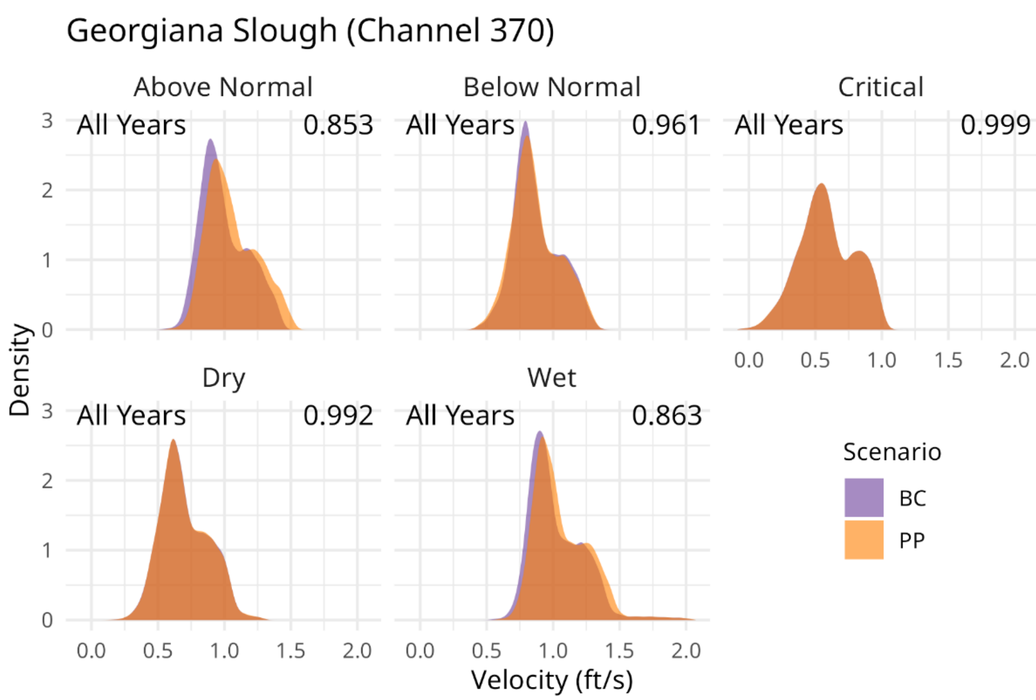
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-47. Velocity Density Distribution for State Water Project, September.



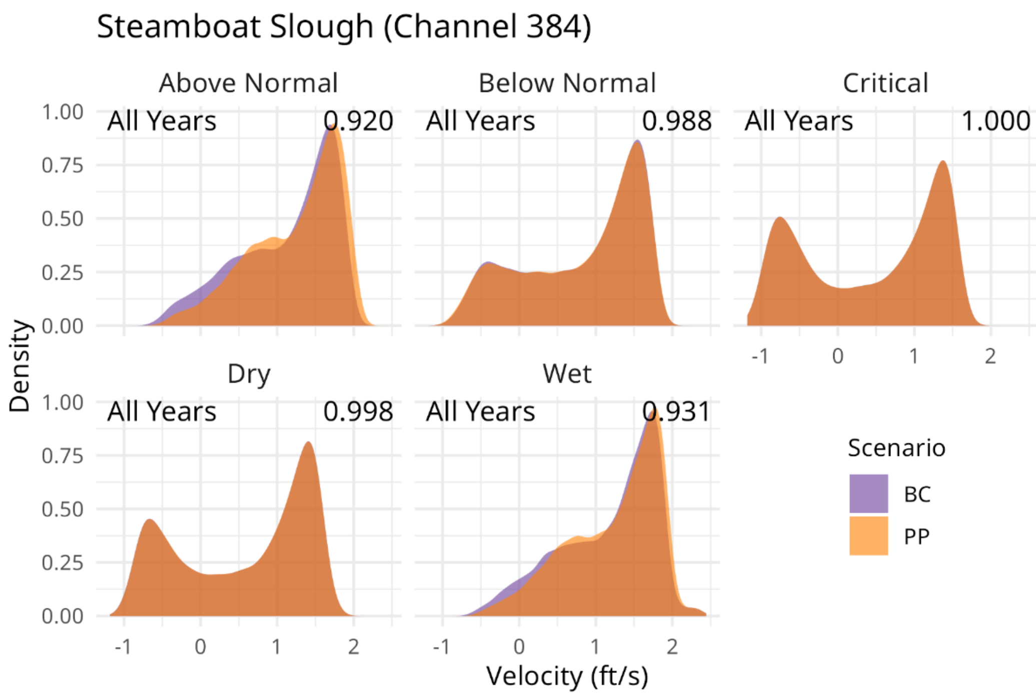
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-48. Velocity Density Distribution for Sevenmile Slough, September.



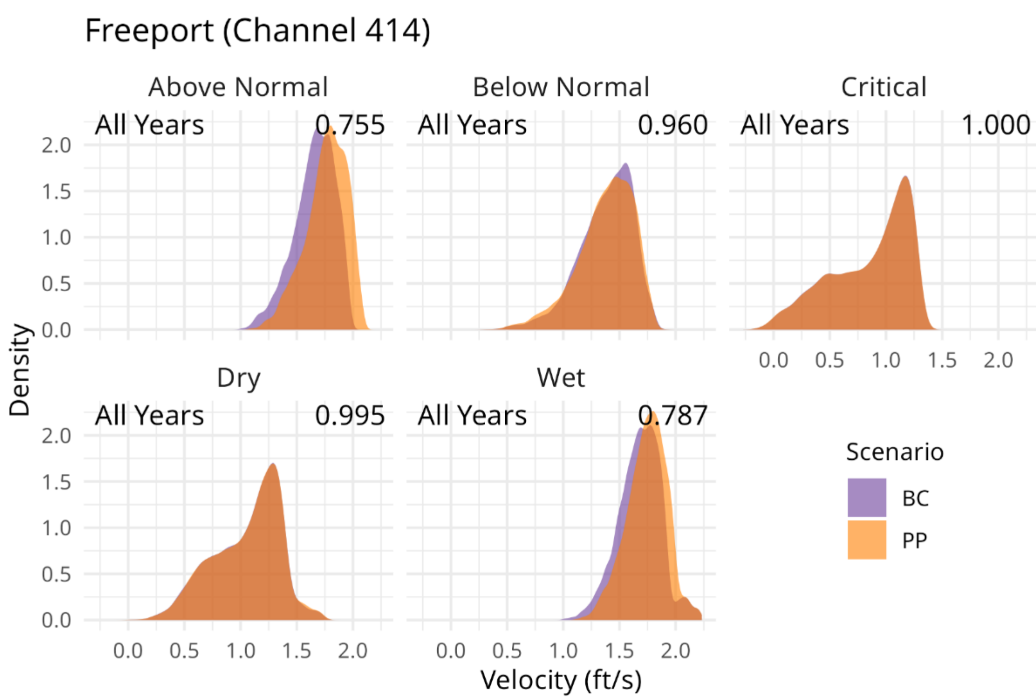
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-49. Velocity Density Distribution for Georgiana Slough, September.



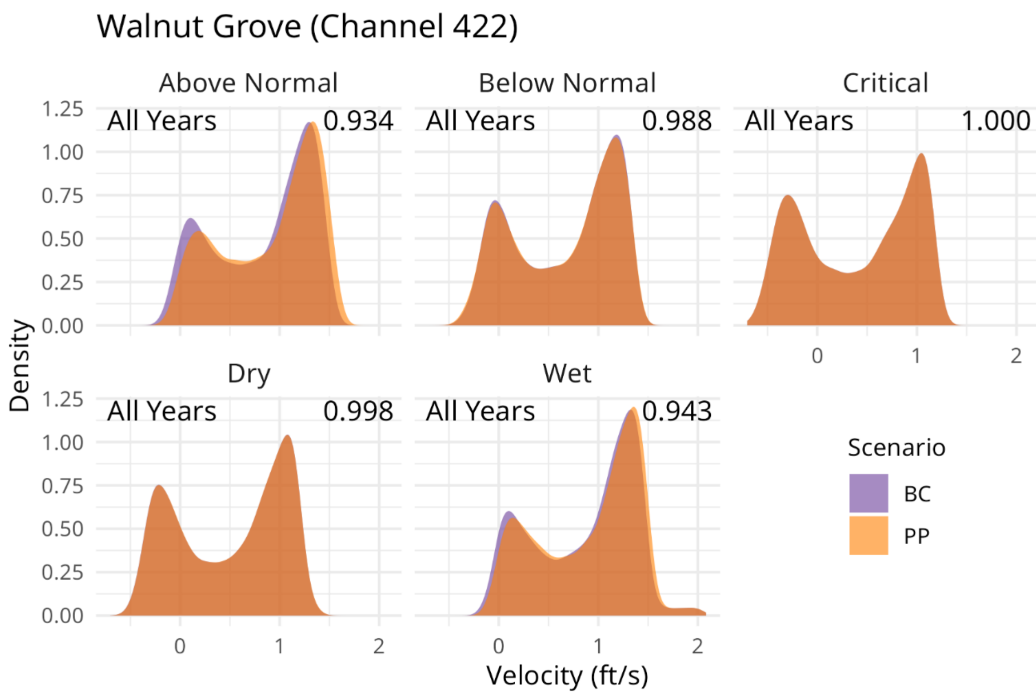
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-50. Velocity Density Distribution for Steamboat Slough, September.



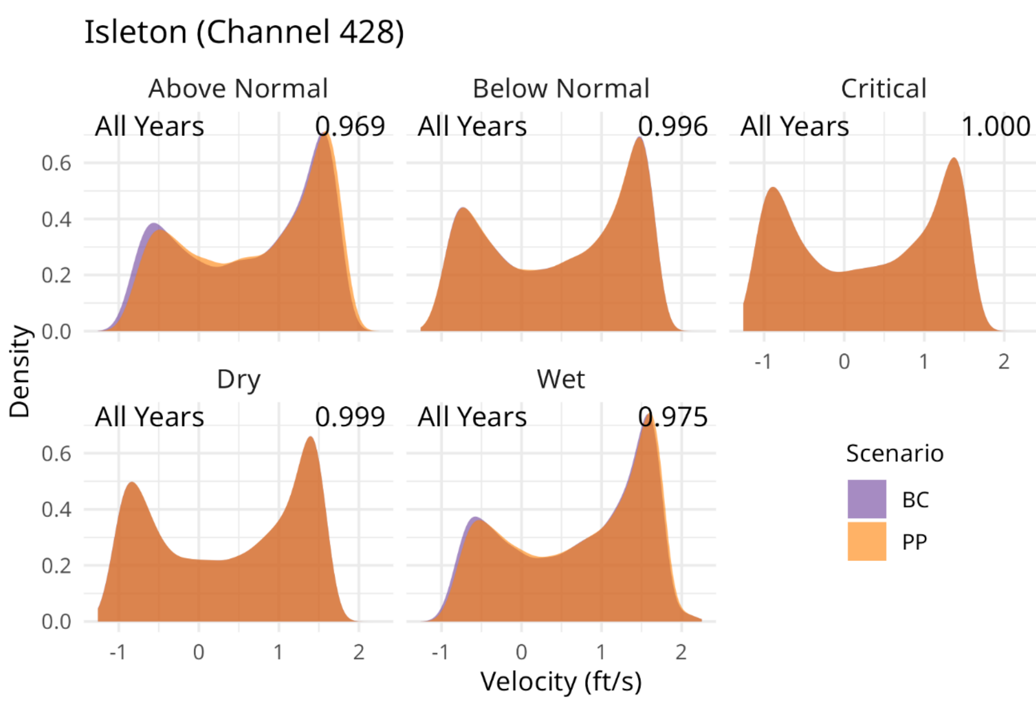
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-51. Velocity Density Distribution for Sacramento River at Freeport, September.



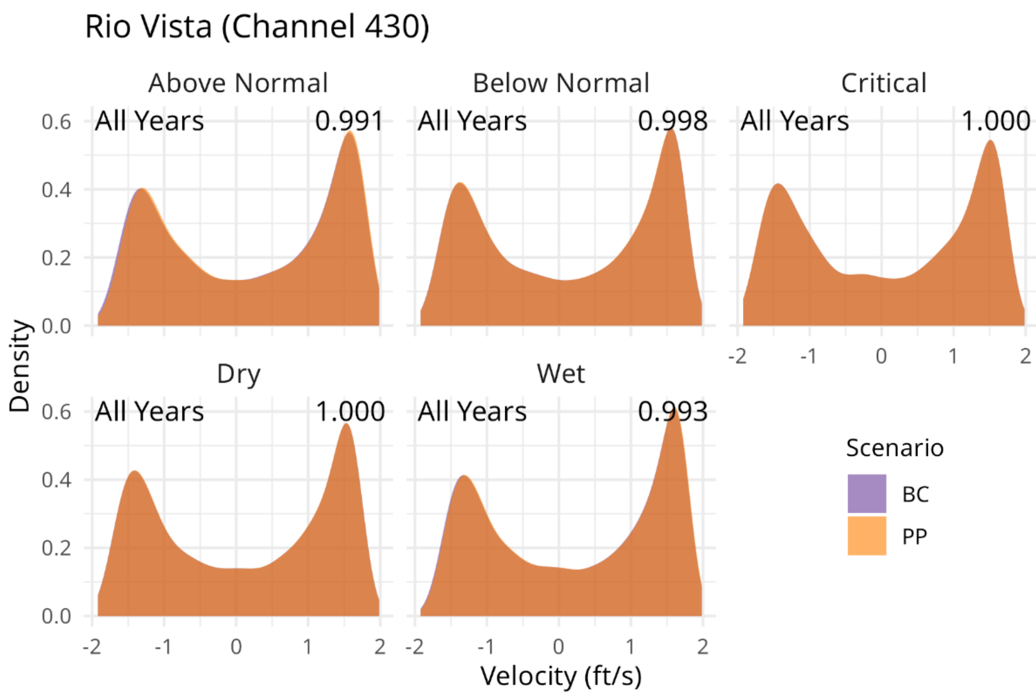
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-52. Velocity Density Distribution for Sacramento River at Walnut Grove (Channel 6), September.



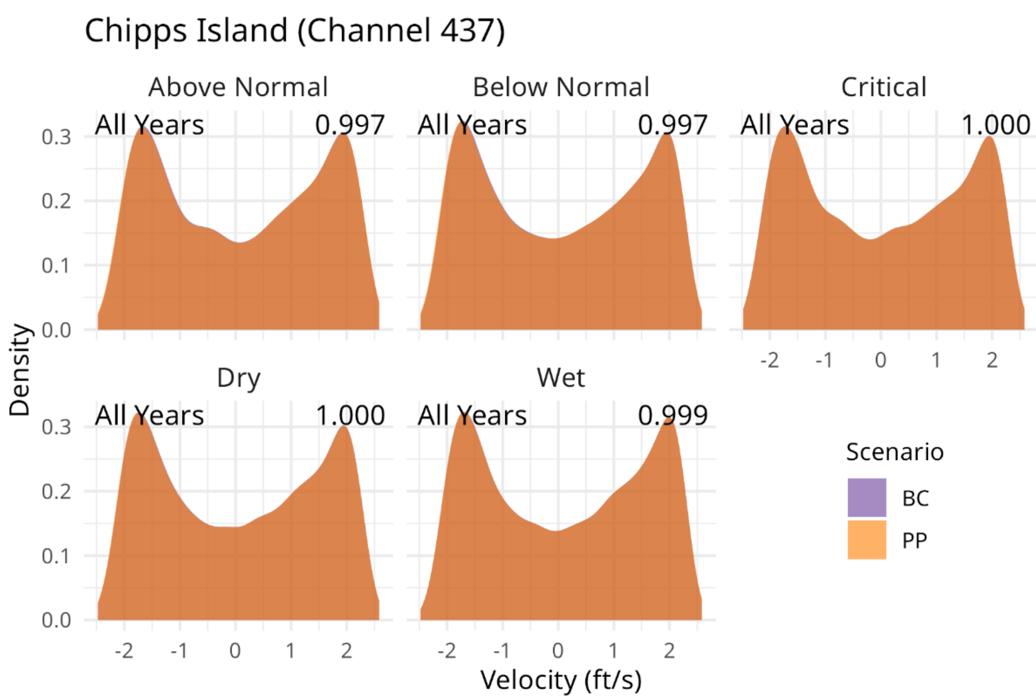
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-53. Velocity Density Distribution for Sacramento River at Isleton, September.



Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

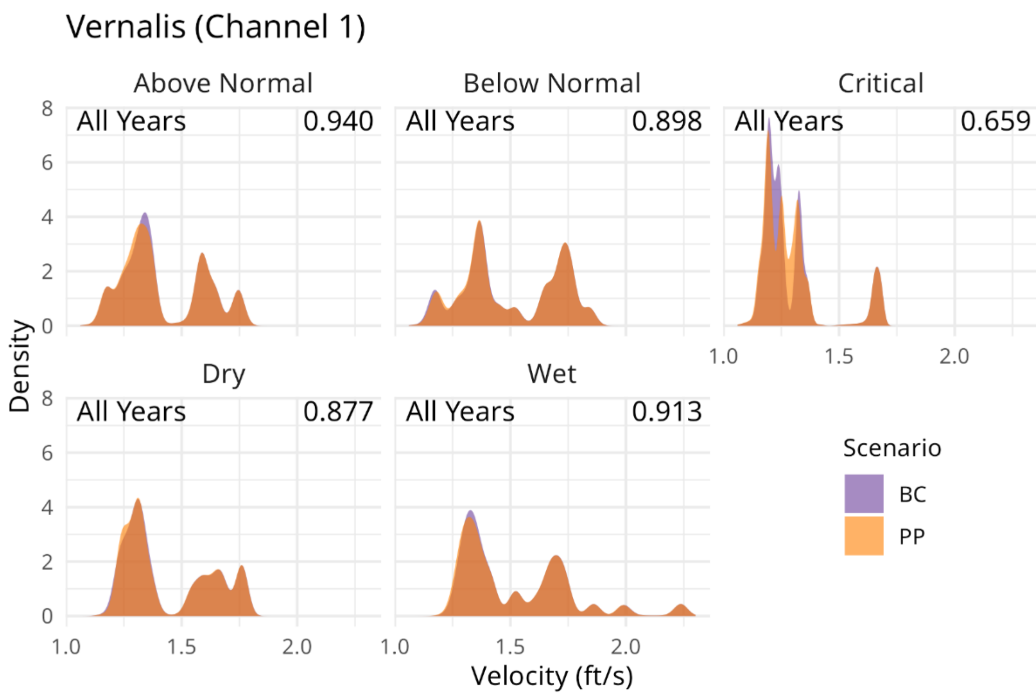
Figure 6B-54. Velocity Density Distribution for Sacramento River at Rio Vista, September.



Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

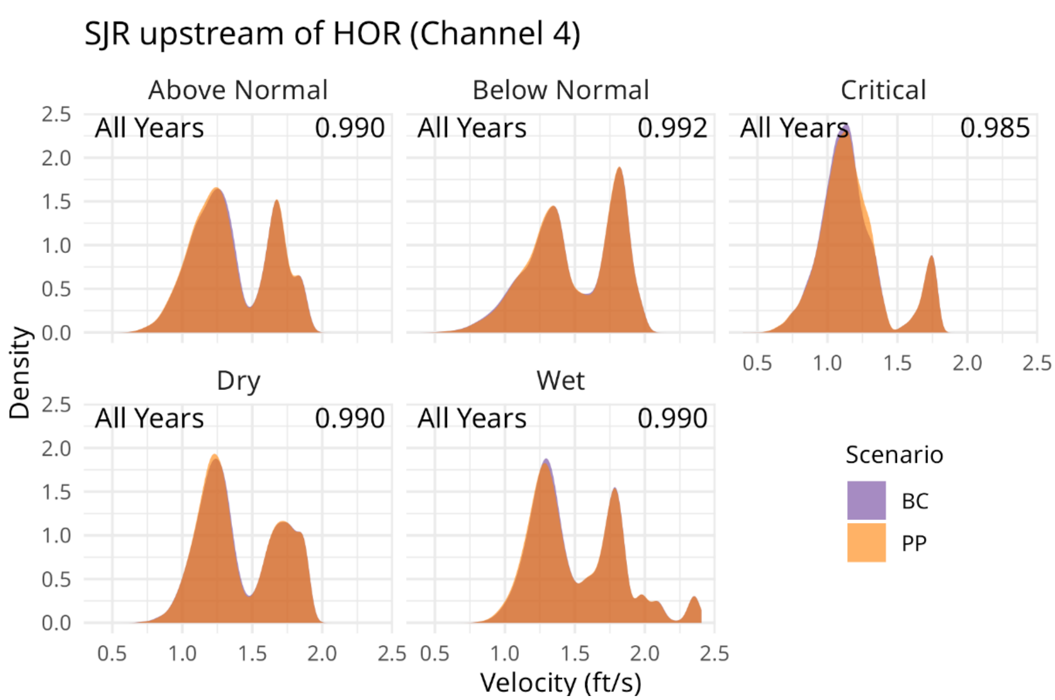
Figure 6B-55. Velocity Density Distribution for Sacramento River at Chipps Island, September.

October



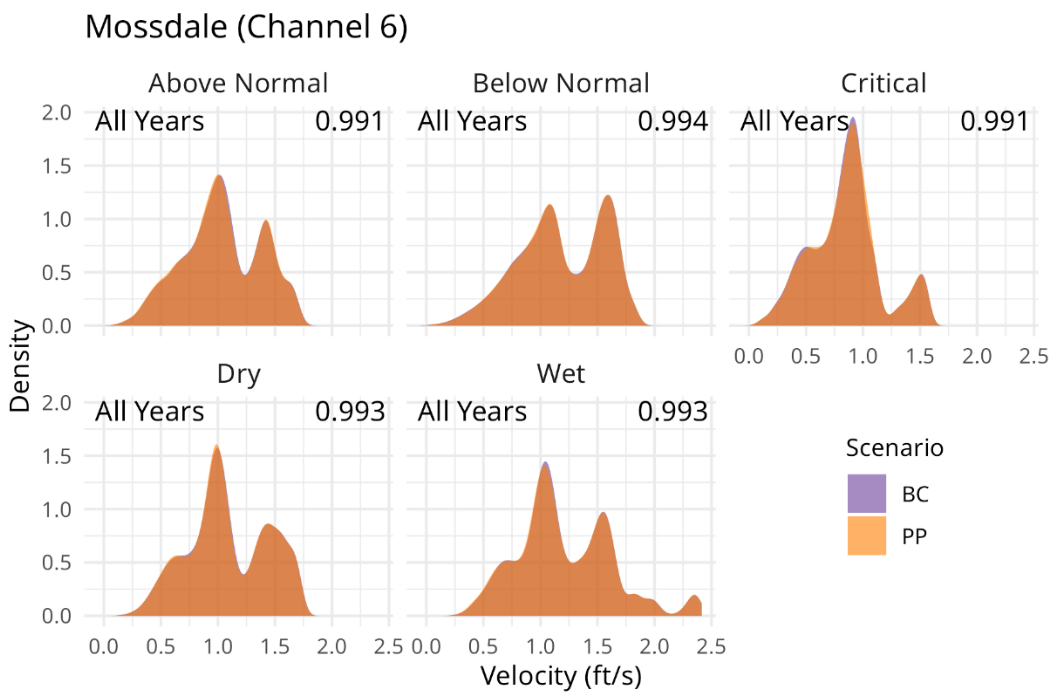
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-56. Velocity Density Distribution for San Joaquin River at Vernalis, October.



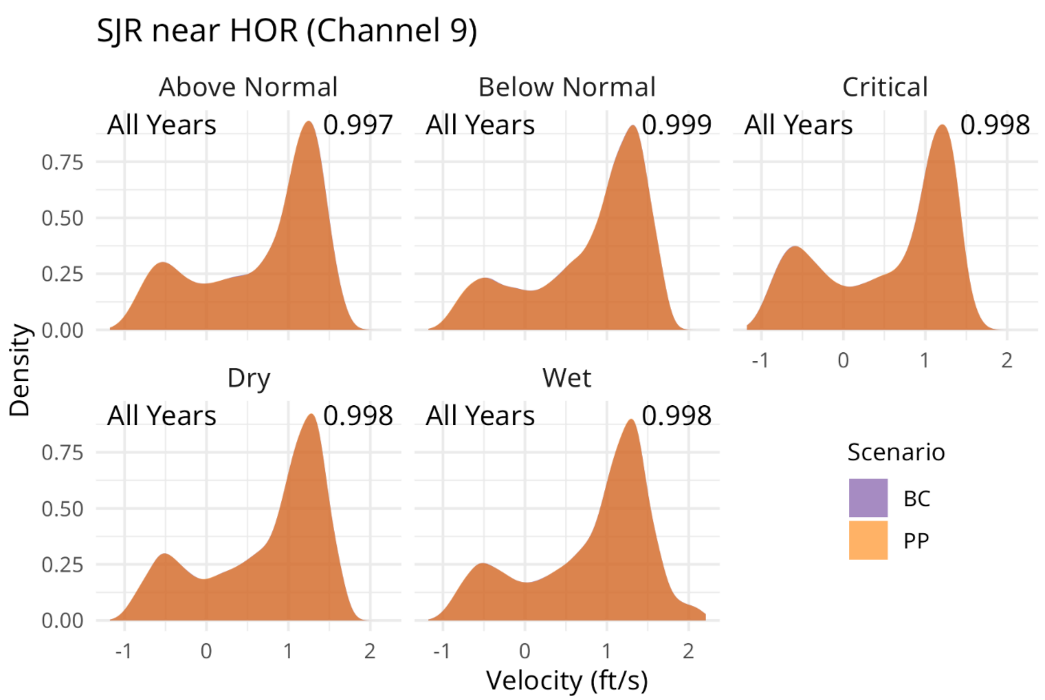
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-57. Velocity Density Distribution for San Joaquin River upstream of Head of Old River, October.



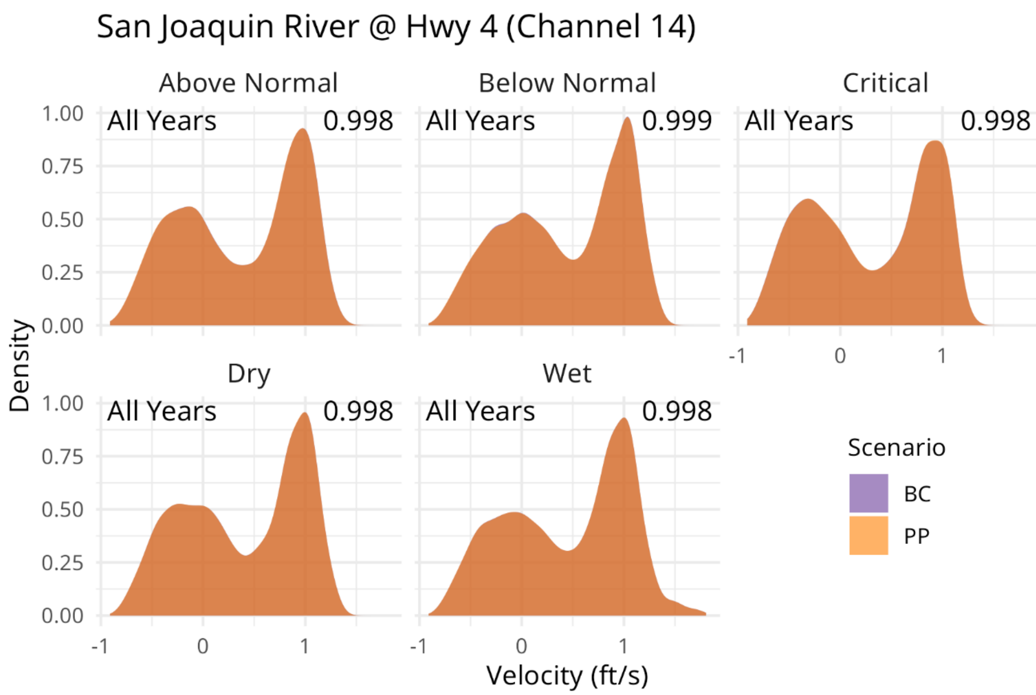
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-58. Velocity Density Distribution for San Joaquin River at Mossdale, October.



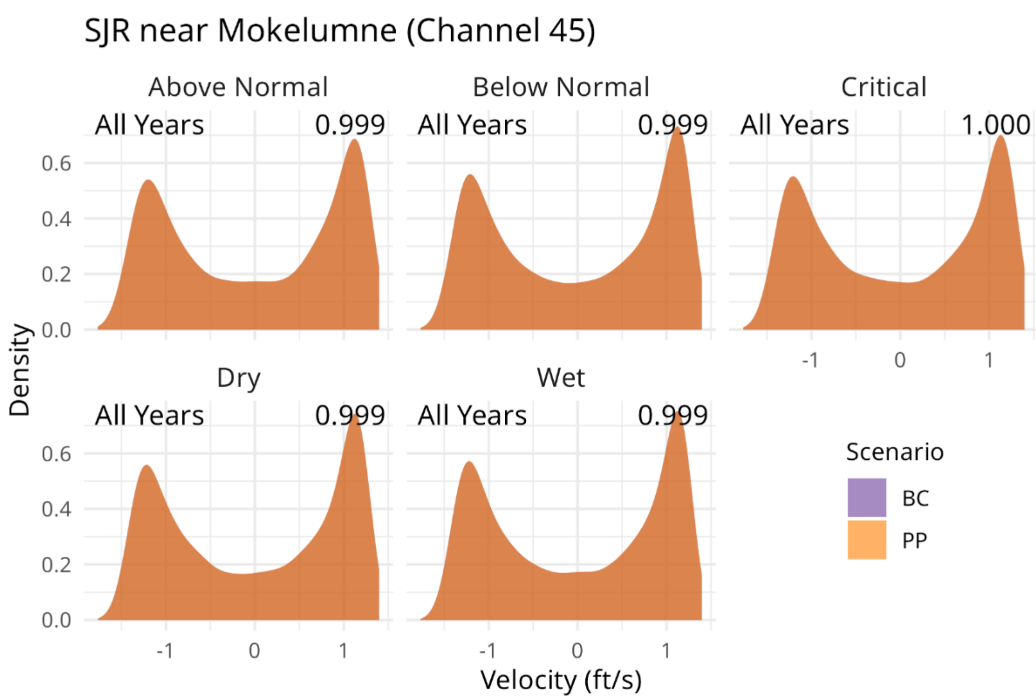
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-59. Velocity Density Distribution for San Joaquin River near Head of Old River, October.



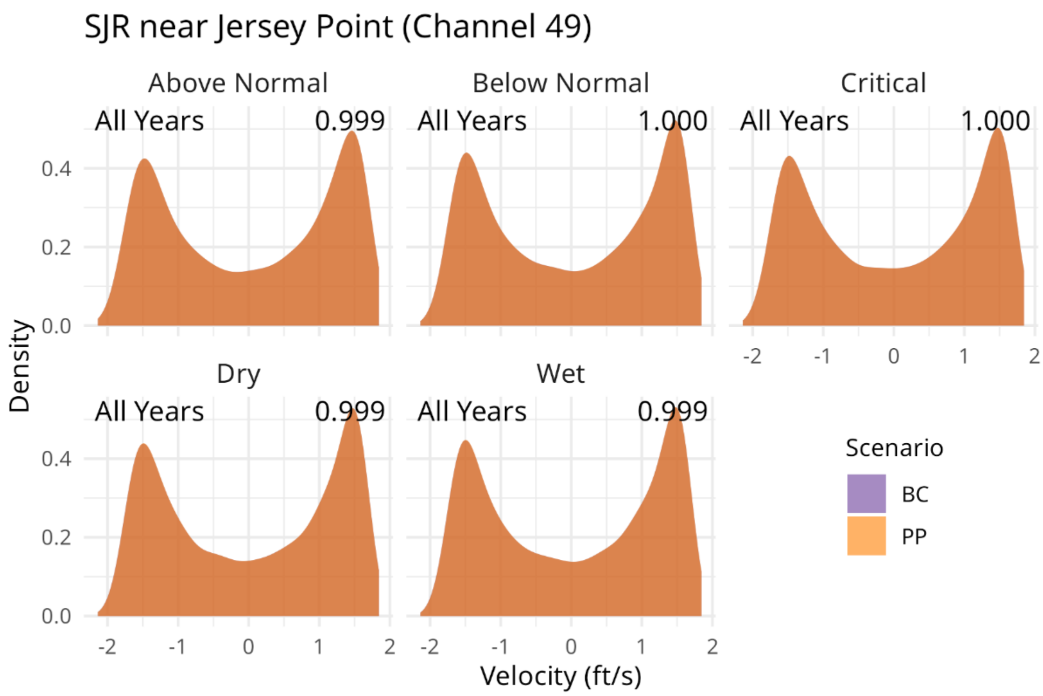
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-60. Velocity Density Distribution for San Joaquin River at Highway 4, October.



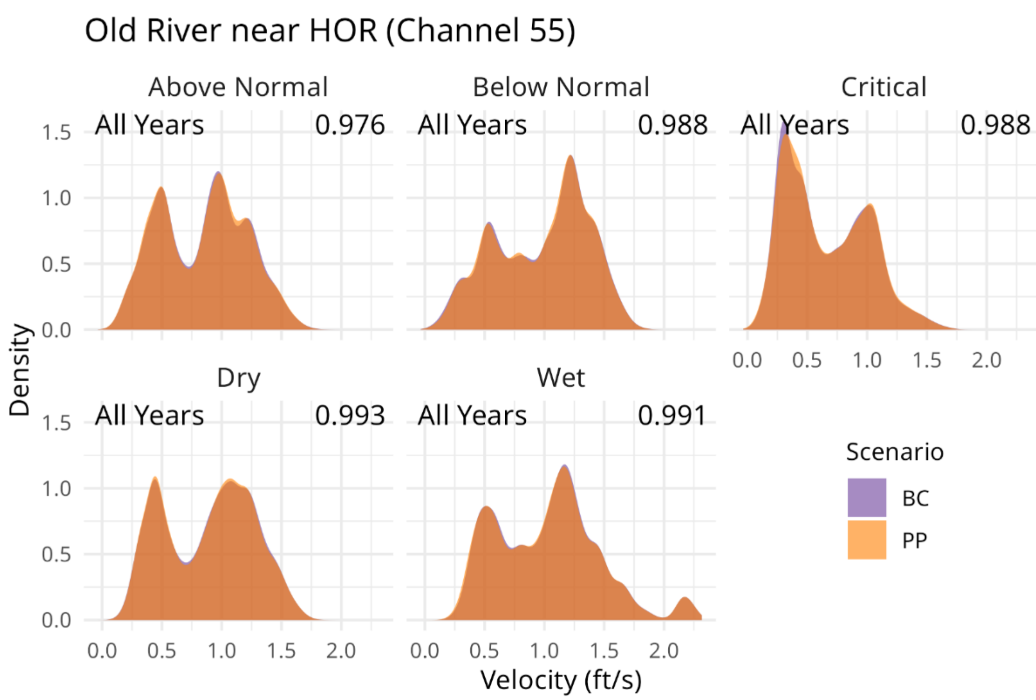
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-61. Velocity Density Distribution for San Joaquin River near Mokelumne River, October.



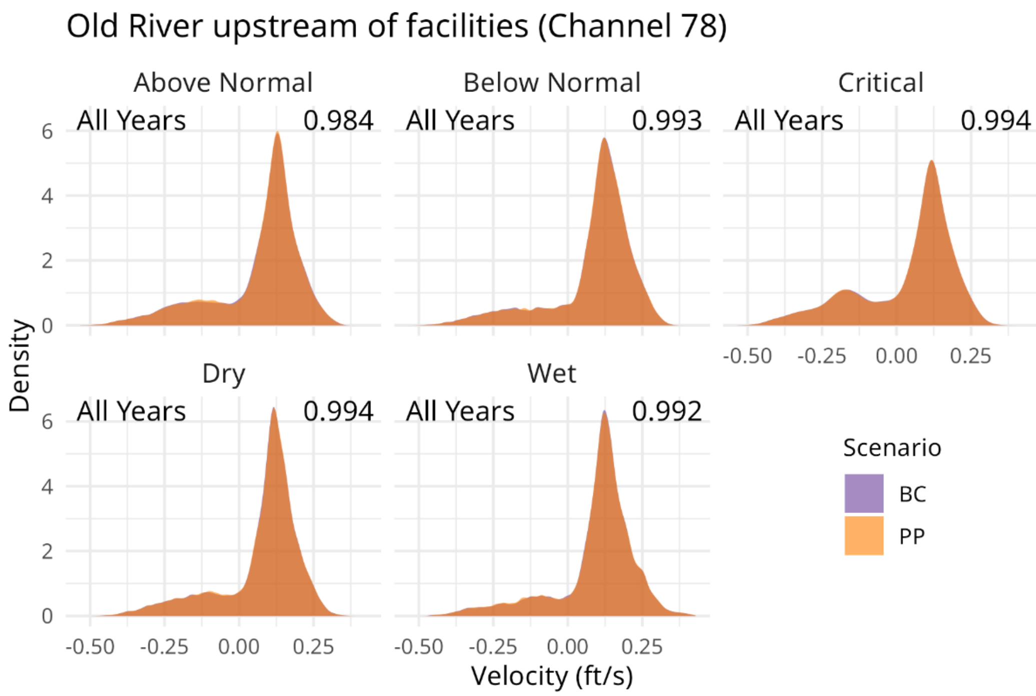
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-62. Velocity Density Distribution for San Joaquin River near Jersey Point, October.



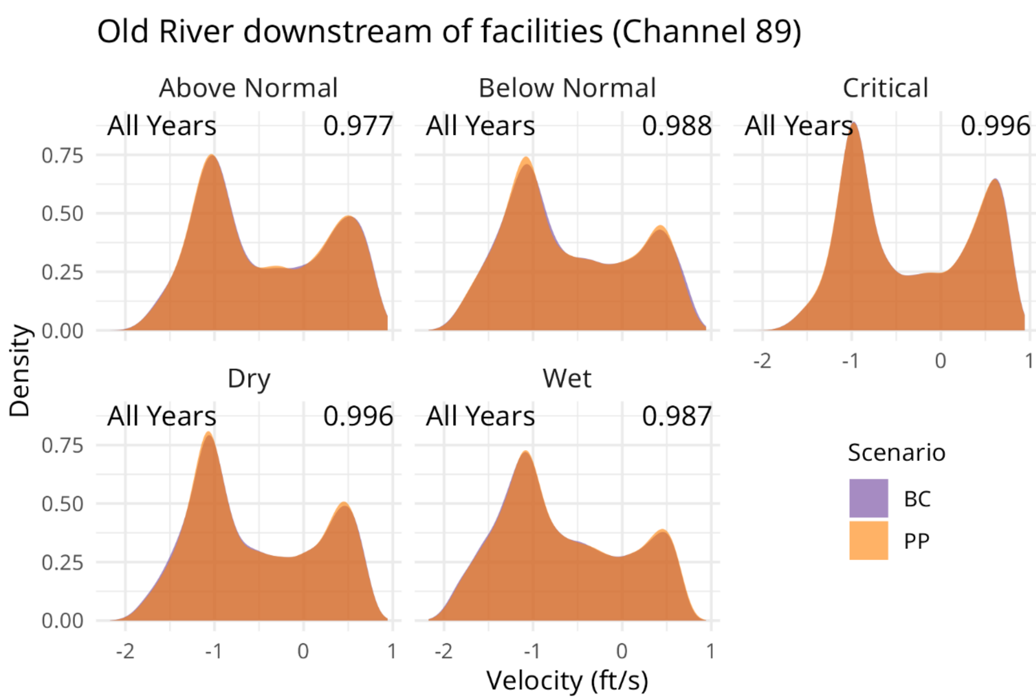
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-63. Velocity Density Distribution for Old River near Head of Old River, October.



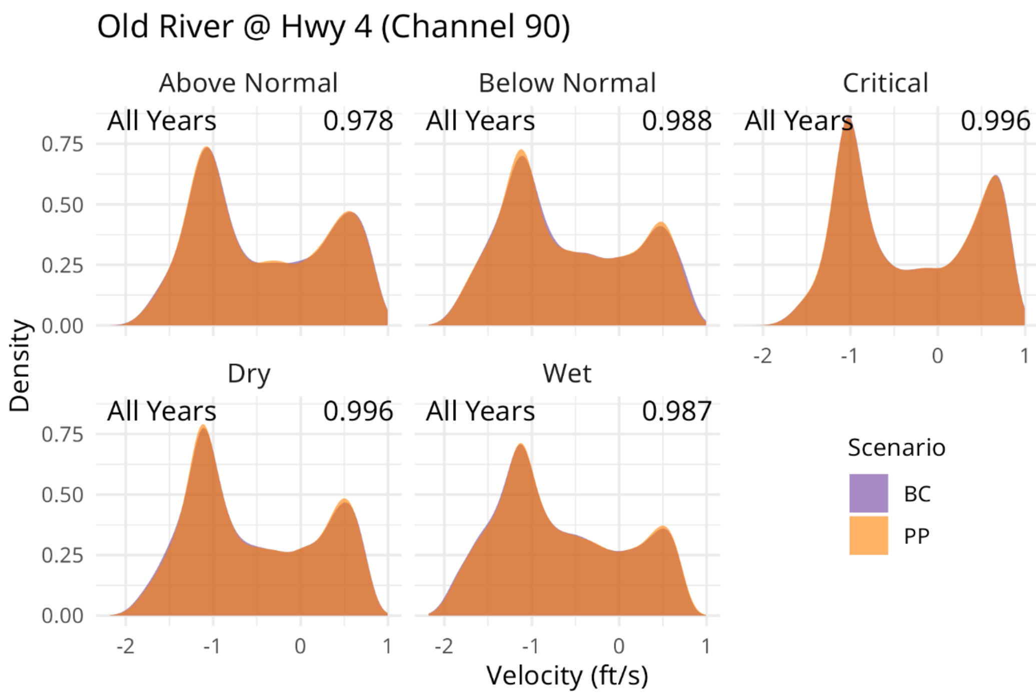
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-64. Velocity Density Distribution for Old River Upstream of the South Delta Export Facilities, October.



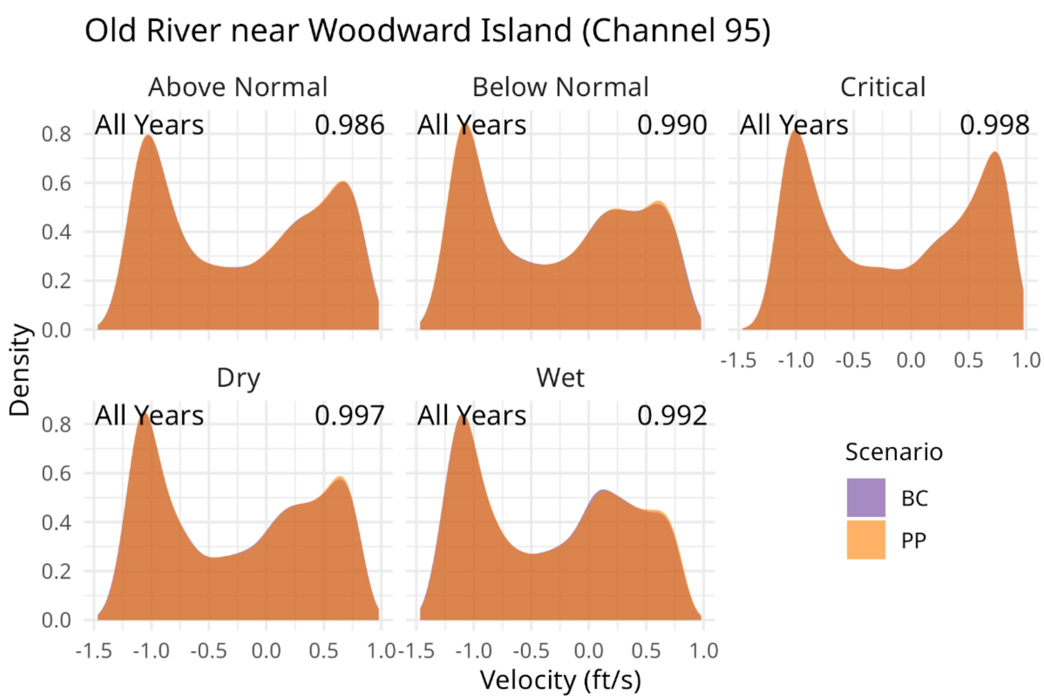
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-65. Velocity Density Distribution for Old River Downstream of the South Delta Export Facilities, October.



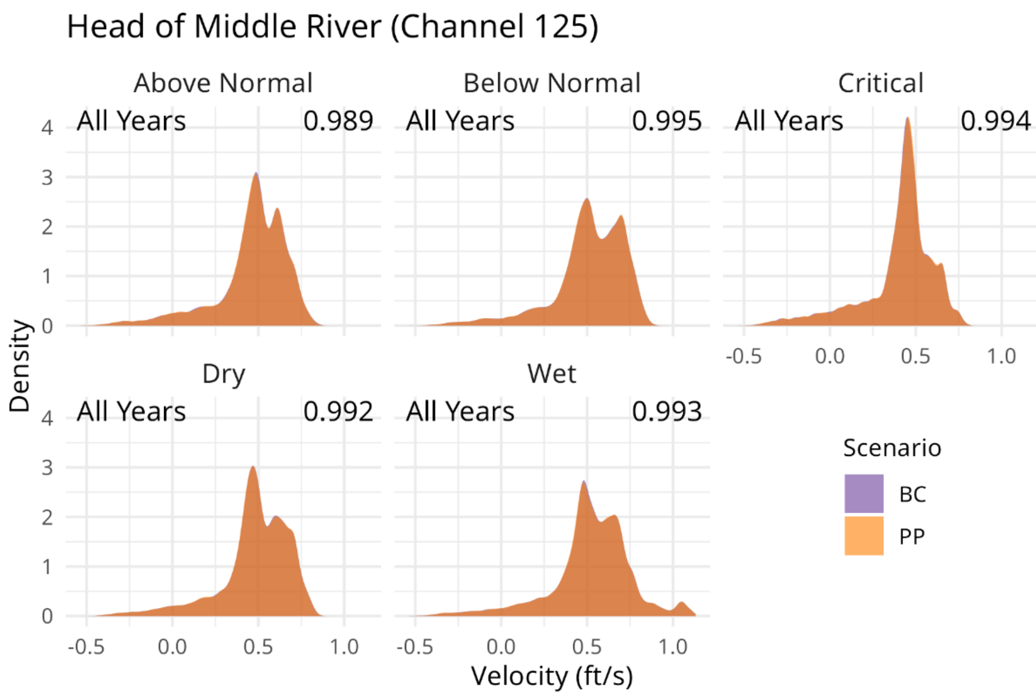
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-66. Velocity Density Distribution for Old River at Highway 4, October.



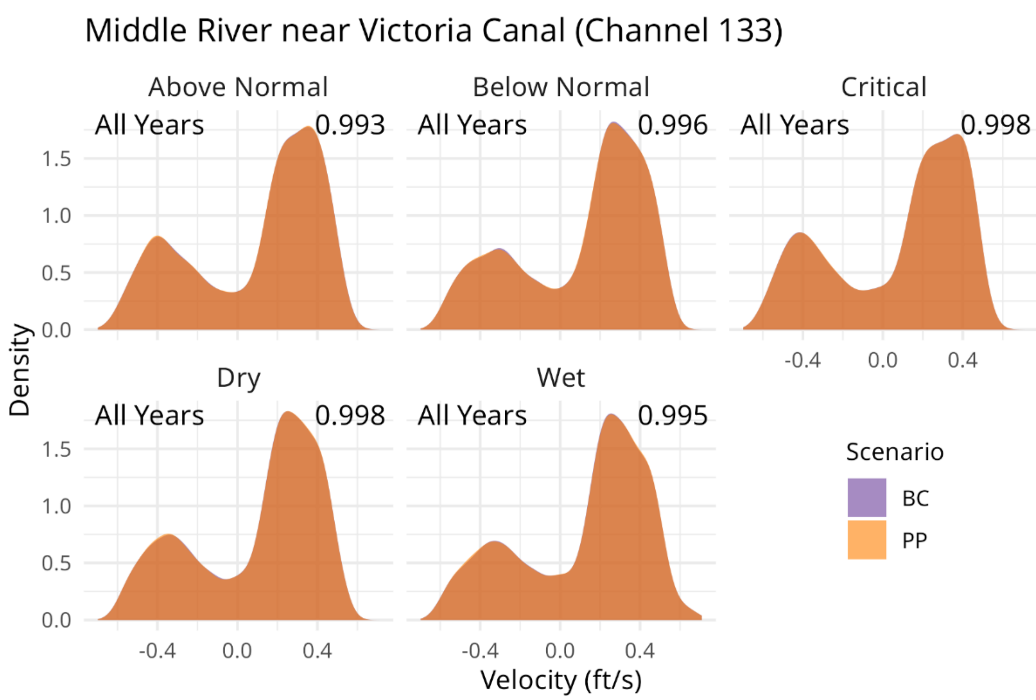
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-67. Velocity Density Distribution for Old River near Woodward Island, October.



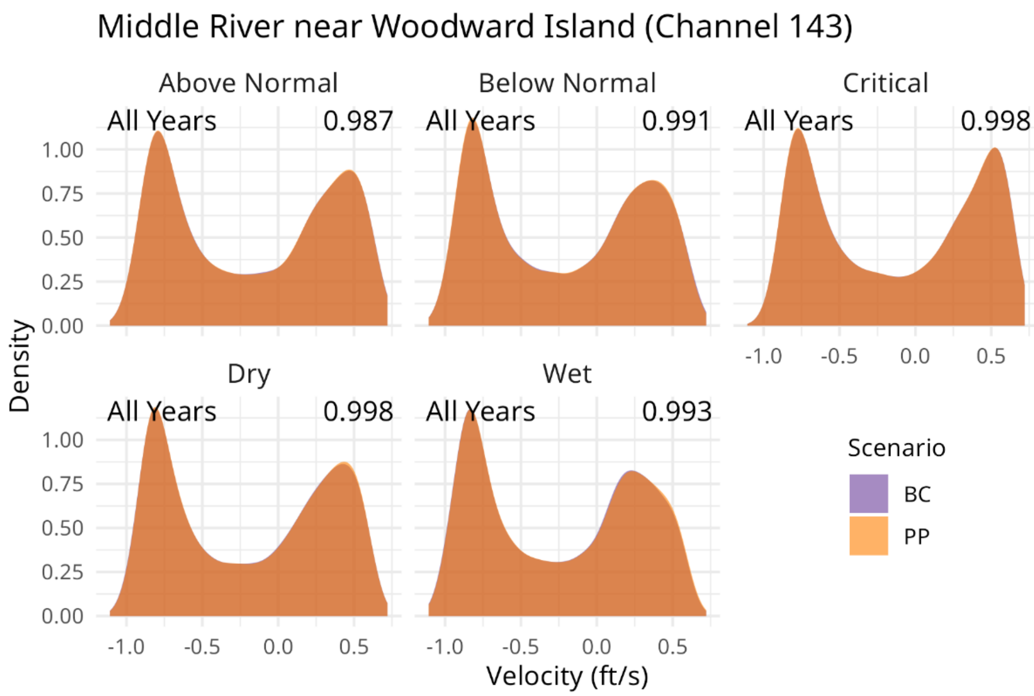
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-68. Velocity Density Distribution for Head of Middle River, October.



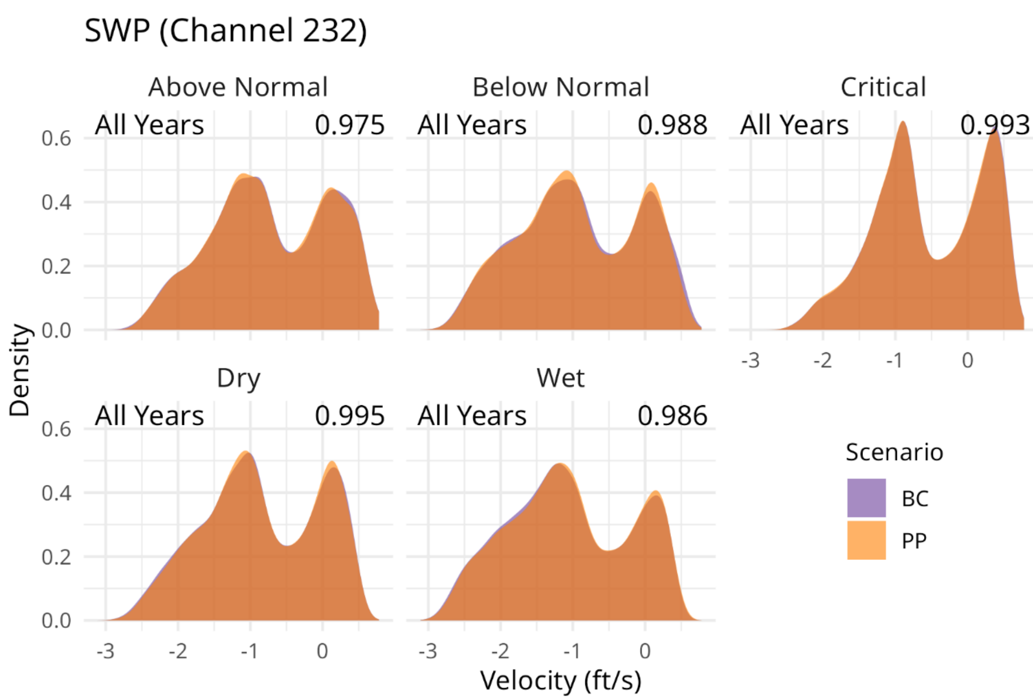
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-69. Velocity Density Distribution for Middle River near Victoria Canal, October.



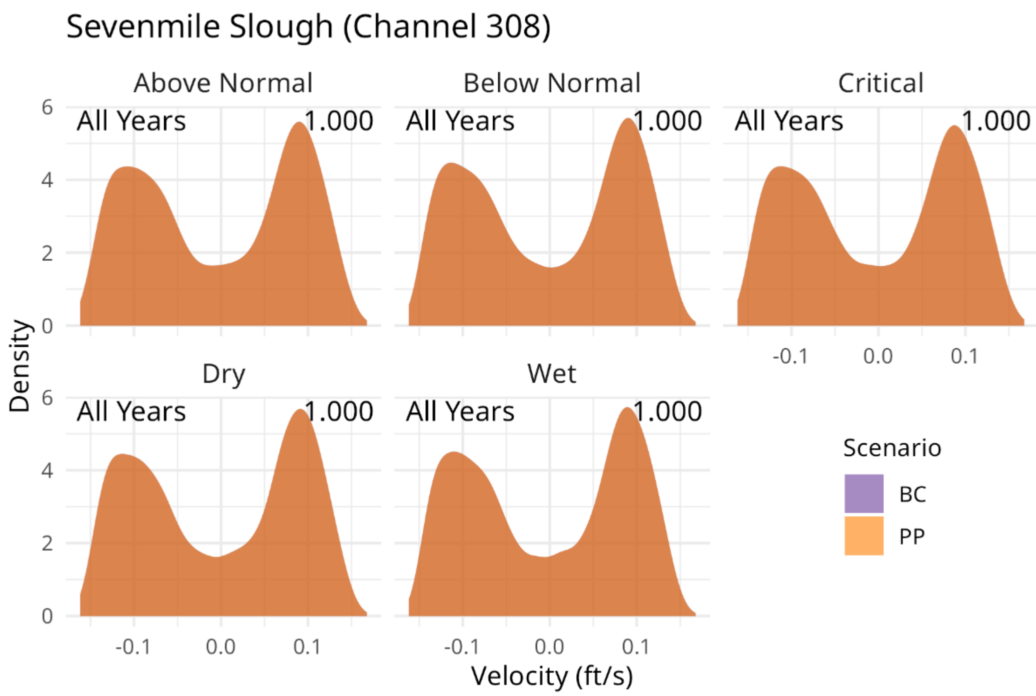
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-70. Velocity Density Distribution for Middle River near Woodward Island, October.



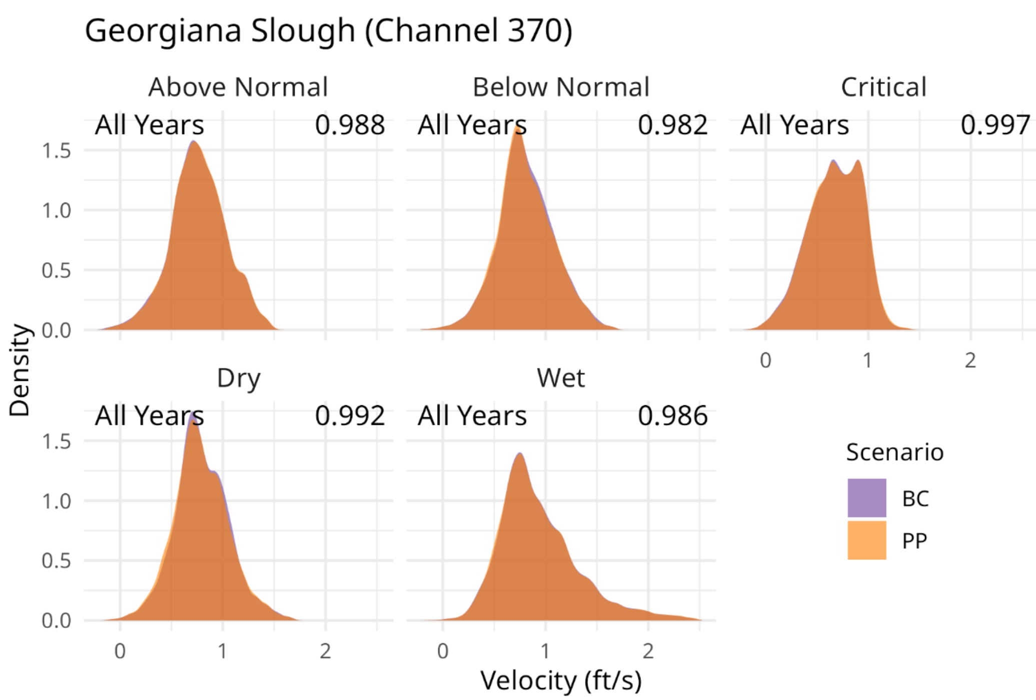
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-71. Velocity Density Distribution for State Water Project, October.



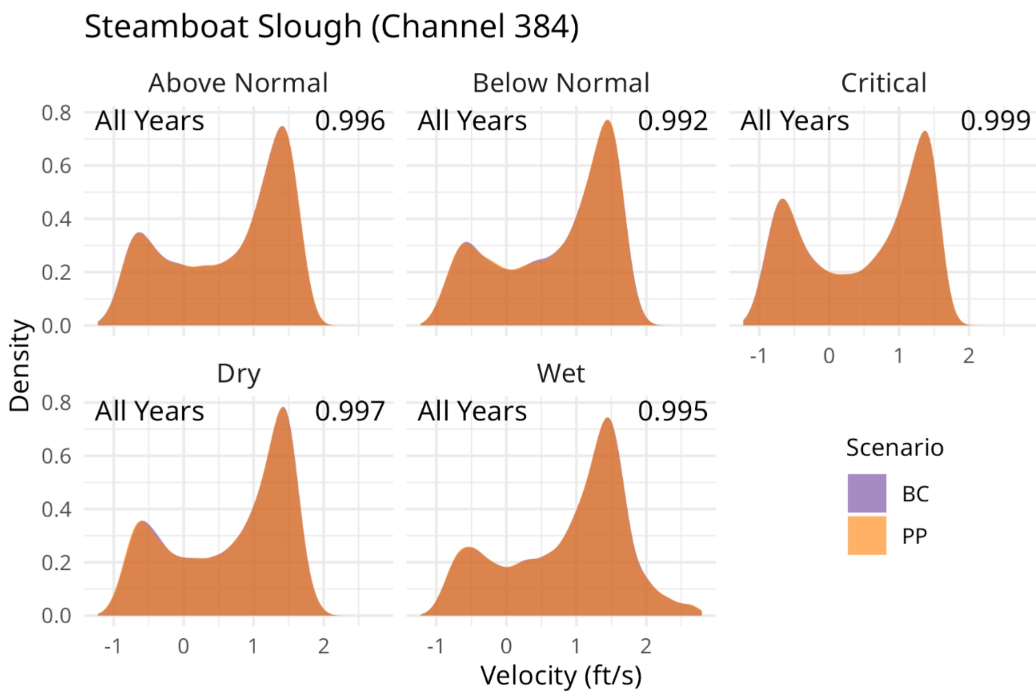
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-72. Velocity Density Distribution for Sevenmile Slough, October.



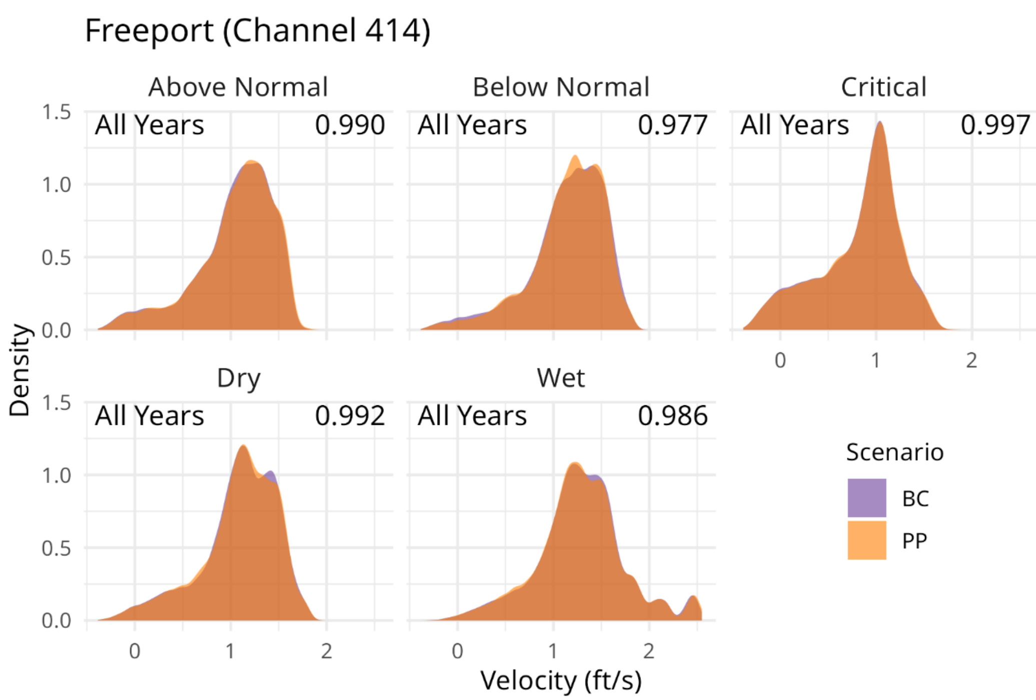
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-73. Velocity Density Distribution for Georgiana Slough, October.



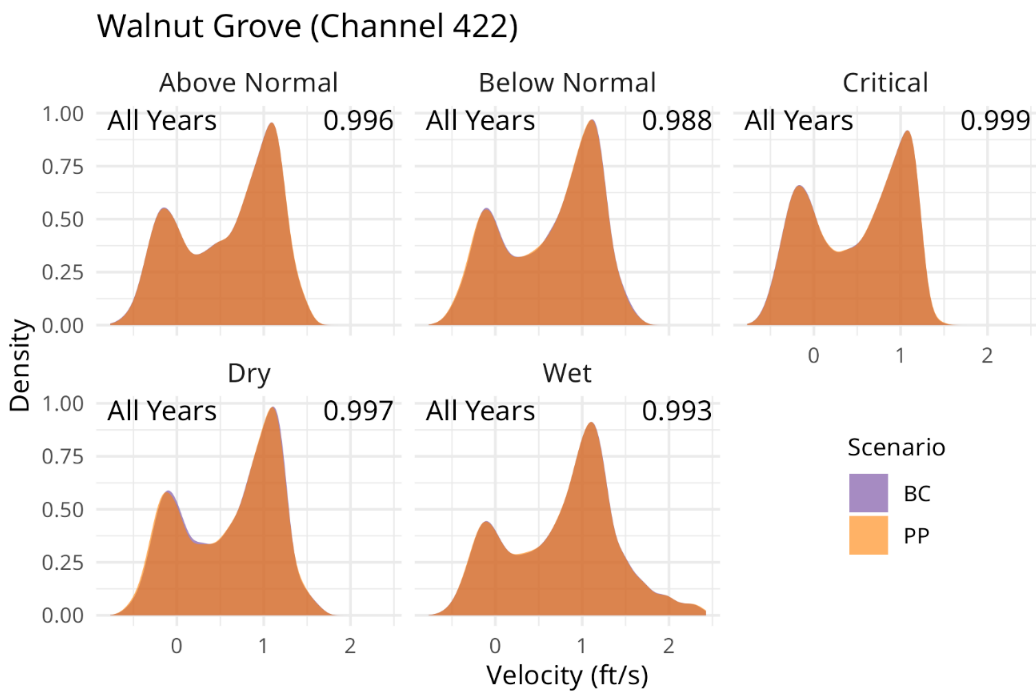
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-74. Velocity Density Distribution for Steamboat Slough, October.



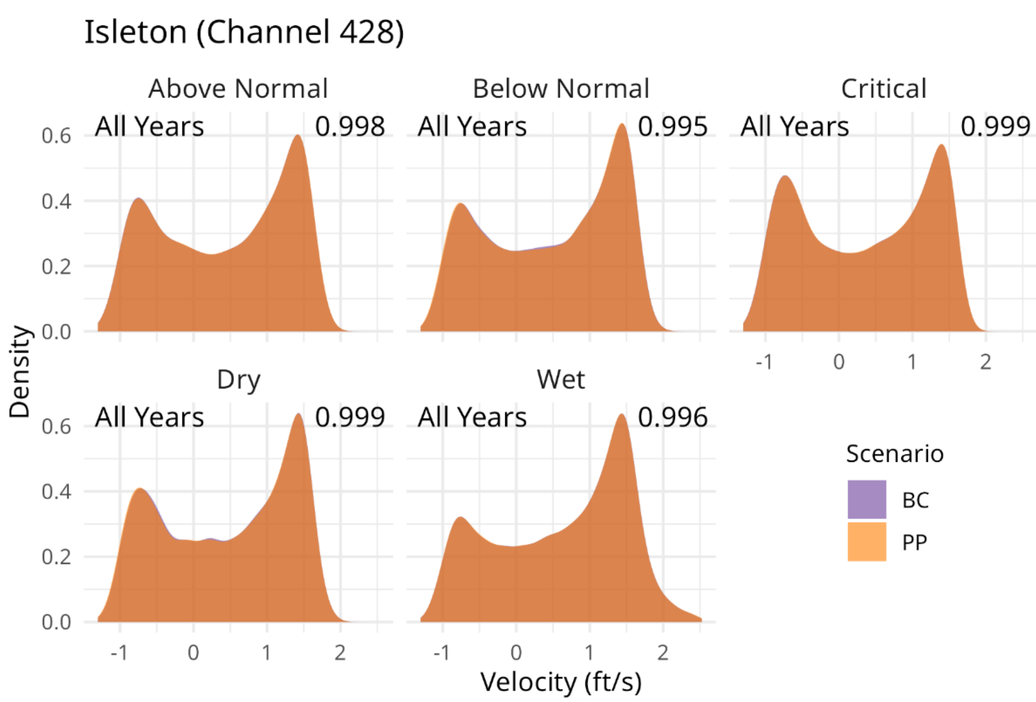
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-75. Velocity Density Distribution for Sacramento River at Freeport, October.



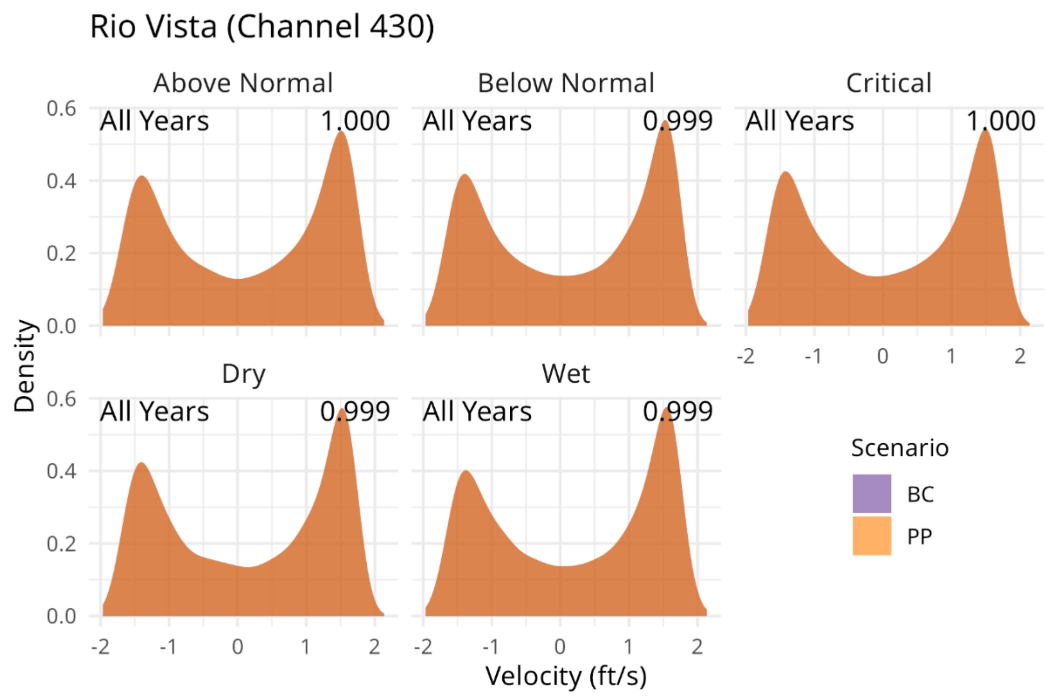
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-76. Velocity Density Distribution for Sacramento River at Walnut Grove, October.



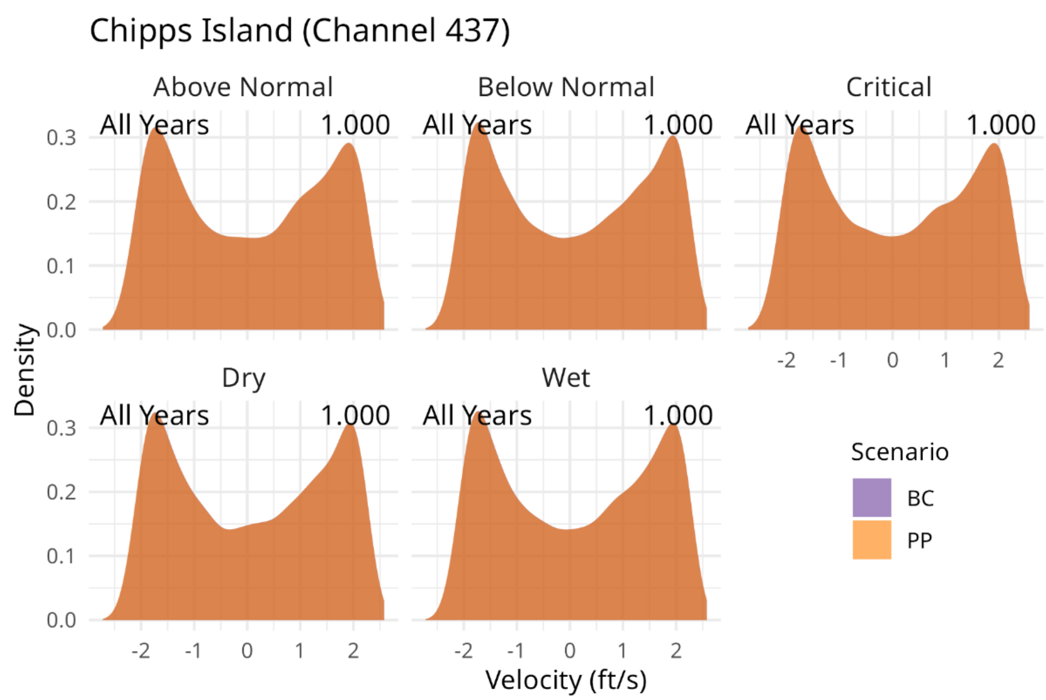
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-77. Velocity Density Distribution for Sacramento River at Isleton, October.



Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

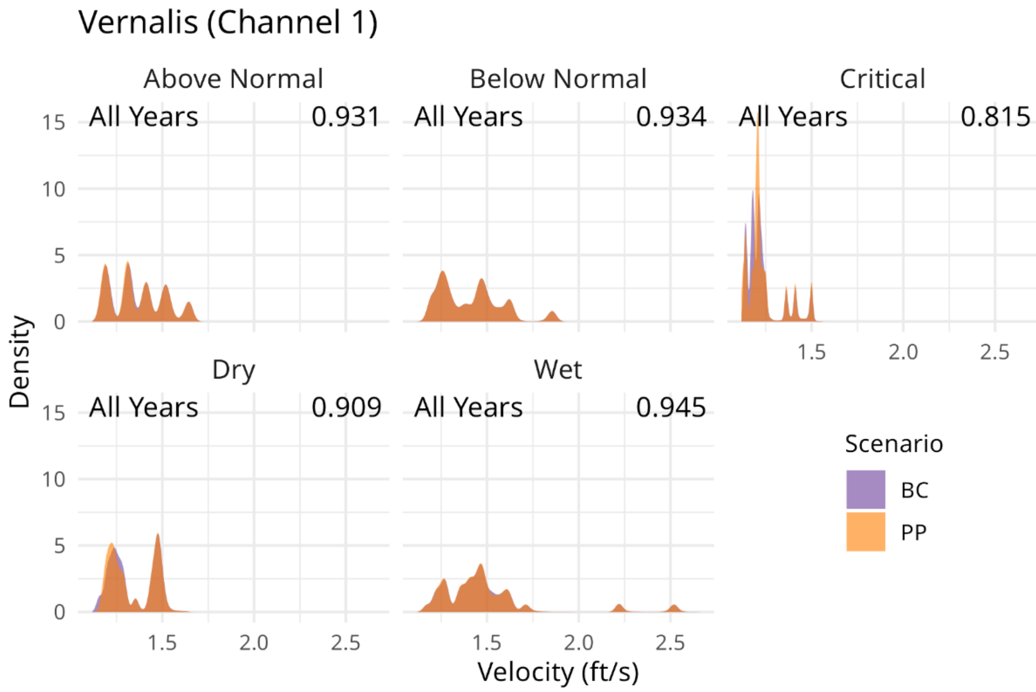
Figure 6B-78. Velocity Density Distribution for Sacramento River at Rio Vista, October.



Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

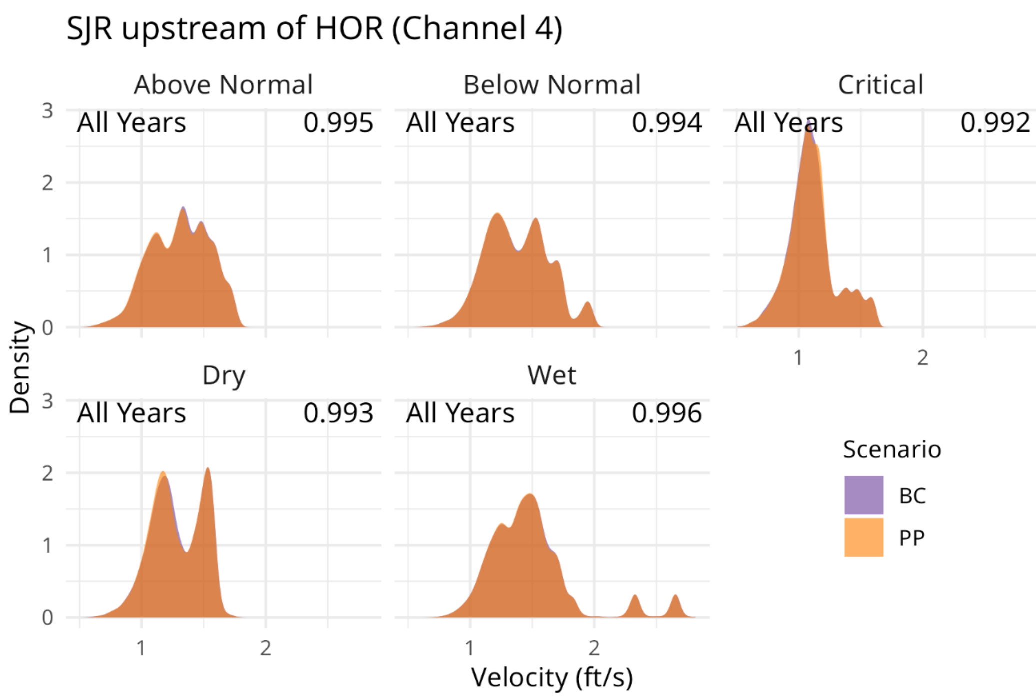
Figure 6B-79. Velocity Density Distribution for Sacramento River at Chipps Island, October.

November



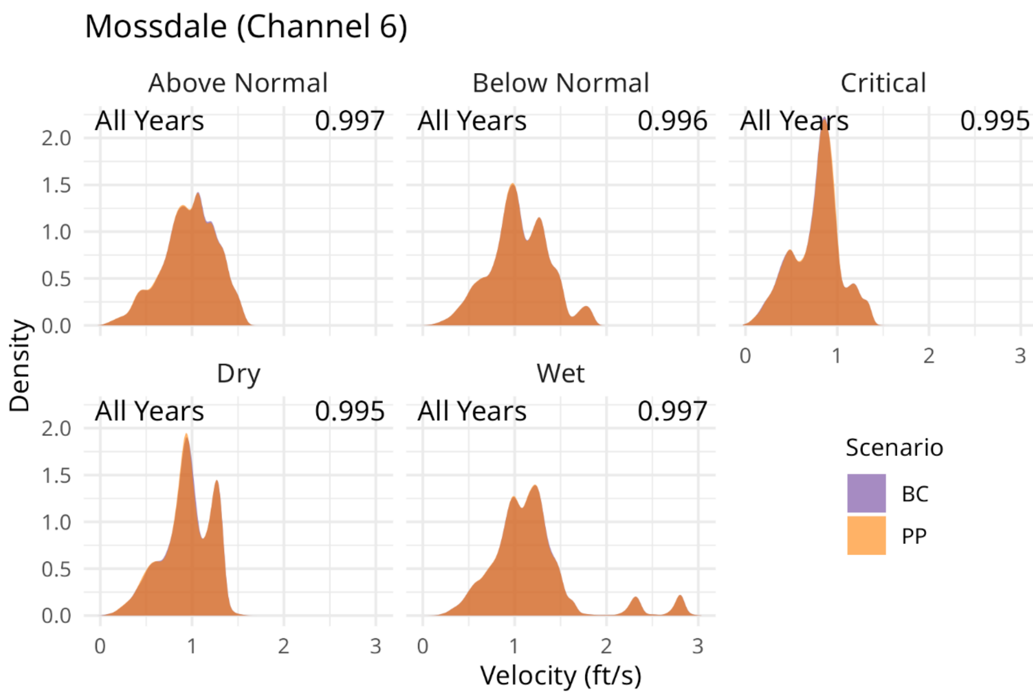
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-80. Velocity Density Distribution for San Joaquin River at Vernalis, November.



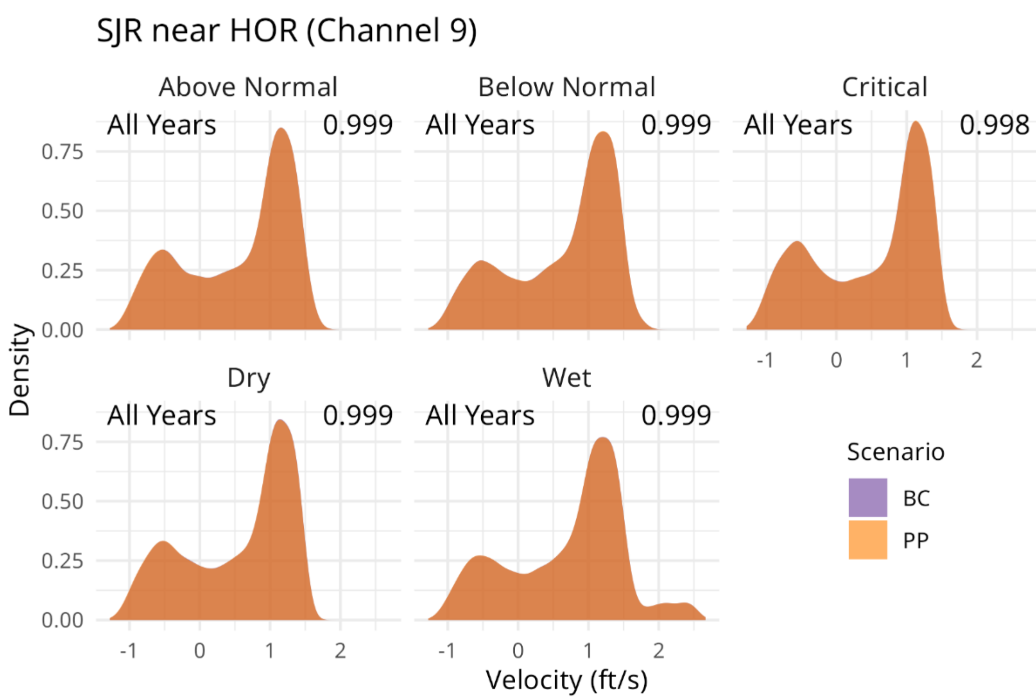
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-81. Velocity Density Distribution for San Joaquin River upstream of Head of Old River, November.



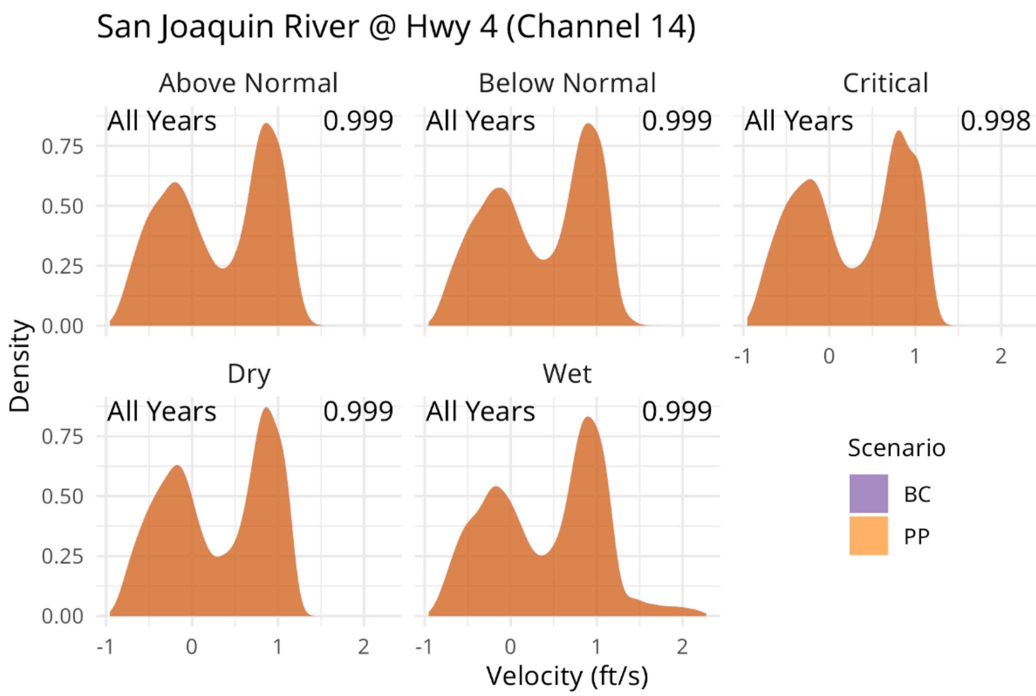
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-82. Velocity Density Distribution for San Joaquin River at Mossdale, November.



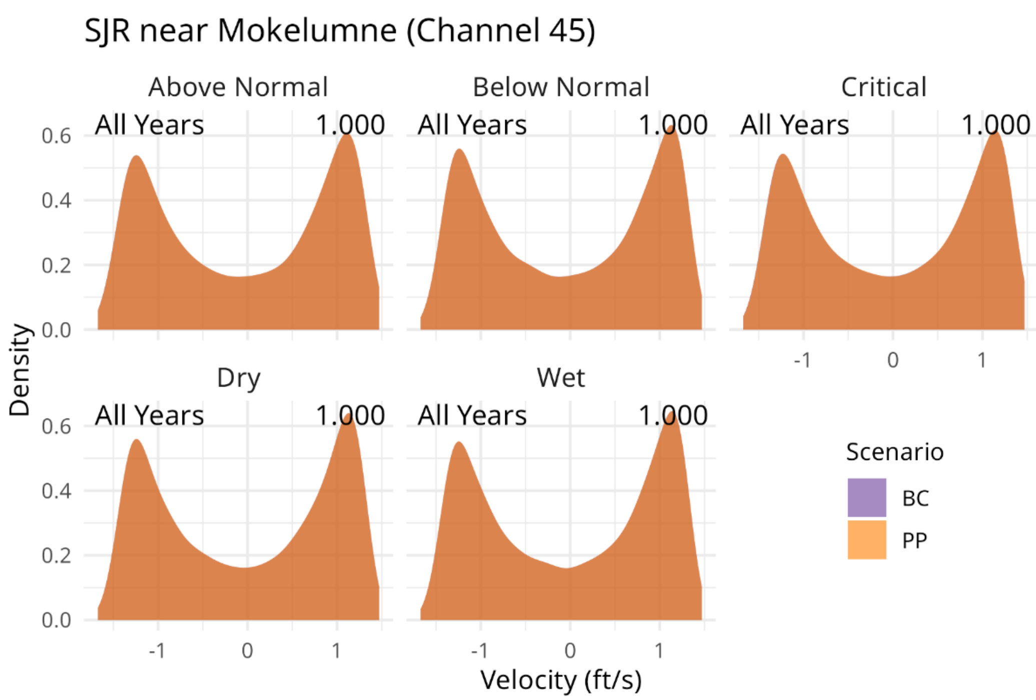
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-83. Velocity Density Distribution for San Joaquin River near Head of Old River, November.



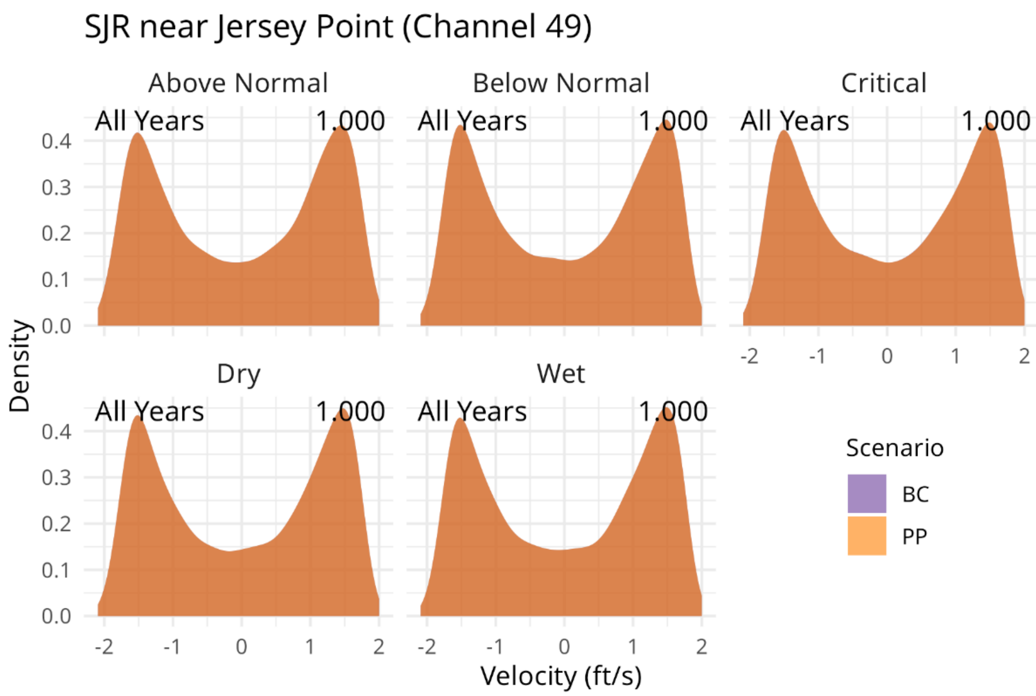
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-84. Velocity Density Distribution for San Joaquin River at Highway 4, November.



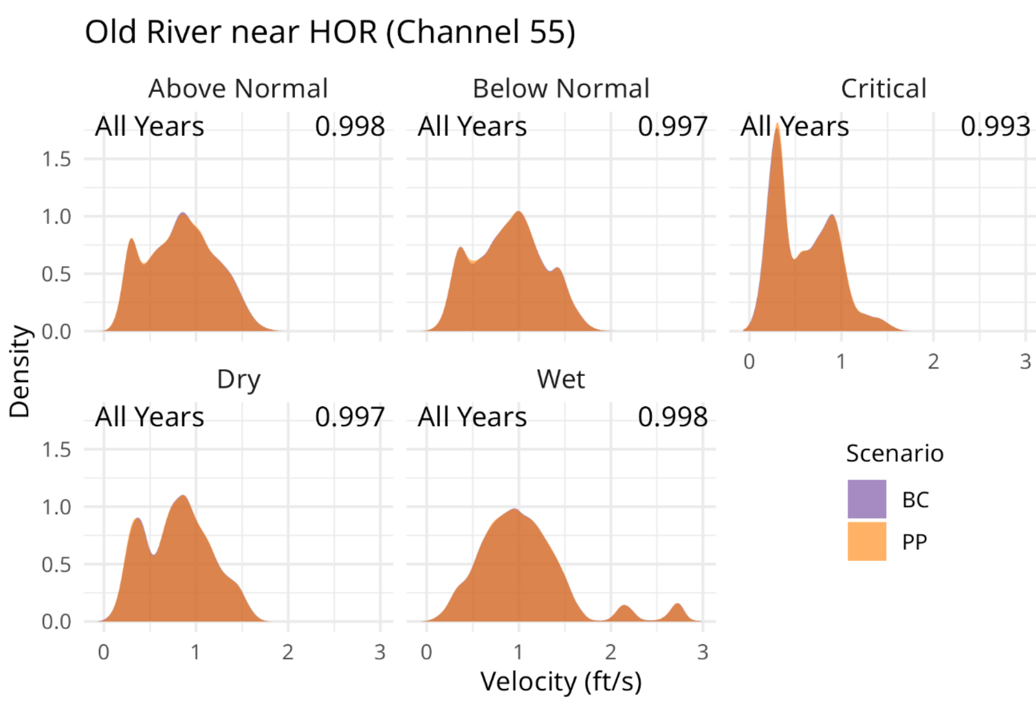
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-85. Velocity Density Distribution for San Joaquin River near Mokelumne River, November.



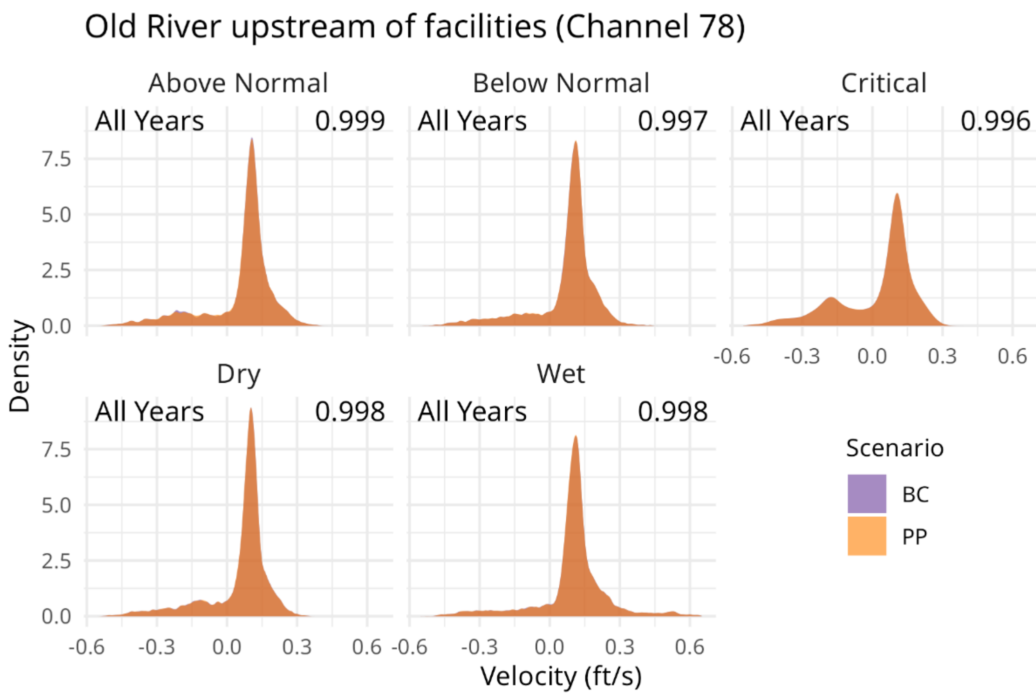
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-86. Velocity Density Distribution for San Joaquin River near Jersey Point, November.



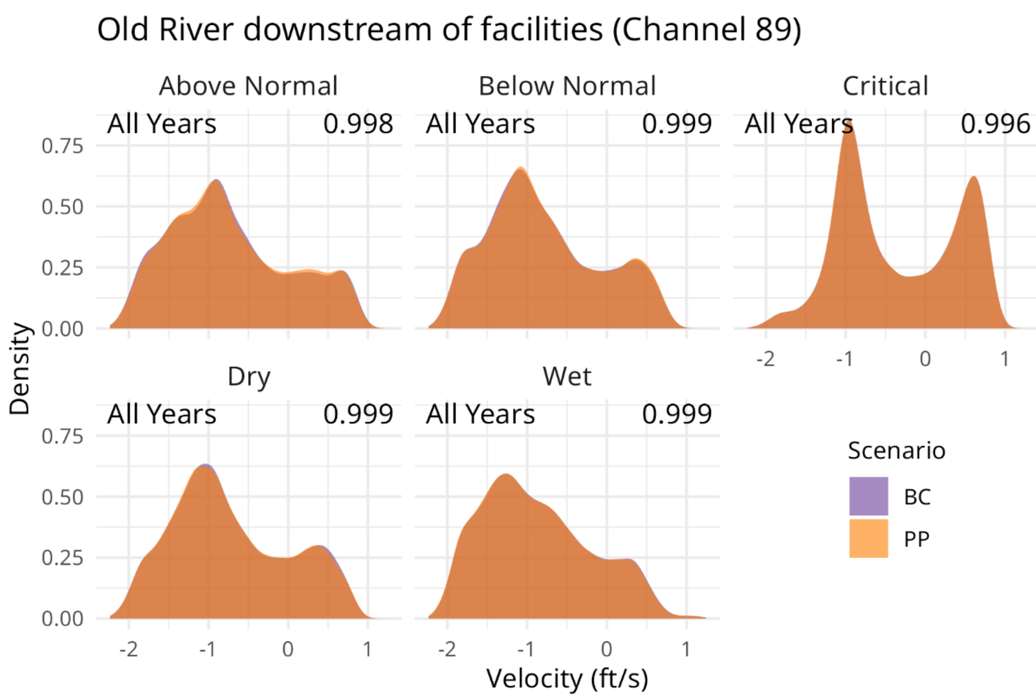
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-87. Velocity Density Distribution for Old River near Head of Old River, November.



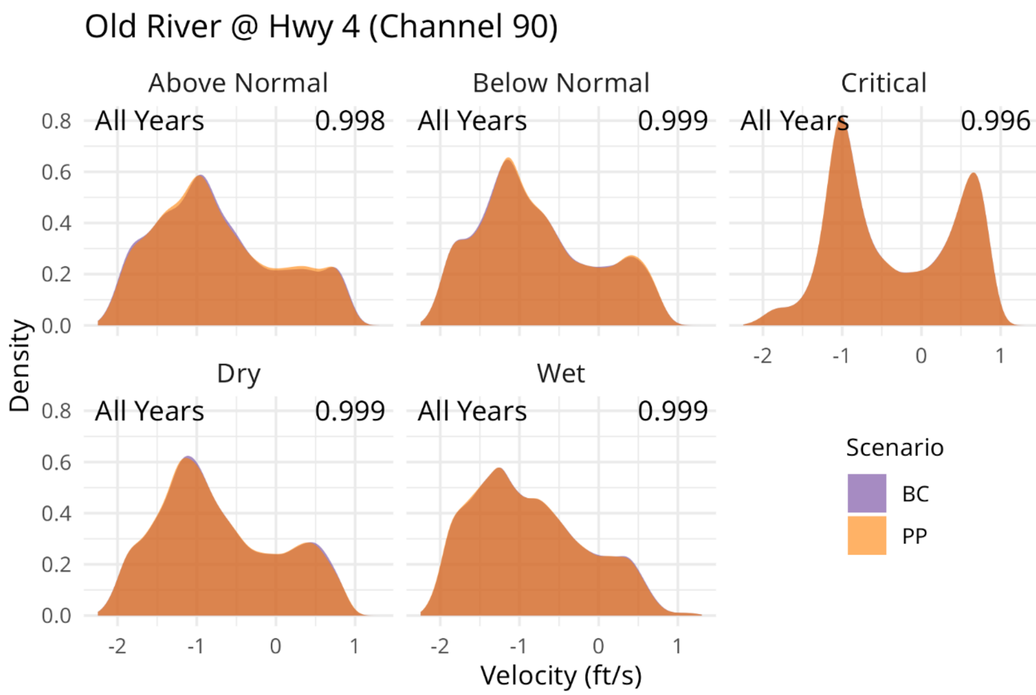
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-88. Velocity Density Distribution for Old River Upstream of the South Delta Export Facilities, November.



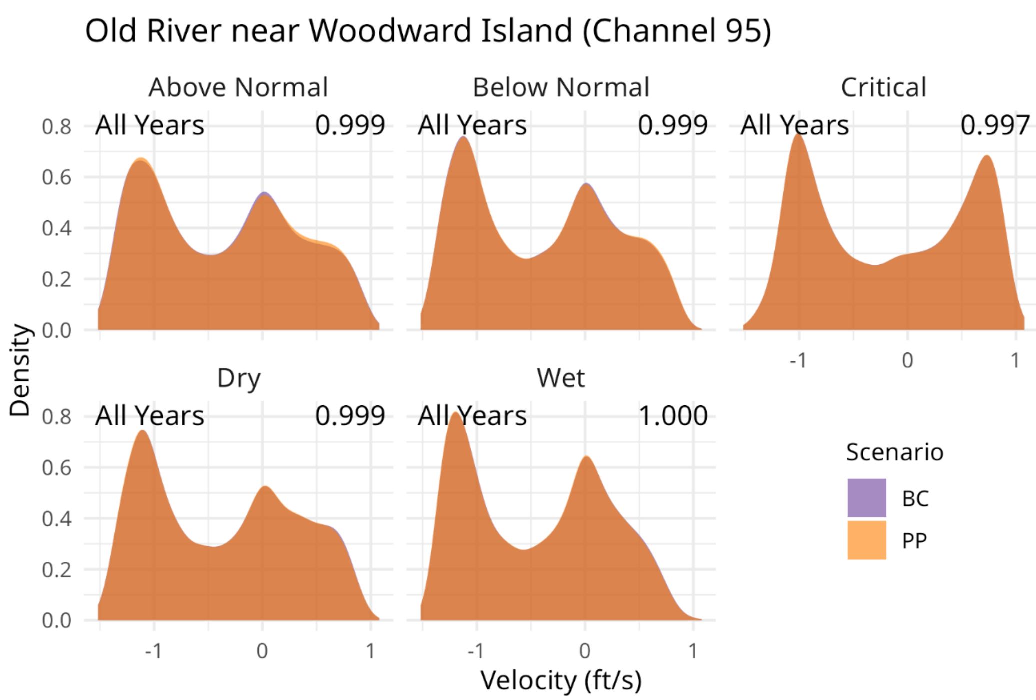
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-89. Velocity Density Distribution for Old River Downstream of the South Delta Export Facilities, November.



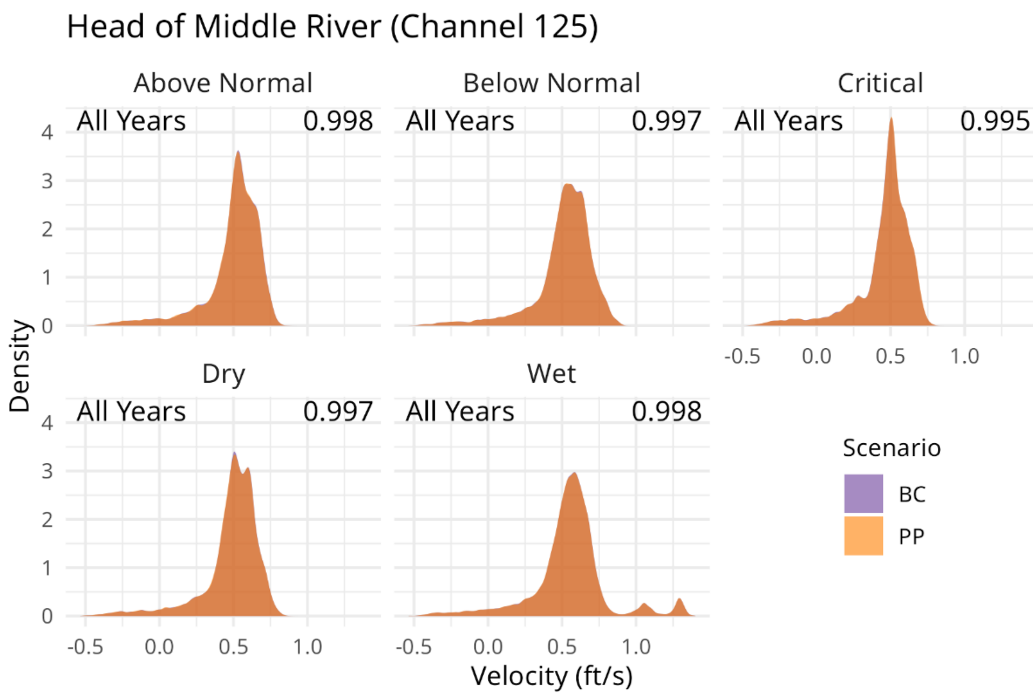
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-90. Velocity Density Distribution for Old River at Highway 4, November.



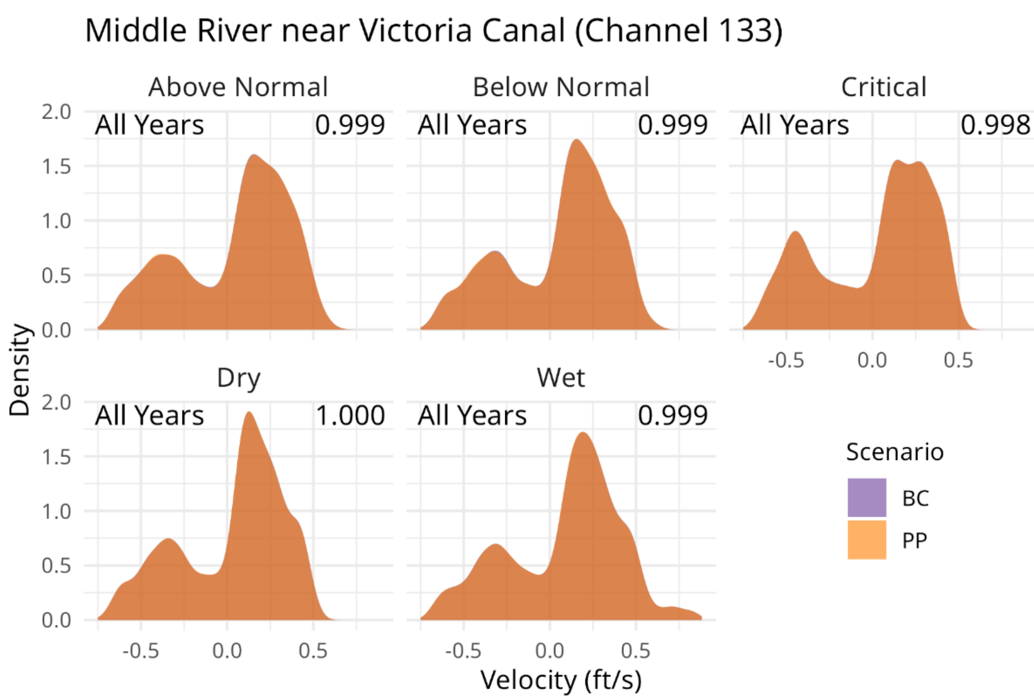
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-91. Velocity Density Distribution for Old River near Woodward Island, November.



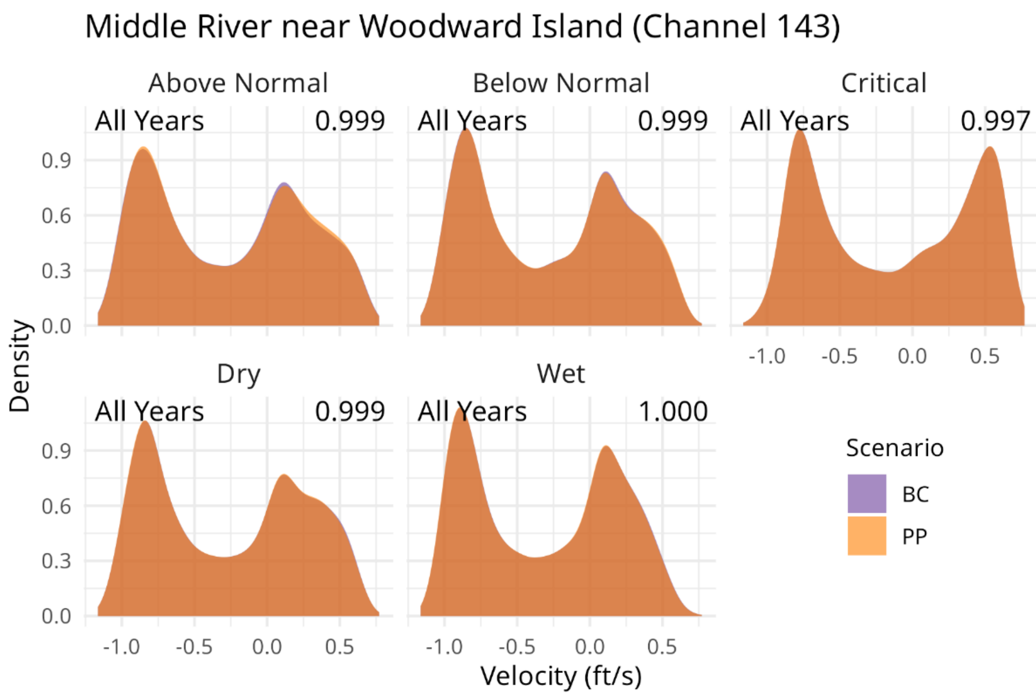
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-92. Velocity Density Distribution for Head of Middle River (Channel 125), November.



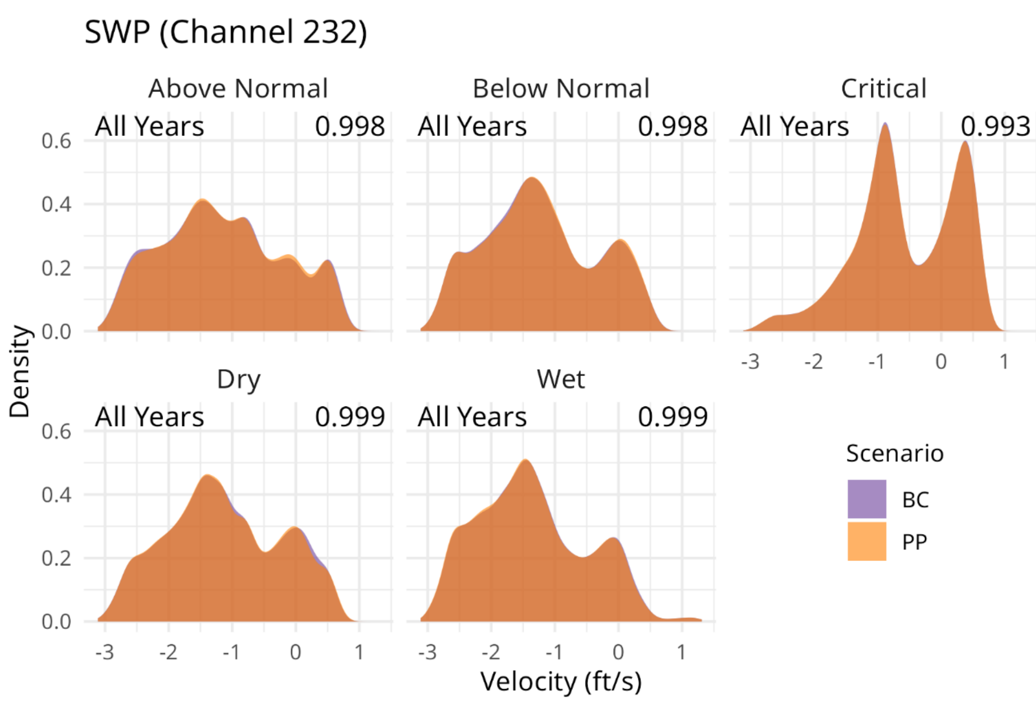
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-93. Velocity Density Distribution for Middle River near Victoria Canal (Channel 133), November.



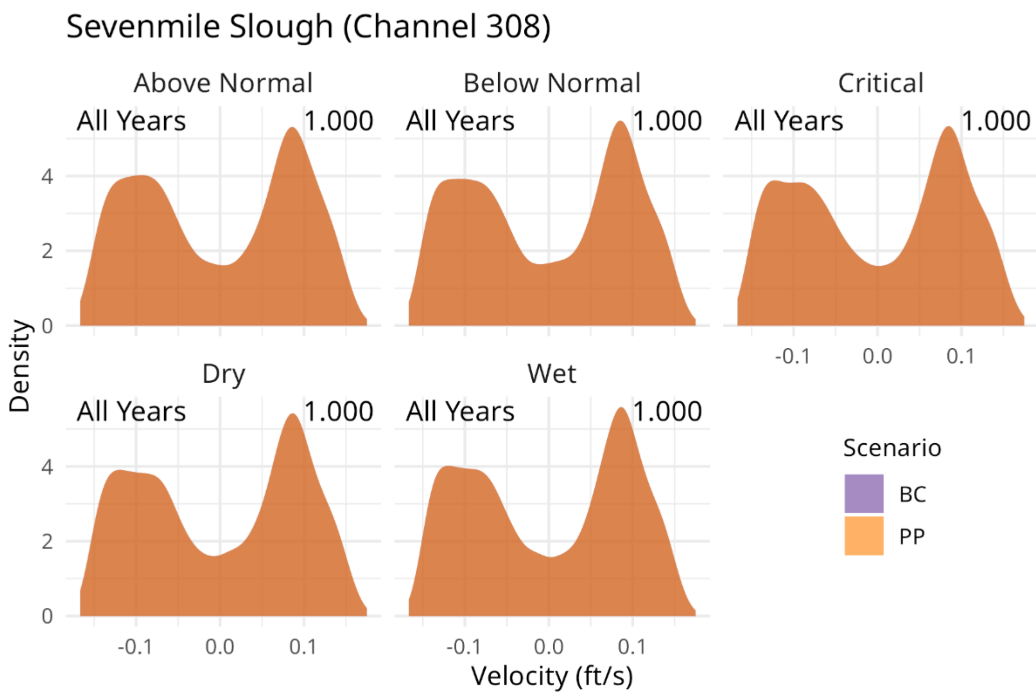
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-94. Velocity Density Distribution for Middle River near Woodward Island, November.



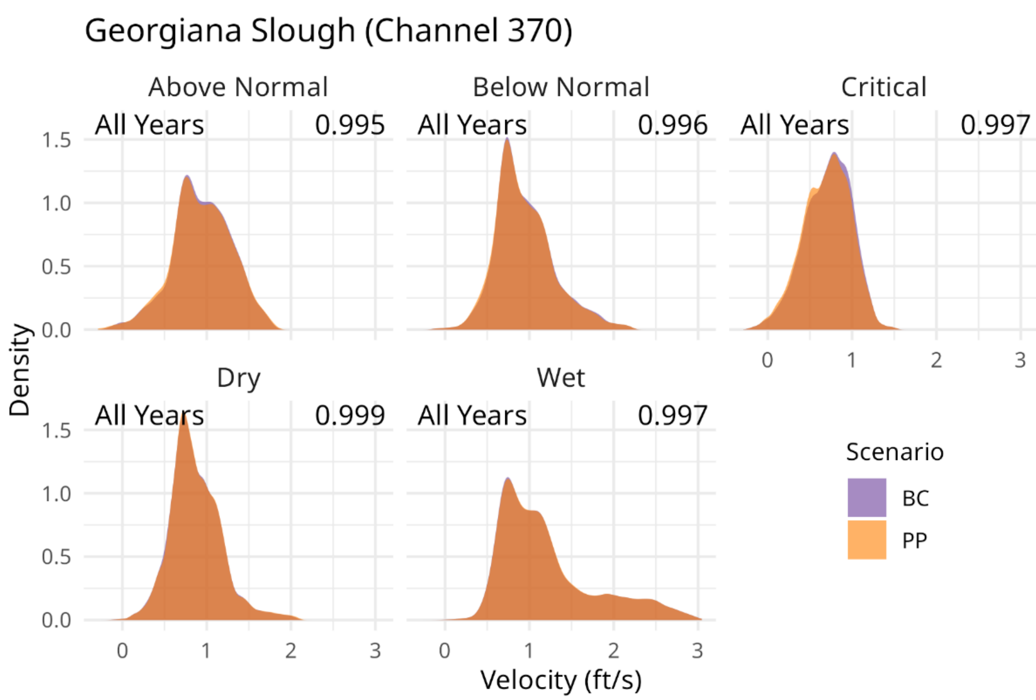
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-95. Velocity Density Distribution for State Water Project, November.



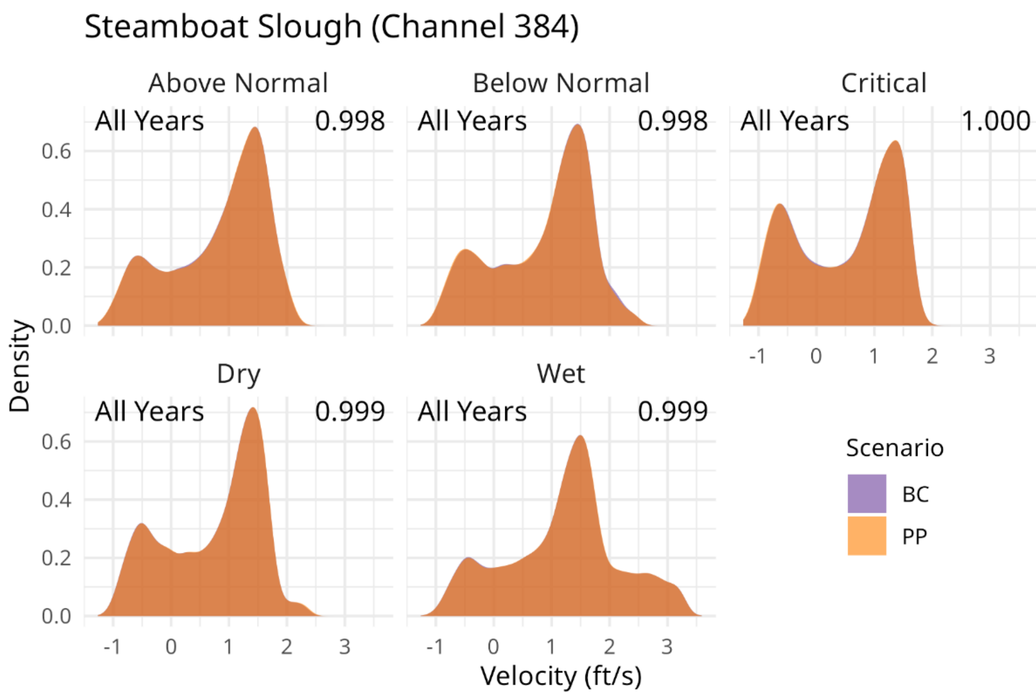
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-96. Velocity Density Distribution for Sevenmile Slough, November.



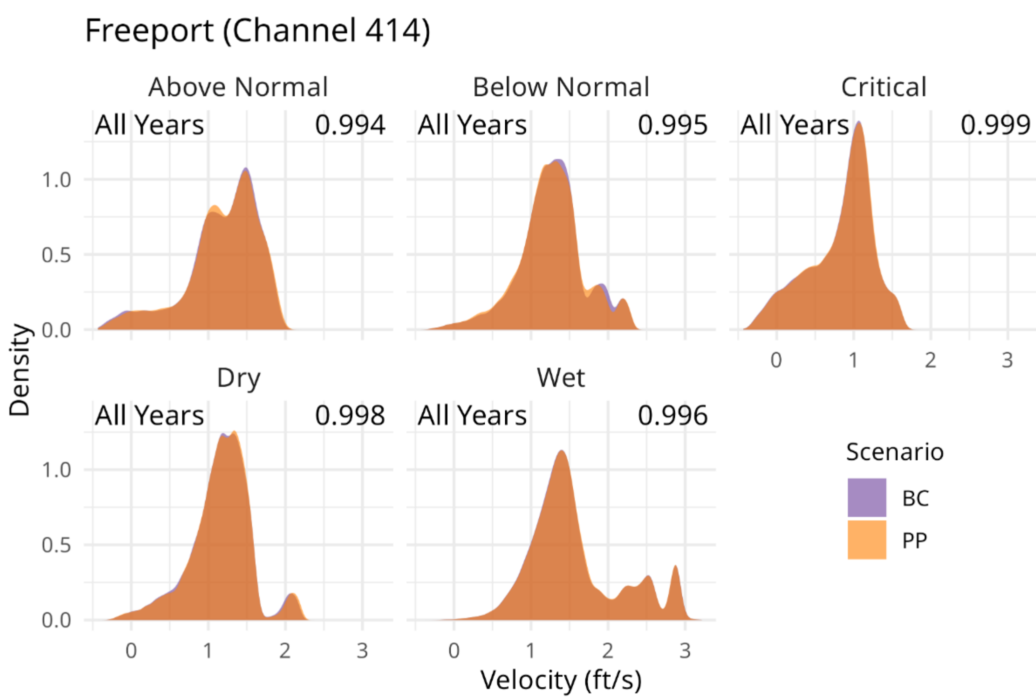
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-97. Velocity Density Distribution for Georgiana Slough, November.



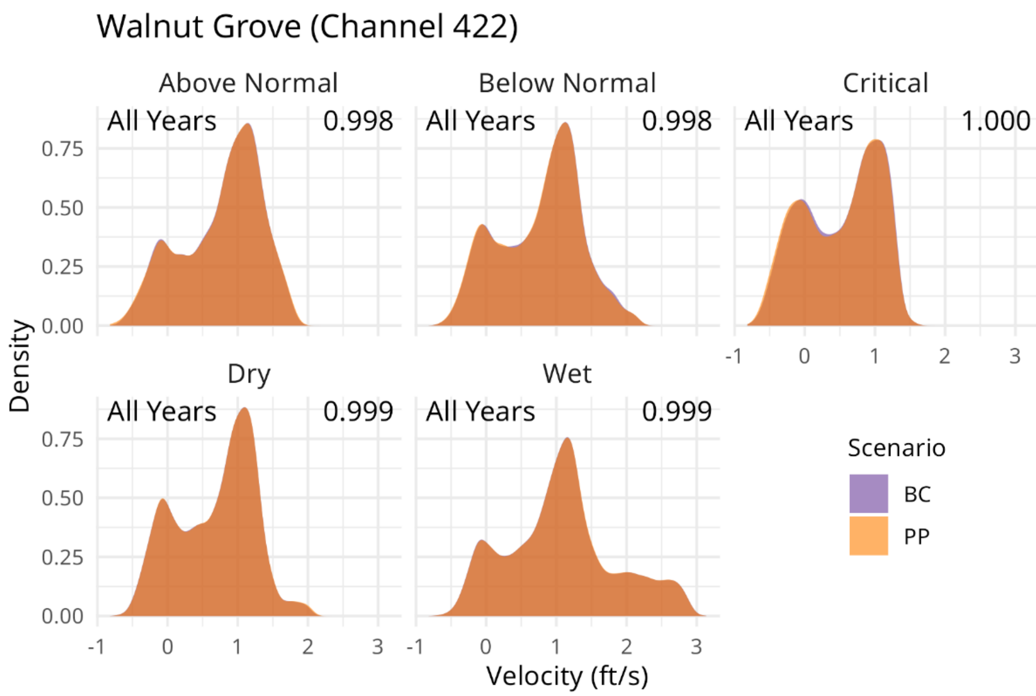
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-98. Velocity Density Distribution for Steamboat Slough, November.



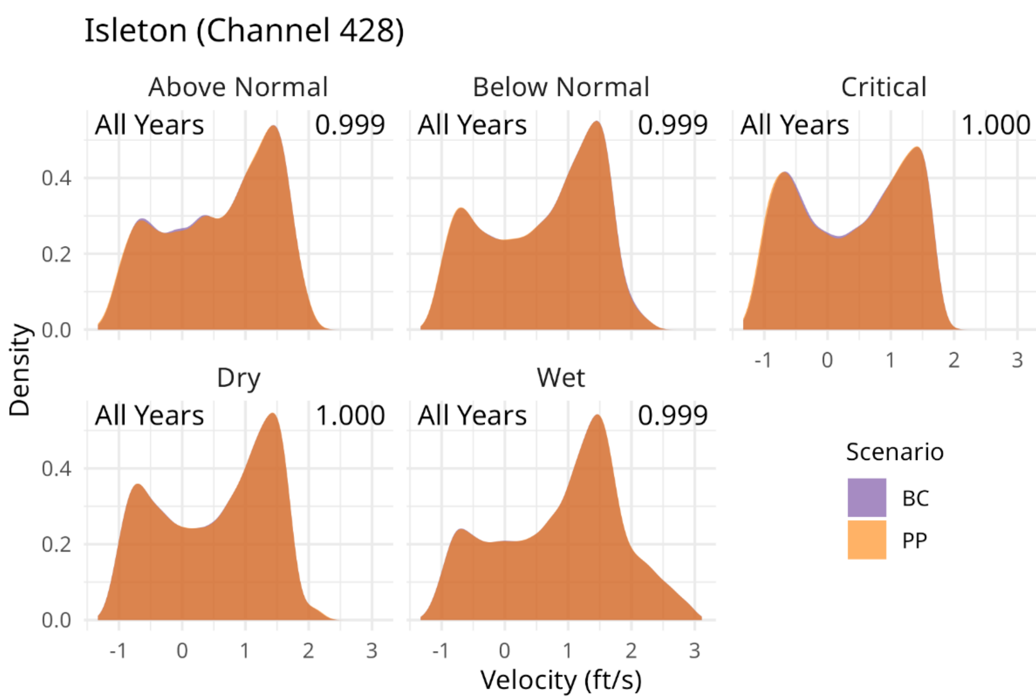
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-99. Velocity Density Distribution for Sacramento River at Freeport, November.



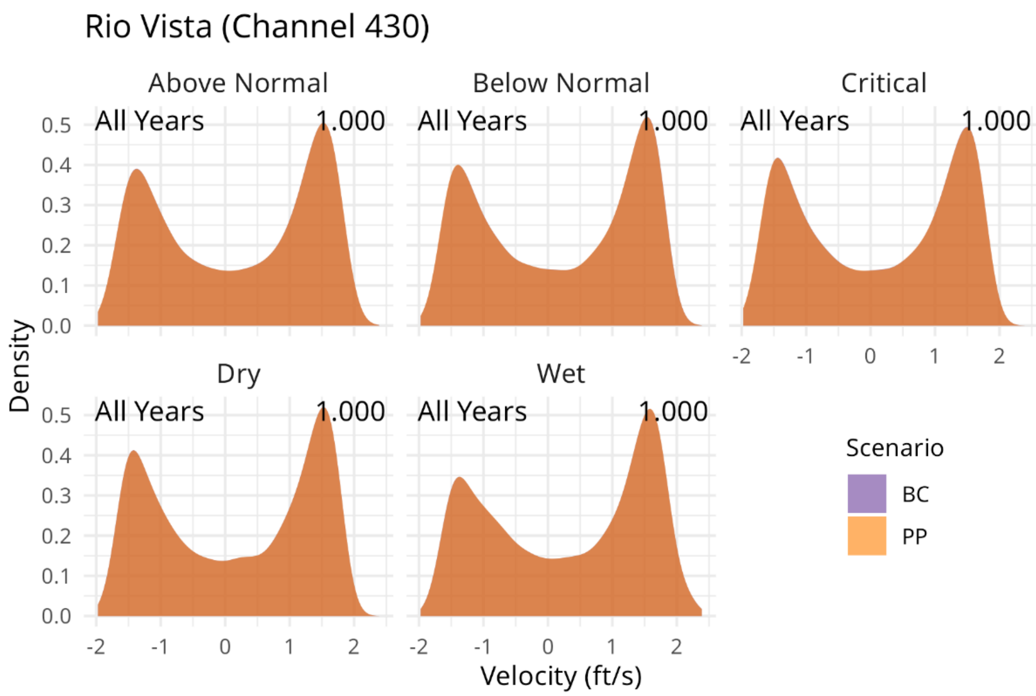
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-100. Velocity Density Distribution for Sacramento River at Walnut Grove, November.



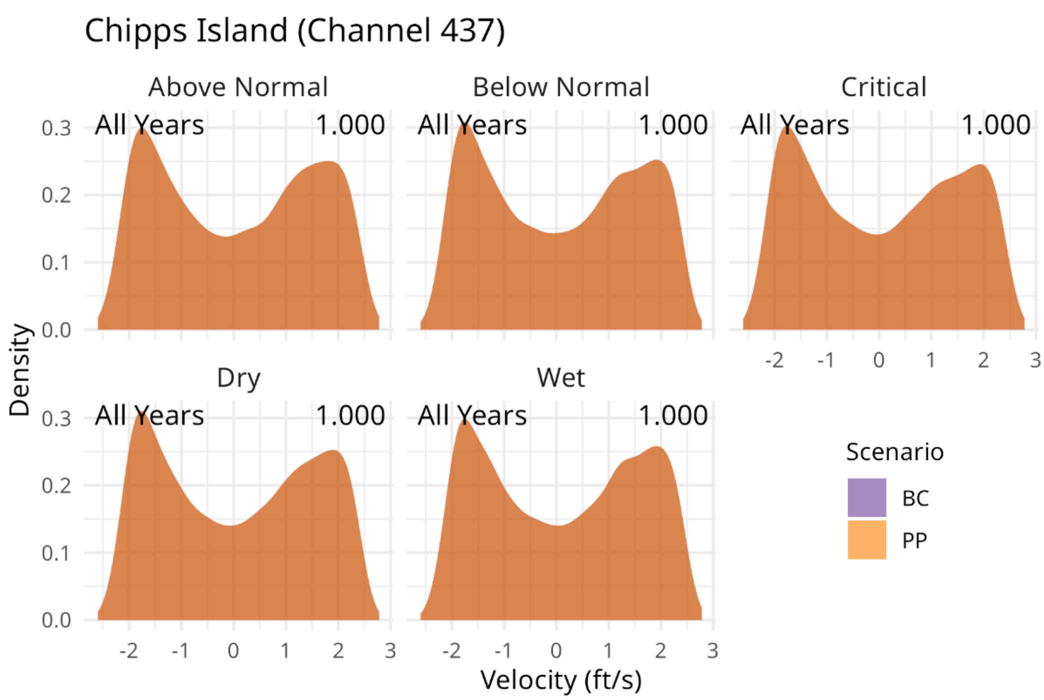
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-101. Velocity Density Distribution for Sacramento River at Isleton, November.



Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

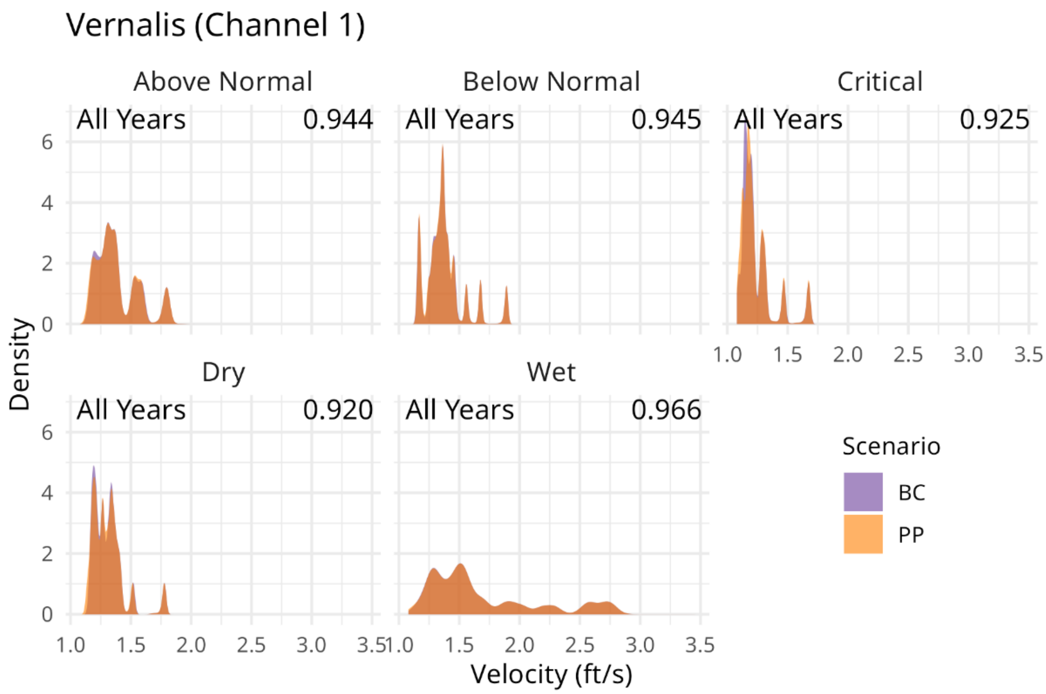
Figure 6B-102. Velocity Density Distribution for Sacramento River at Rio Vista, November.



Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

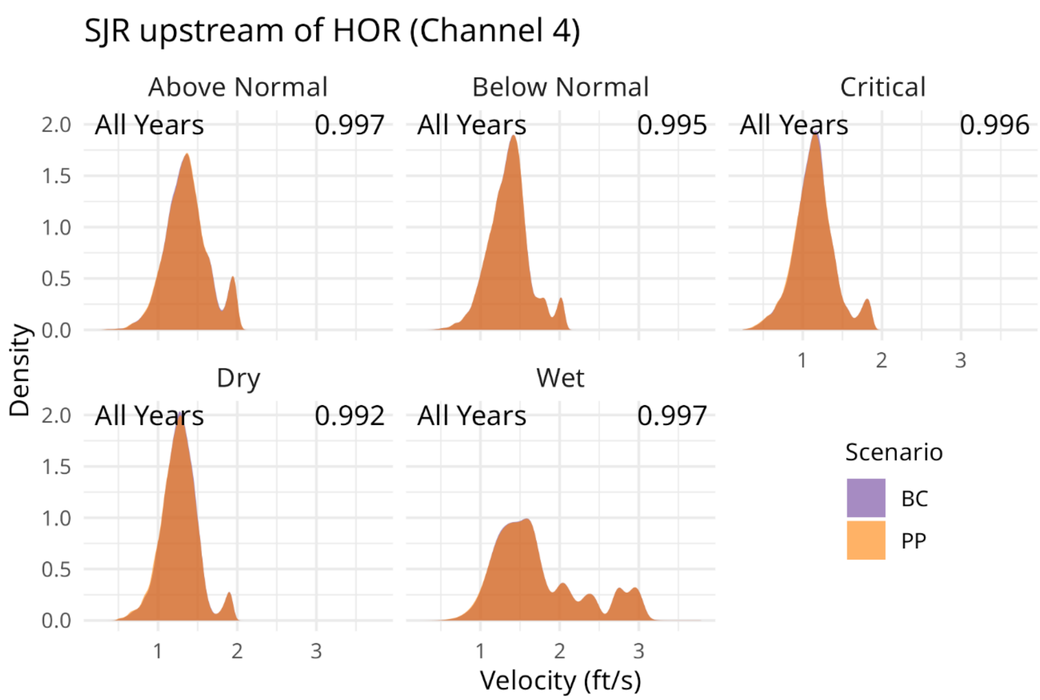
Figure 6B-103. Velocity Density Distribution for Sacramento River at Chipps Island, November.

December



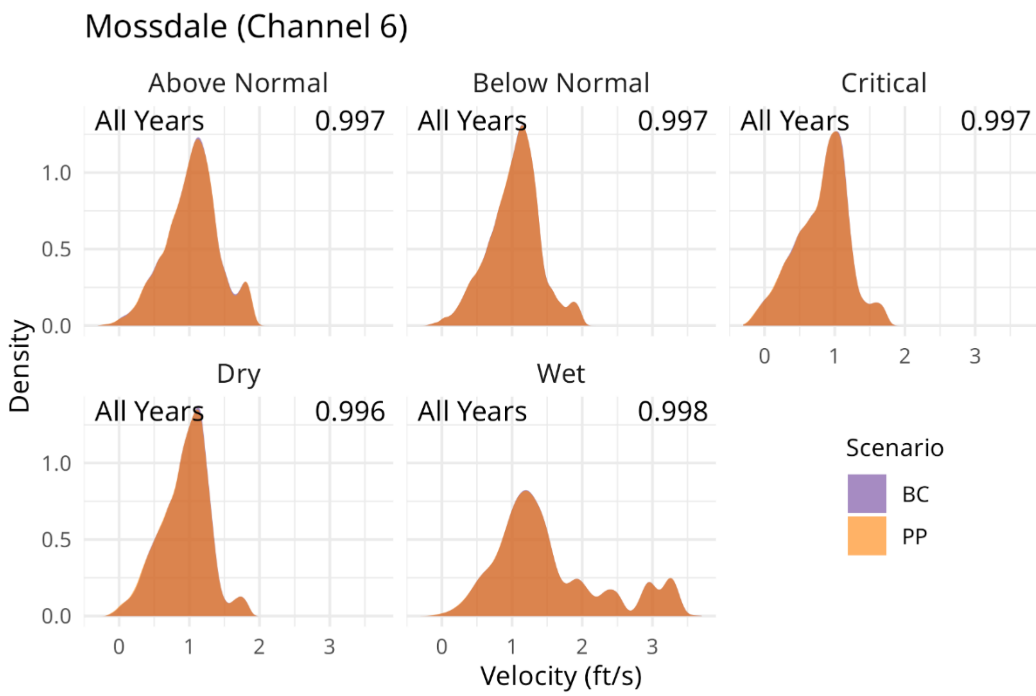
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-104. Velocity Density Distribution for San Joaquin River at Vernalis, December.



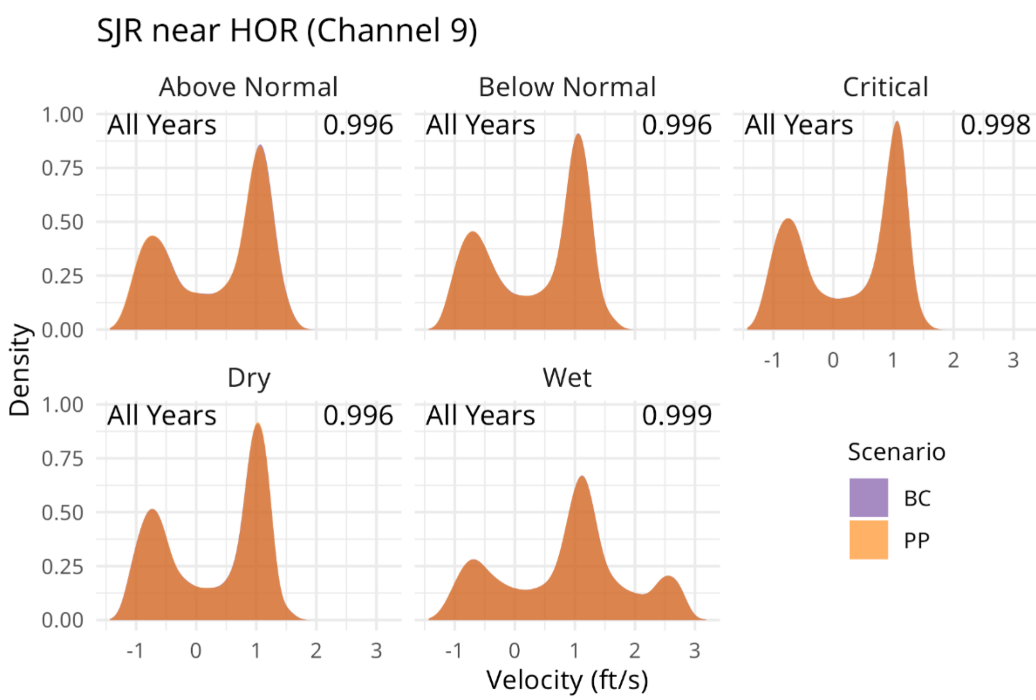
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-105. Velocity Density Distribution for San Joaquin River upstream of Head of Old River, December.



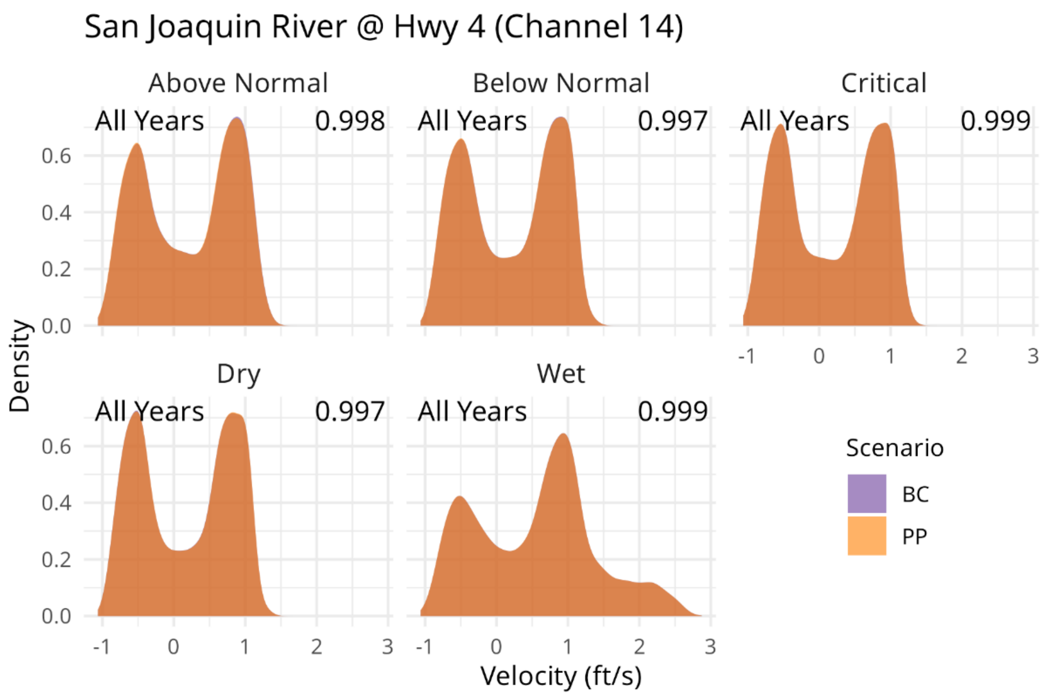
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-106. Velocity Density Distribution for San Joaquin River at Mossdale, December.



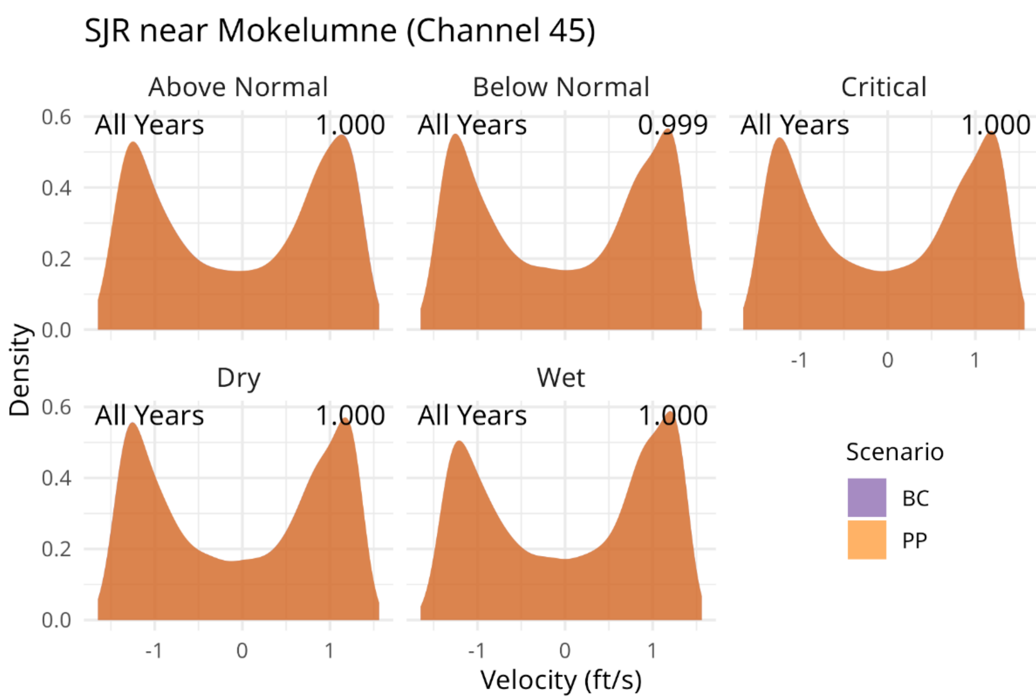
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-107. Velocity Density Distribution for San Joaquin River near Head of Old River, December.



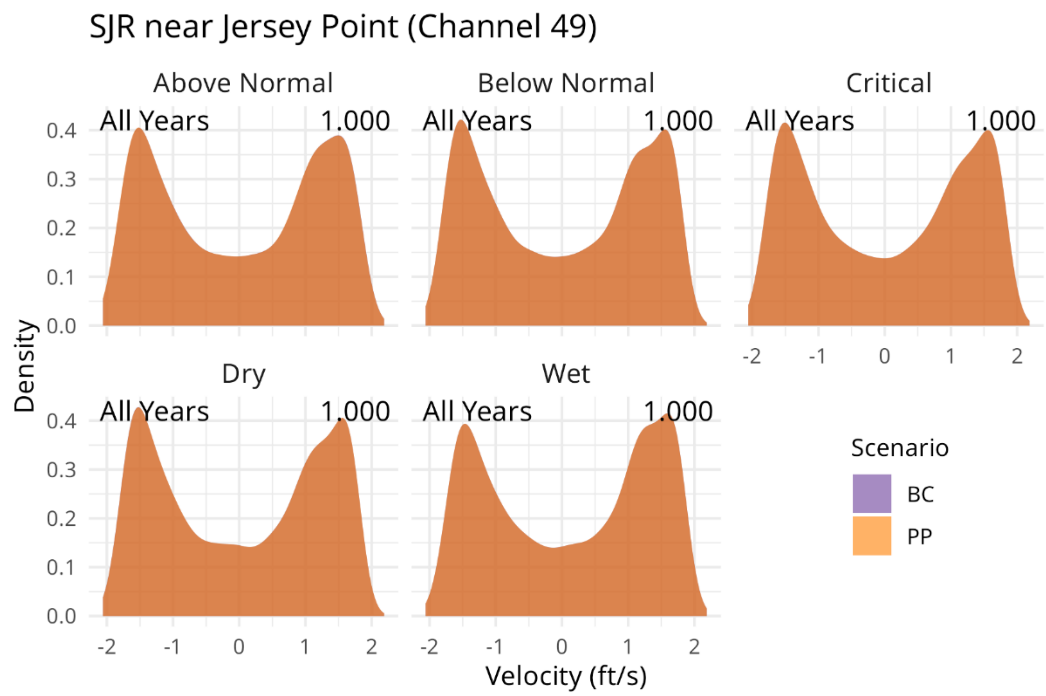
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-108. Velocity Density Distribution for San Joaquin River at Highway 4, December.



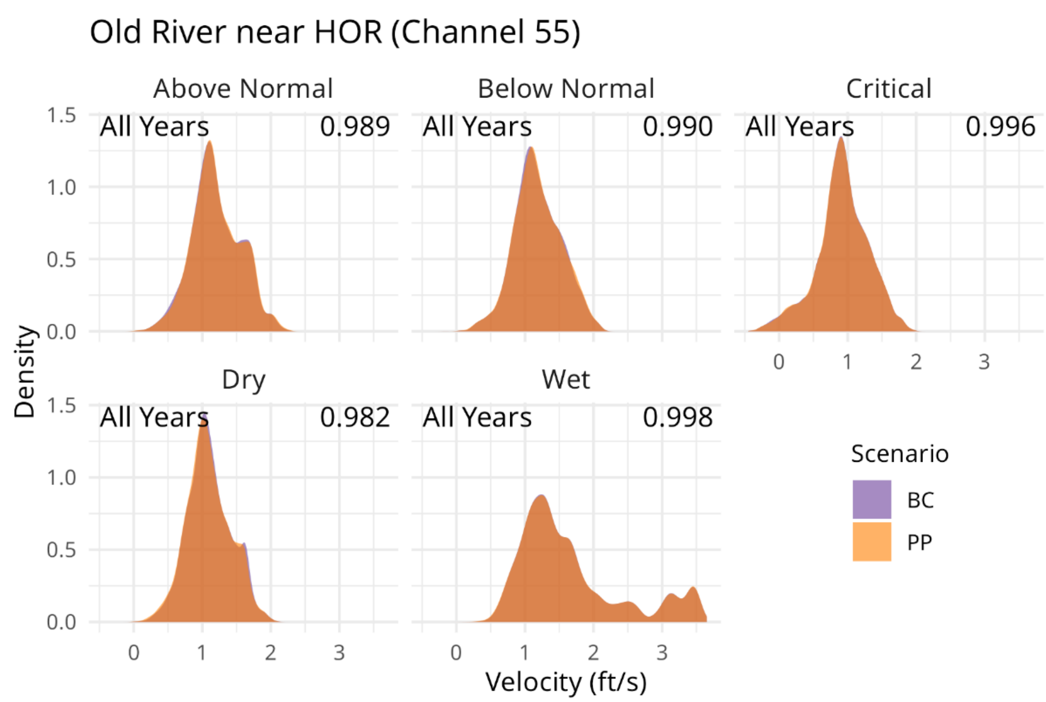
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-109. Velocity Density Distribution for San Joaquin River near Mokelumne River, December.



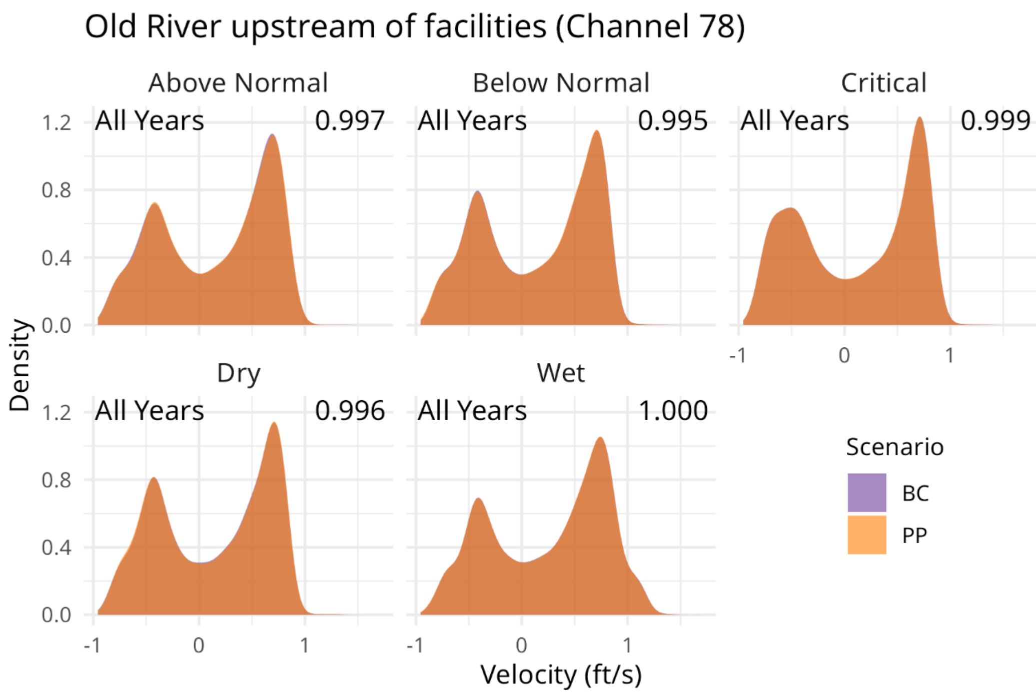
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-110. Velocity Density Distribution for San Joaquin River near Jersey Point, December.



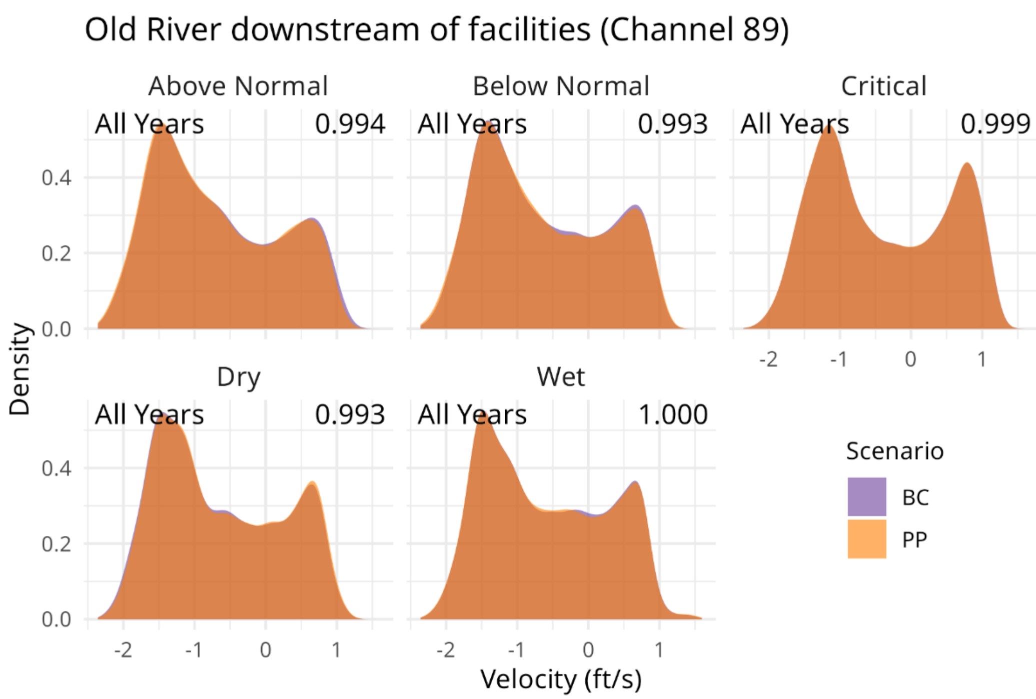
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-111. Velocity Density Distribution for Old River near Head of Old River, December.



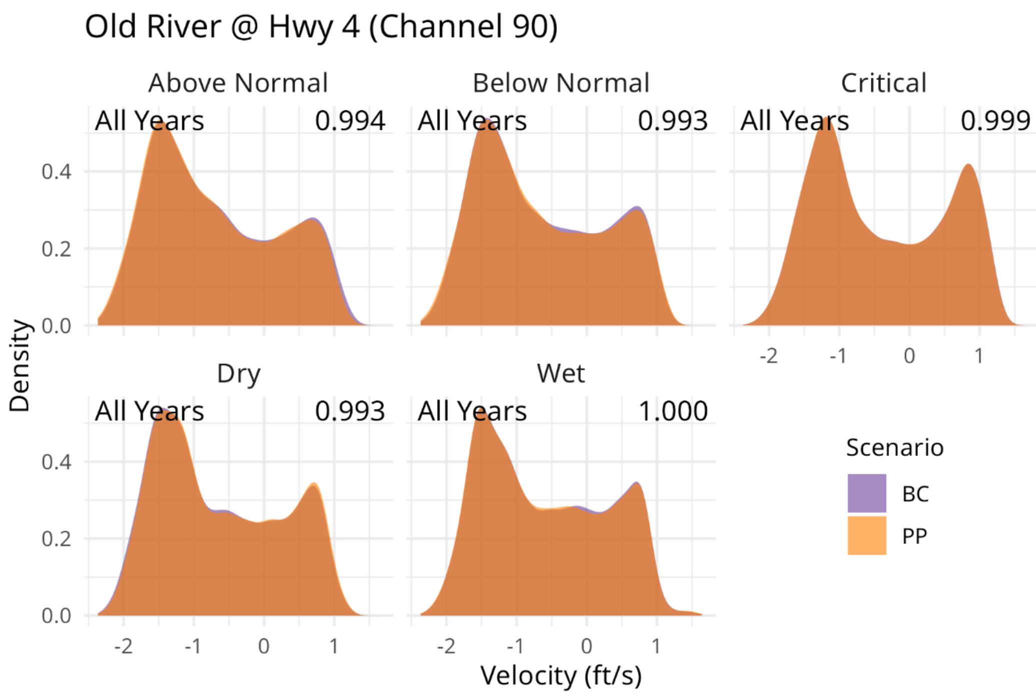
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-112. Velocity Density Distribution for Old River Upstream of the South Delta Export Facilities, December.



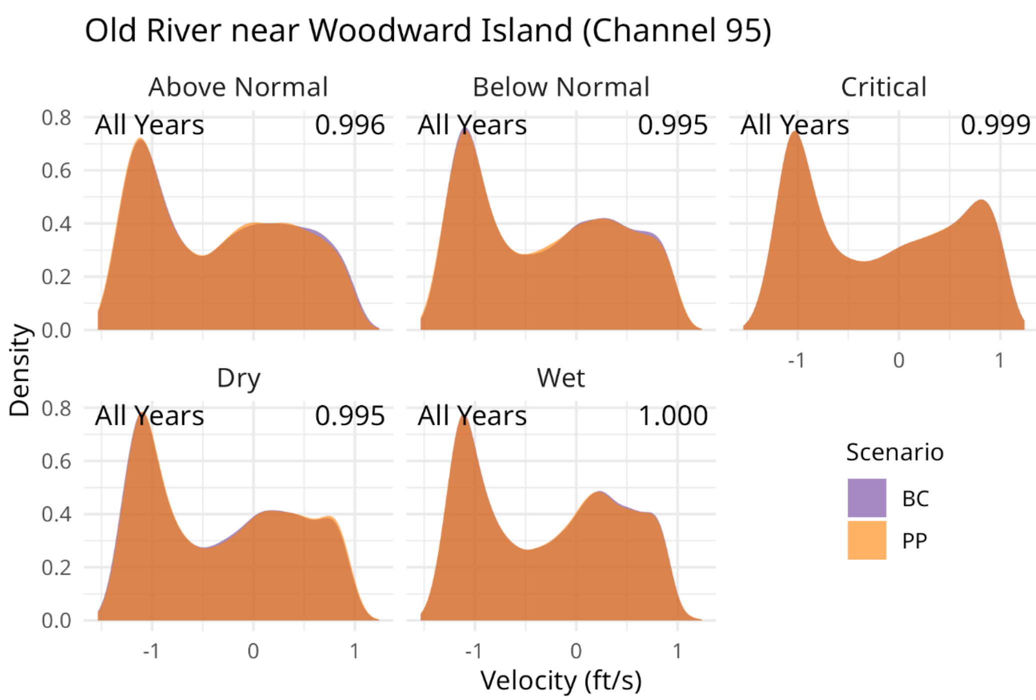
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-113. Velocity Density Distribution for Old River Downstream of the South Delta Export Facilities, December.



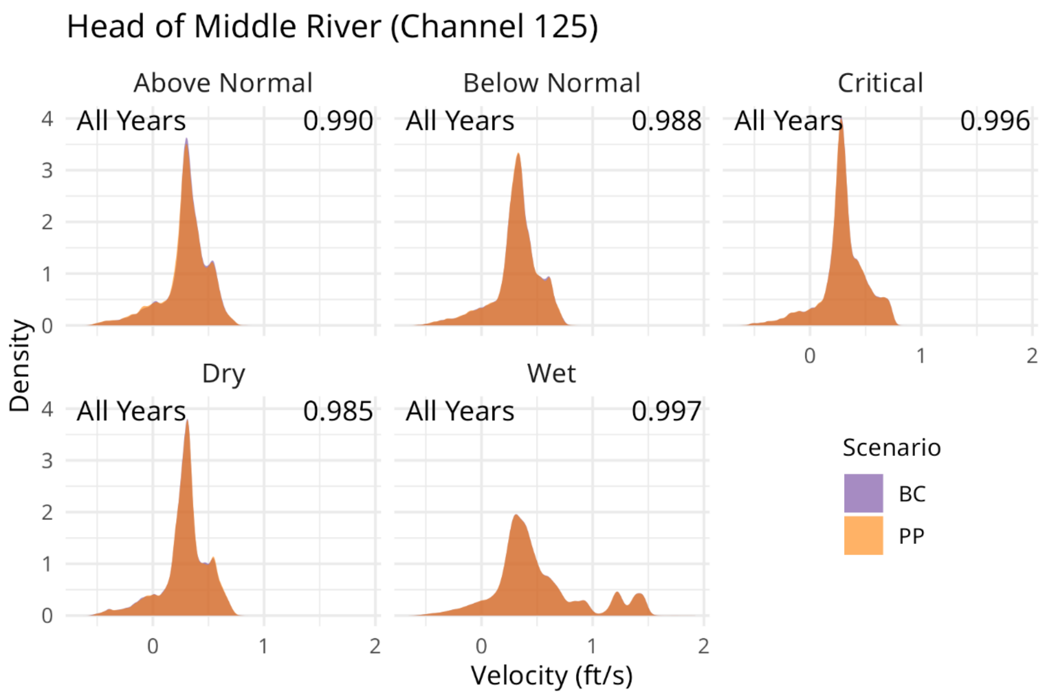
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-114. Velocity Density Distribution for Old River at Highway 4, December.



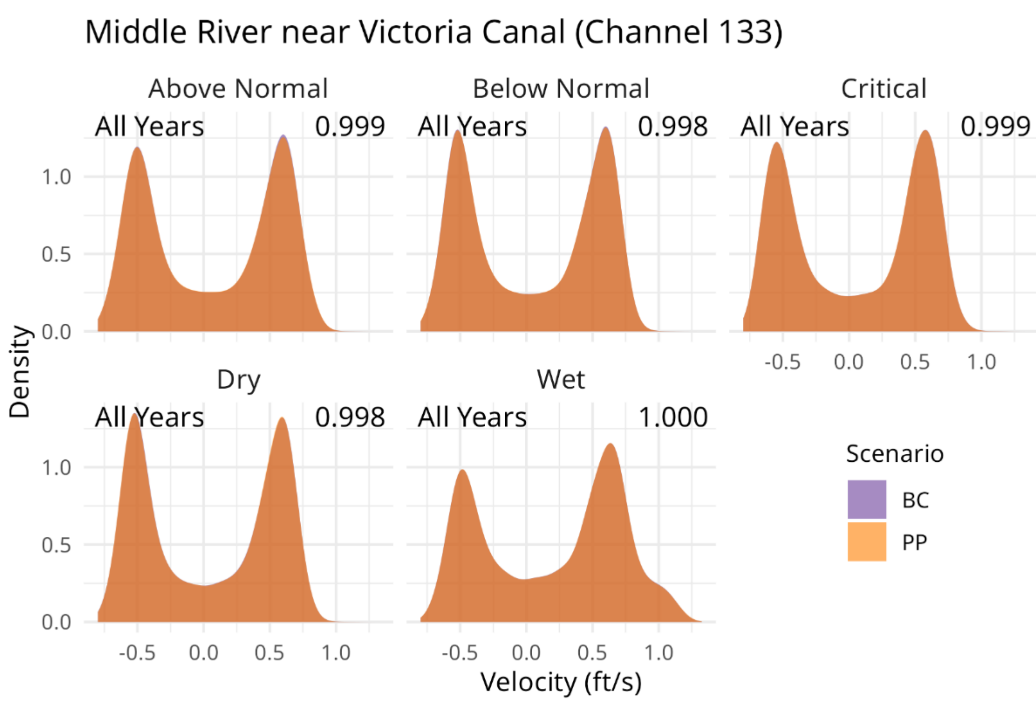
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-115. Velocity Density Distribution for Old River near Woodward Island, December.



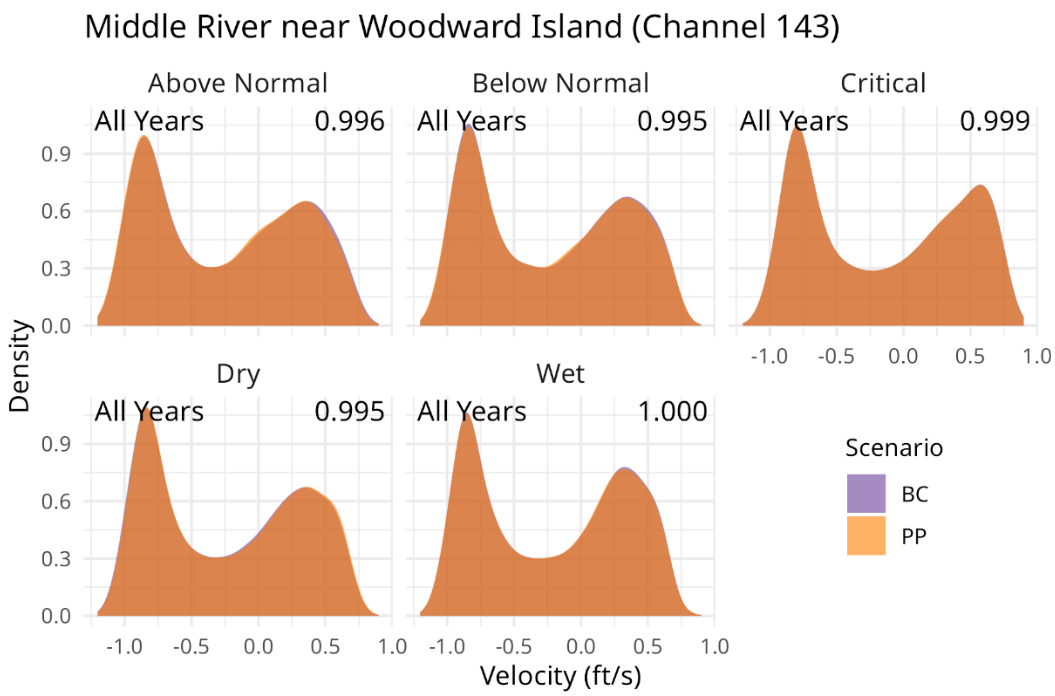
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-116. Velocity Density Distribution for Head of Middle River, December.



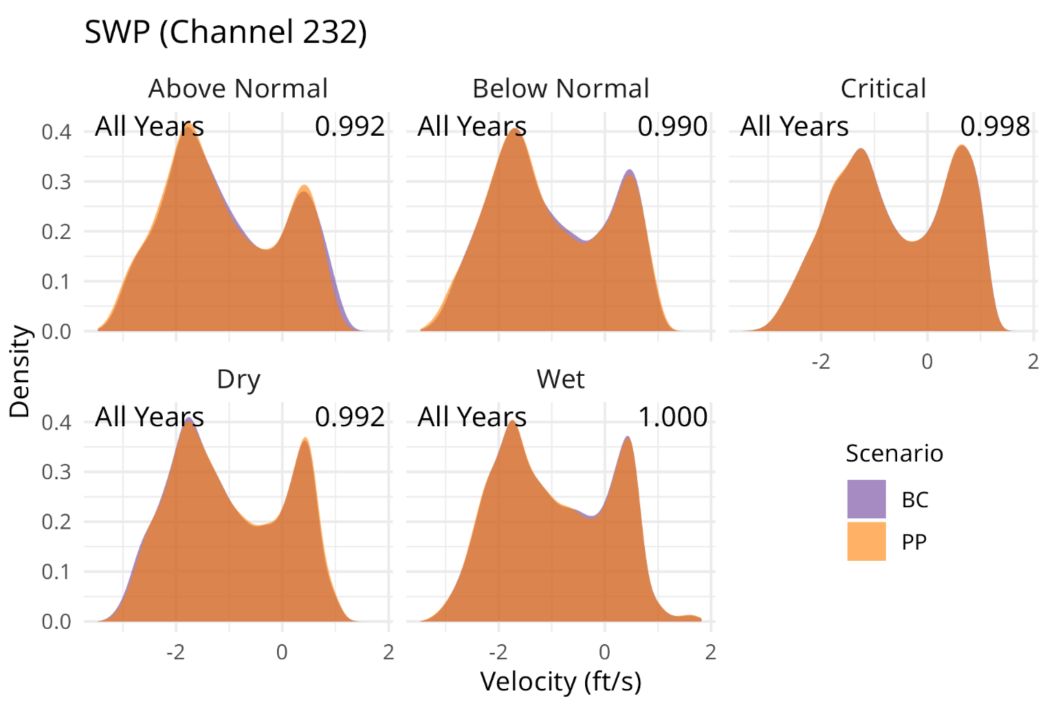
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-117. Velocity Density Distribution for Middle River near Victoria Canal, December.



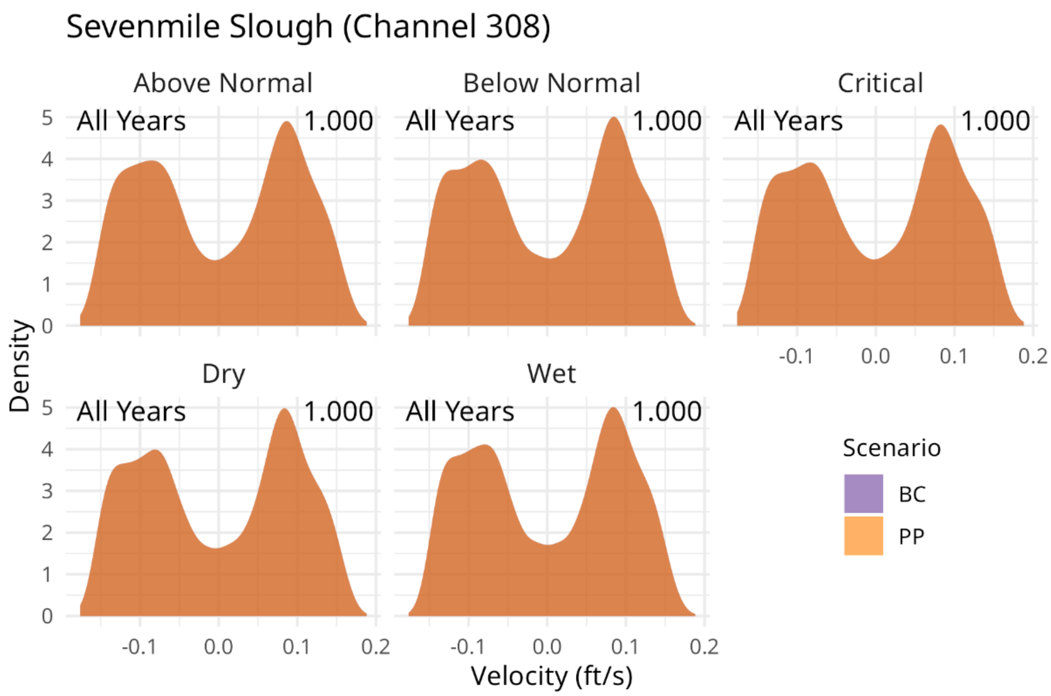
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-118. Velocity Density Distribution for Middle River near Woodward Island, December.



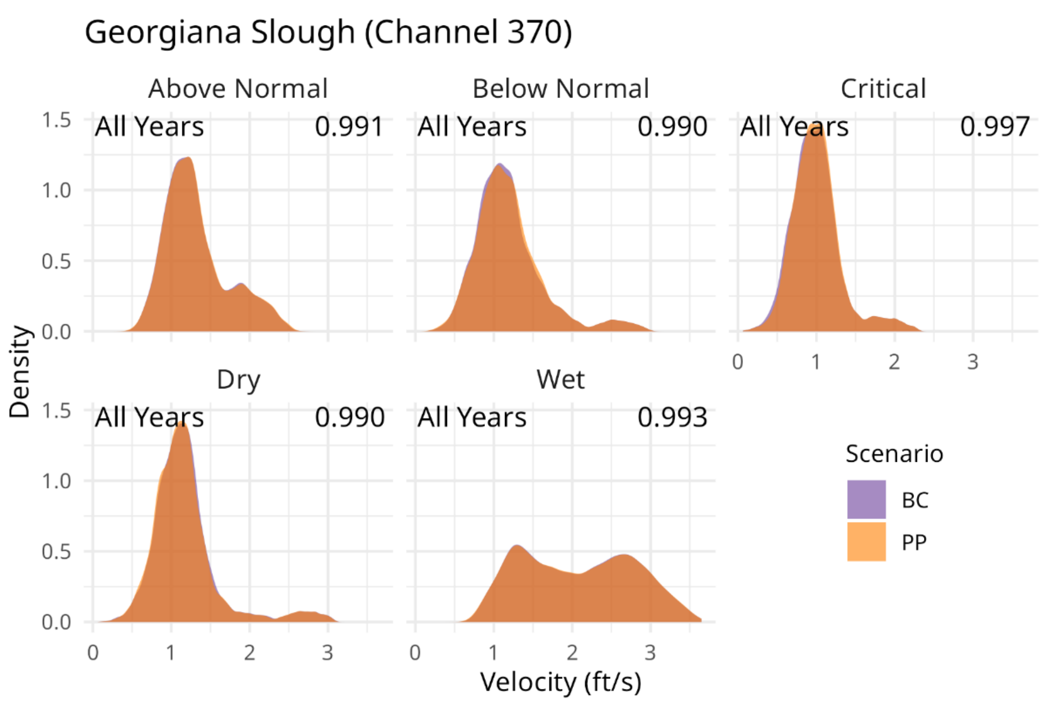
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-119. Velocity Density Distribution for State Water Project, December.



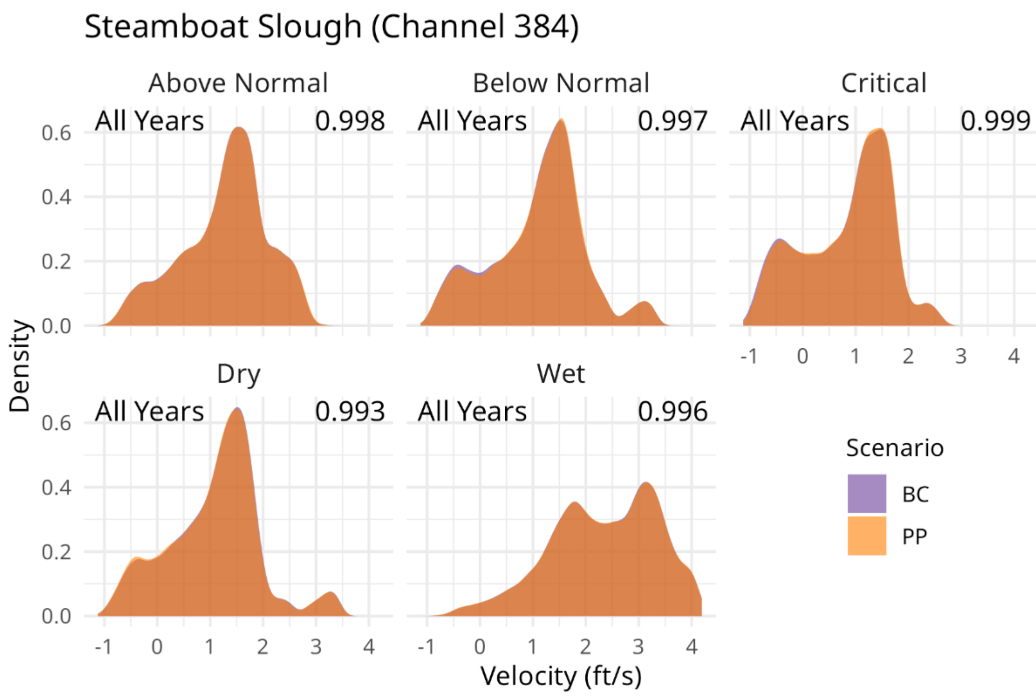
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-120. Velocity Density Distribution for Sevenmile Slough, December.



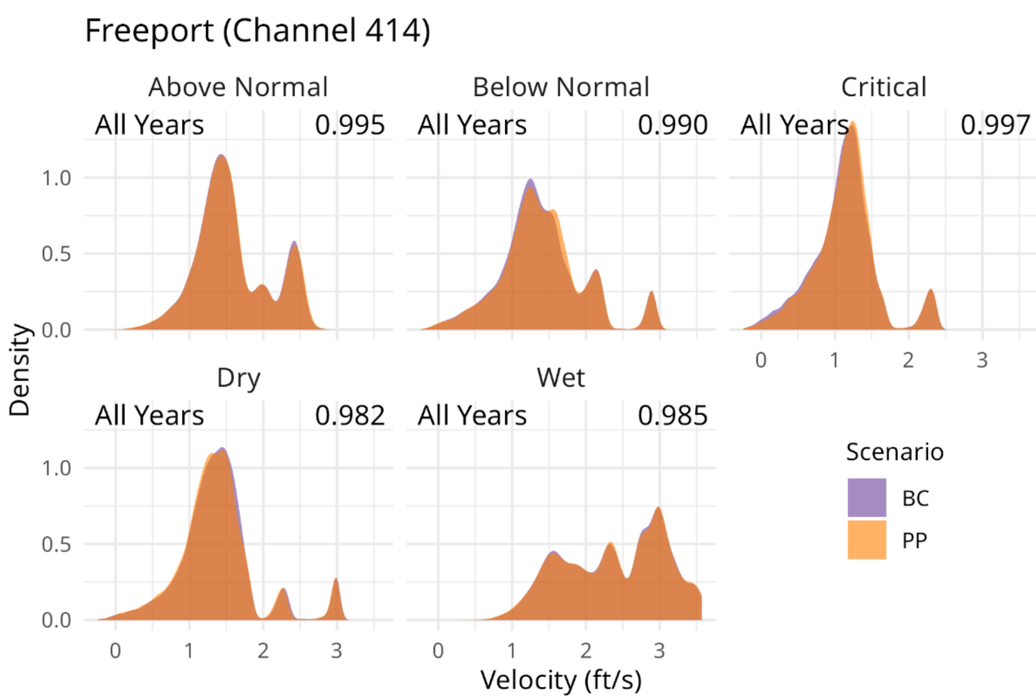
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-121. Velocity Density Distribution for Georgiana Slough, December.



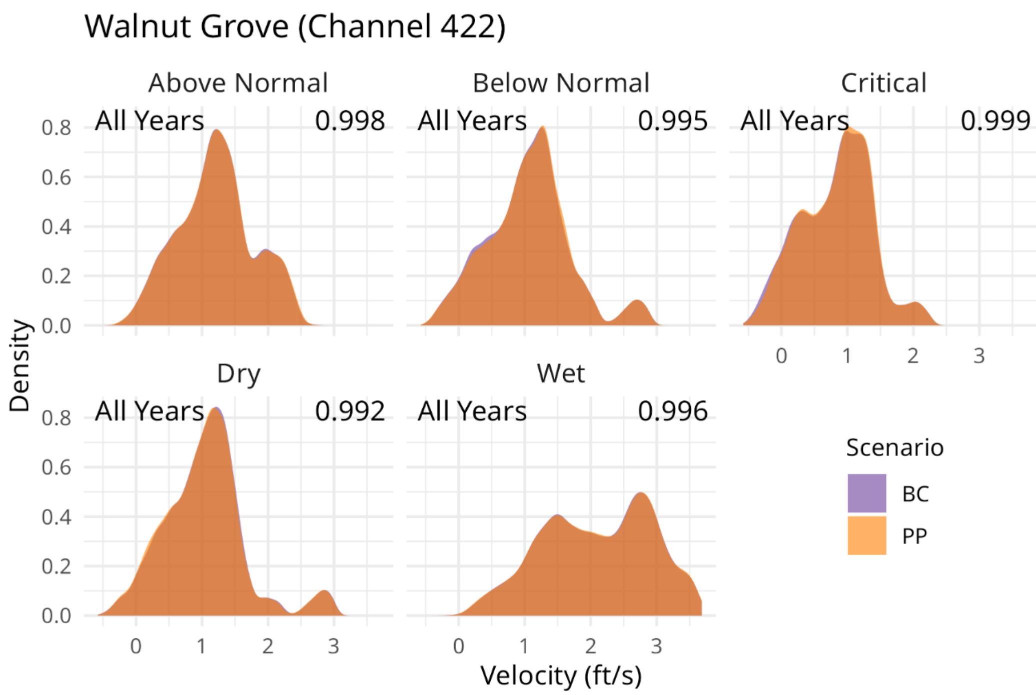
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-122. Velocity Density Distribution for Steamboat Slough, December.



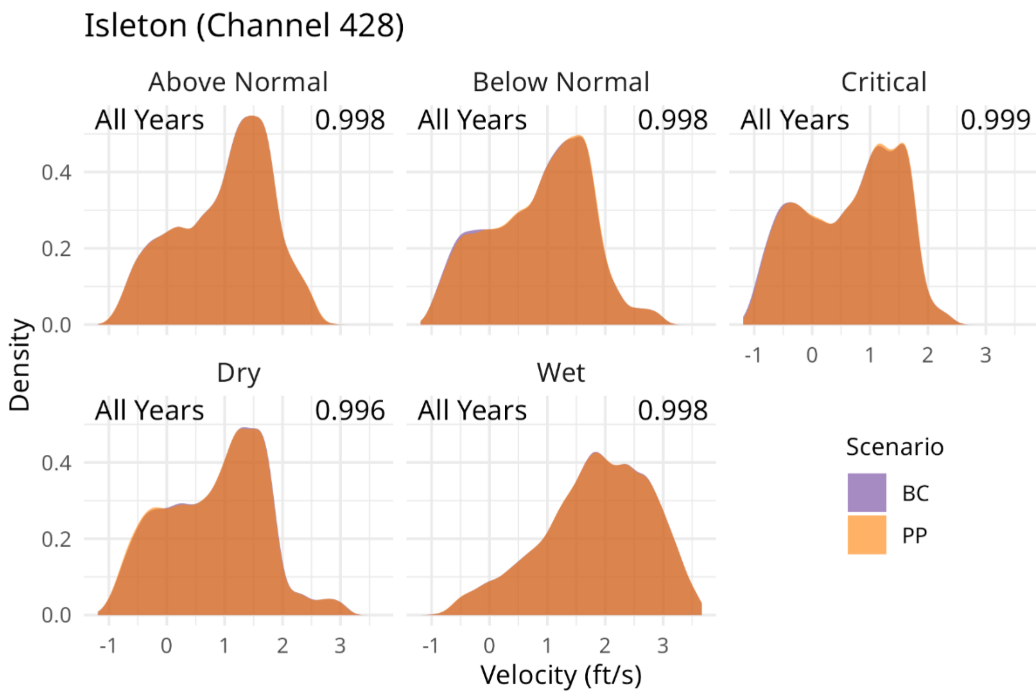
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-123. Velocity Density Distribution for Sacramento River at Freeport, December.



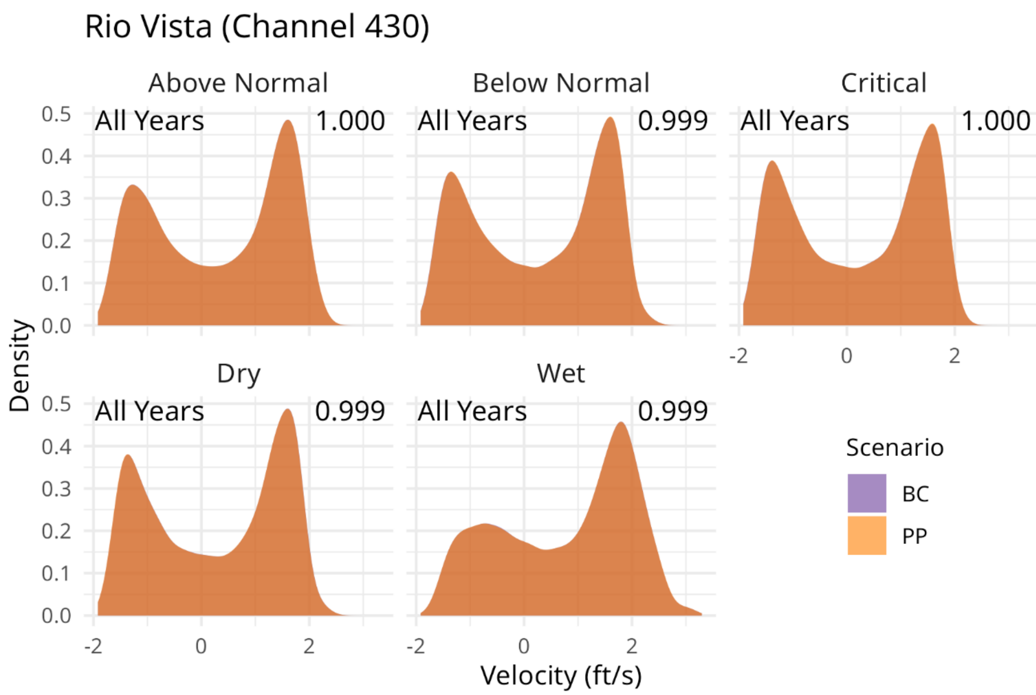
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-124. Velocity Density Distribution for Sacramento River at Walnut Grove, December.



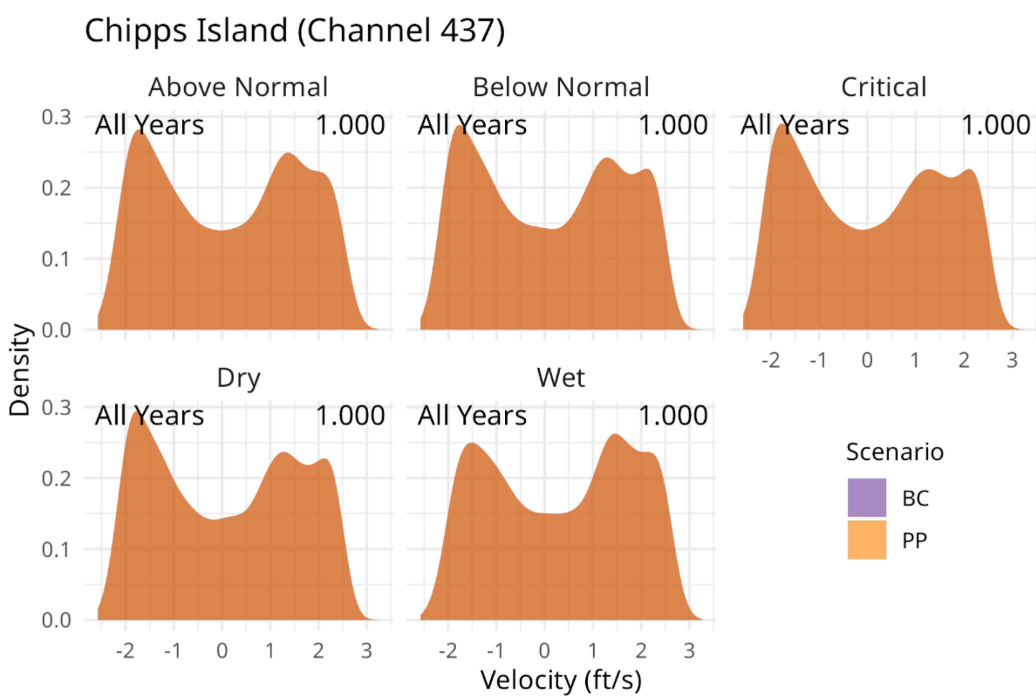
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-125. Velocity Density Distribution for Sacramento River at Isleton, December.



Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

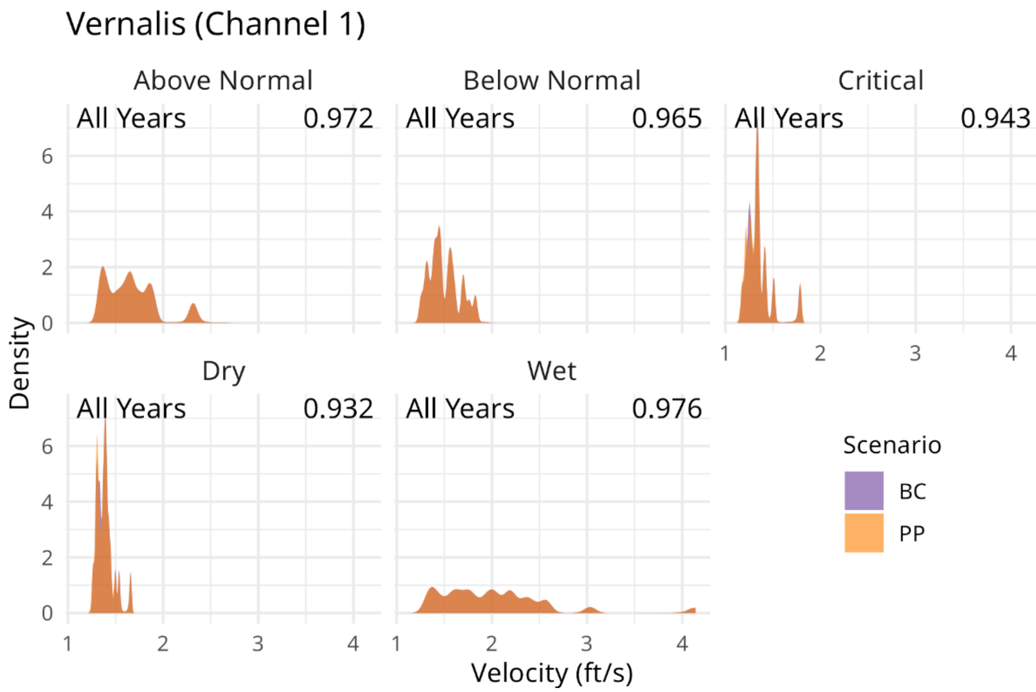
Figure 6B-126. Velocity Density Distribution for Sacramento River at Rio Vista, December.



Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

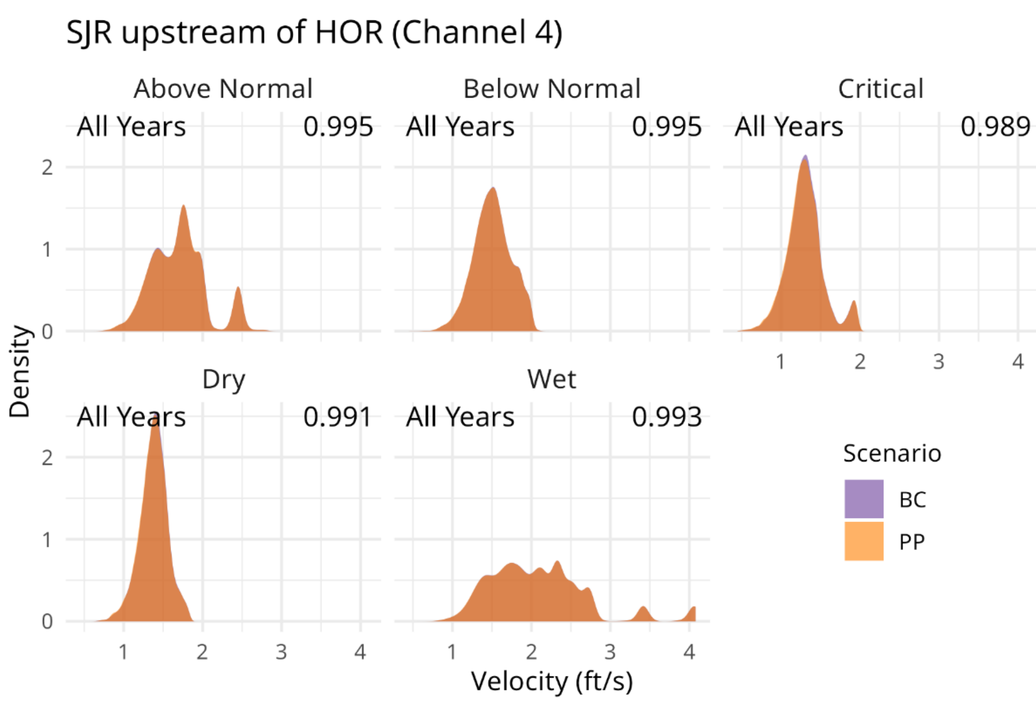
Figure 6B-127. Velocity Density Distribution for Sacramento River at Chipps Island, December.

January



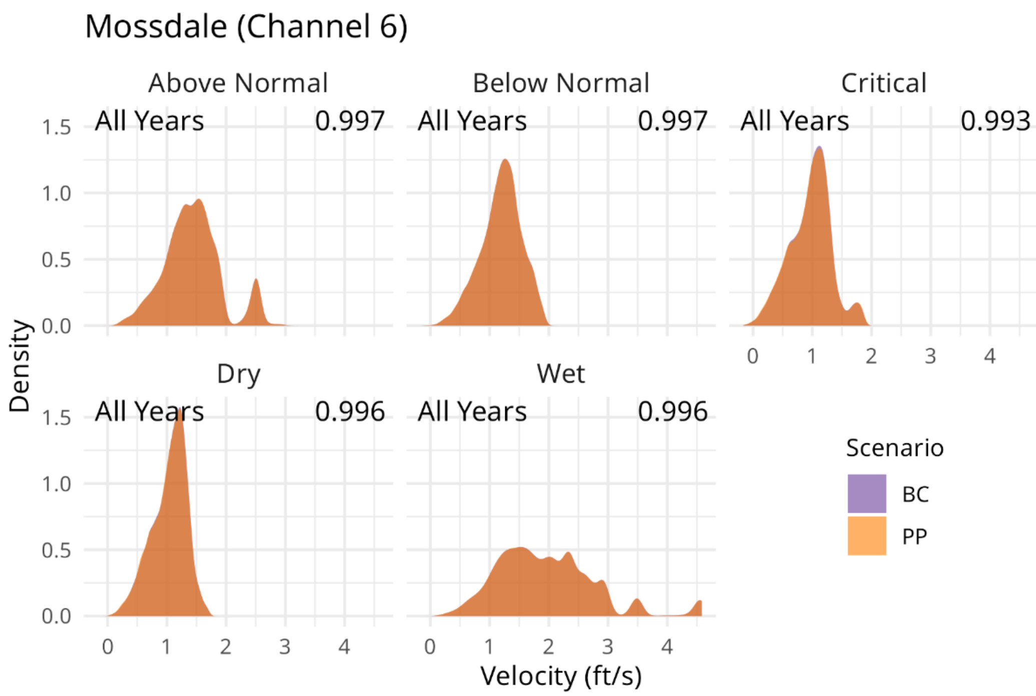
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-128. Velocity Density Distribution for San Joaquin River at Vernalis, January.



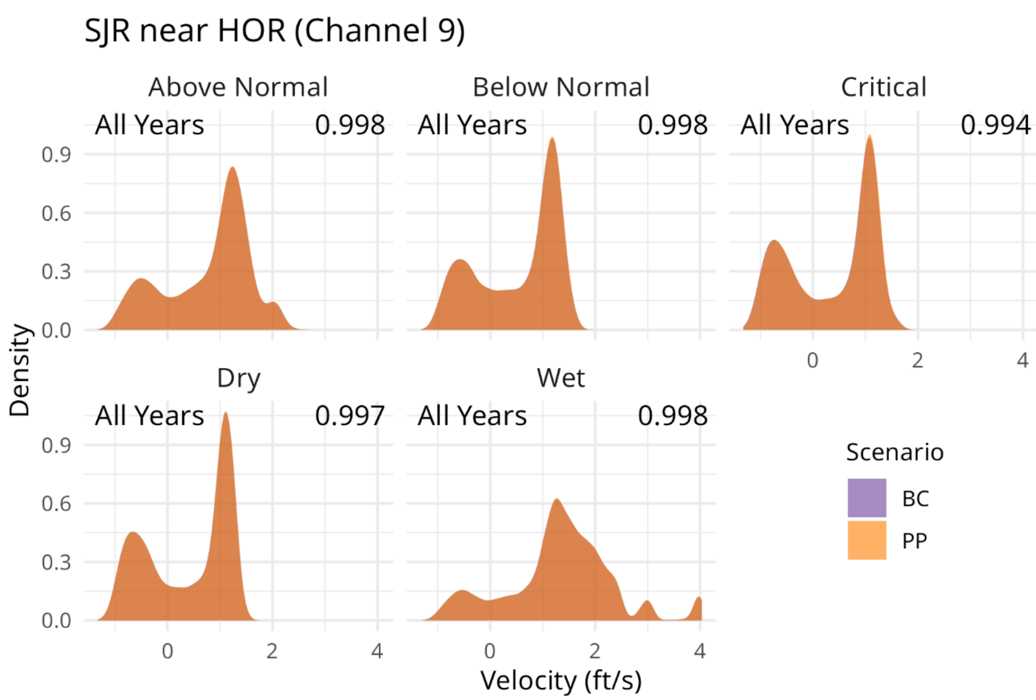
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-129. Velocity Density Distribution for San Joaquin River upstream of Head of Old River, January.



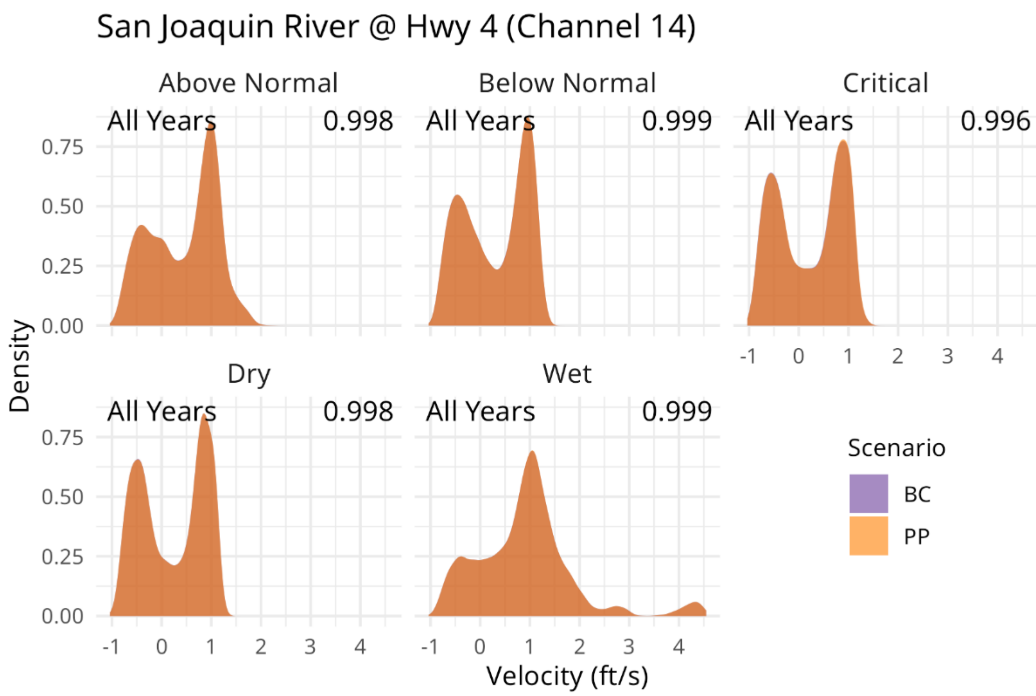
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-130. Velocity Density Distribution for San Joaquin River at Mossdale, January.



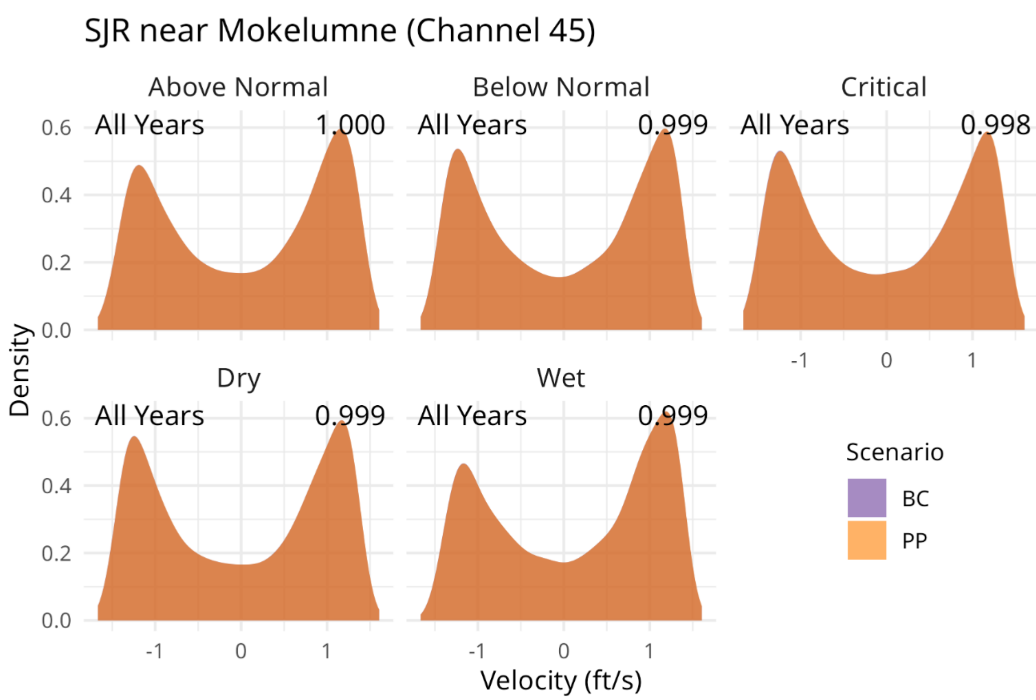
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-131. Velocity Density Distribution for San Joaquin River near Head of Old River, January.



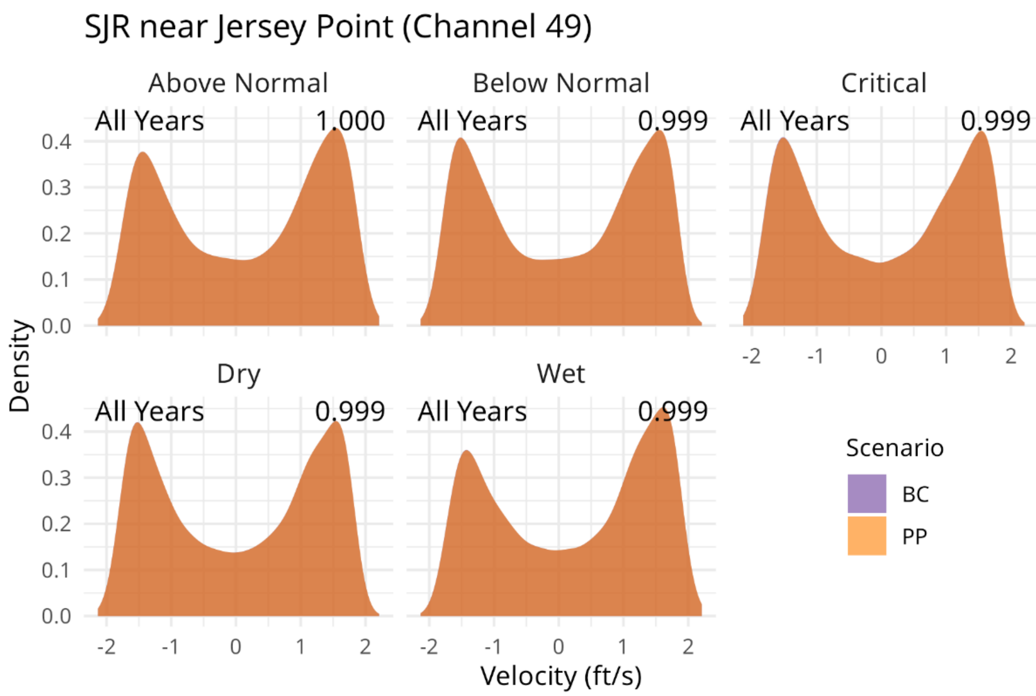
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-132. Velocity Density Distribution for San Joaquin River at Highway 4, January.



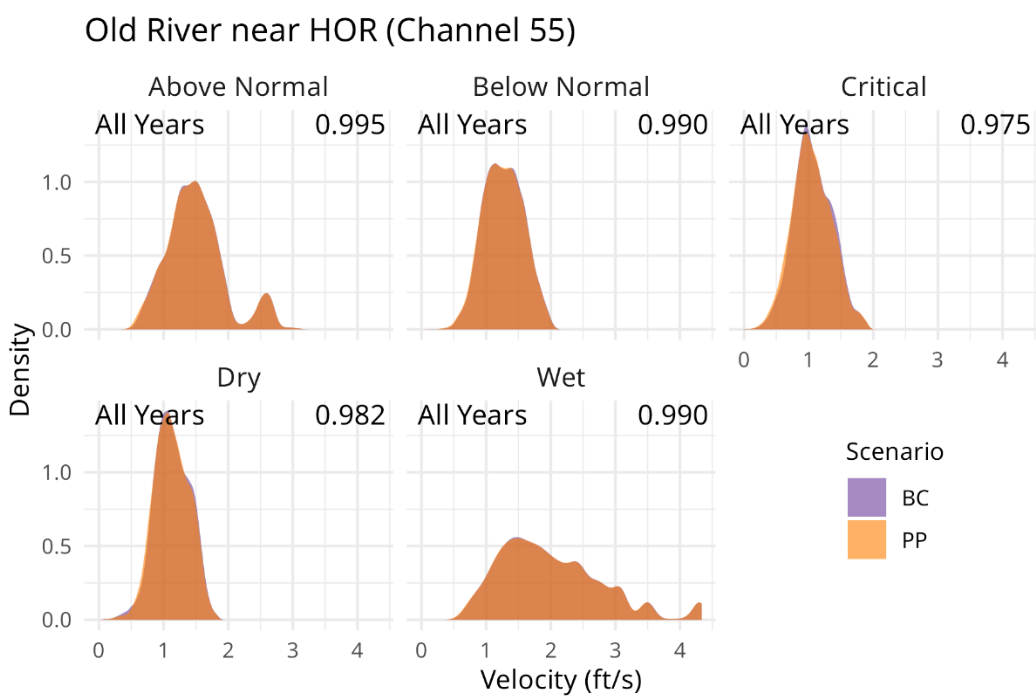
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-133. Velocity Density Distribution for San Joaquin River near Mokelumne River, January.



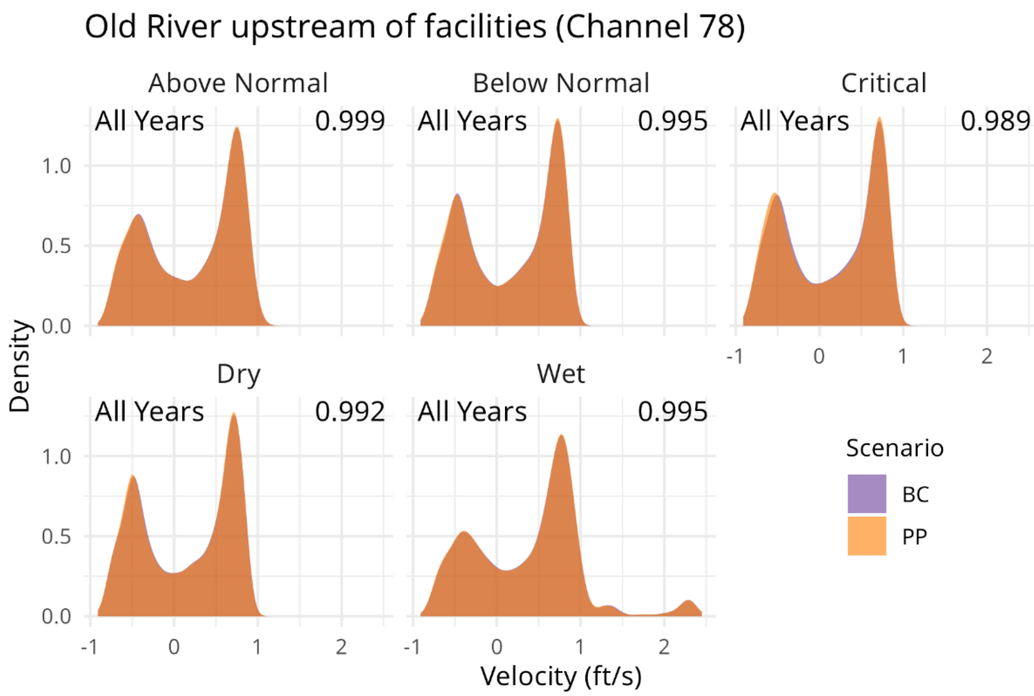
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-134. Velocity Density Distribution for San Joaquin River near Jersey Point, January.



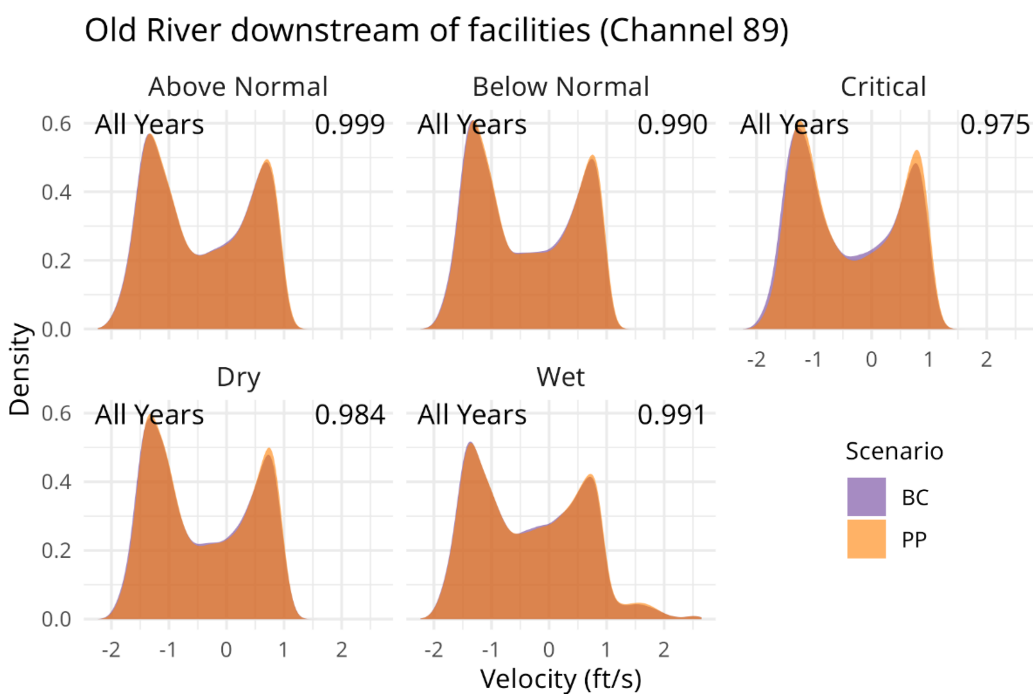
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-135. Velocity Density Distribution for Old River near Head of Old River, January.



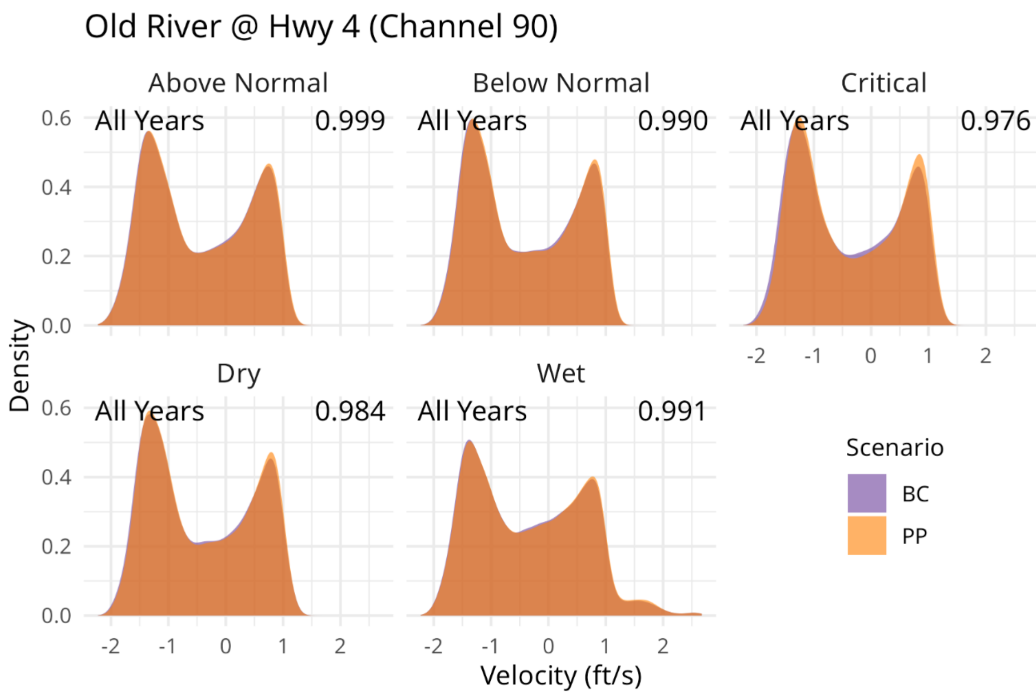
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-136. Velocity Density Distribution for Old River Upstream of the South Delta Export Facilities, January.



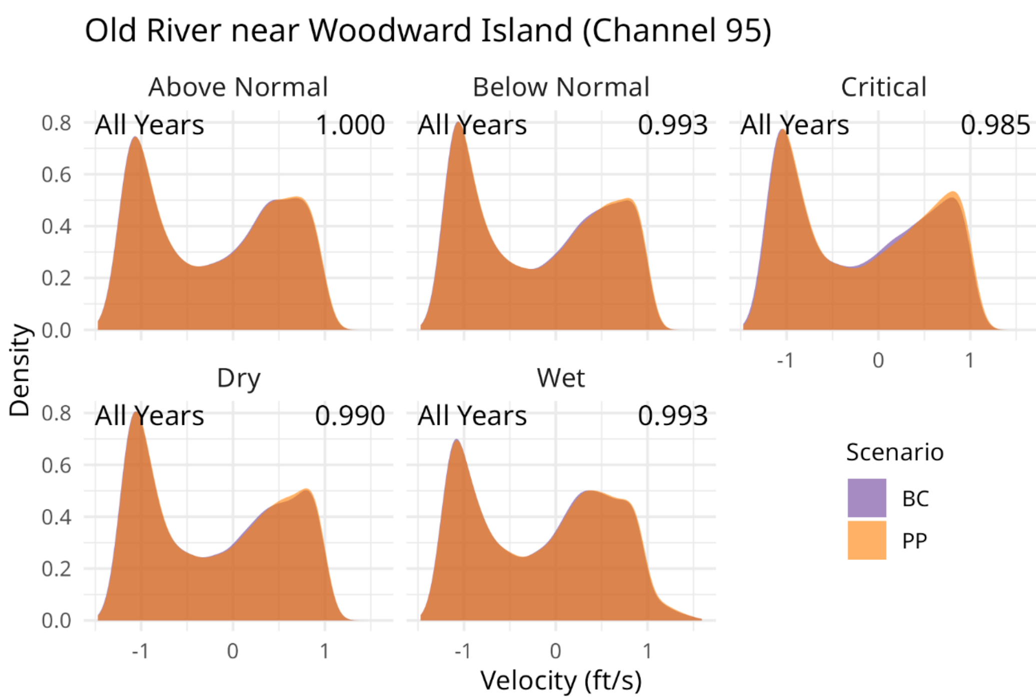
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-137. Velocity Density Distribution for Old River Downstream of the South Delta Export Facilities, January.



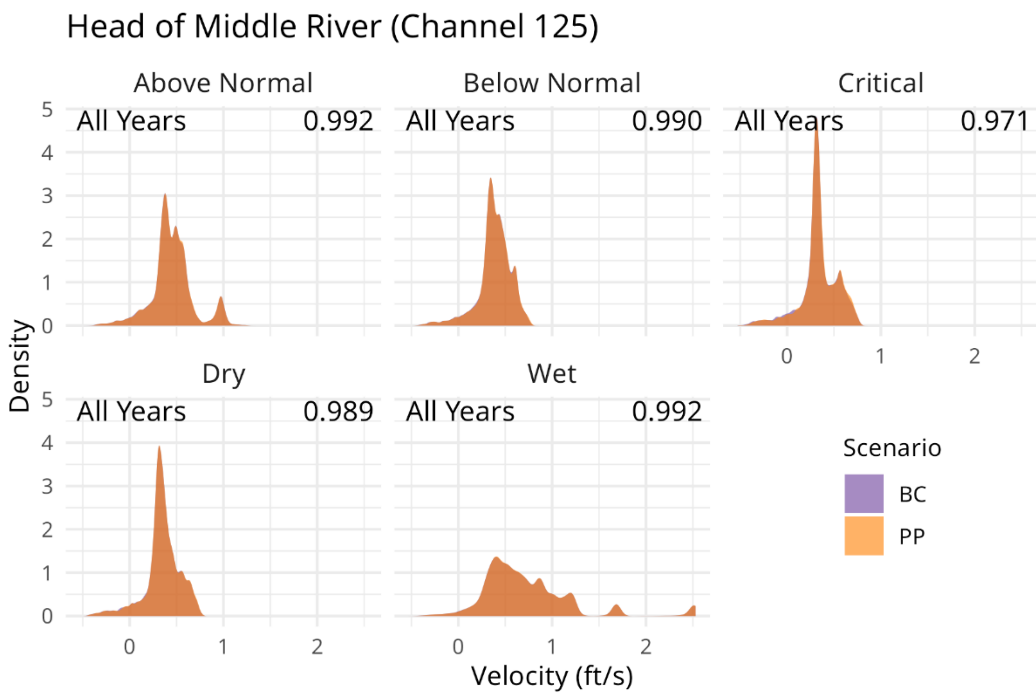
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-138. Velocity Density Distribution for Old River at Highway 4, January.



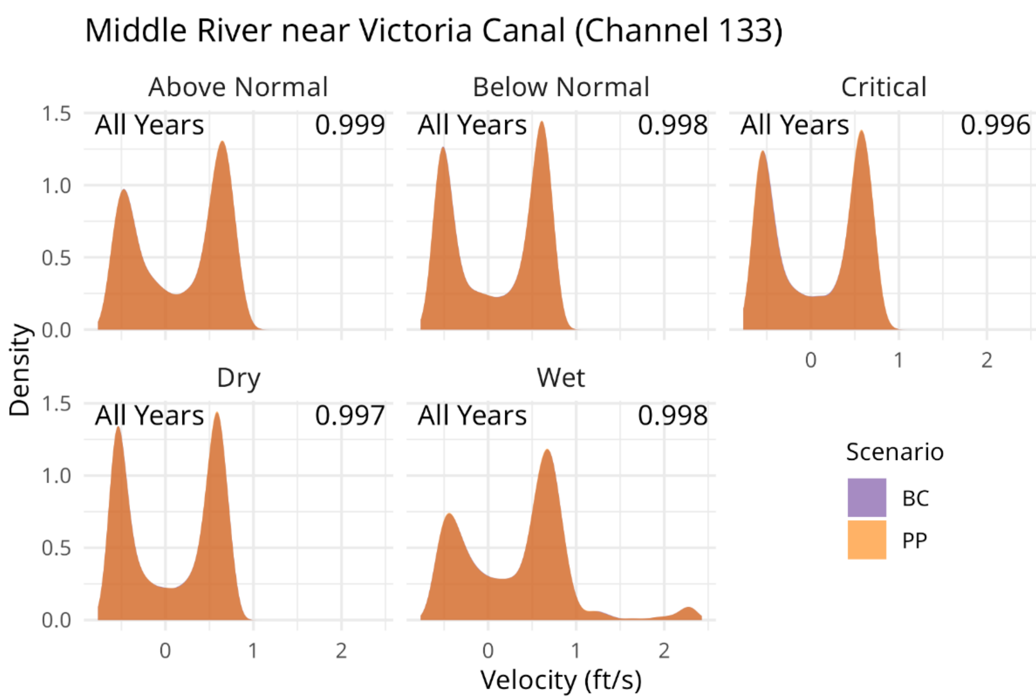
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-139. Velocity Density Distribution for Old River near Woodward Island, January.



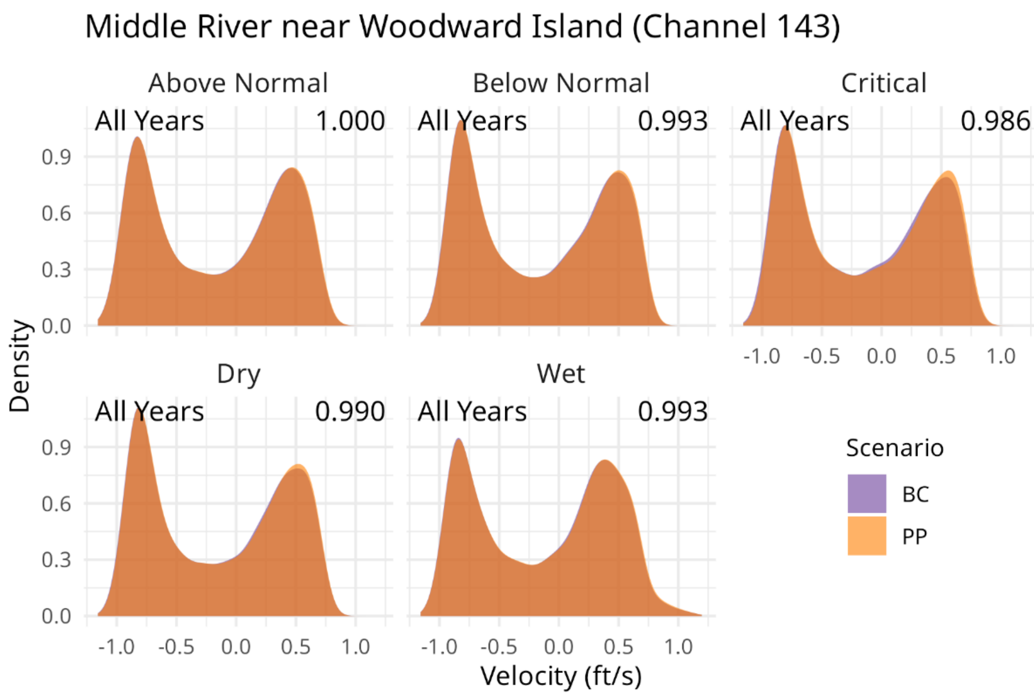
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-140. Velocity Density Distribution for Head of Middle River, January.



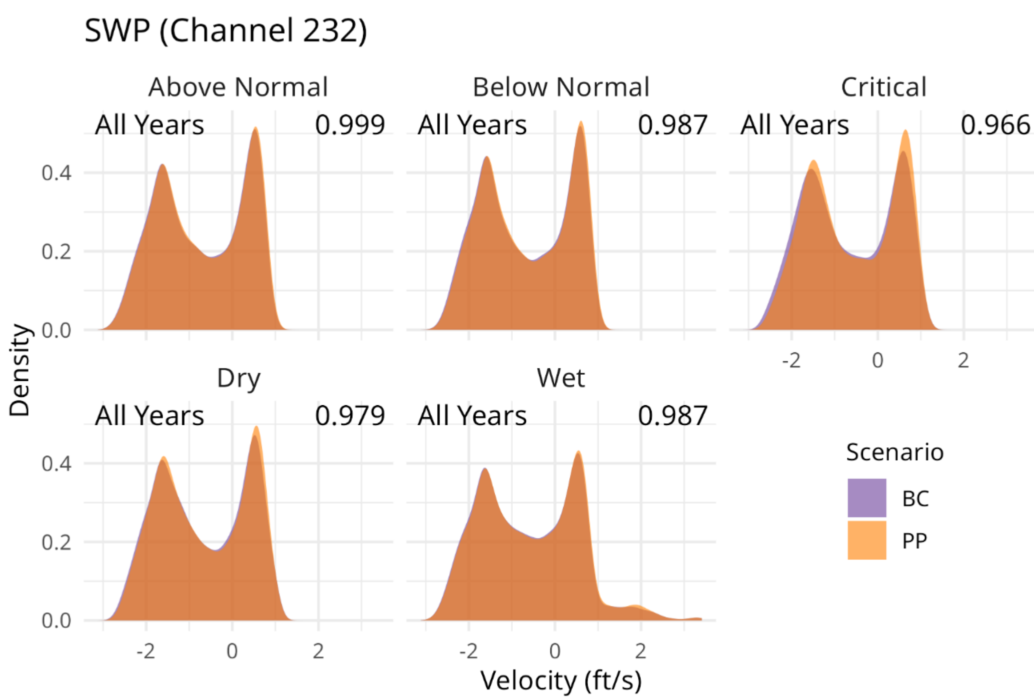
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-141. Velocity Density Distribution for Middle River near Victoria Canal, January.



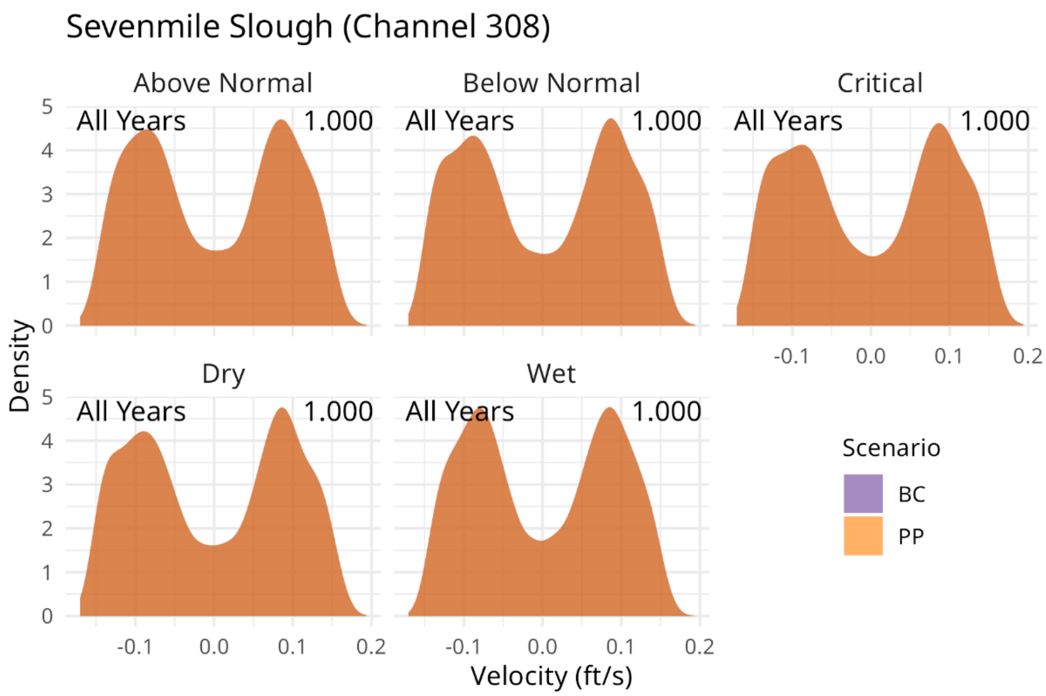
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-142. Velocity Density Distribution for Middle River near Woodward Island, January.



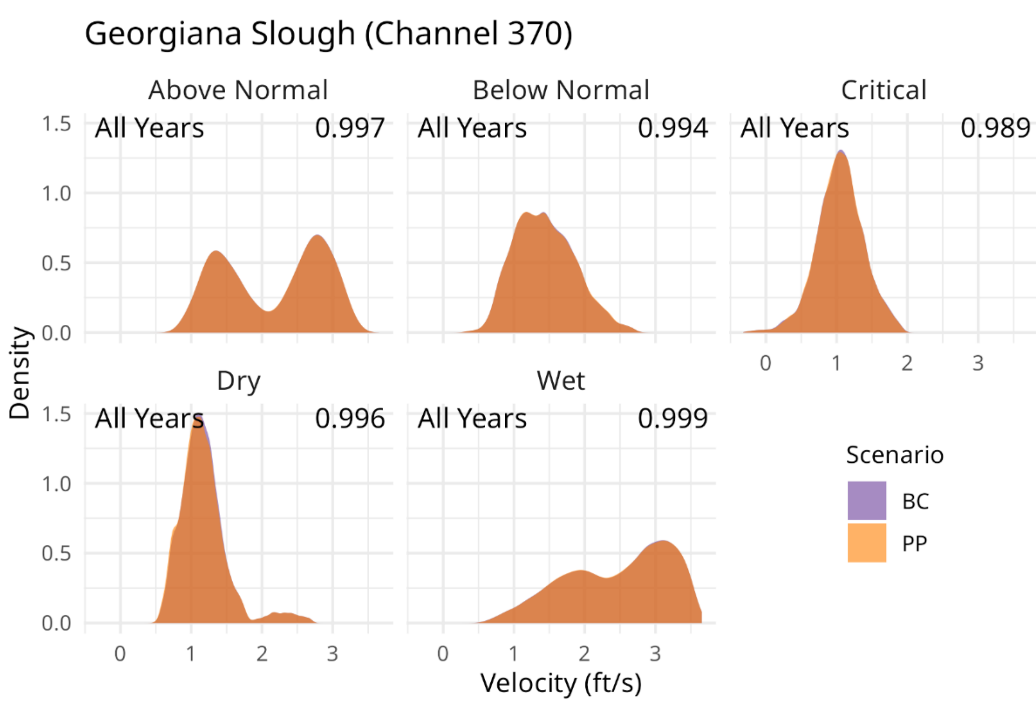
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-143. Velocity Density Distribution for State Water Project, January.



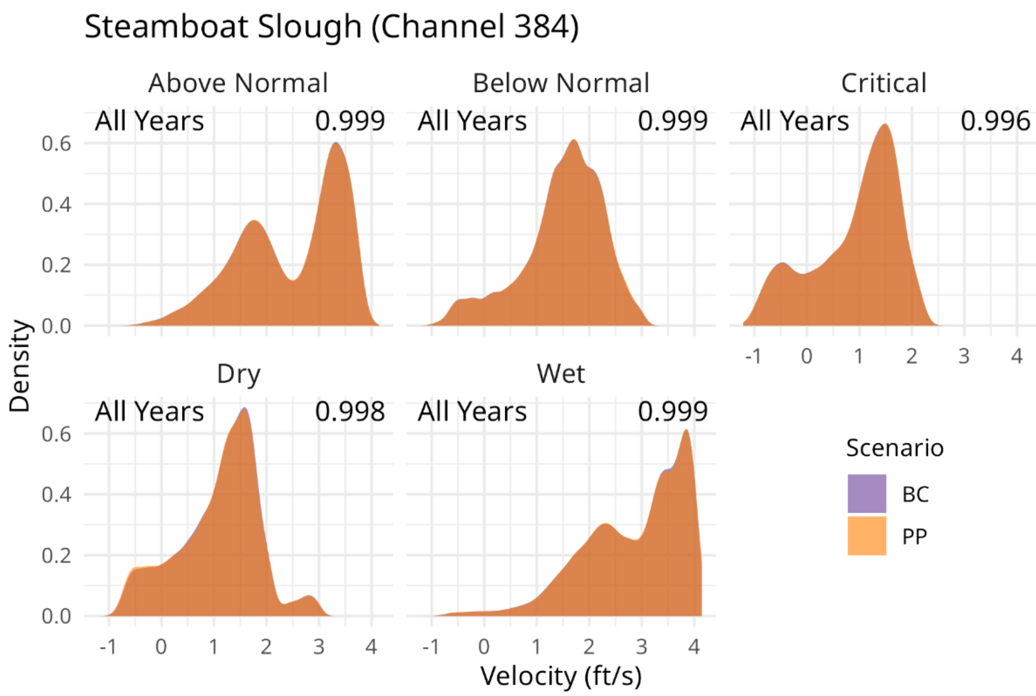
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-144. Velocity Density Distribution for Sevenmile Slough, January.



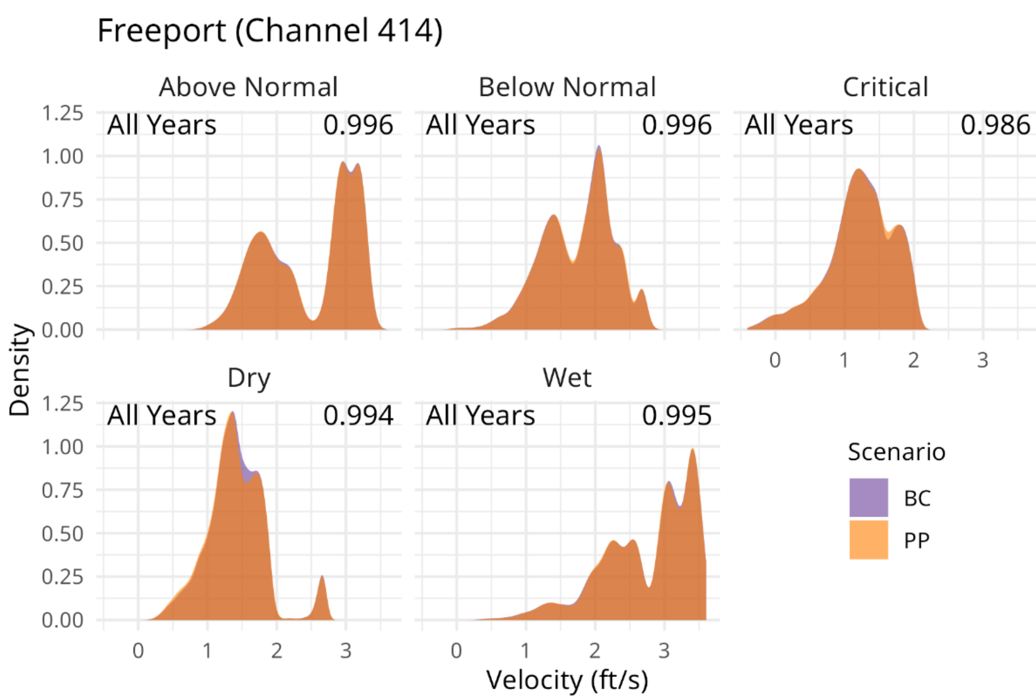
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-145. Velocity Density Distribution for Georgiana Slough, January.



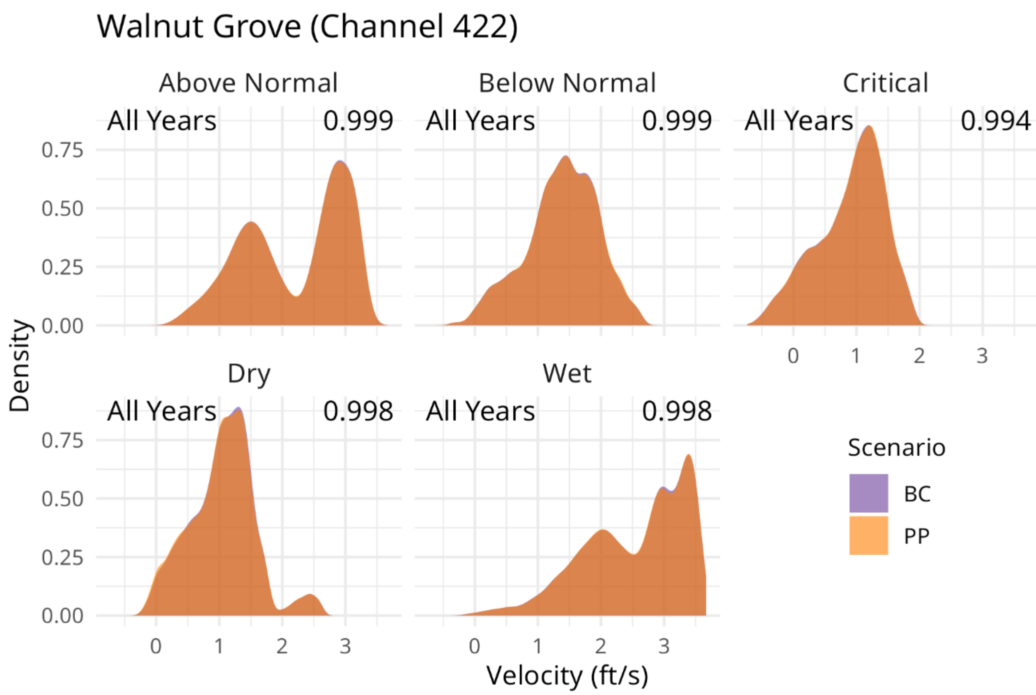
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-146. Velocity Density Distribution for Steamboat Slough, January.



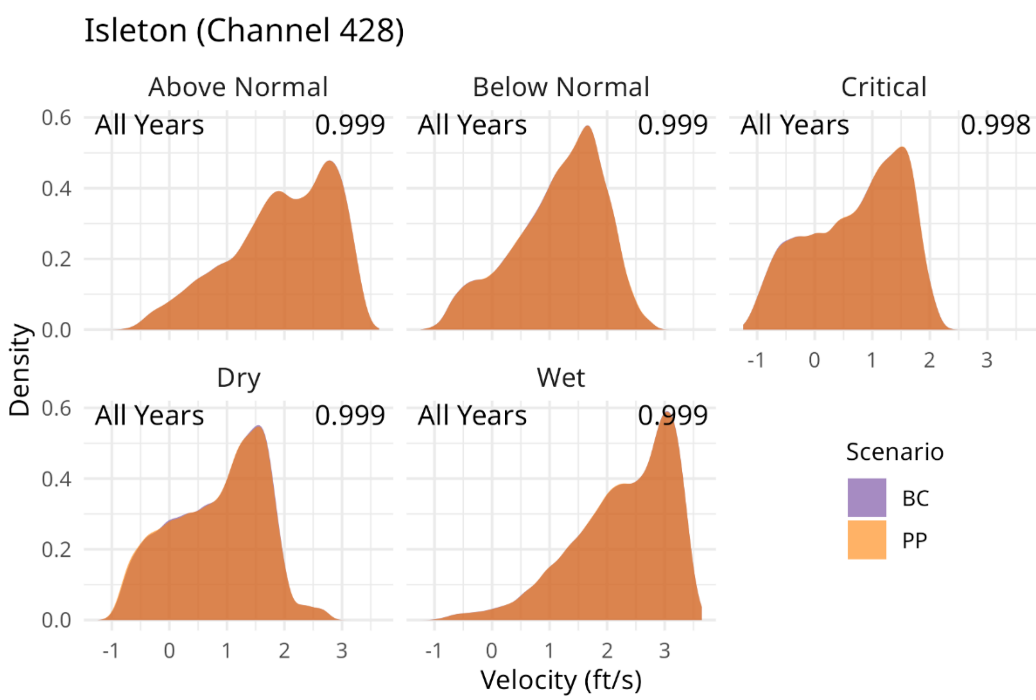
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-147. Velocity Density Distribution for Sacramento River at Freeport, January.



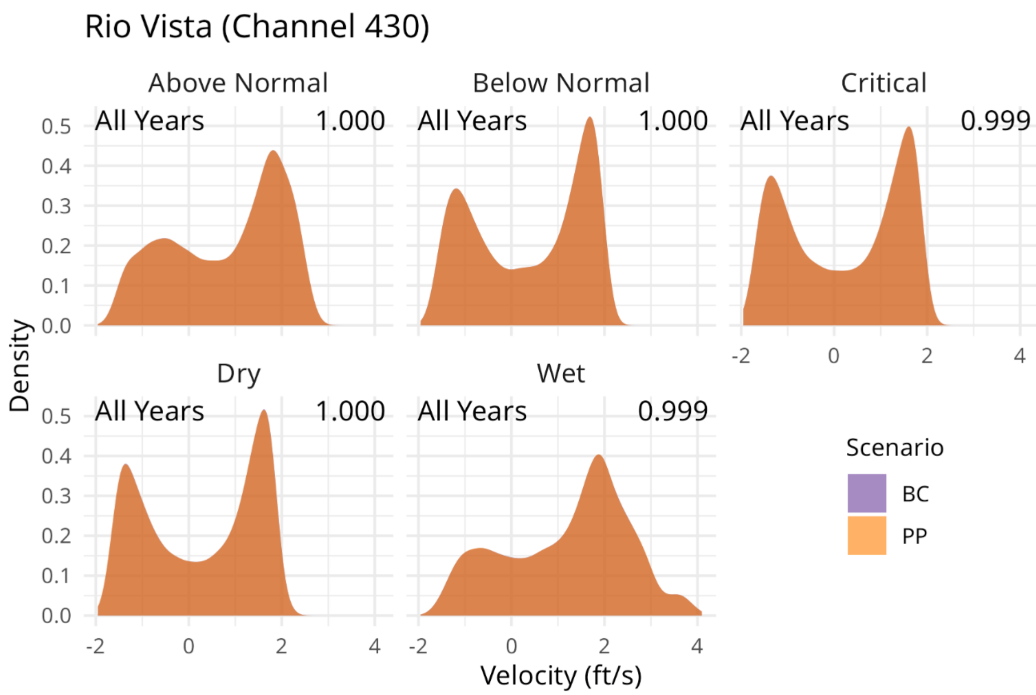
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-148. Velocity Density Distribution for Sacramento River at Walnut Grove, January.



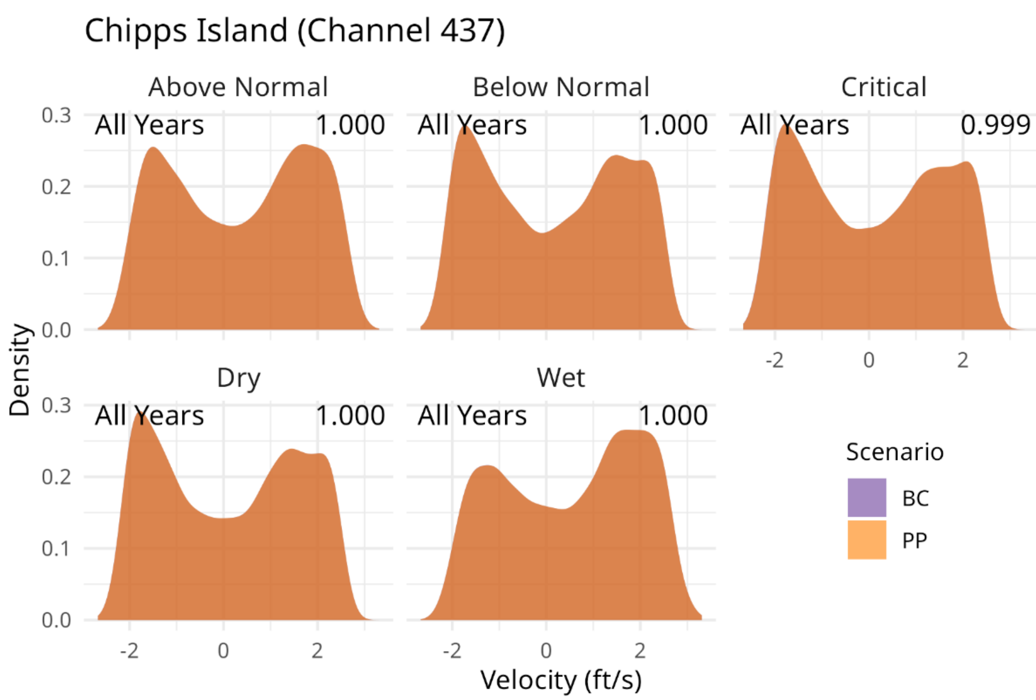
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-149. Velocity Density Distribution for Sacramento River at Isleton, January.



Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

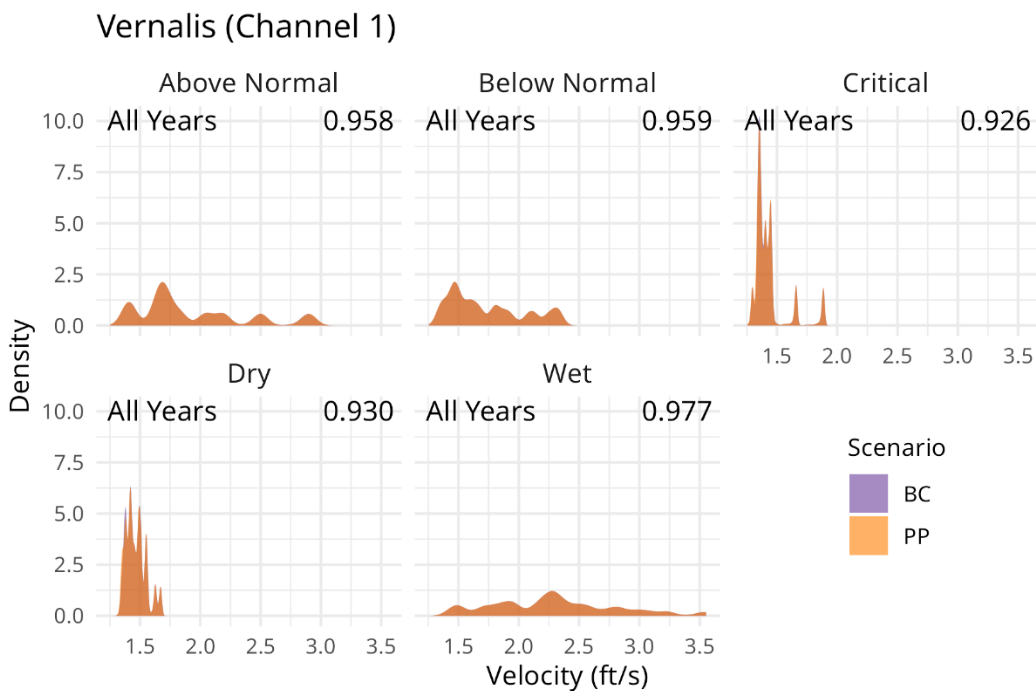
Figure 6B-150. Velocity Density Distribution for Sacramento River at Rio Vista, January.



Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

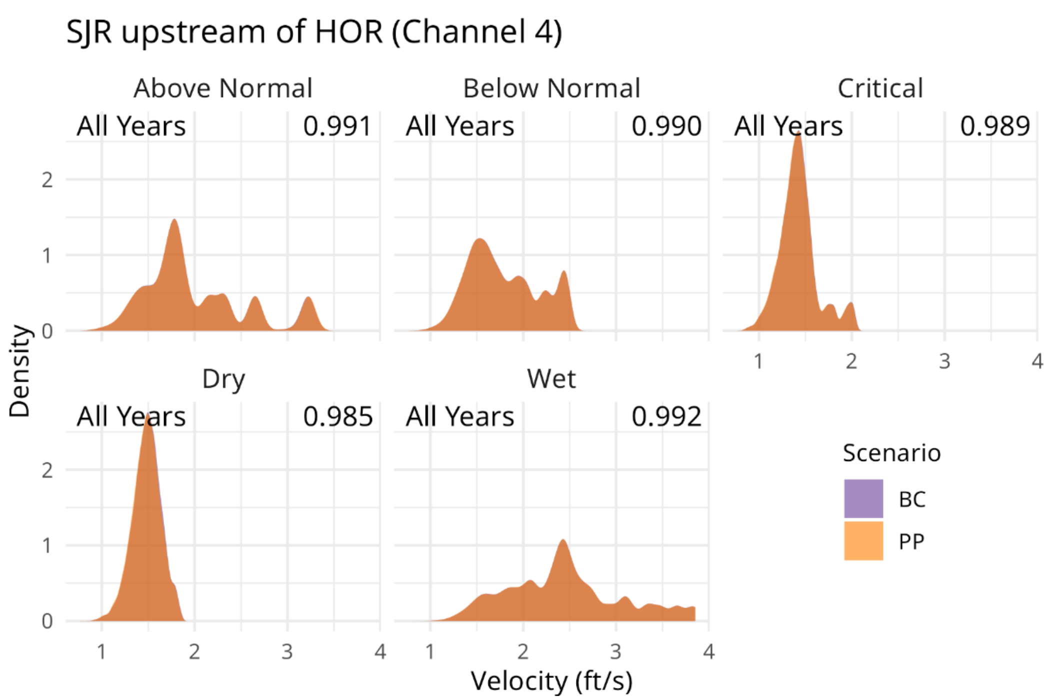
Figure 6B-151. Velocity Density Distribution for Sacramento River at Chipps Island, January.

February



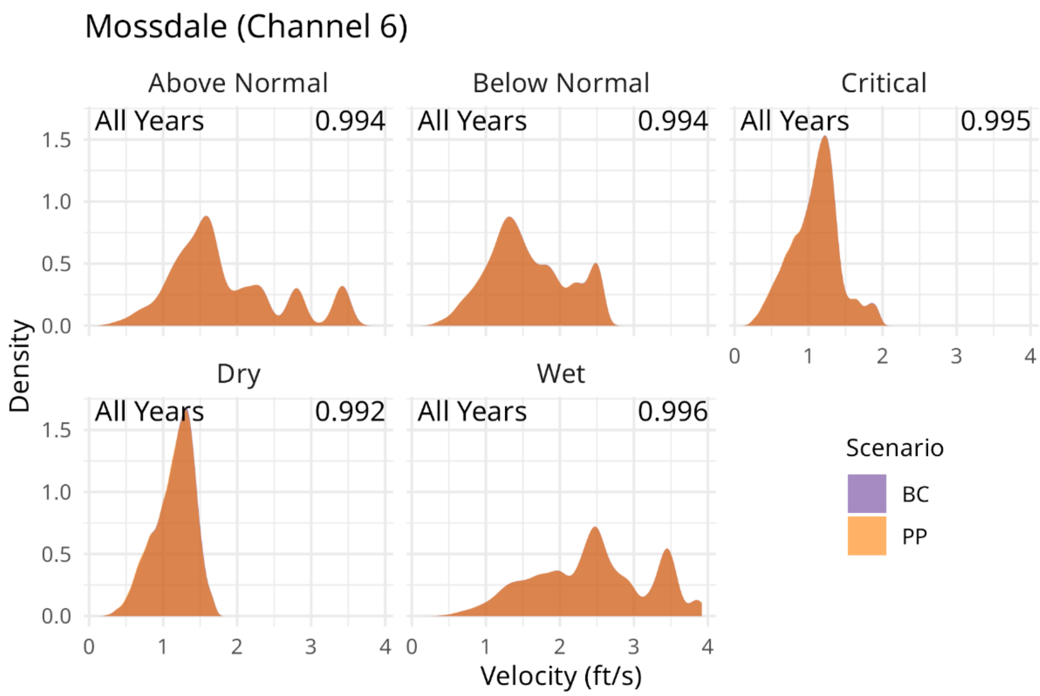
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-152. Velocity Density Distribution for San Joaquin River at Vernalis, February.



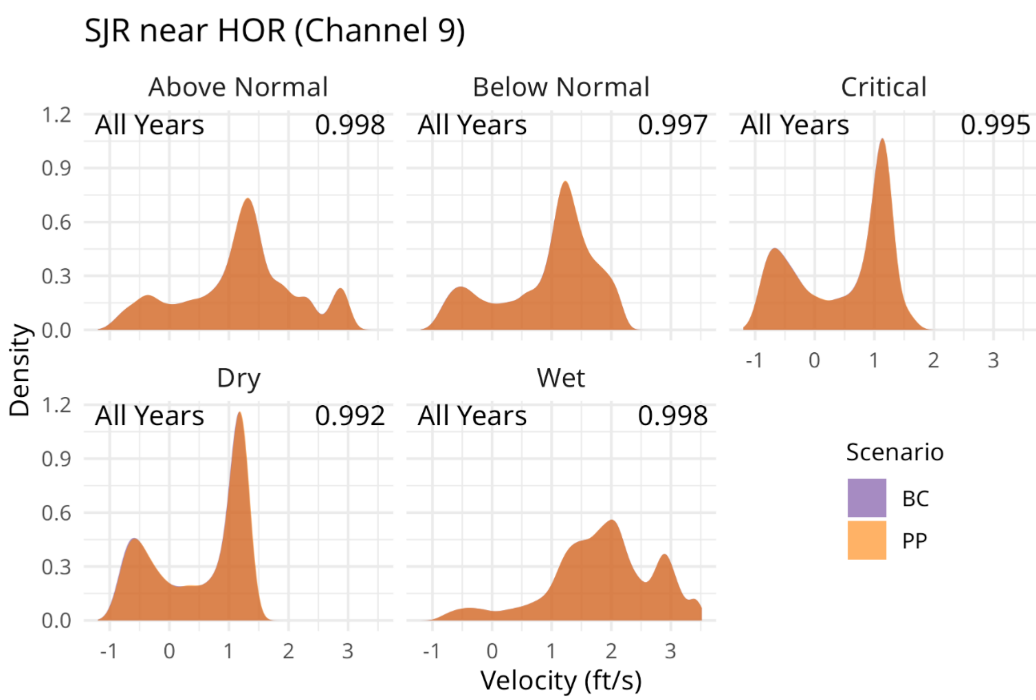
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-153. Velocity Density Distribution for San Joaquin River upstream of Head of Old River, February.



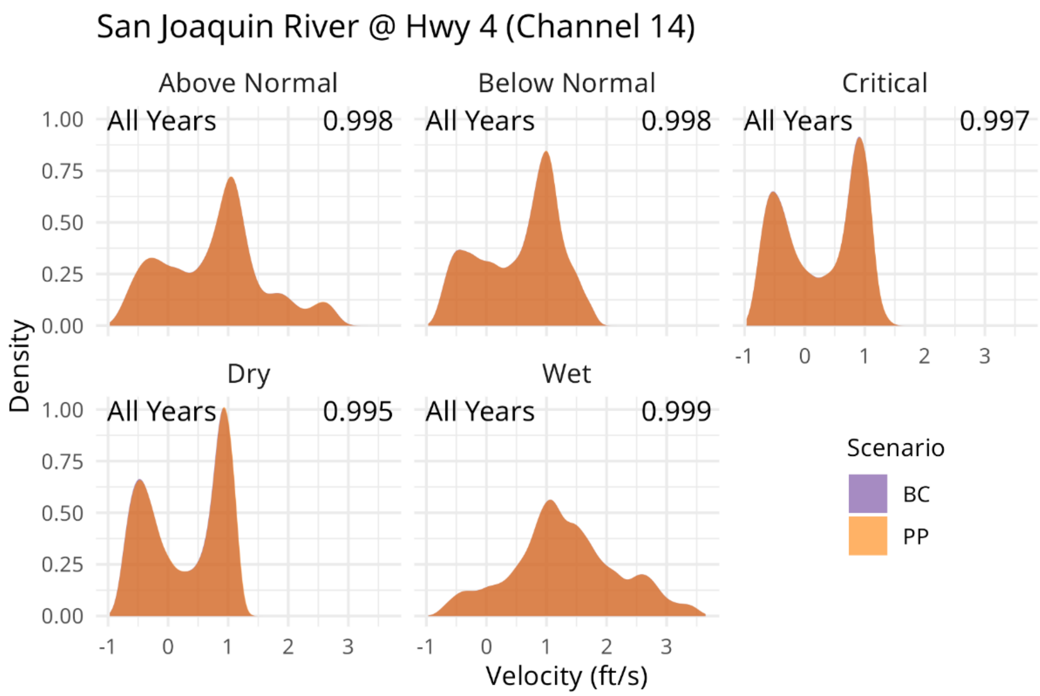
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-154. Velocity Density Distribution for San Joaquin River at Mossdale, February.



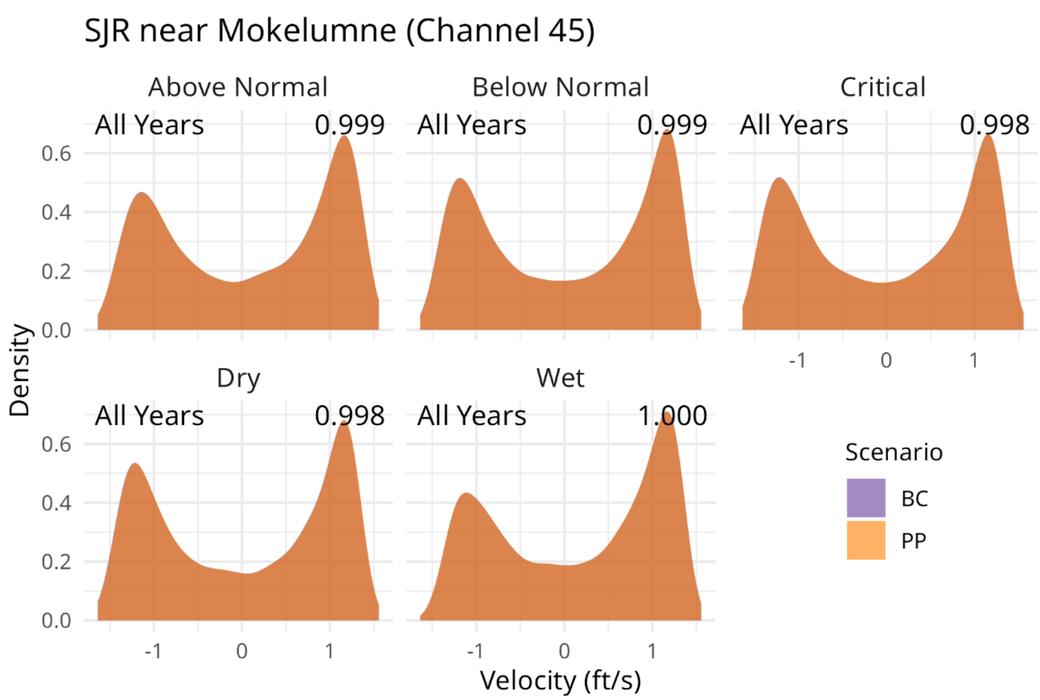
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-155. Velocity Density Distribution for San Joaquin River near Head of Old River, February.



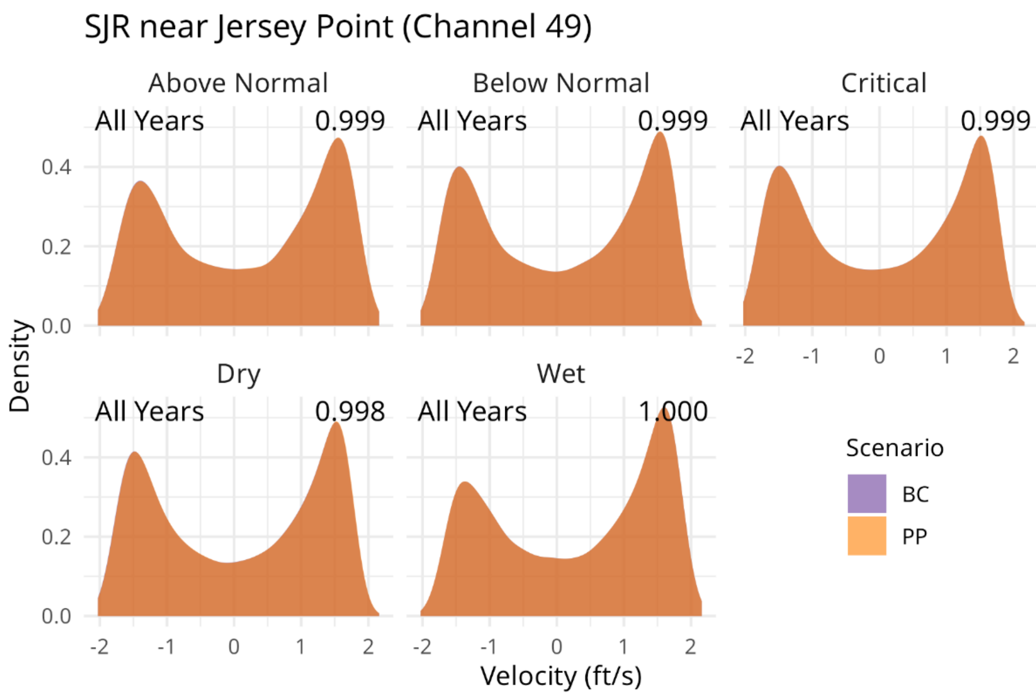
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-156. Velocity Density Distribution for San Joaquin River at Highway 4, February.



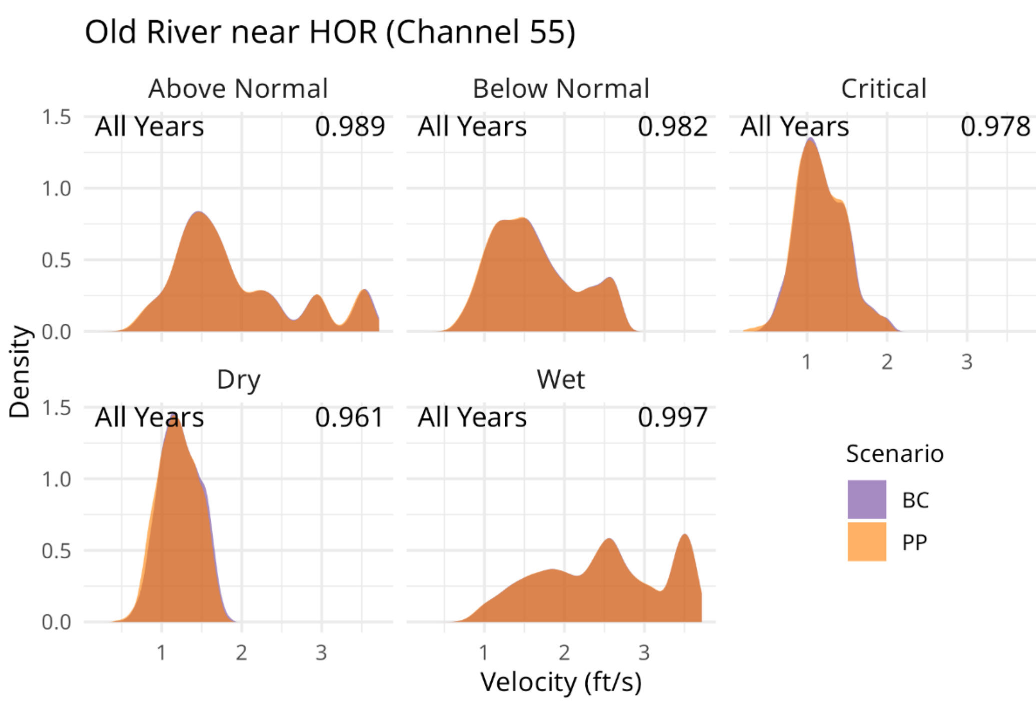
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-157. Velocity Density Distribution for San Joaquin River near Mokelumne River, February.



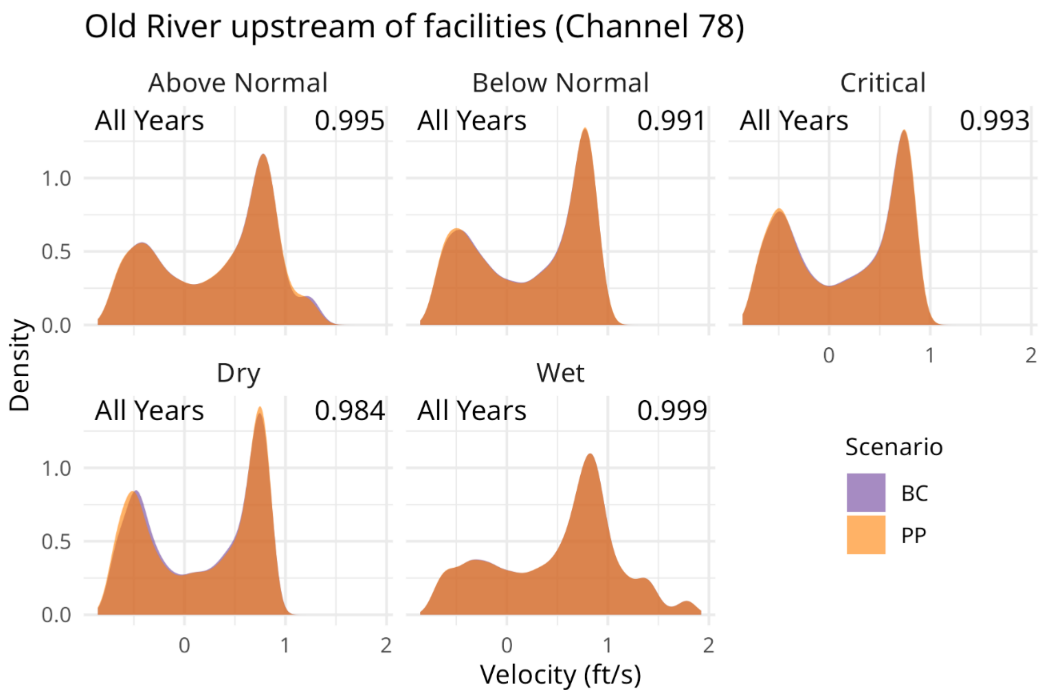
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-158. Velocity Density Distribution for San Joaquin River near Jersey Point, February.



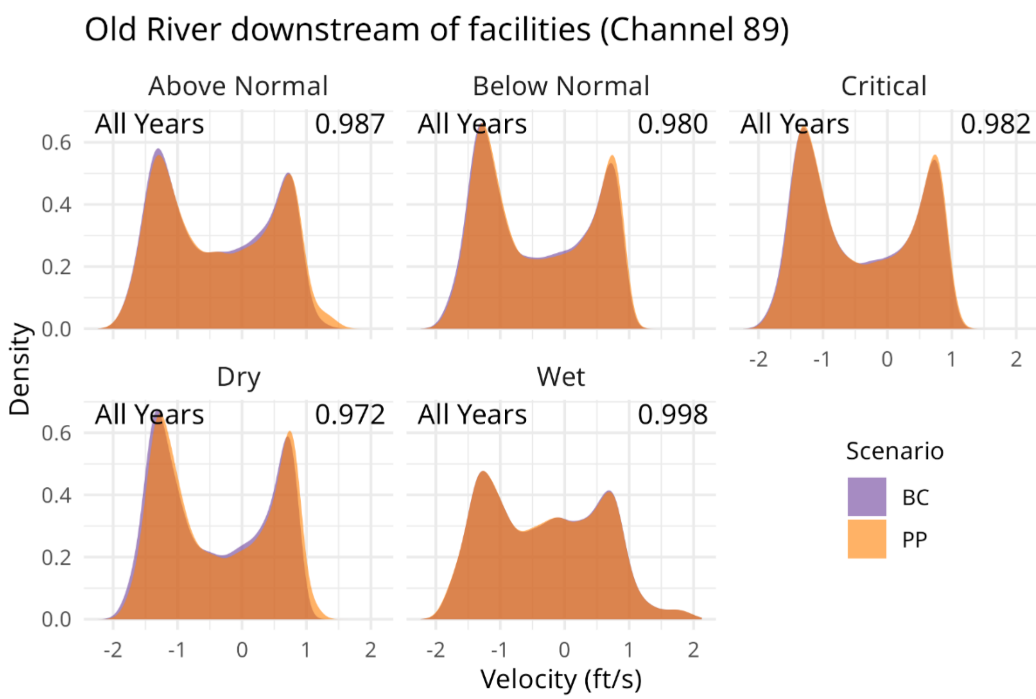
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-159. Velocity Density Distribution for Old River near Head of Old River, February.



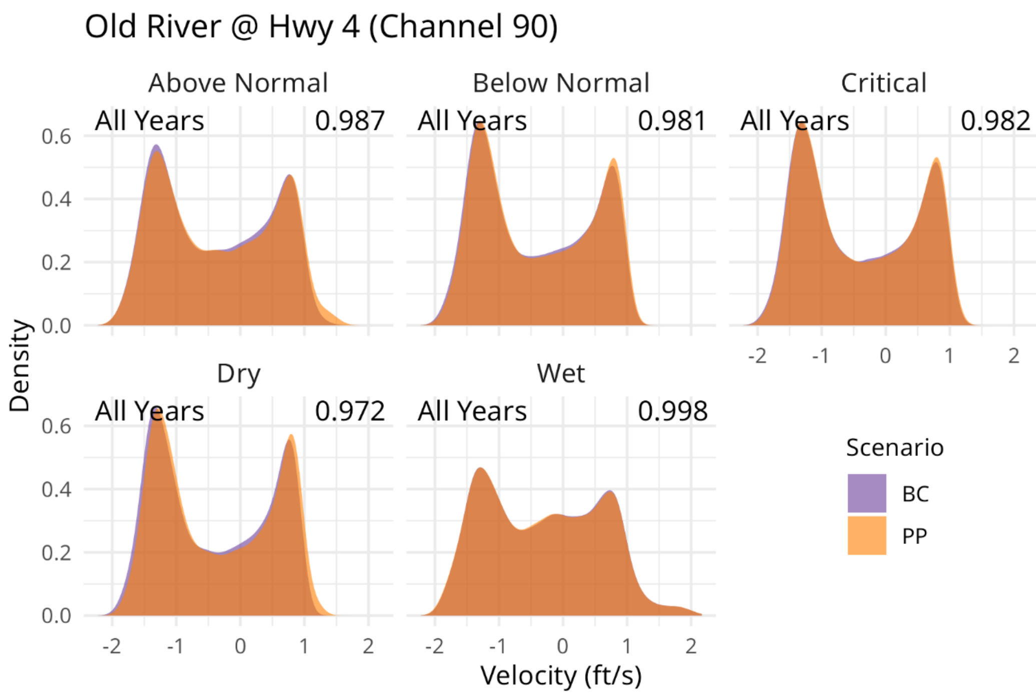
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-160. Velocity Density Distribution for Old River Upstream of the South Delta Export Facilities, February.



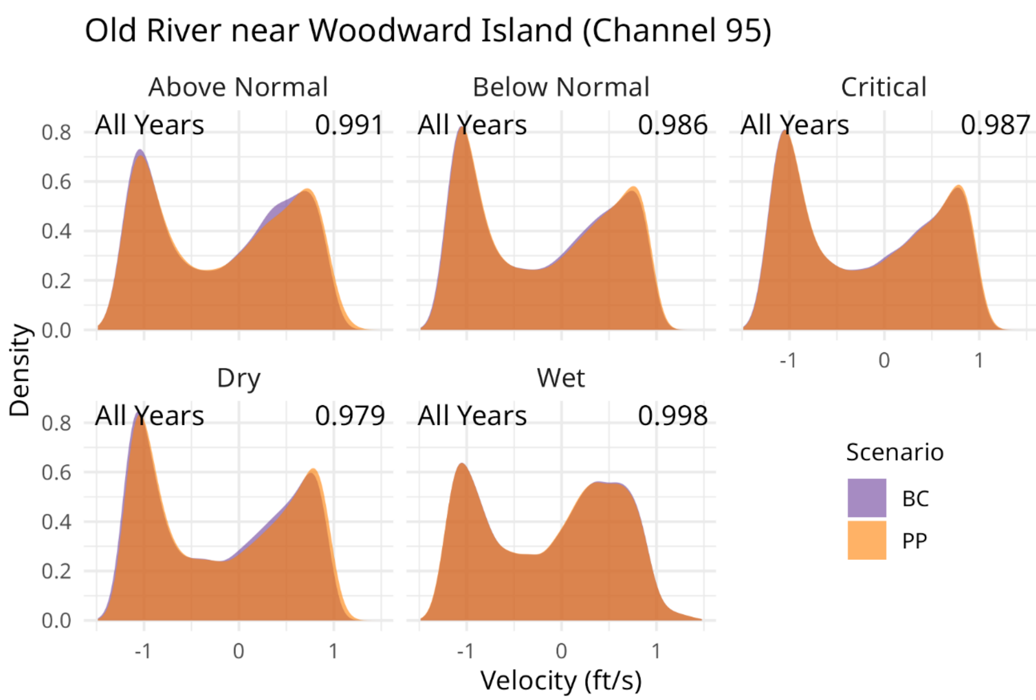
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-161. Velocity Density Distribution for Old River Downstream of the South Delta Export Facilities, February.



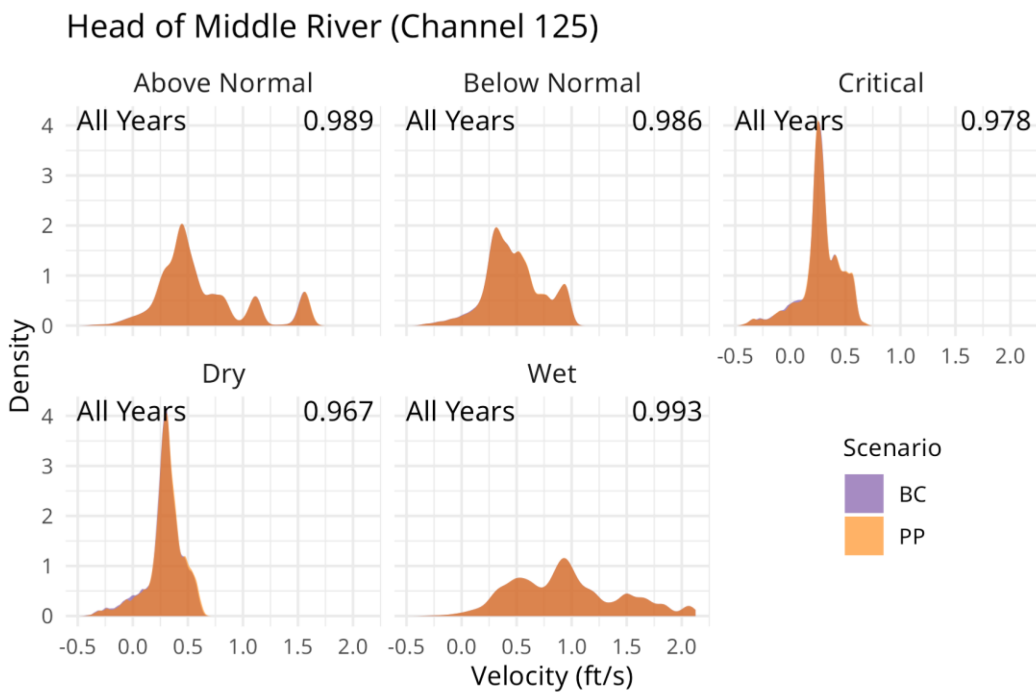
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-162. Velocity Density Distribution for Old River at Highway 4, February.



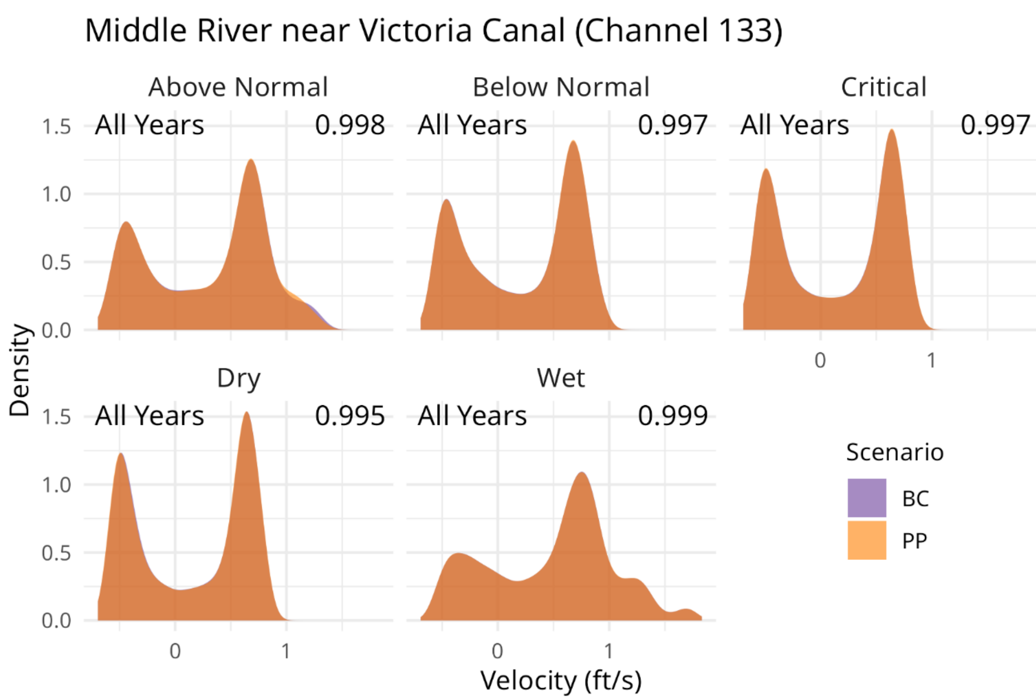
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-163. Velocity Density Distribution for Old River near Woodward Island, February.



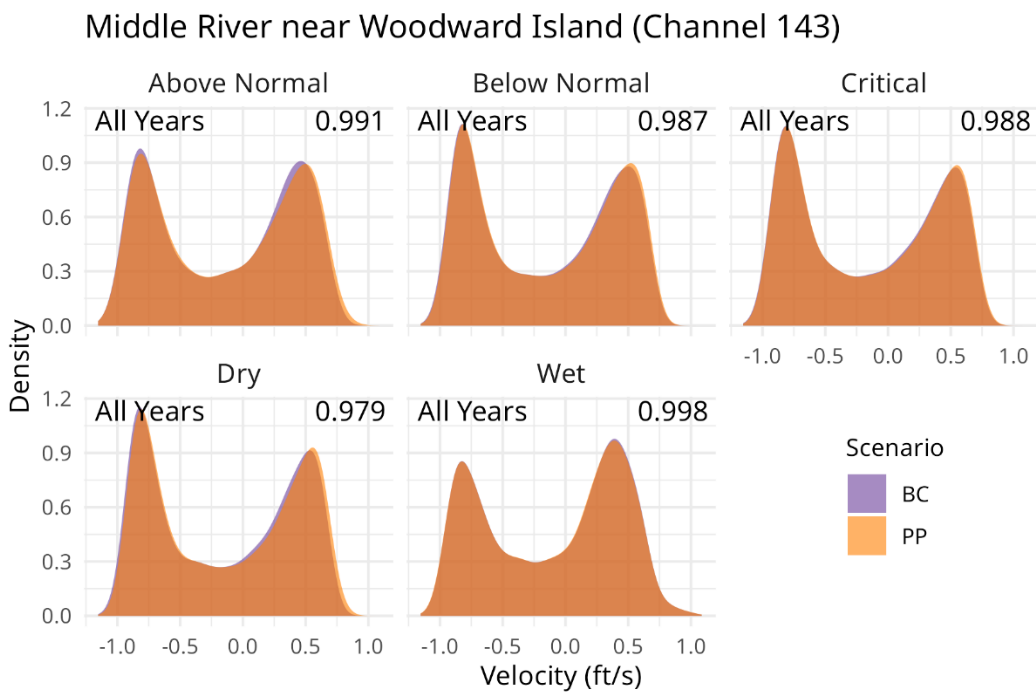
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-164. Velocity Density Distribution for Head of Middle River, February.



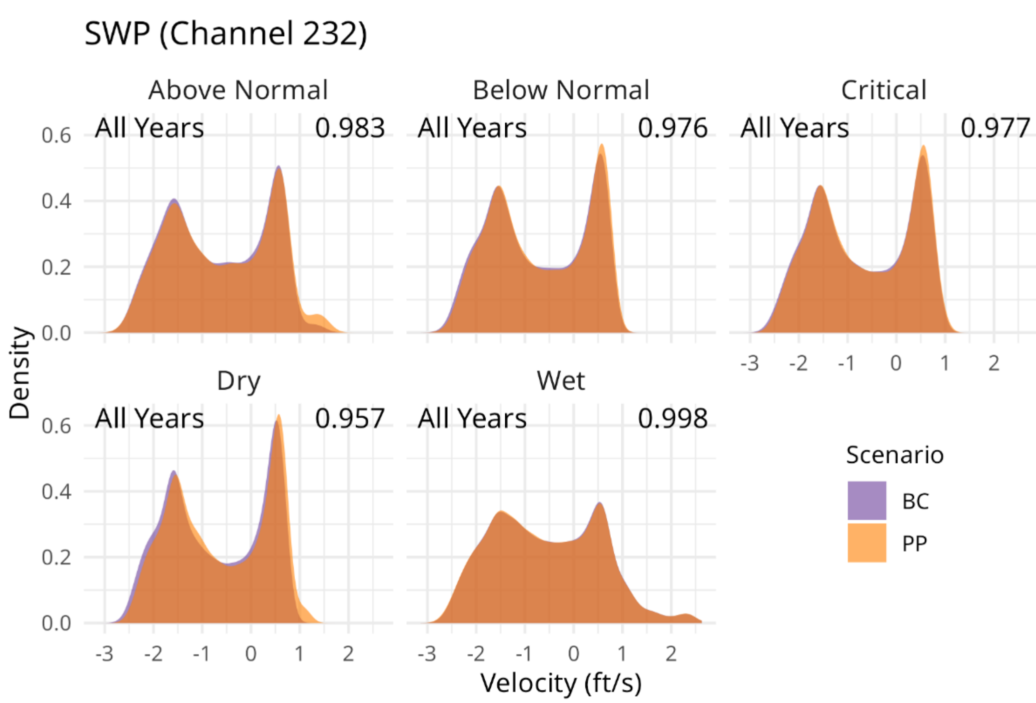
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-165. Velocity Density Distribution for Middle River near Victoria Canal, February.



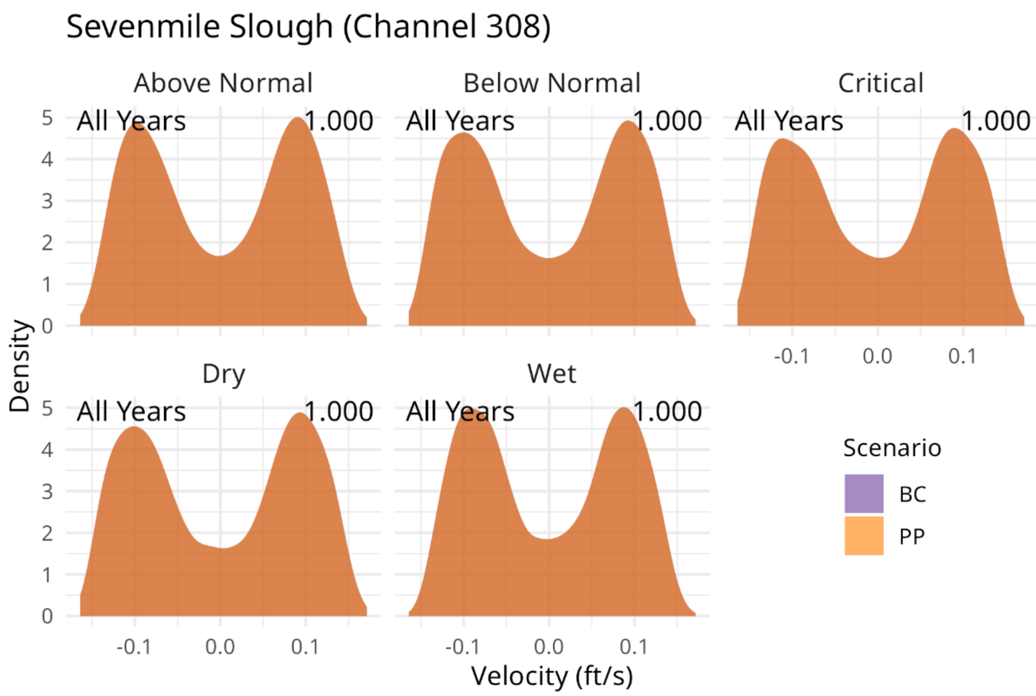
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-166. Velocity Density Distribution for Middle River near Woodward Island, February.



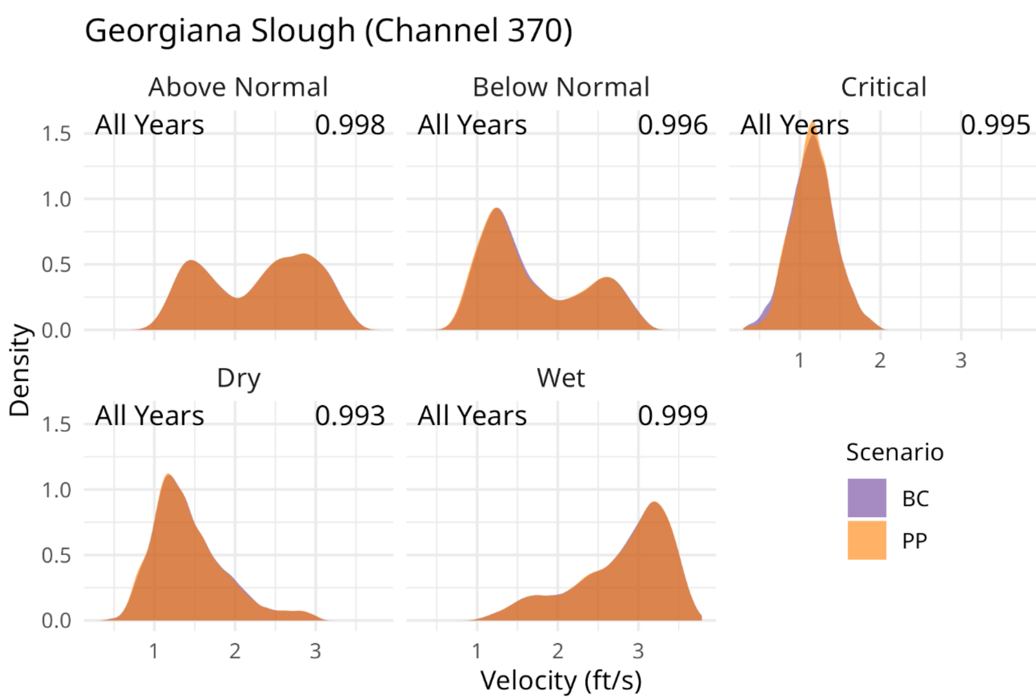
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-167. Velocity Density Distribution for State Water Project, February.



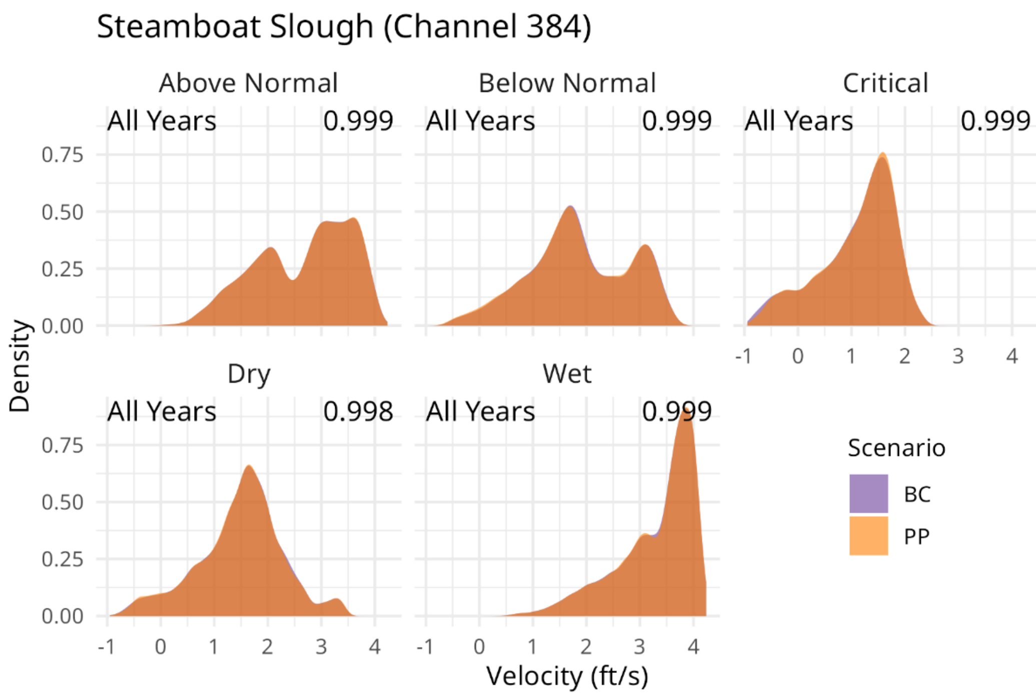
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-168. Velocity Density Distribution for Sevenmile Slough, February.



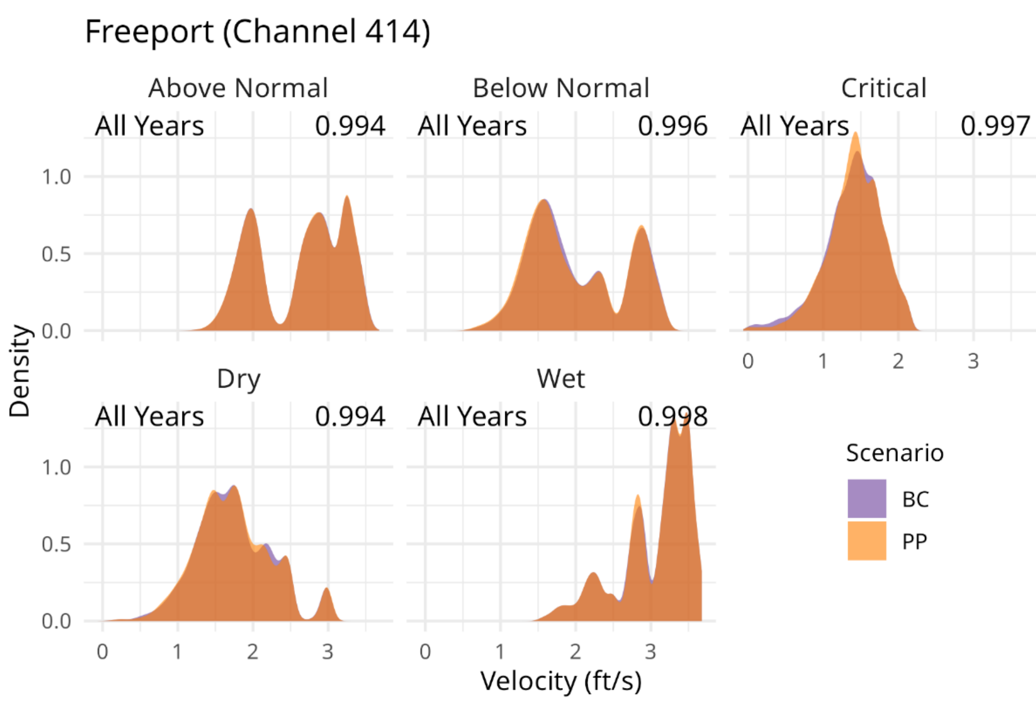
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-169. Velocity Density Distribution for Georgiana Slough, February.



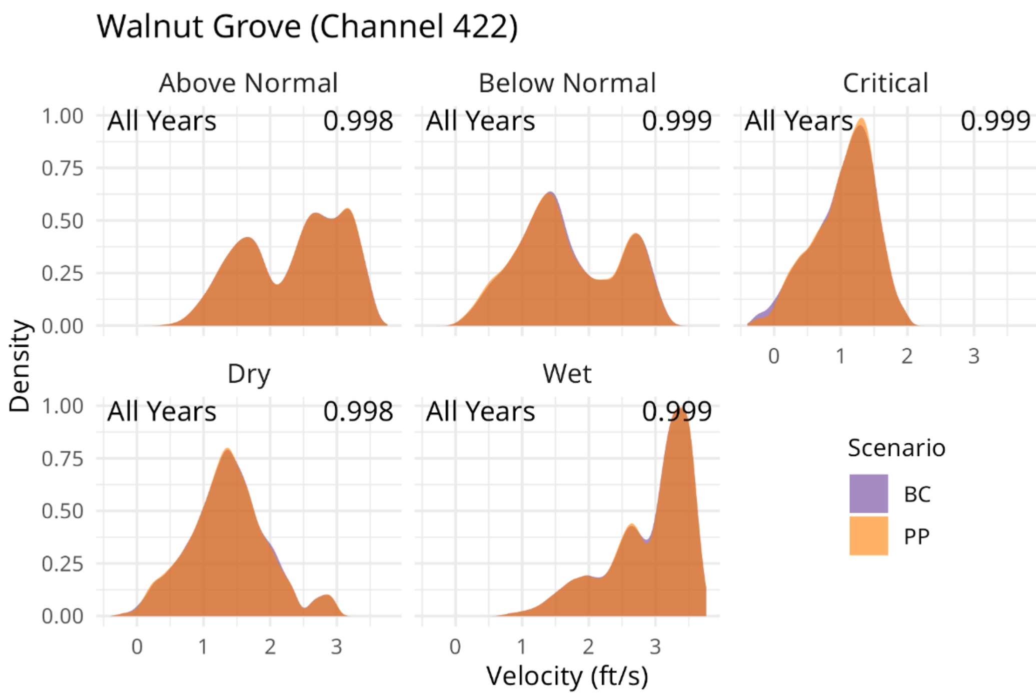
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-170. Velocity Density Distribution for Steamboat Slough, February.



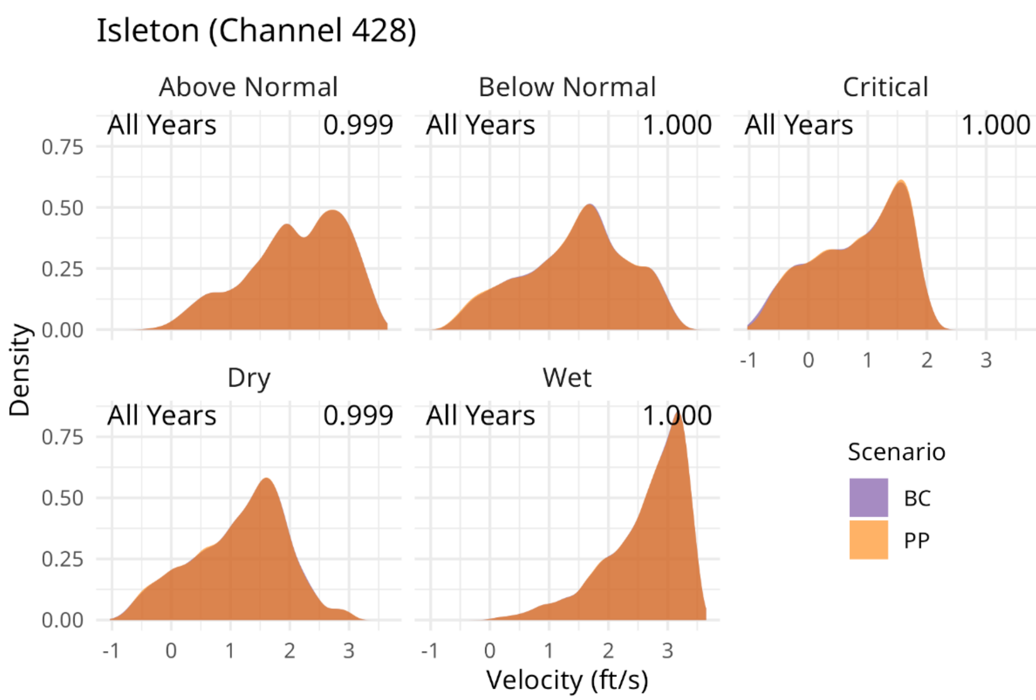
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-171. Velocity Density Distribution for Sacramento River at Freeport, February.



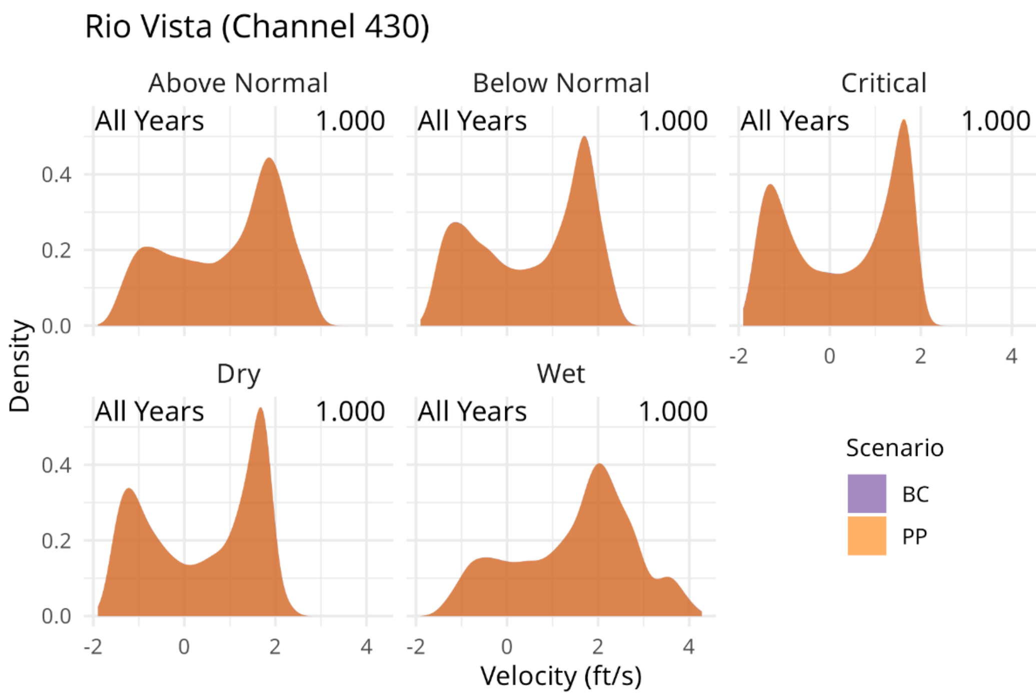
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-172. Velocity Density Distribution for Sacramento River at Walnut Grove, February.



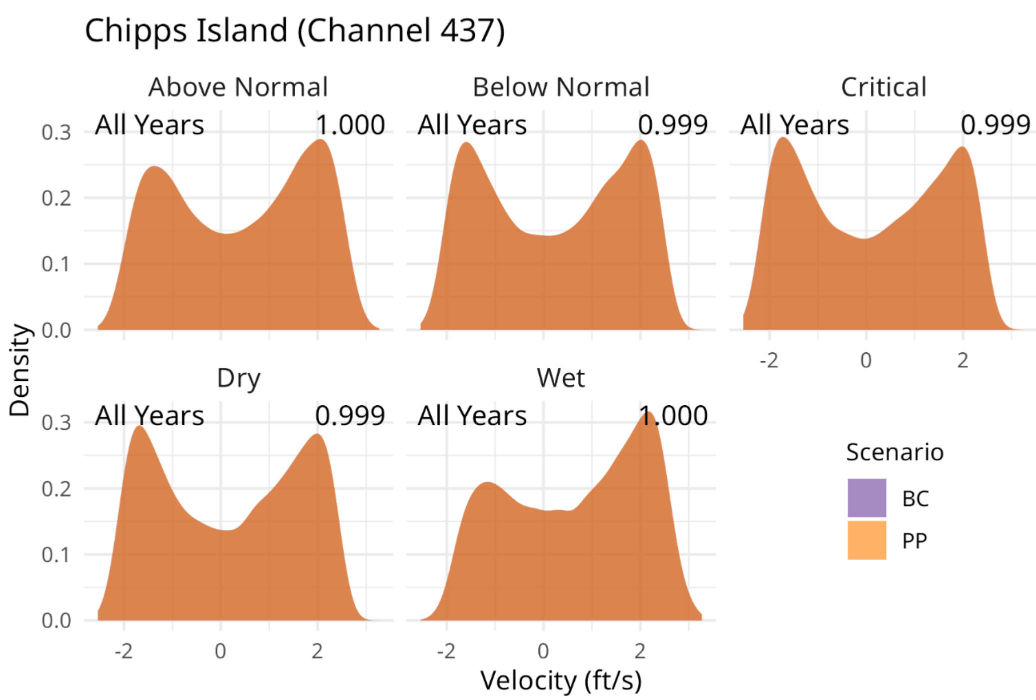
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-173. Velocity Density Distribution for Sacramento River at Isleton, February.



Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

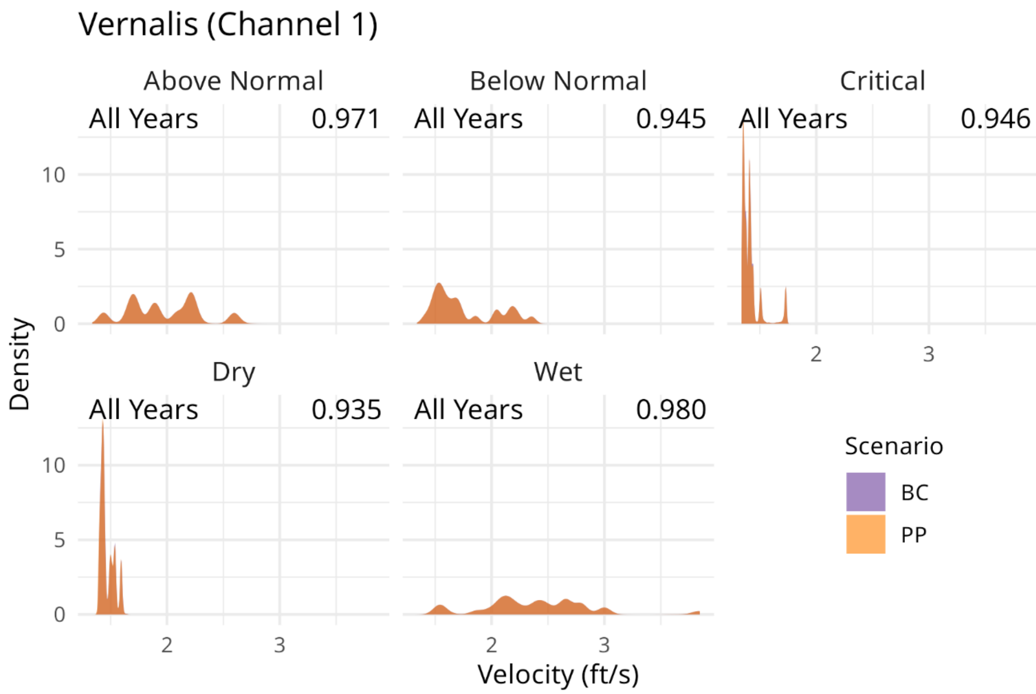
Figure 6B-174. Velocity Density Distribution for Sacramento River at Rio Vista, February.



Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

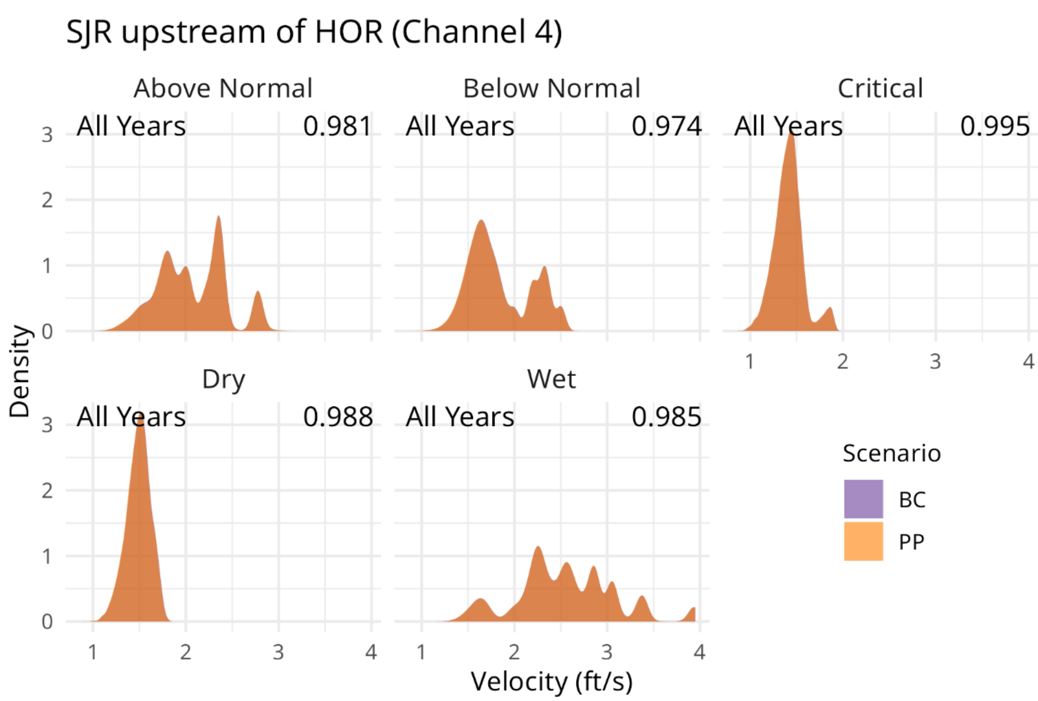
Figure 6B-175. Velocity Density Distribution for Sacramento River at Chipps Island, February.

March



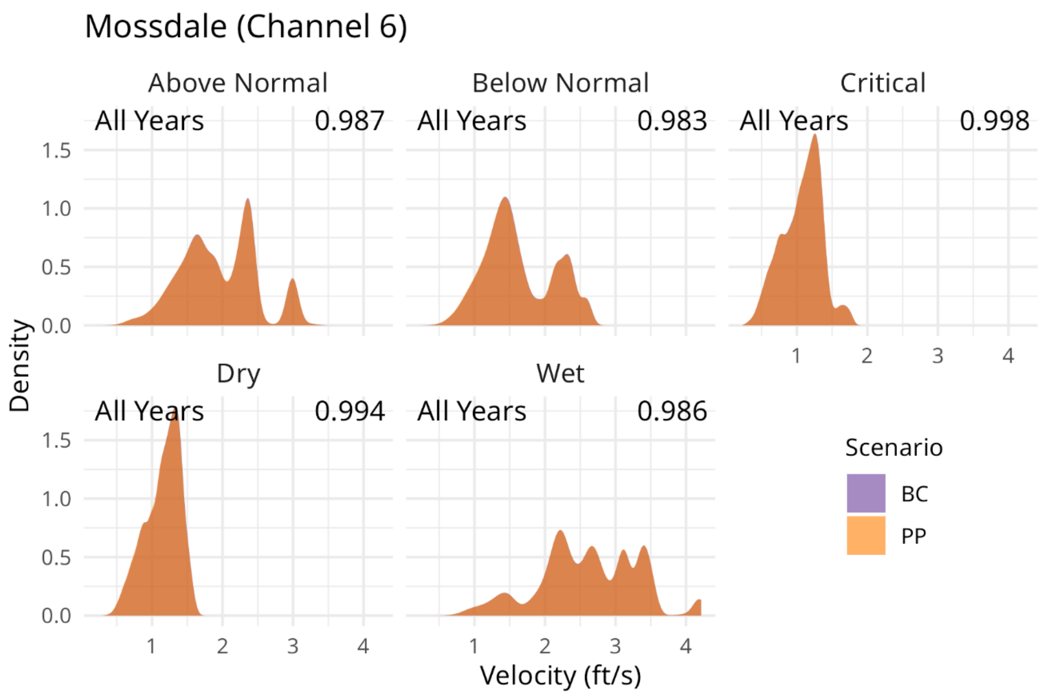
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-176. Velocity Density Distribution for San Joaquin River at Vernalis, March.



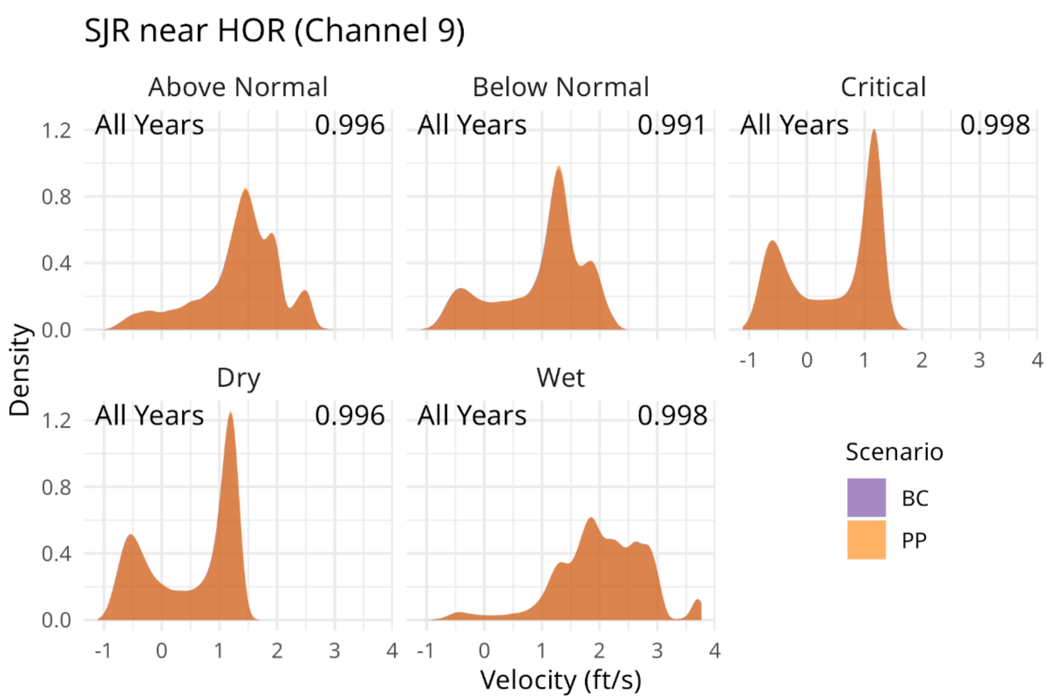
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-177. Velocity Density Distribution for San Joaquin River upstream of Head of Old River, March.



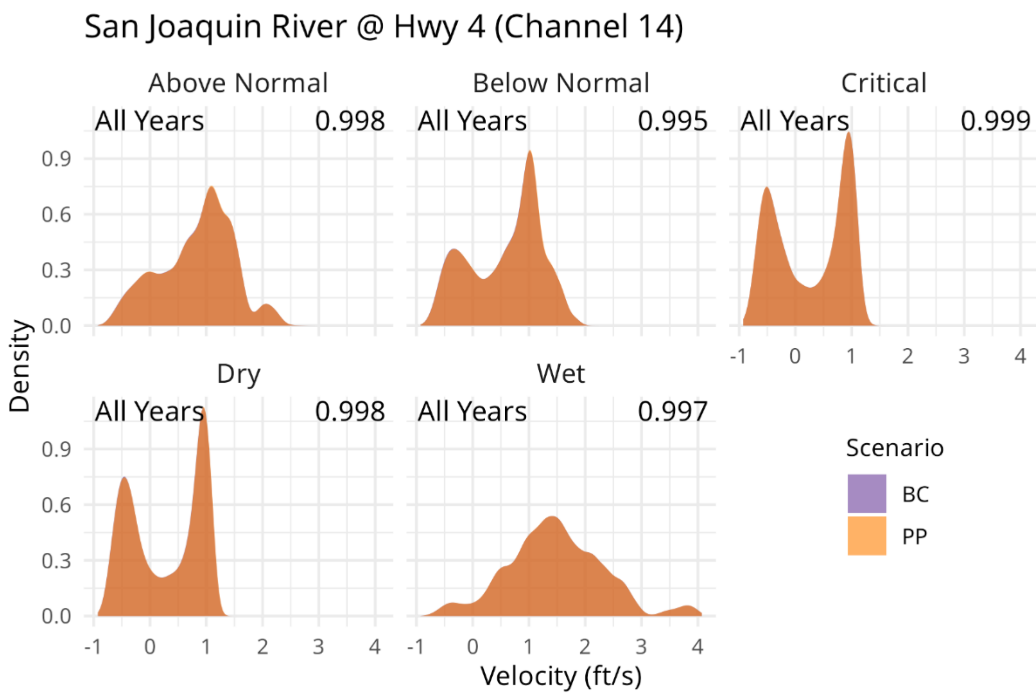
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-178. Velocity Density Distribution for San Joaquin River at Mossdale, March.



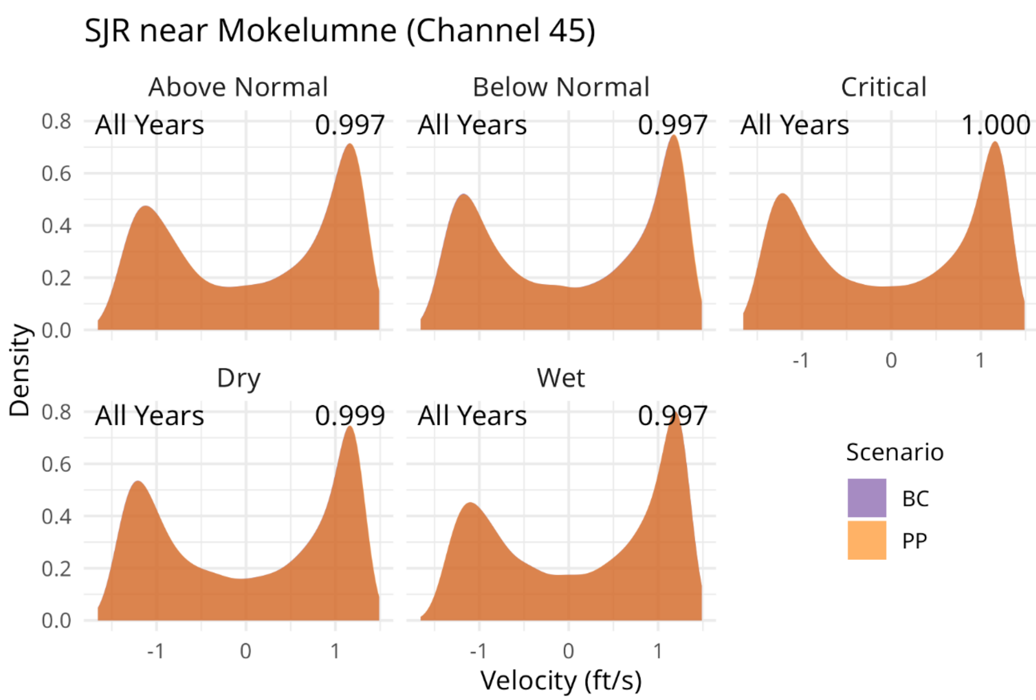
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-179. Velocity Density Distribution for San Joaquin River near Head of Old River, March.



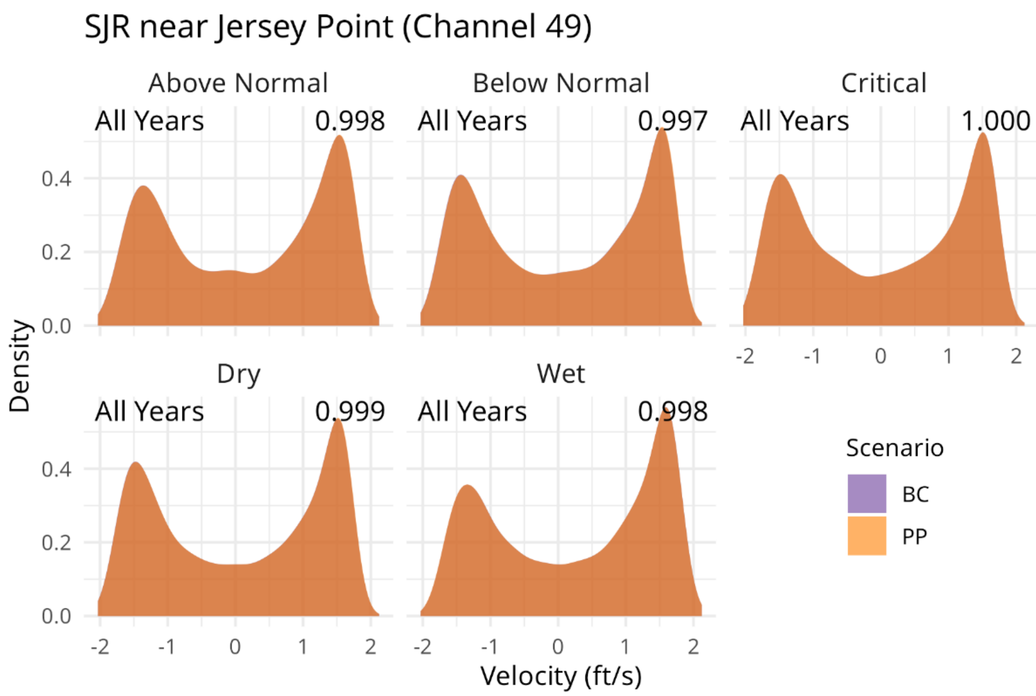
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-180. Velocity Density Distribution for San Joaquin River at Highway 4, March.



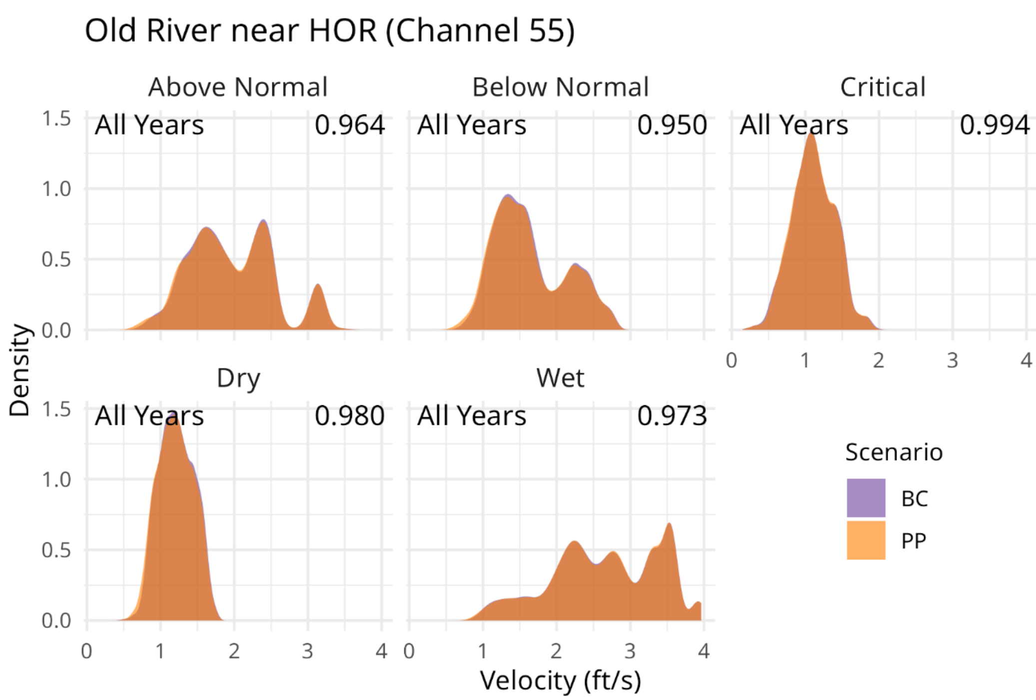
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-181. Velocity Density Distribution for San Joaquin River near Mokelumne River, March.



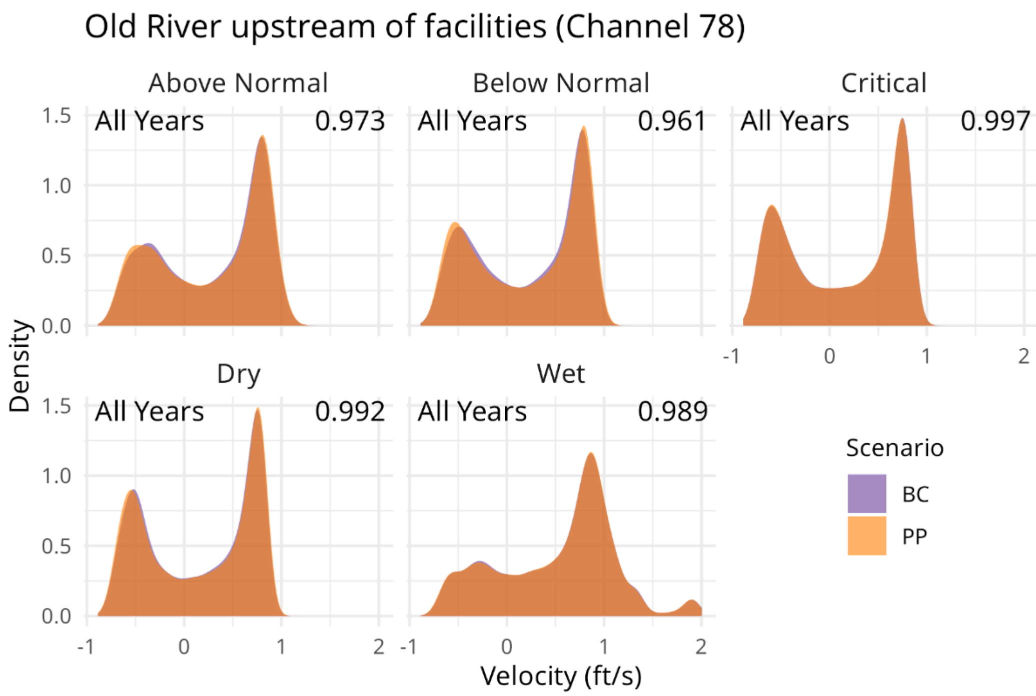
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-182. Velocity Density Distribution for San Joaquin River near Jersey Point, March.



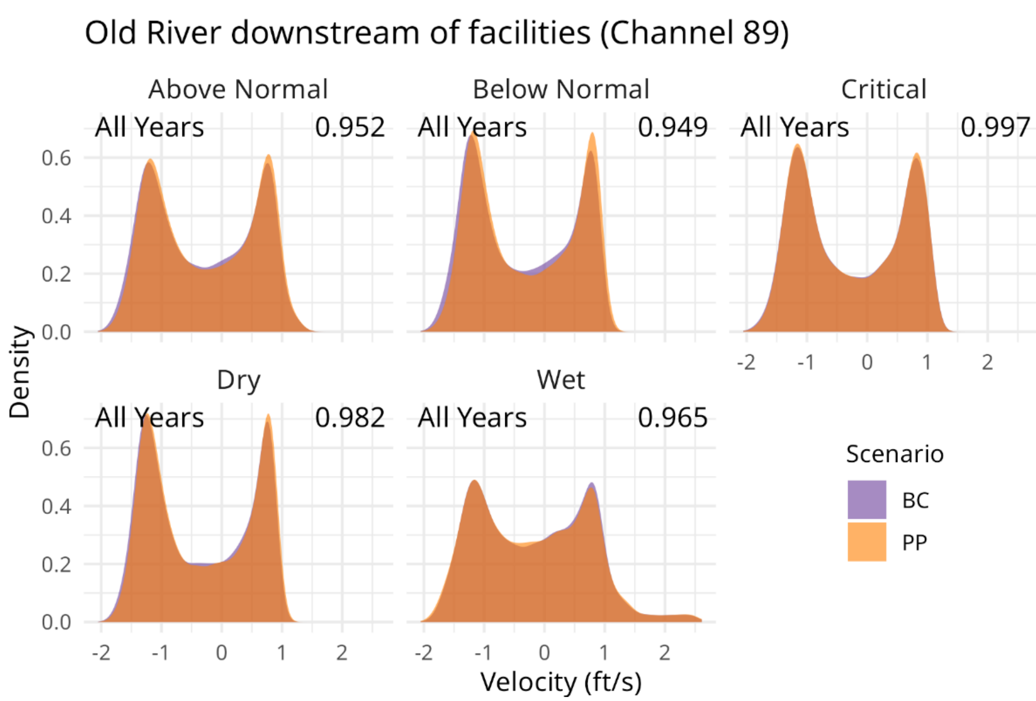
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-183. Velocity Density Distribution for Old River near Head of Old River, March.



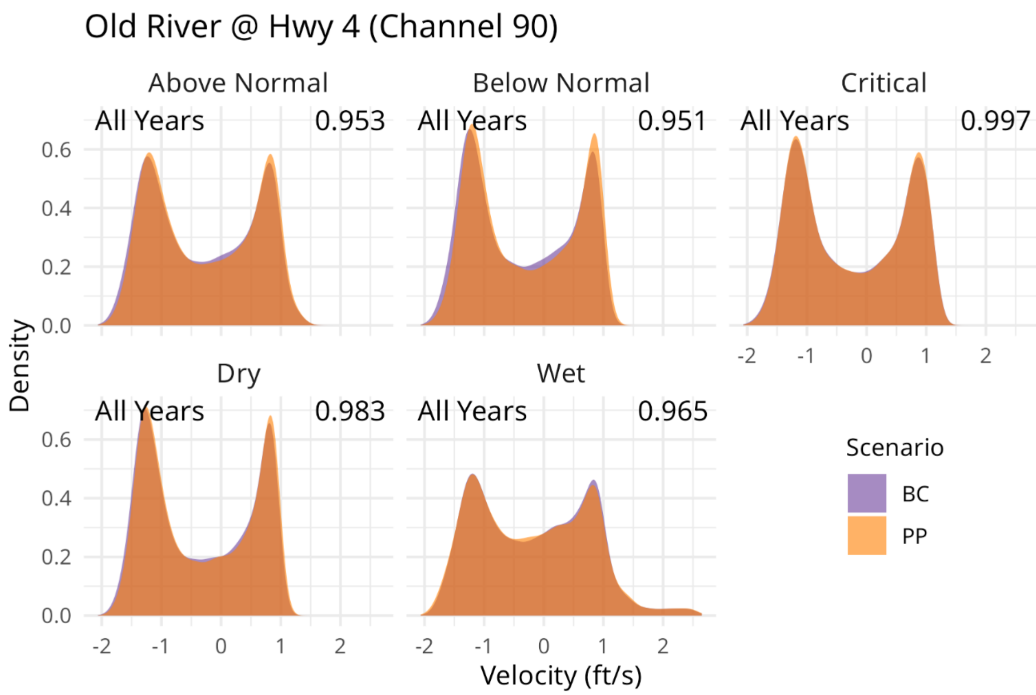
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-184. Velocity Density Distribution for Old River Upstream of the South Delta Export Facilities, March.



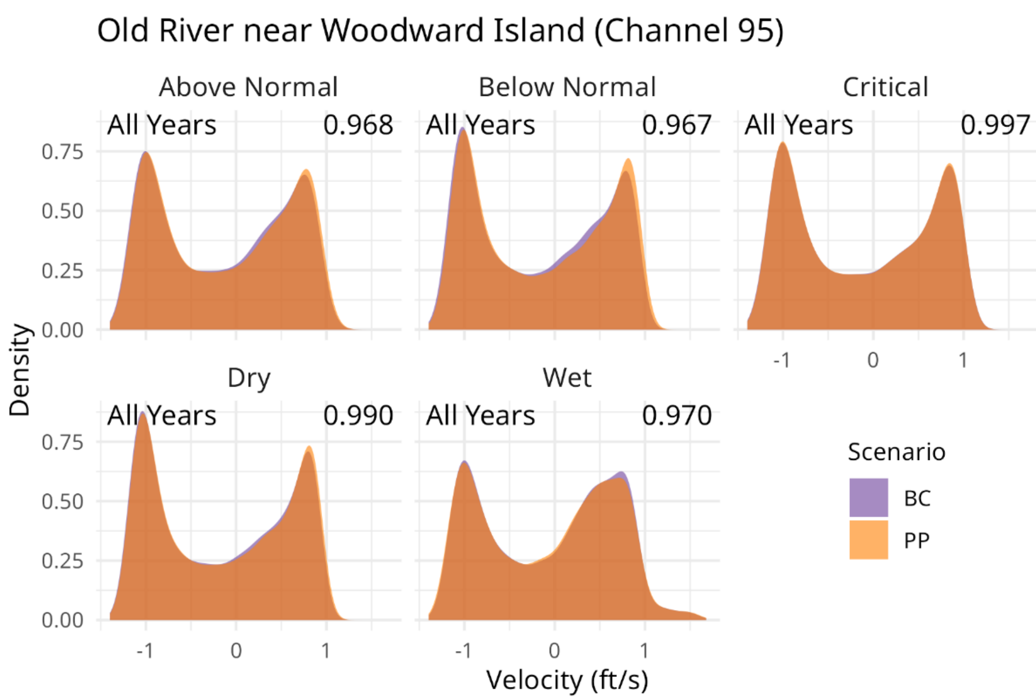
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-185. Velocity Density Distribution for Old River Downstream of the South Delta Export Facilities, March.



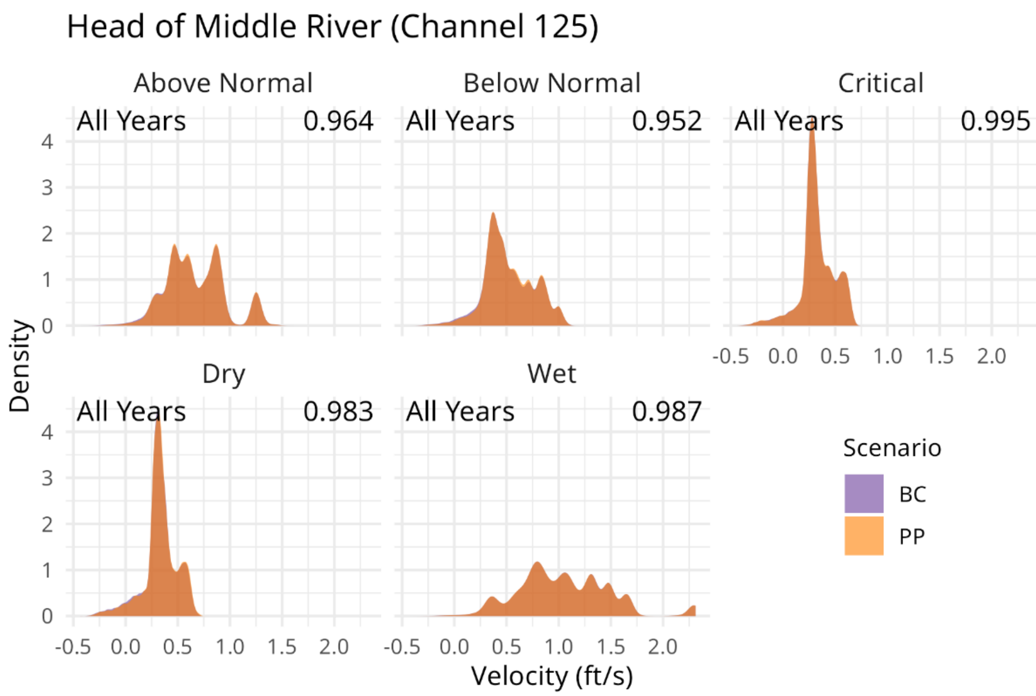
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-186. Velocity Density Distribution for Old River at Highway 4, March.



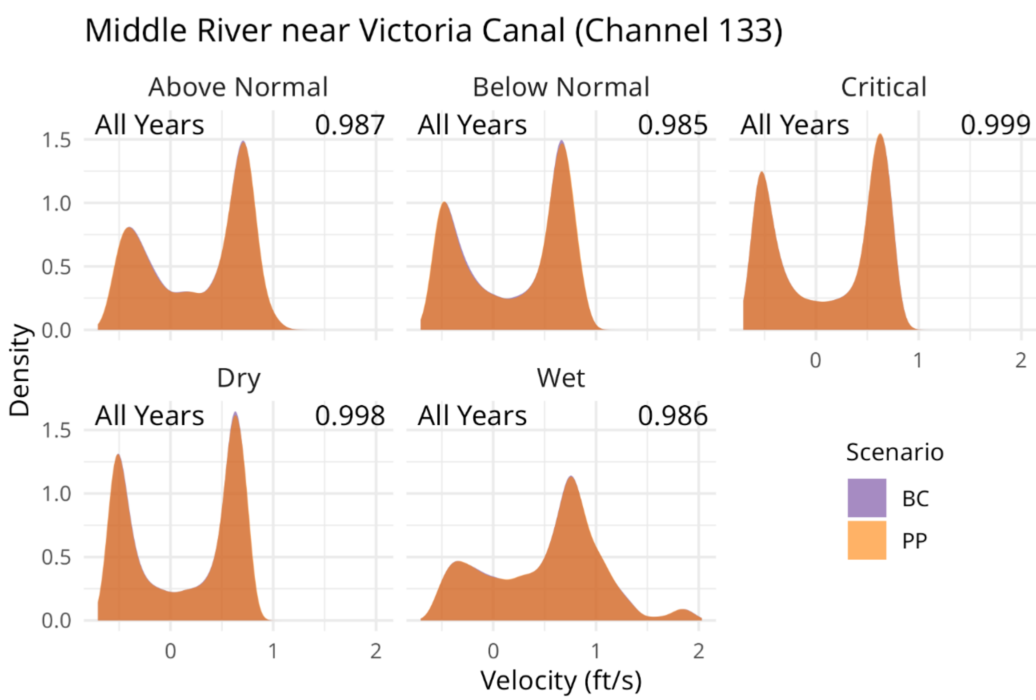
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-187. Velocity Density Distribution for Old River near Woodward Island, March.



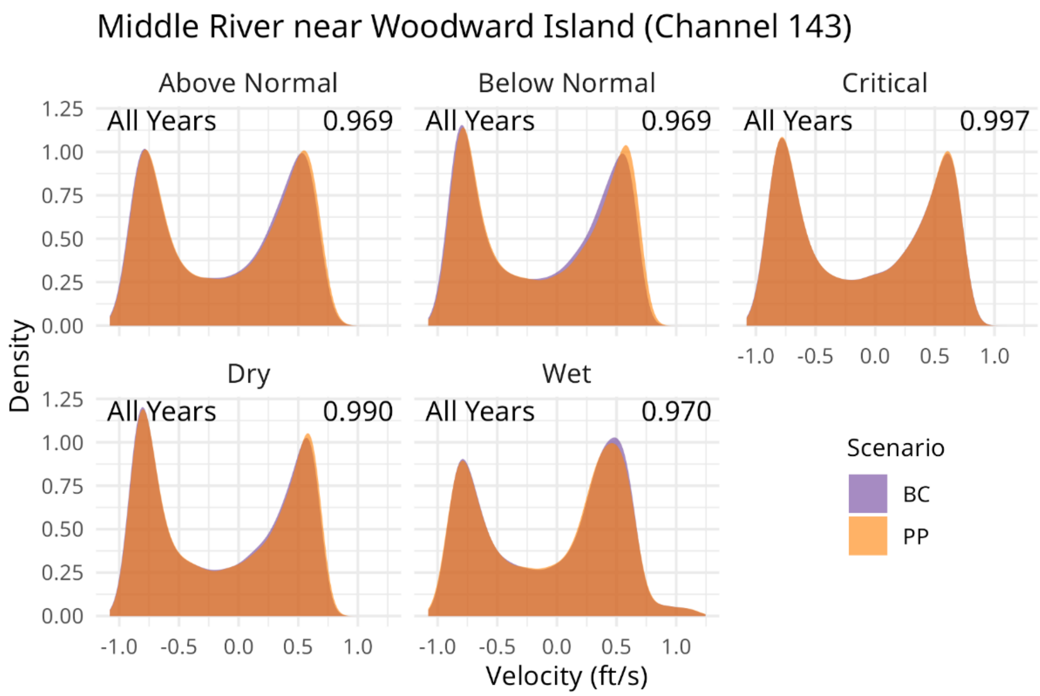
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-188. Velocity Density Distribution for Head of Middle River, March.



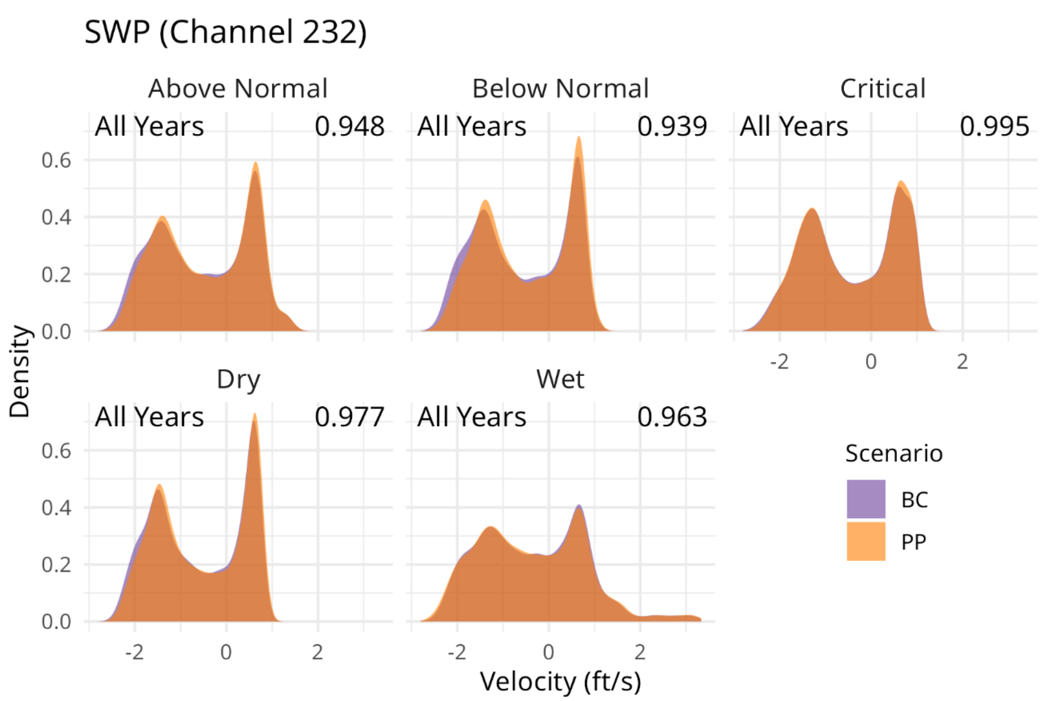
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-189. Velocity Density Distribution for Middle River near Victoria Canal, March.



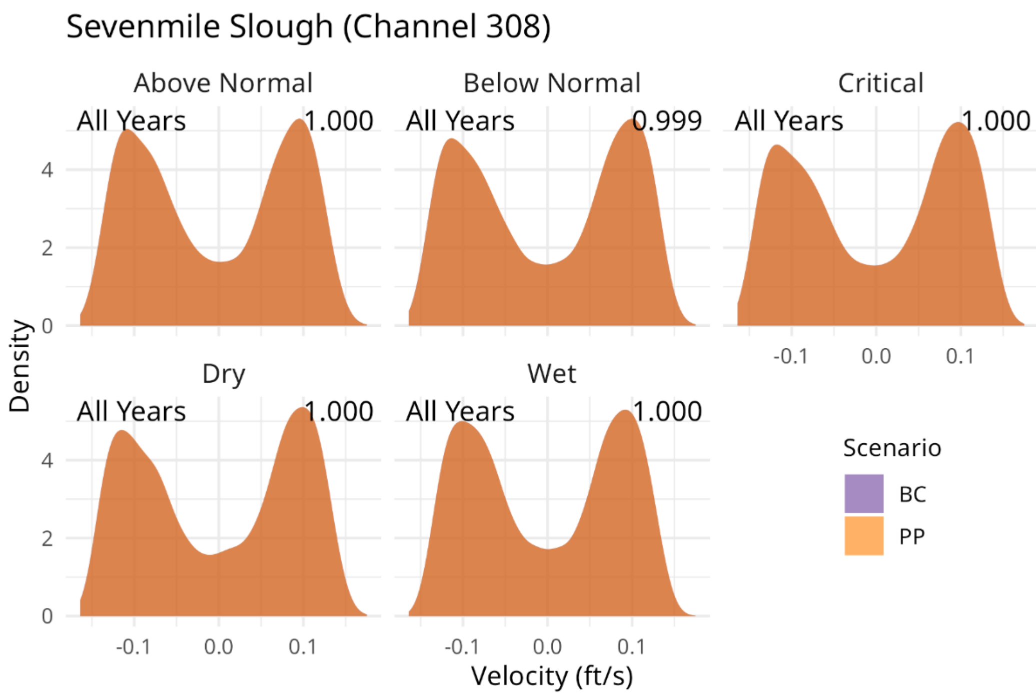
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-190. Velocity Density Distribution for Middle River near Woodward Island, March.



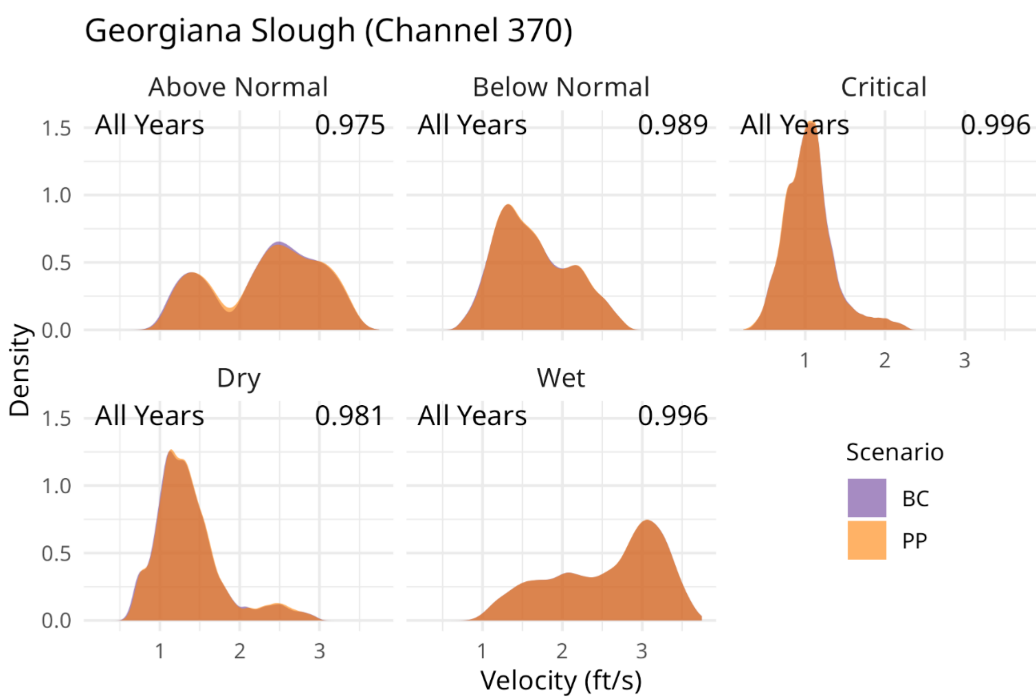
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-191. Velocity Density Distribution for State Water Project, March.



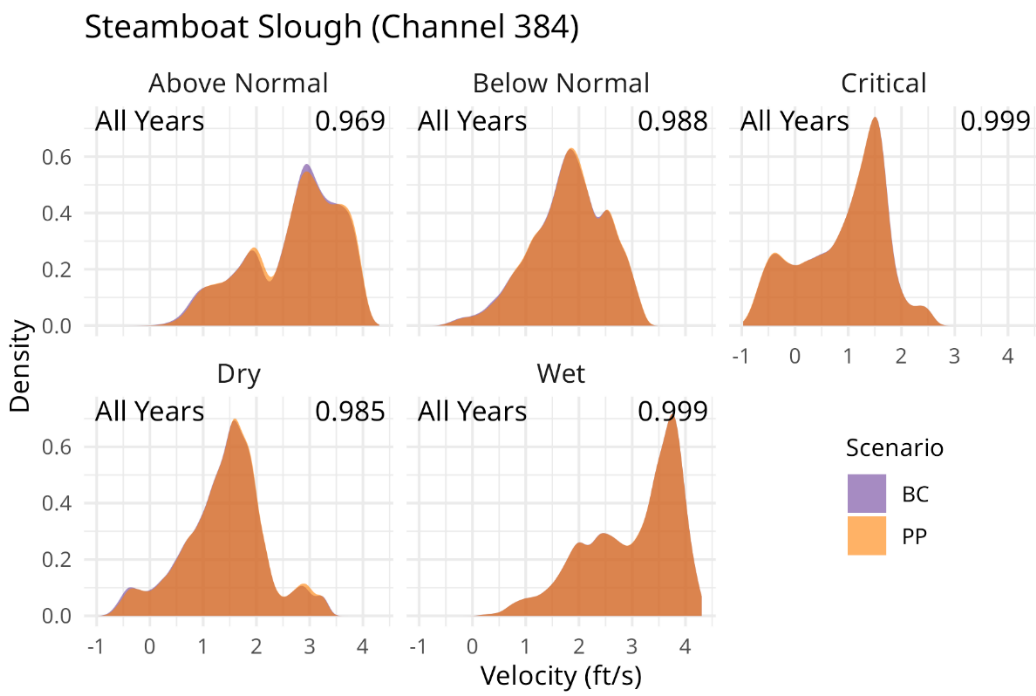
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-192. Velocity Density Distribution for Sevenmile Slough, March.



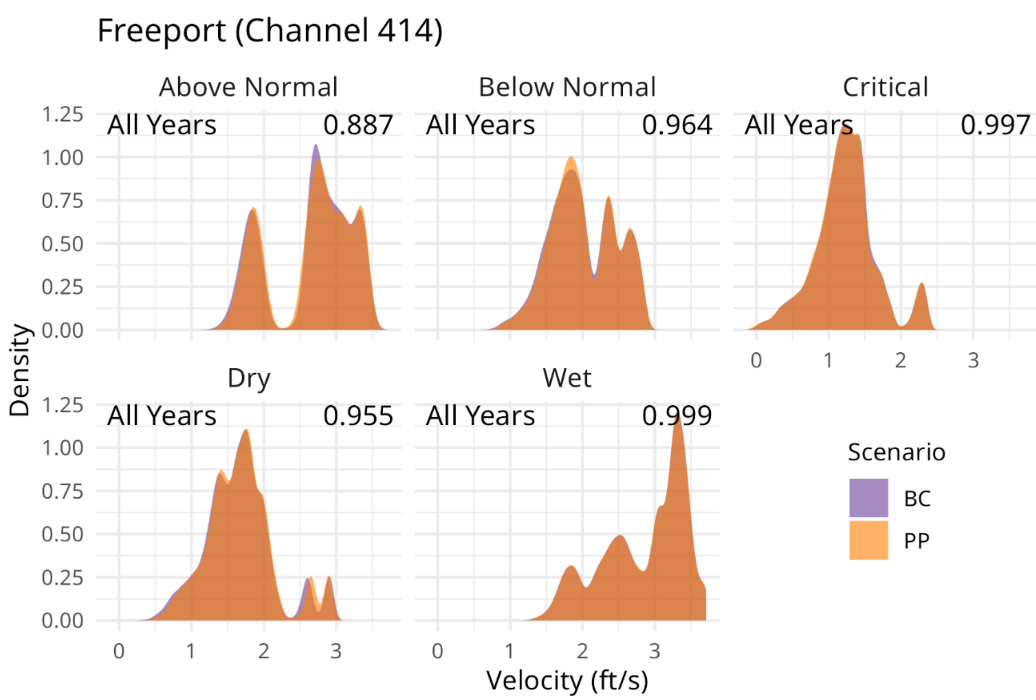
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-193. Velocity Density Distribution for Georgiana Slough, March.



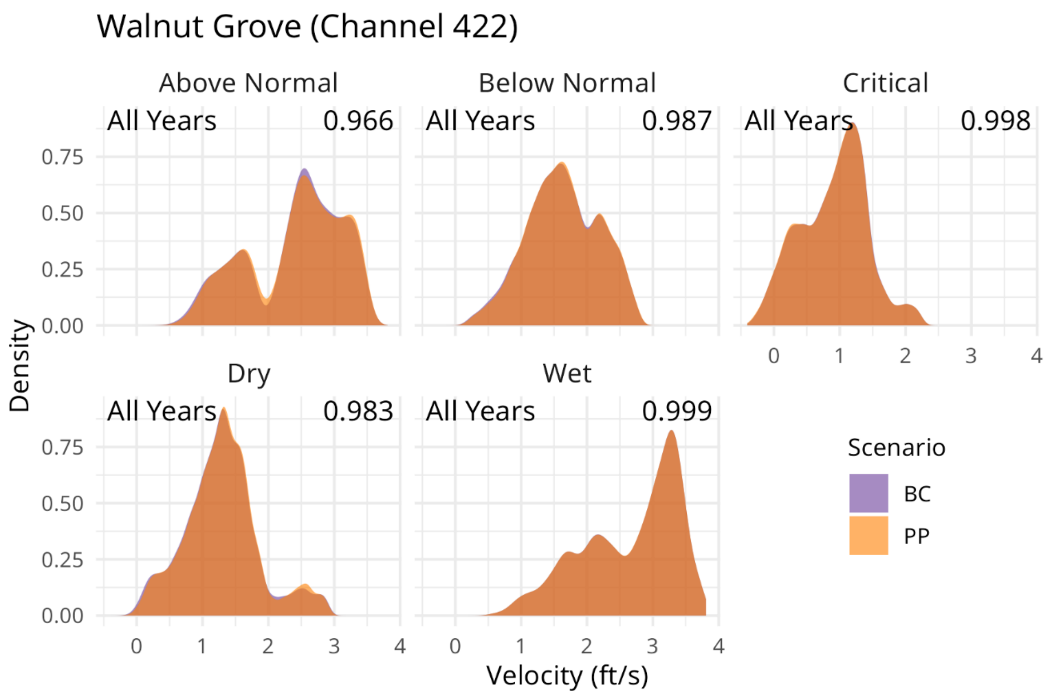
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-194. Velocity Density Distribution for Steamboat Slough, March.



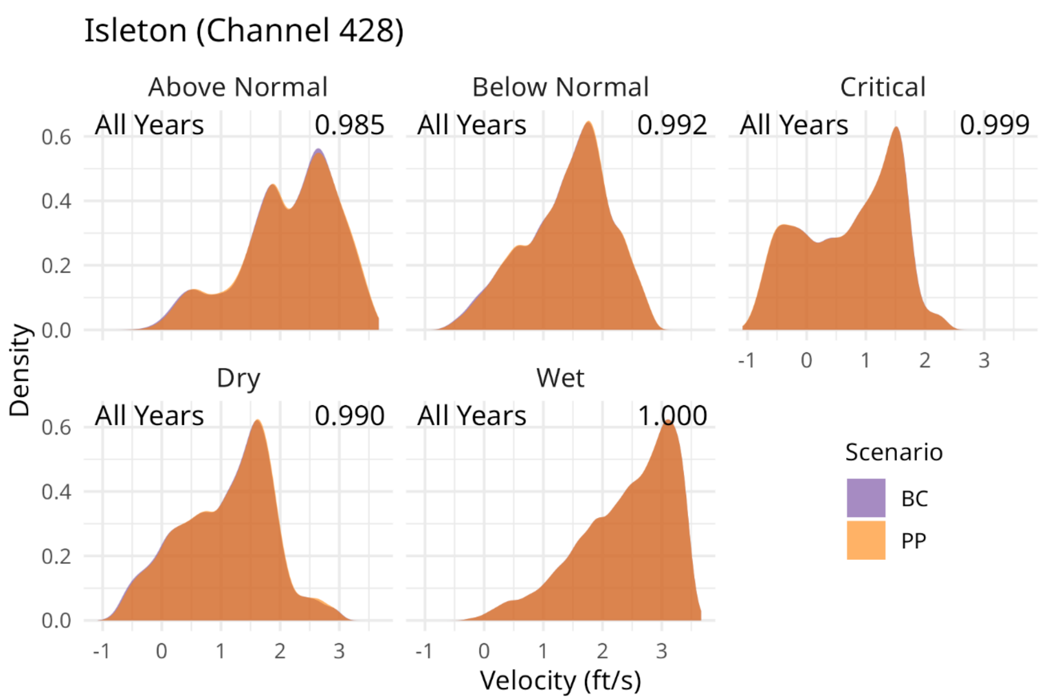
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-195. Velocity Density Distribution for Sacramento River at Freeport, March.



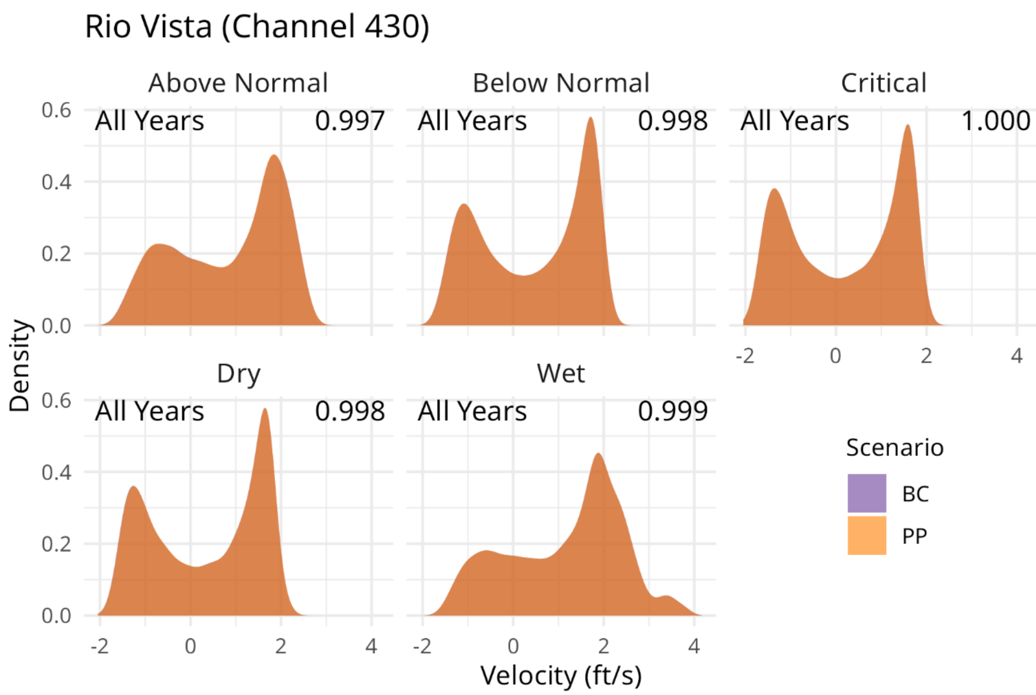
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-196. Velocity Density Distribution for Sacramento River at Walnut Grove, March.



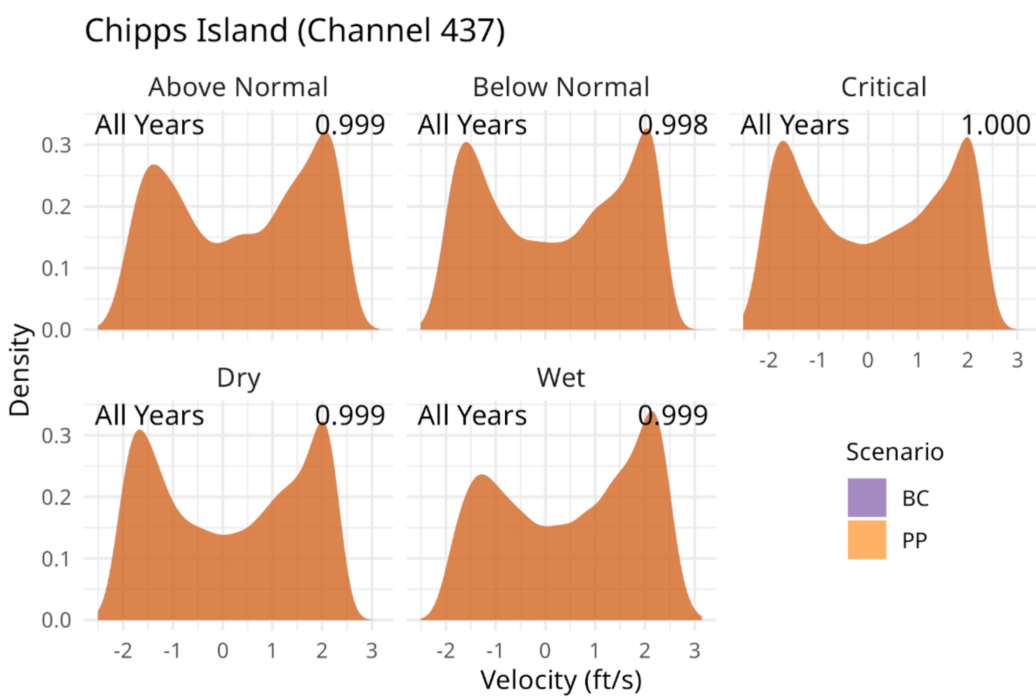
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-197. Velocity Density Distribution for Sacramento River at Isleton, March.



Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

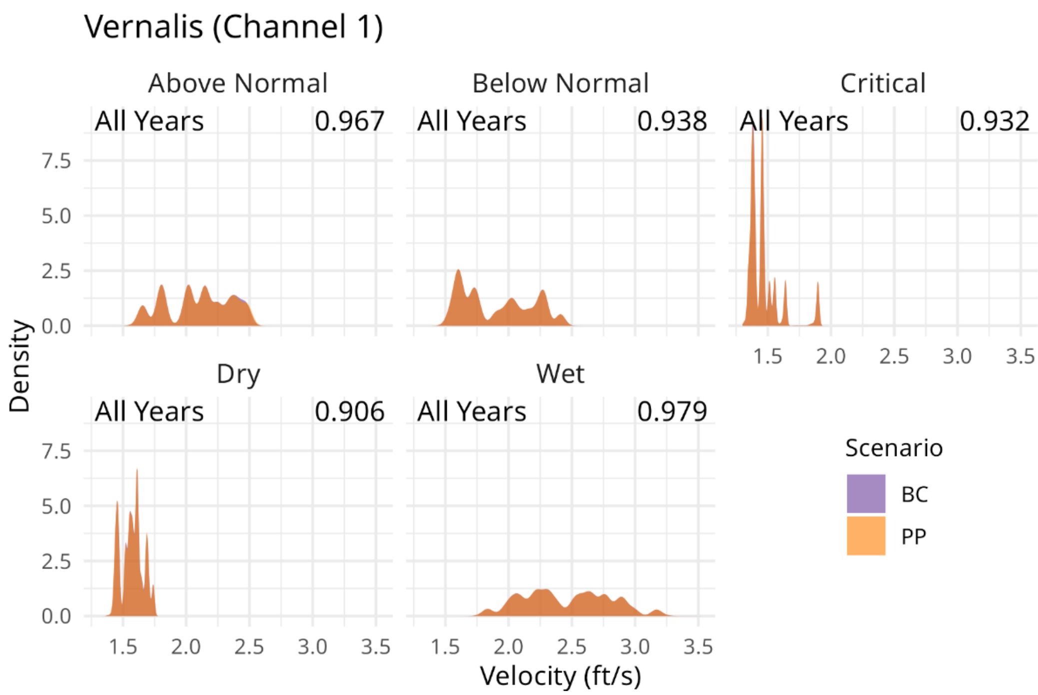
Figure 6B-198. Velocity Density Distribution for Sacramento River at Rio Vista, March.



Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

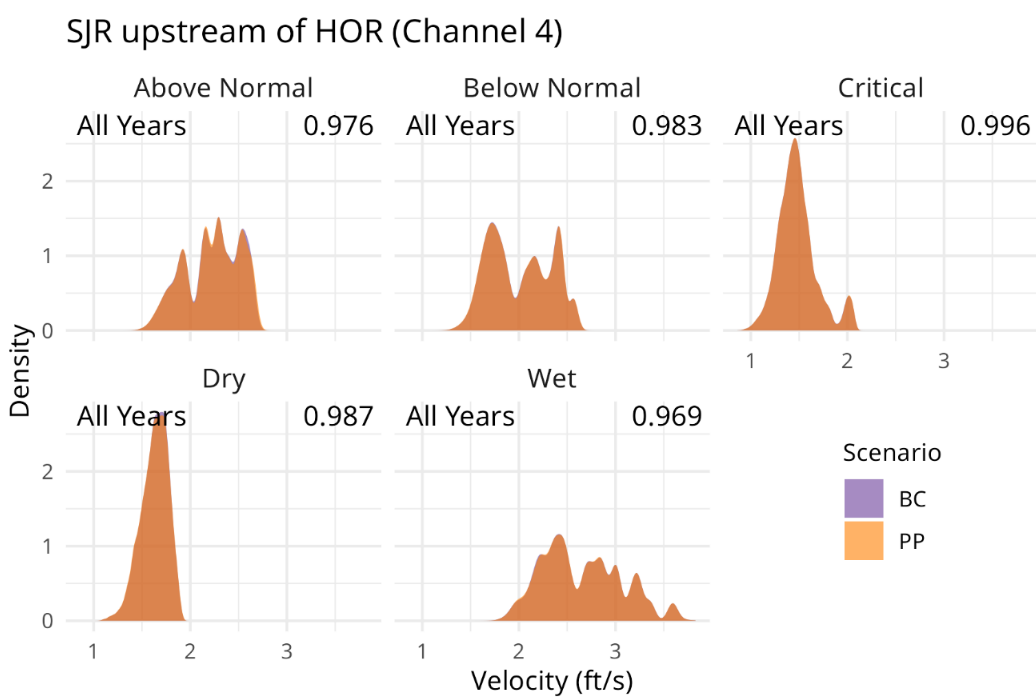
Figure 6B-199. Velocity Density Distribution for Sacramento River at Chipps Island, March.

April



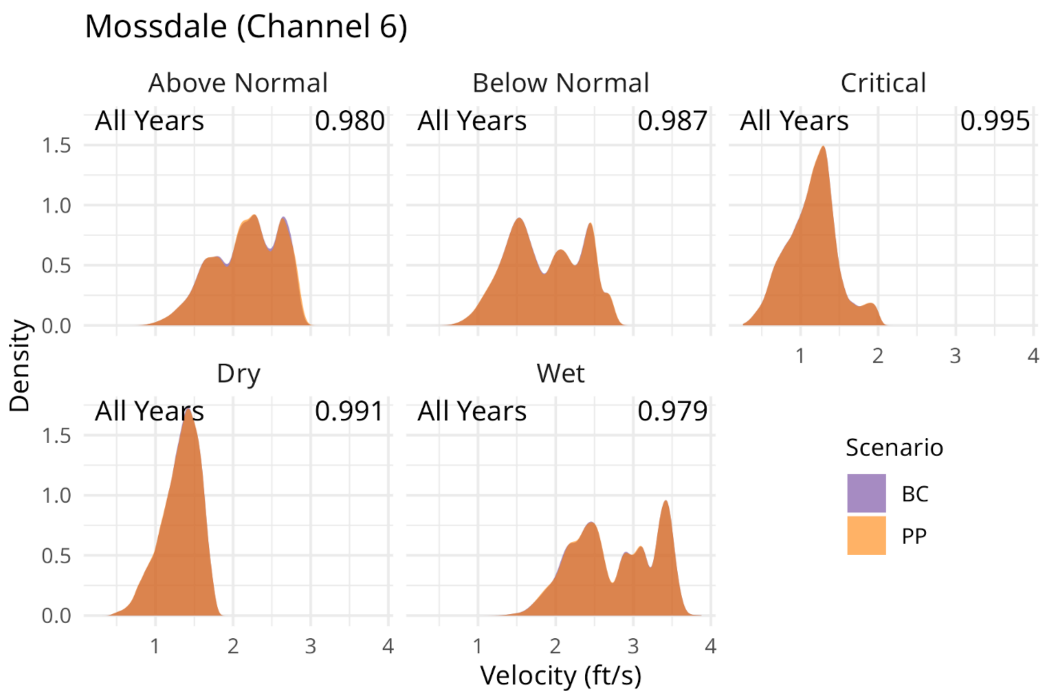
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-200. Velocity Density Distribution for San Joaquin River at Vernalis, April.



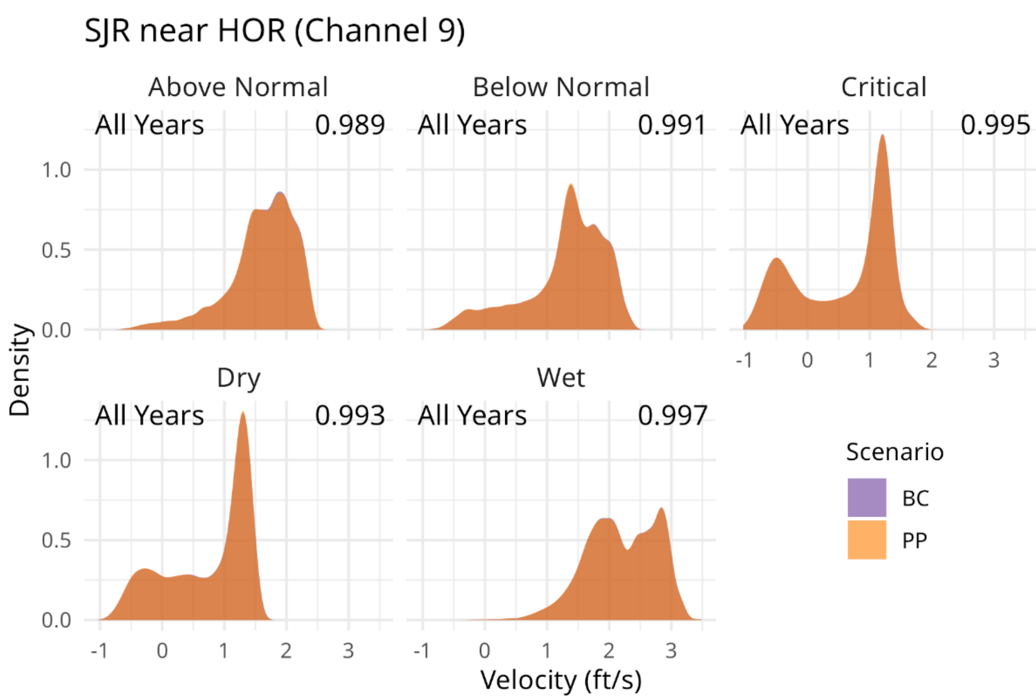
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-201. Velocity Density Distribution for San Joaquin River upstream of Head of Old River, April.



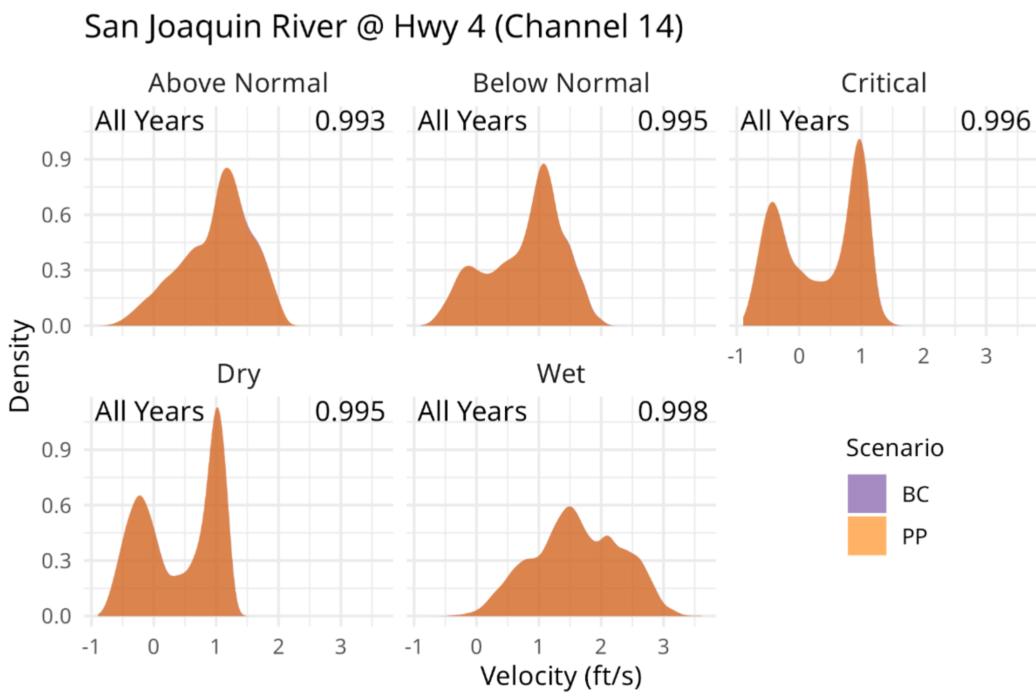
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-202. Velocity Density Distribution for San Joaquin River at Mossdale, April.



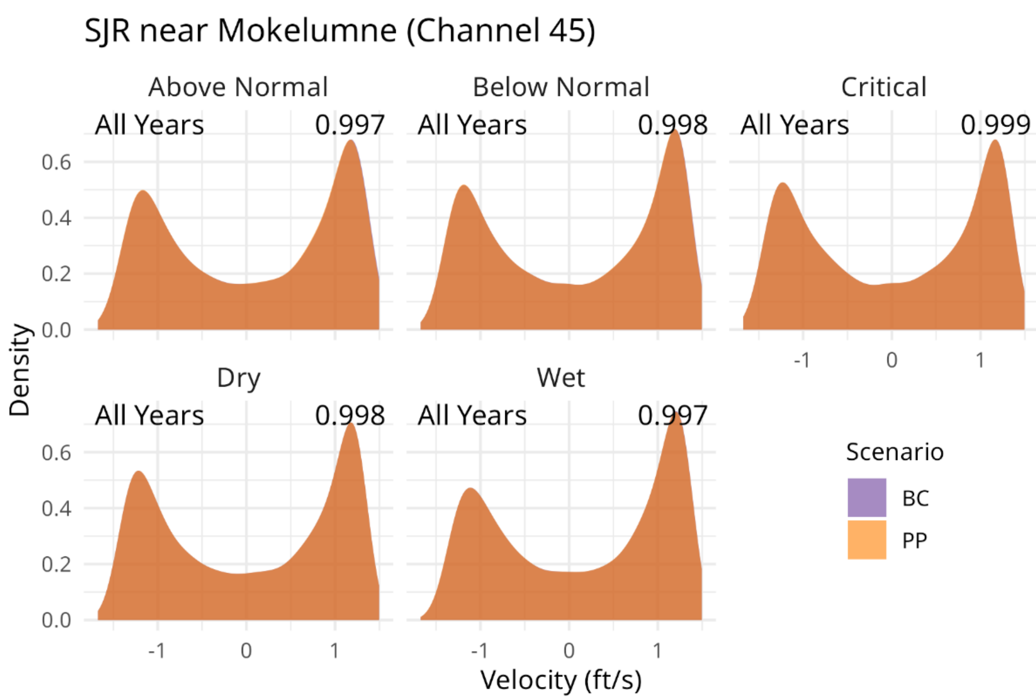
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-203. Velocity Density Distribution for San Joaquin River near Head of Old River, April.



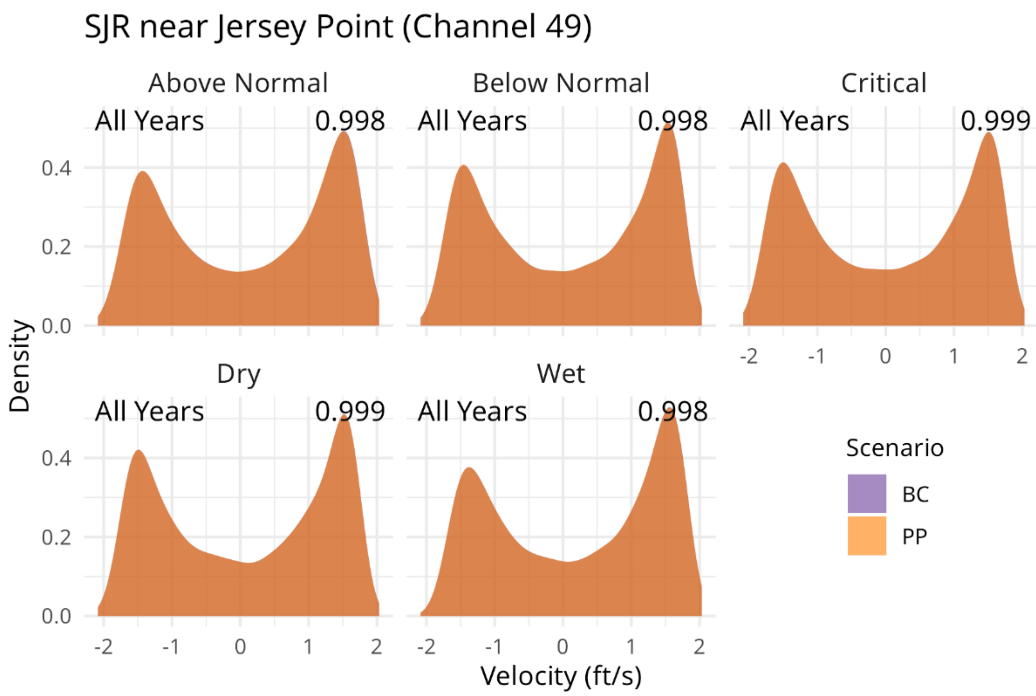
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-204. Velocity Density Distribution for San Joaquin River at Highway 4, April.



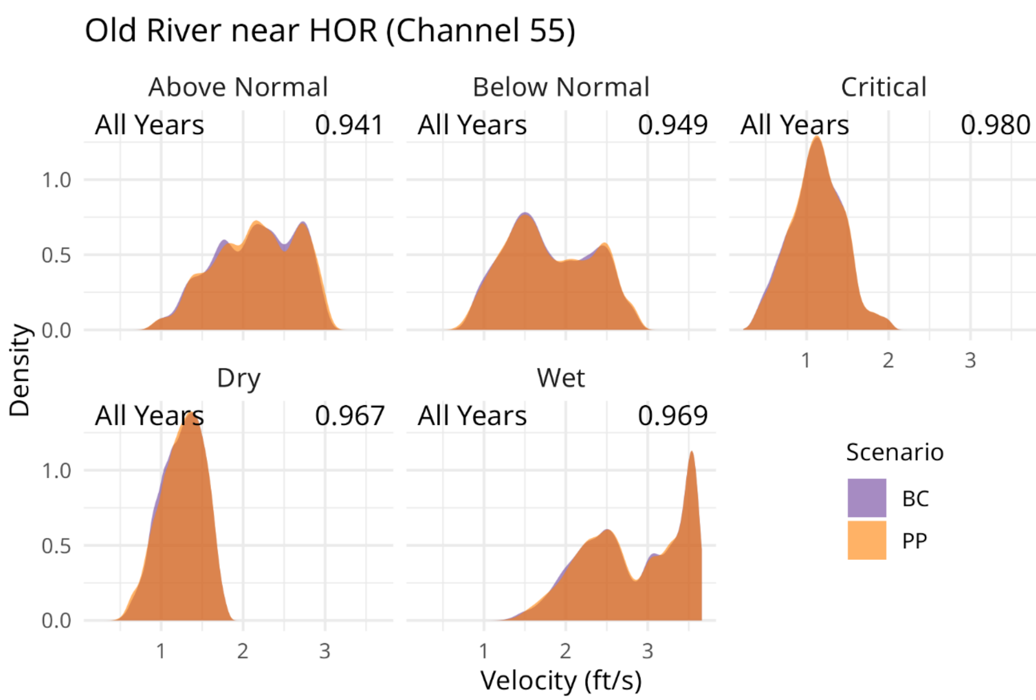
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-205. Velocity Density Distribution for San Joaquin River near Mokelumne River, April.



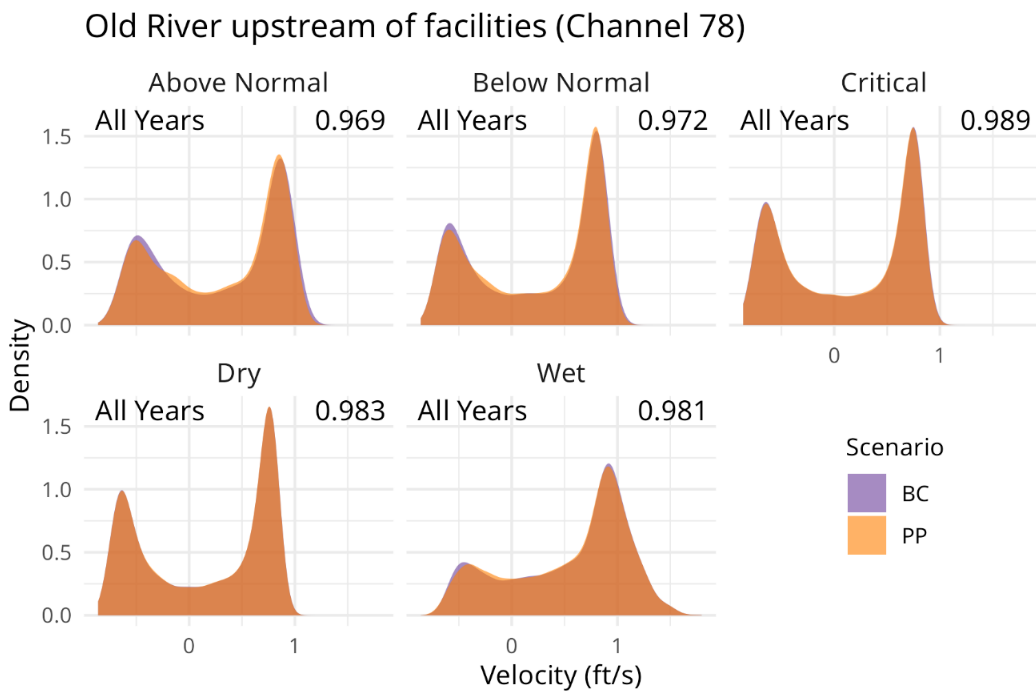
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-206. Velocity Density Distribution for San Joaquin River near Jersey Point, April.



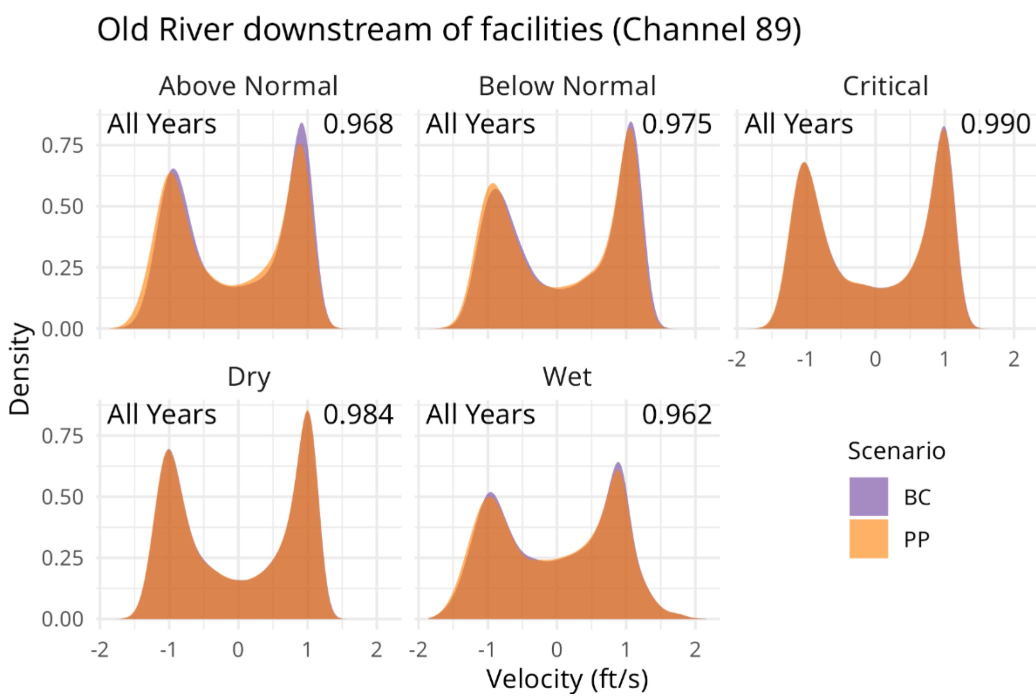
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-207. Velocity Density Distribution for Old River near Head of Old River, April.



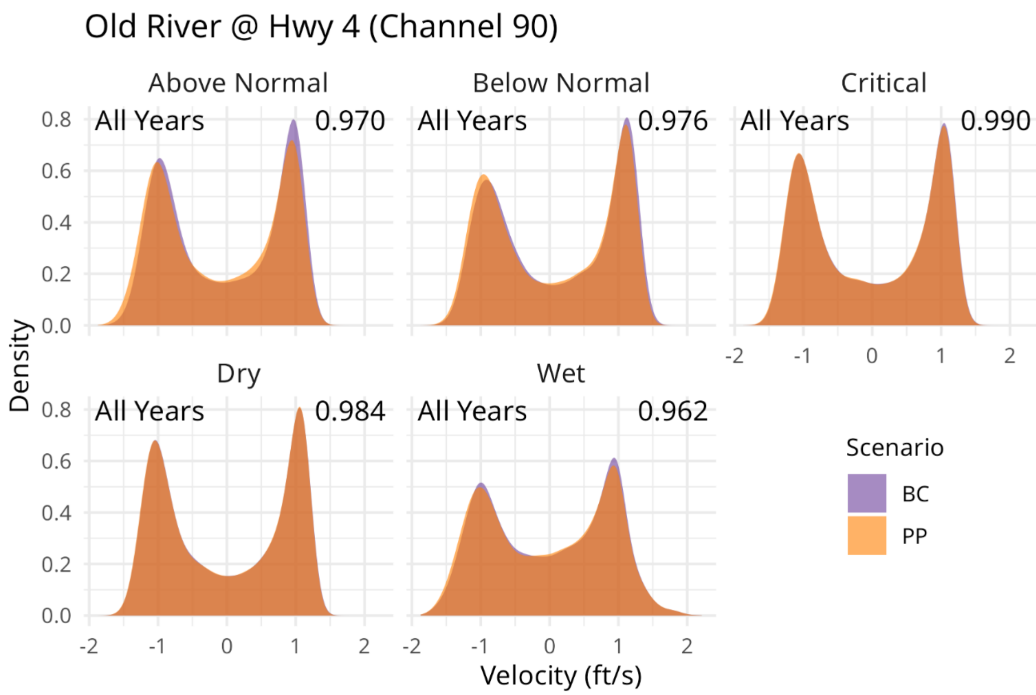
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-208. Velocity Density Distribution for Old River Upstream of the South Delta Export Facilities, April.



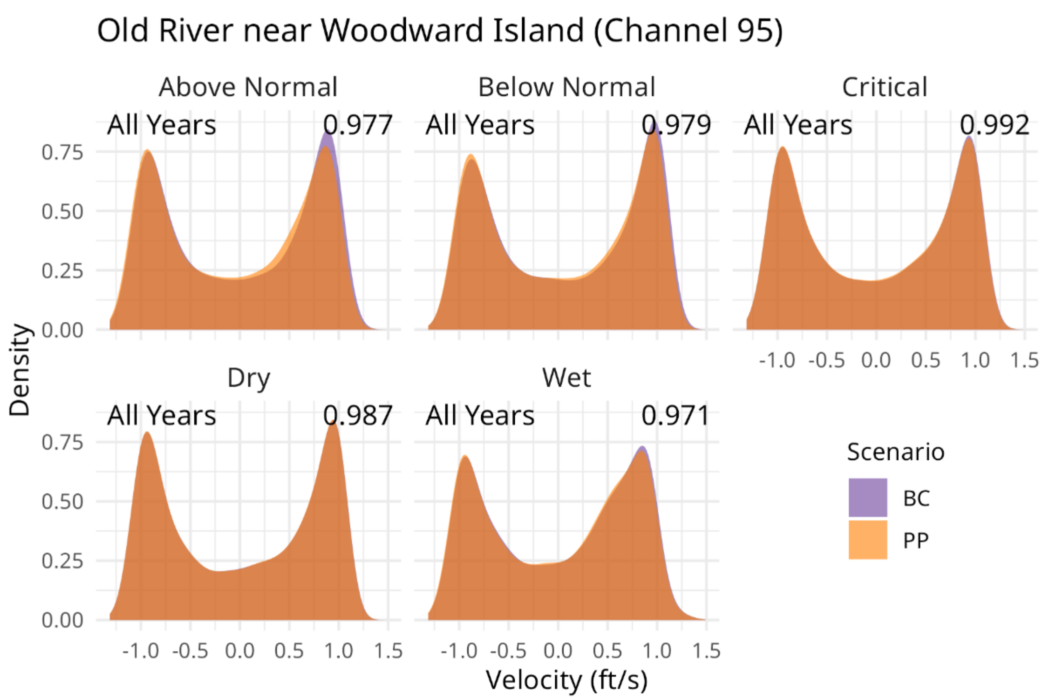
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-209. Velocity Density Distribution for Old River Downstream of the South Delta Export Facilities, April.



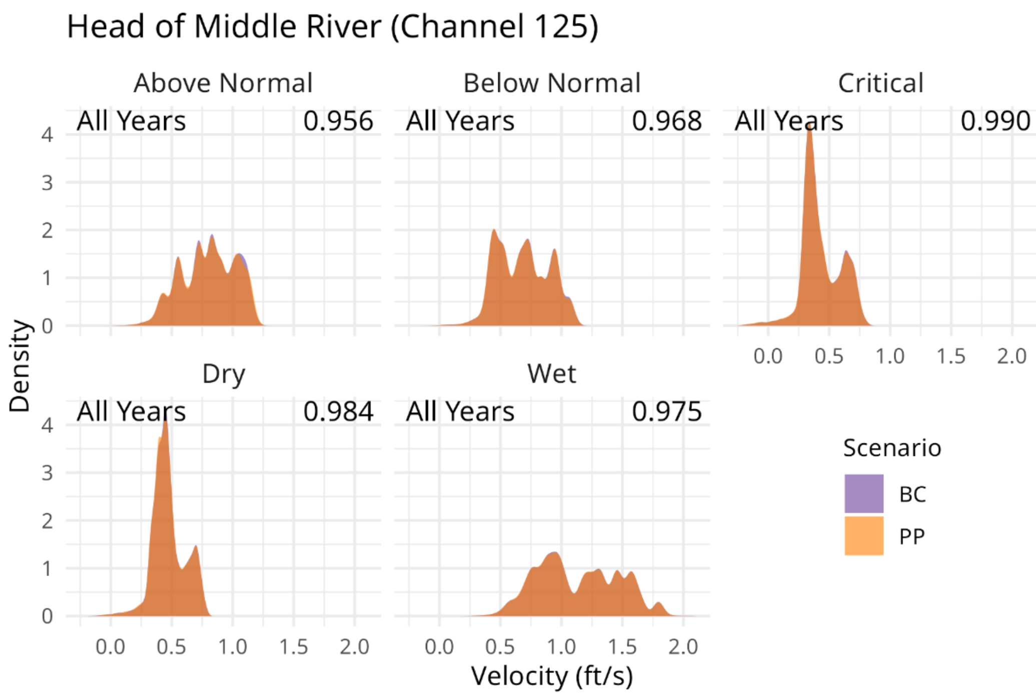
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-210. Velocity Density Distribution for Old River at Highway 4, April.



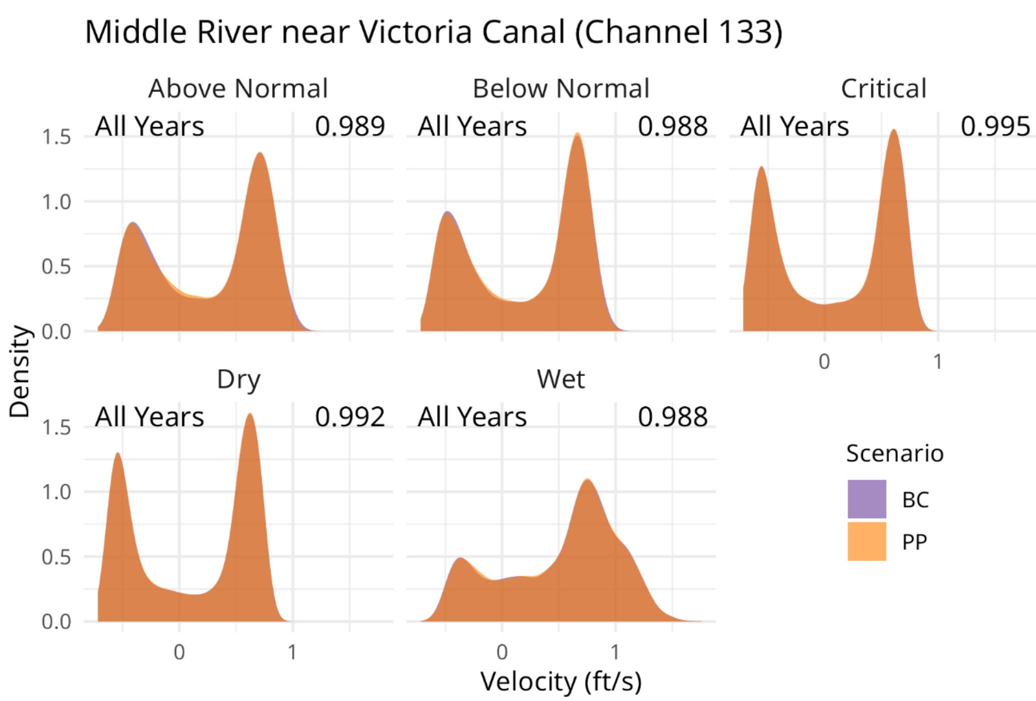
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-211. Velocity Density Distribution for Old River near Woodward Island, April.



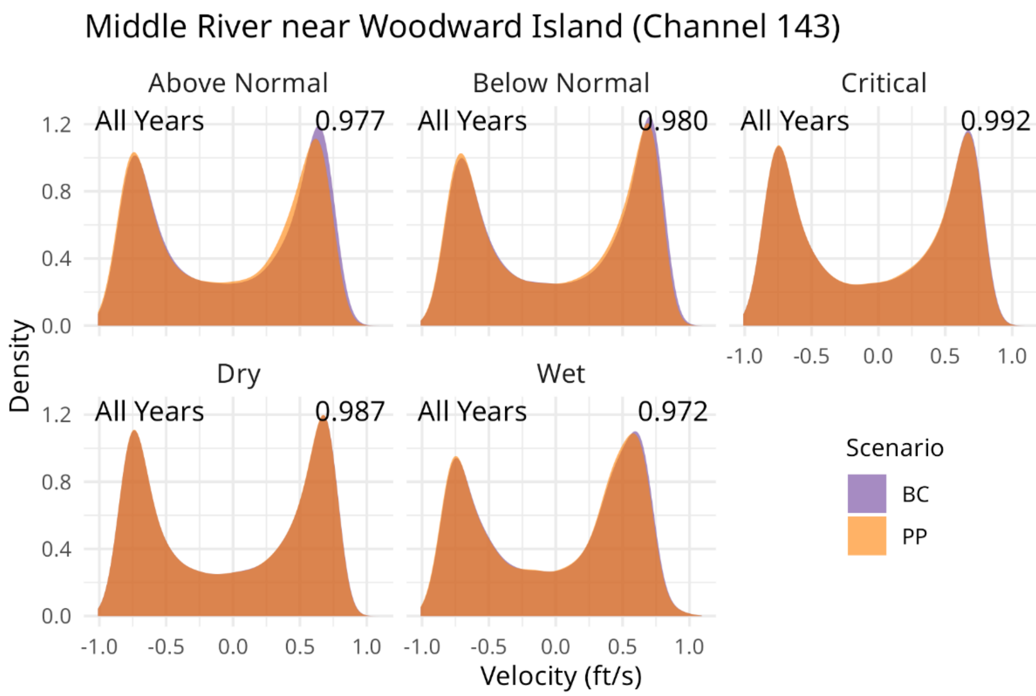
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-212. Velocity Density Distribution for Head of Middle River, April.



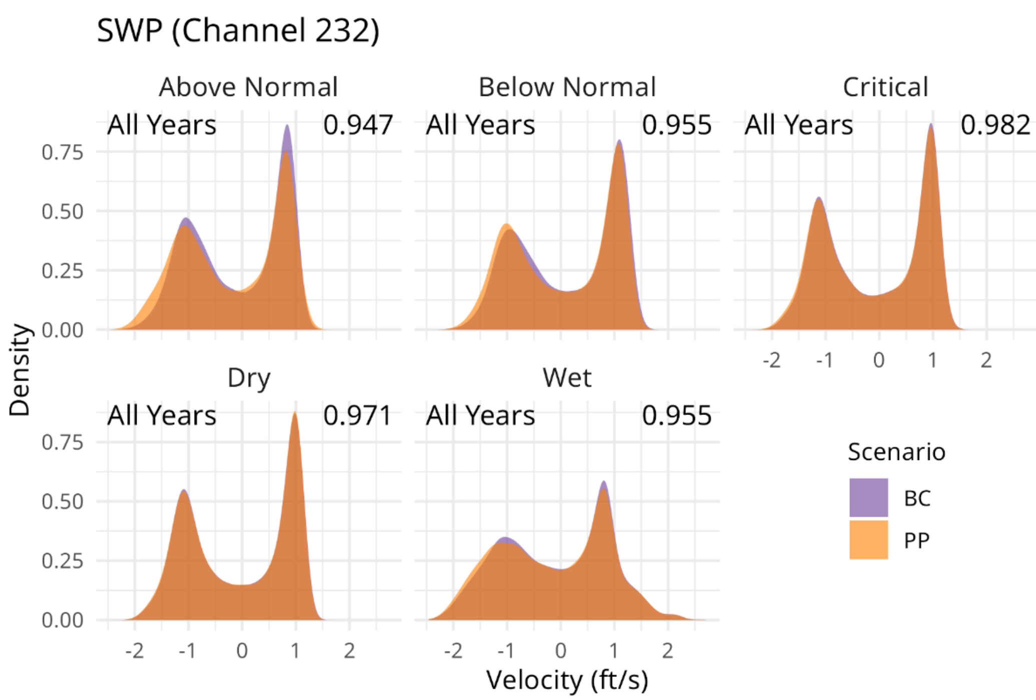
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-213. Velocity Density Distribution for Middle River near Victoria Canal, April.



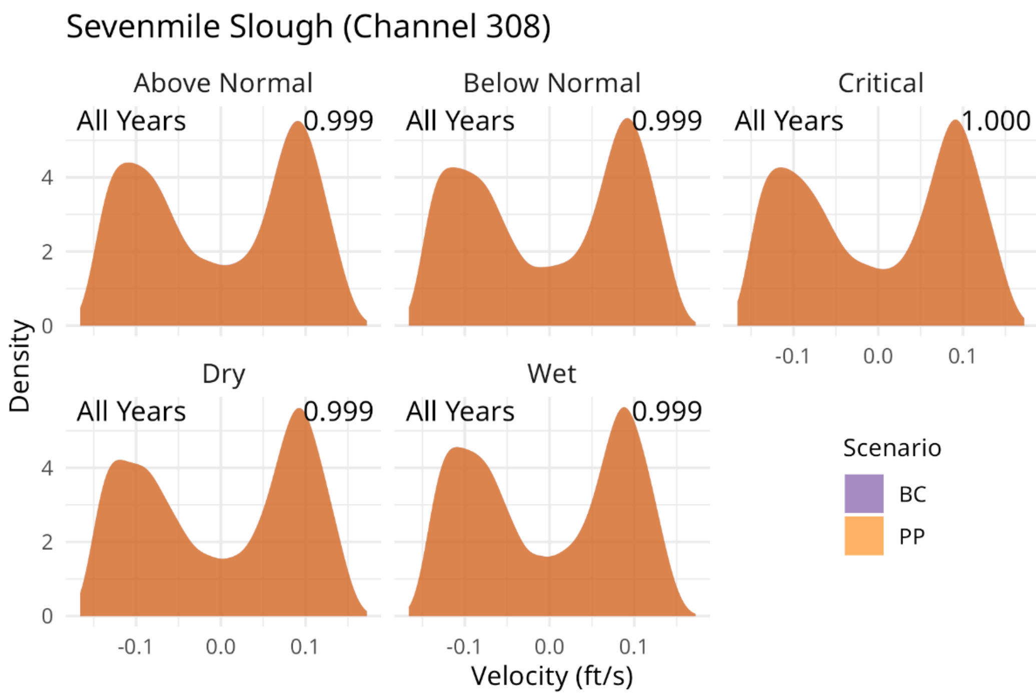
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-214. Velocity Density Distribution for Middle River near Woodward Island, April.



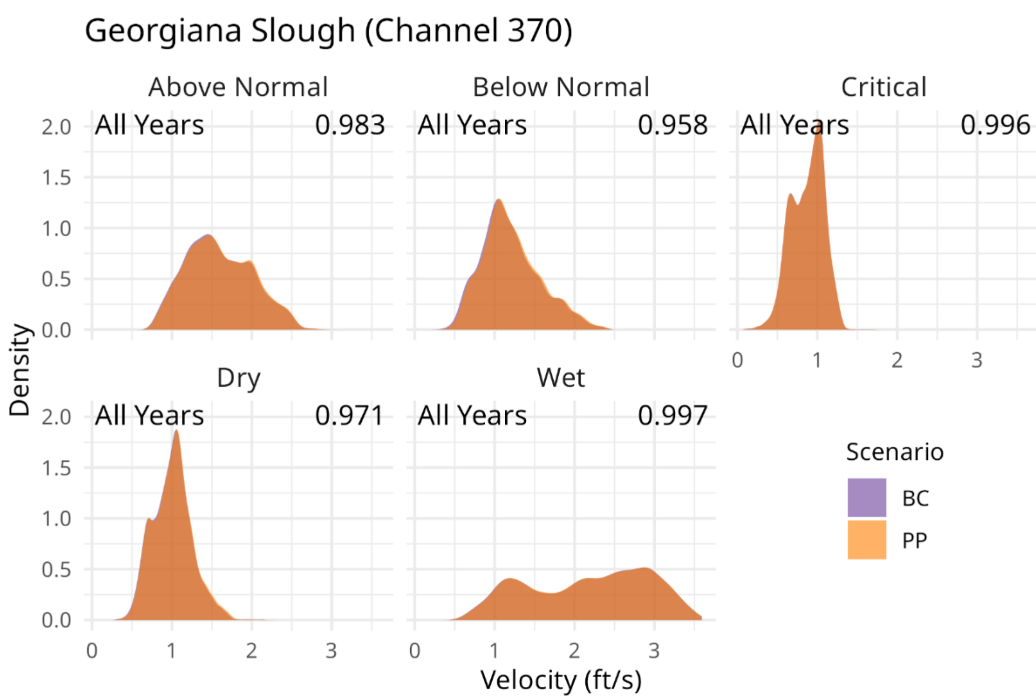
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-215. Velocity Density Distribution for State Water Project, April.



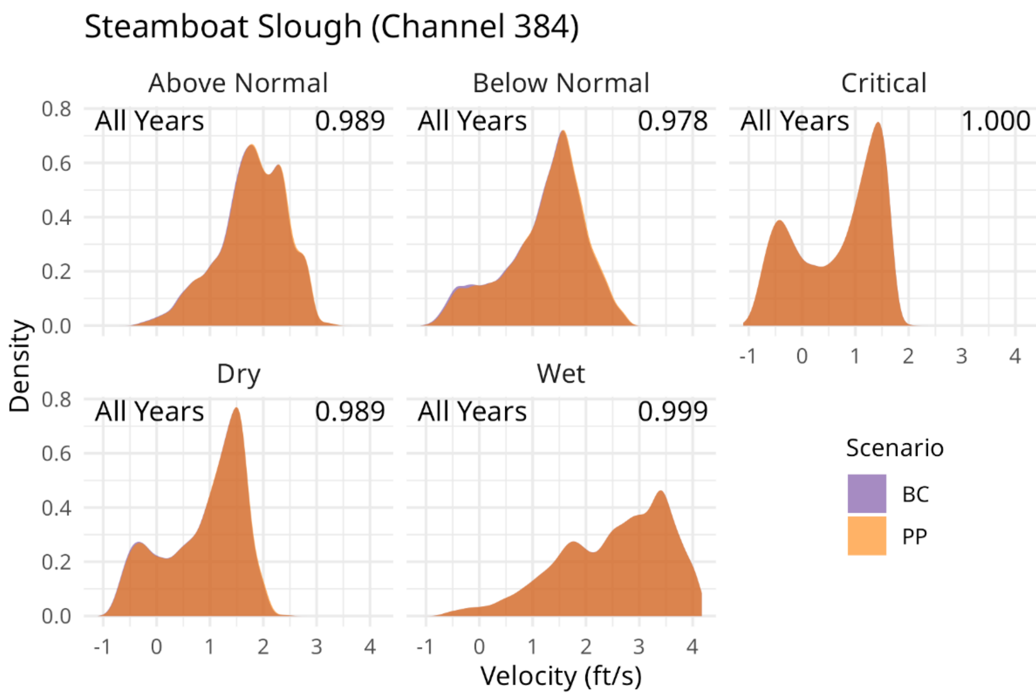
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-216. Velocity Density Distribution for Sevenmile Slough, April.



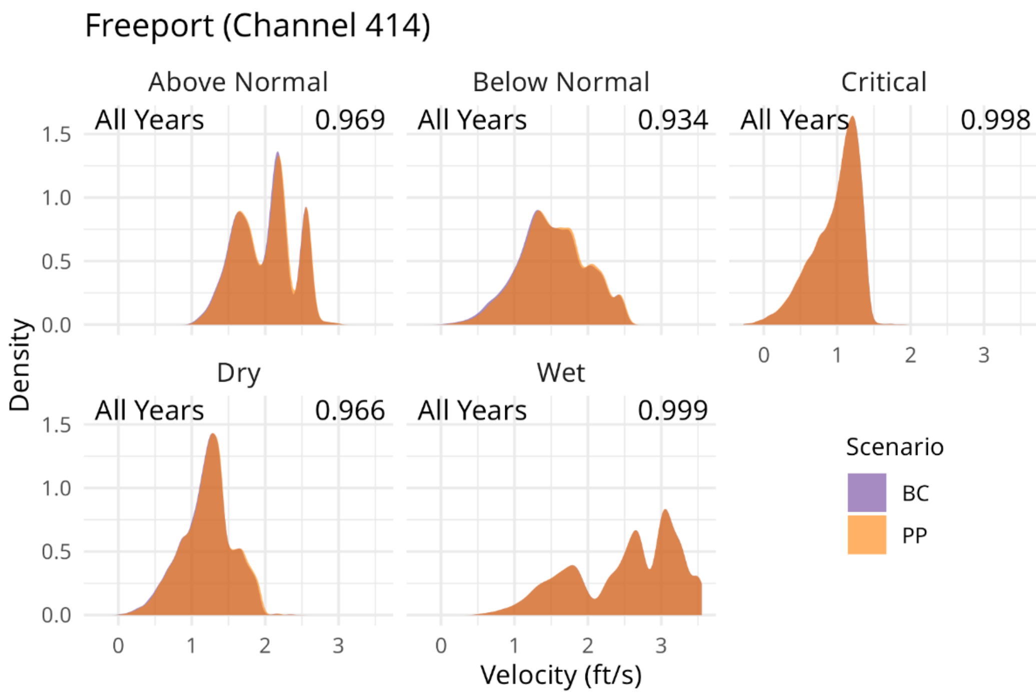
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-217. Velocity Density Distribution for Georgiana Slough, April.



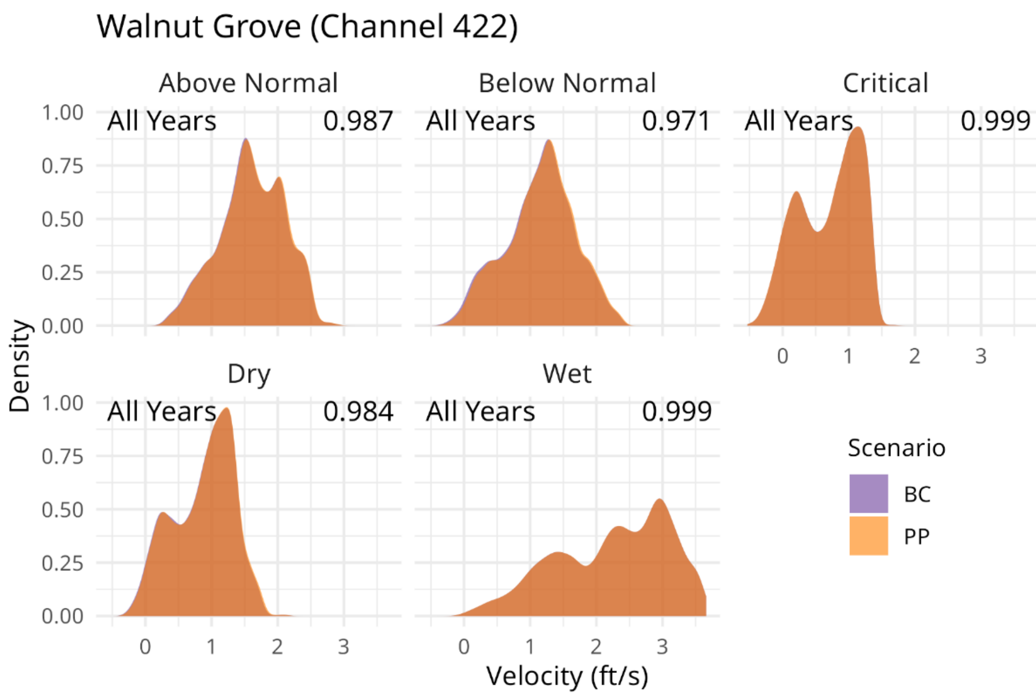
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-218. Velocity Density Distribution for Steamboat Slough, April.



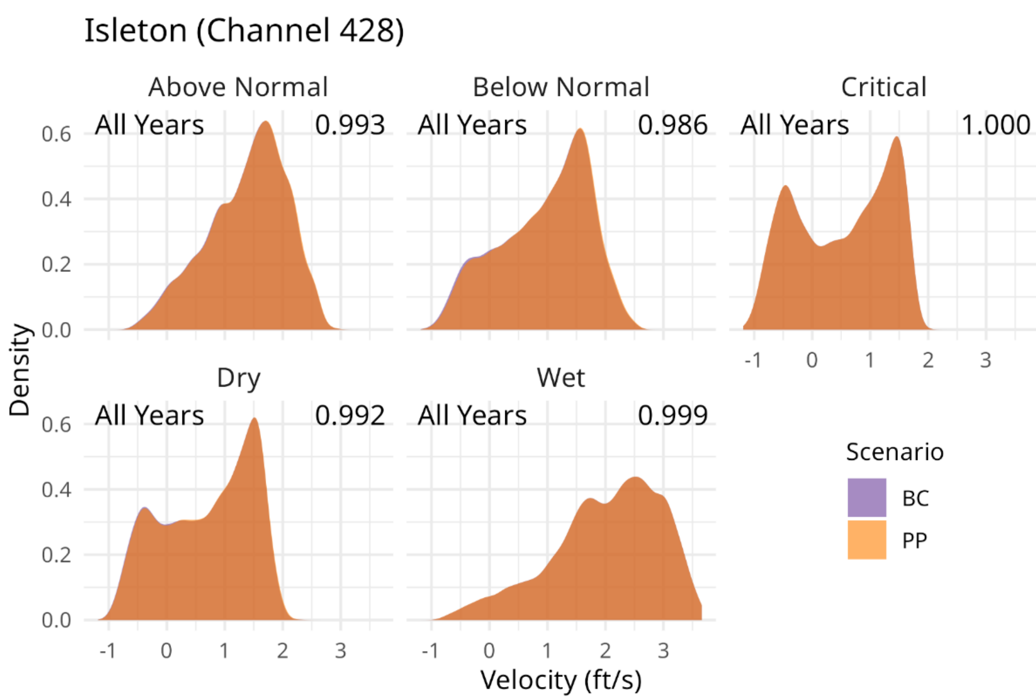
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-219. Velocity Density Distribution for Sacramento River at Freeport, April.



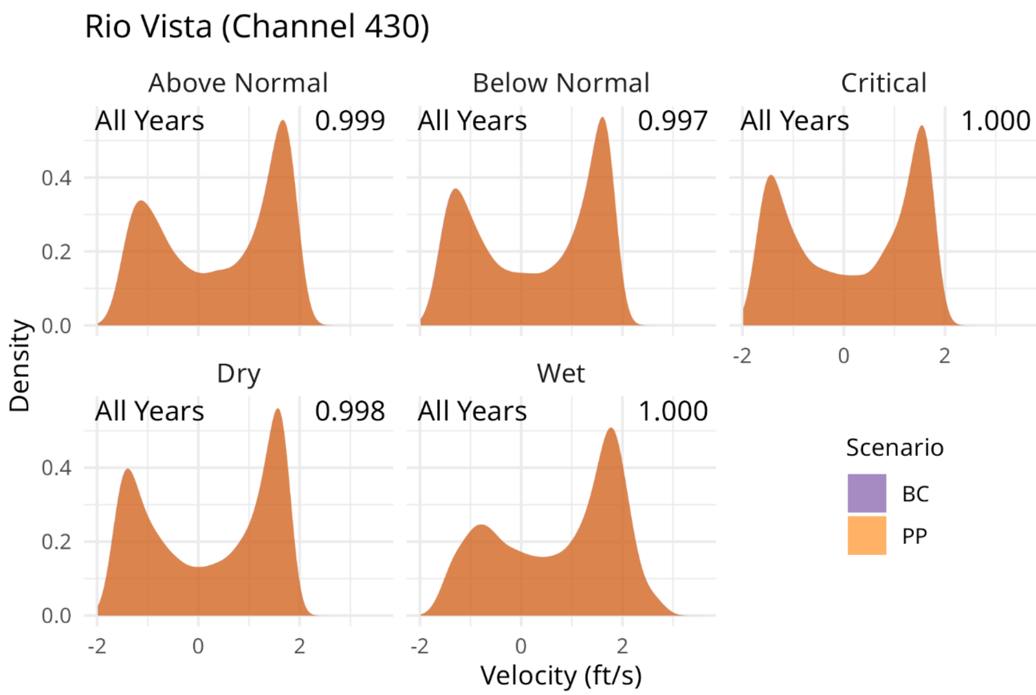
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-220. Velocity Density Distribution for Sacramento River at Walnut Grove, April.



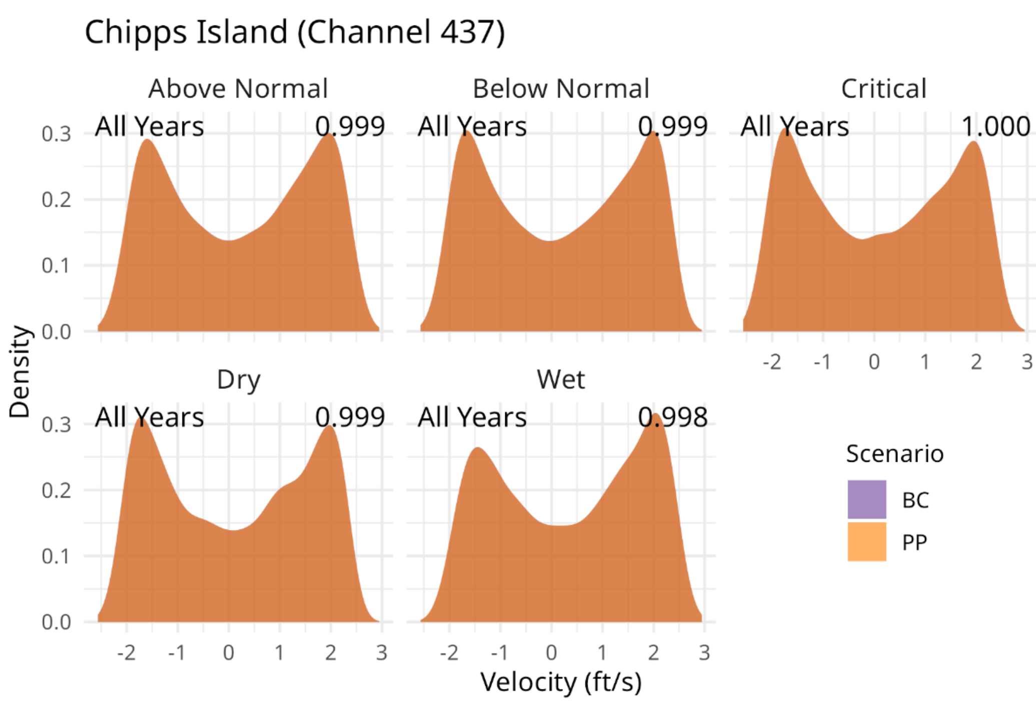
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-221. Velocity Density Distribution for Sacramento River at Isleton, April.



Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

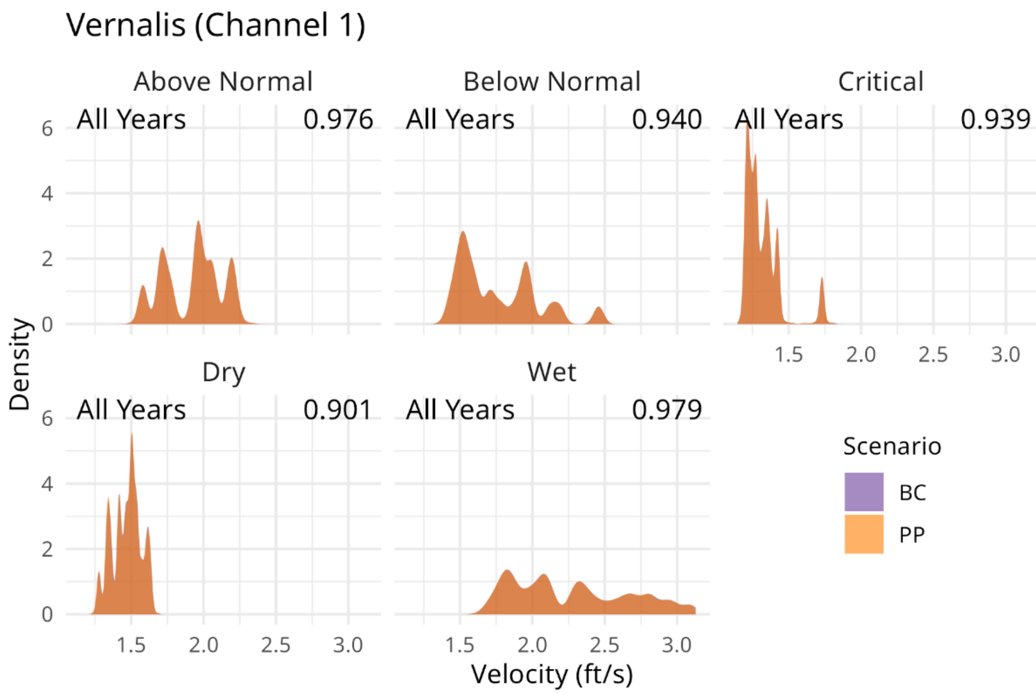
Figure 6B-222. Velocity Density Distribution for Sacramento River at Rio Vista, April.



Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

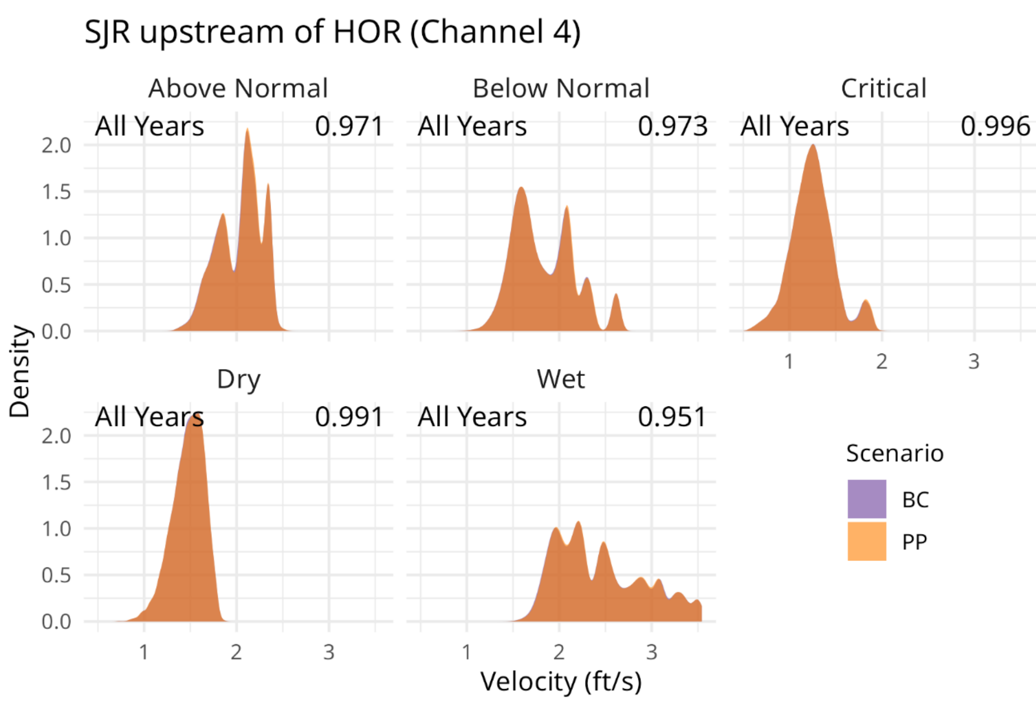
Figure 6B-223. Velocity Density Distribution for Sacramento River at Chipps Island, April.

May



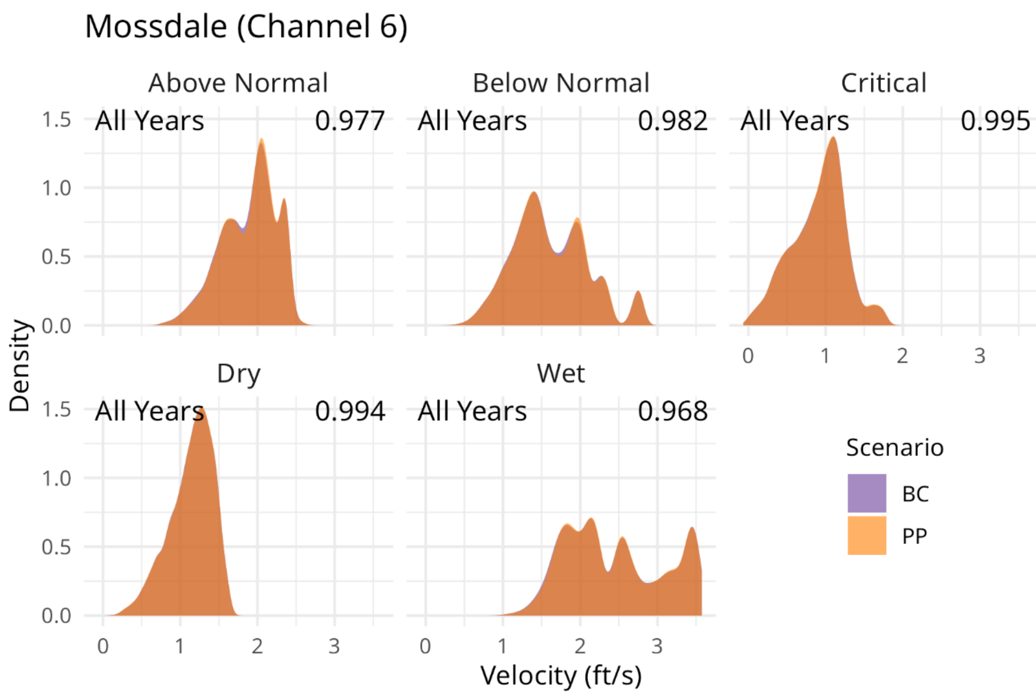
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-224. Velocity Density Distribution for San Joaquin River at Vernalis, May.



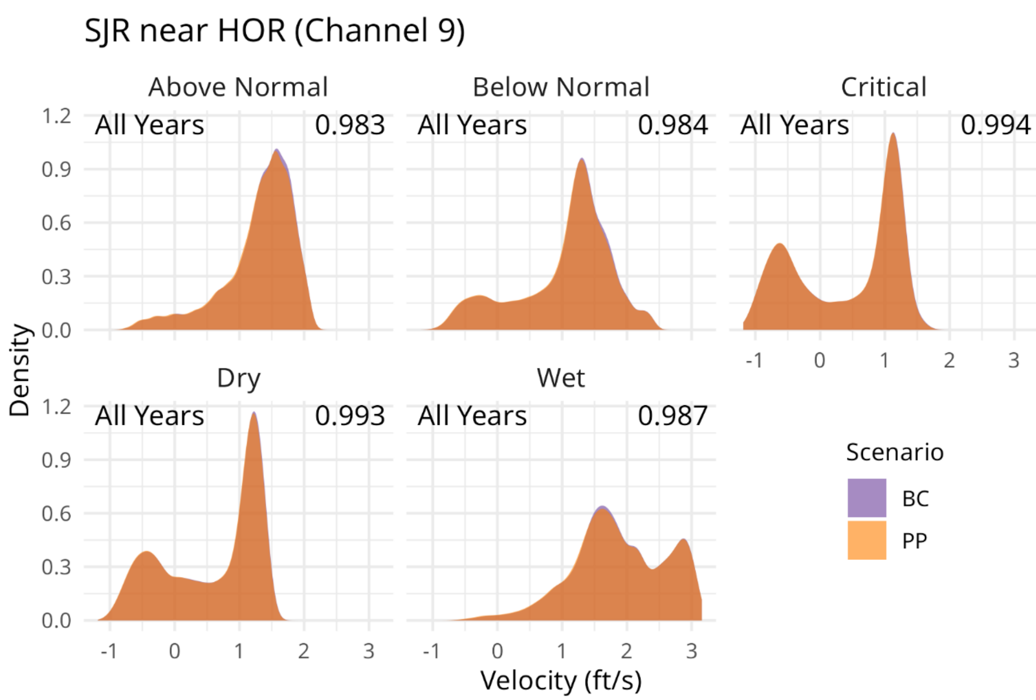
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-225. Velocity Density Distribution for San Joaquin River upstream of Head of Old River, May.



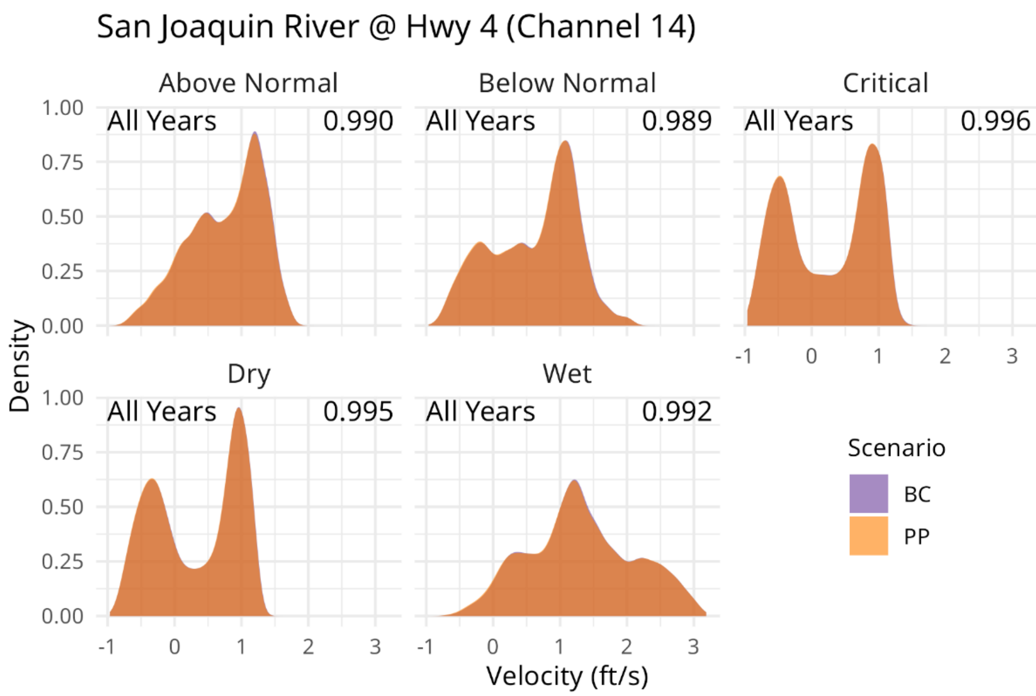
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-226. Velocity Density Distribution for San Joaquin River at Mossdale, May.



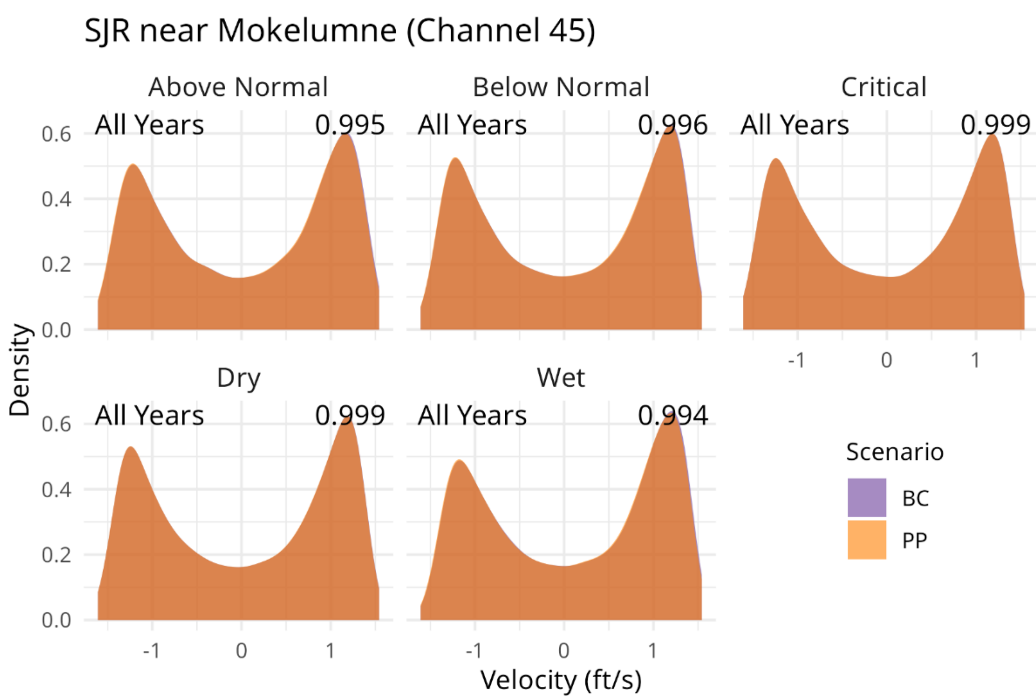
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-227. Velocity Density Distribution for San Joaquin River near Head of Old River, May.



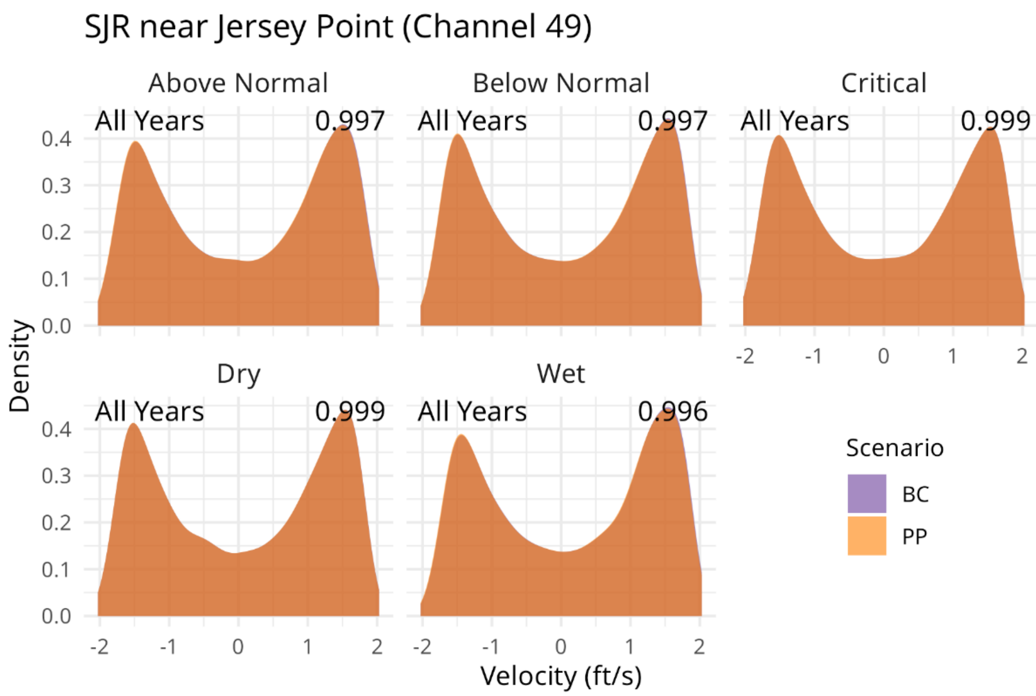
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-228. Velocity Density Distribution for San Joaquin River at Highway 4, May.



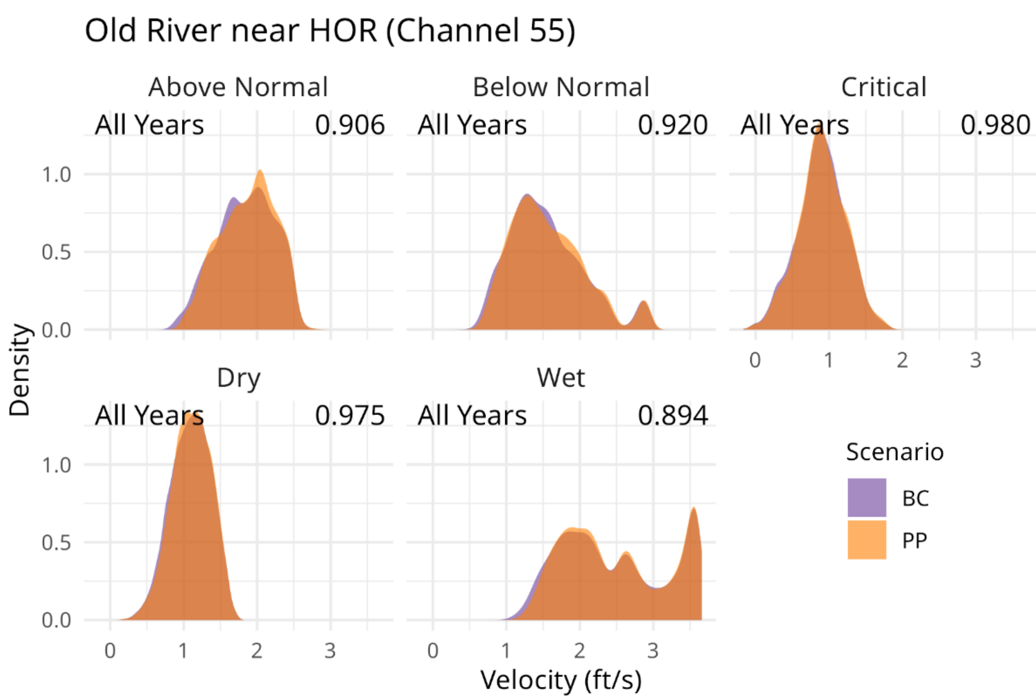
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-229. Velocity Density Distribution for San Joaquin River near Mokelumne River, May.



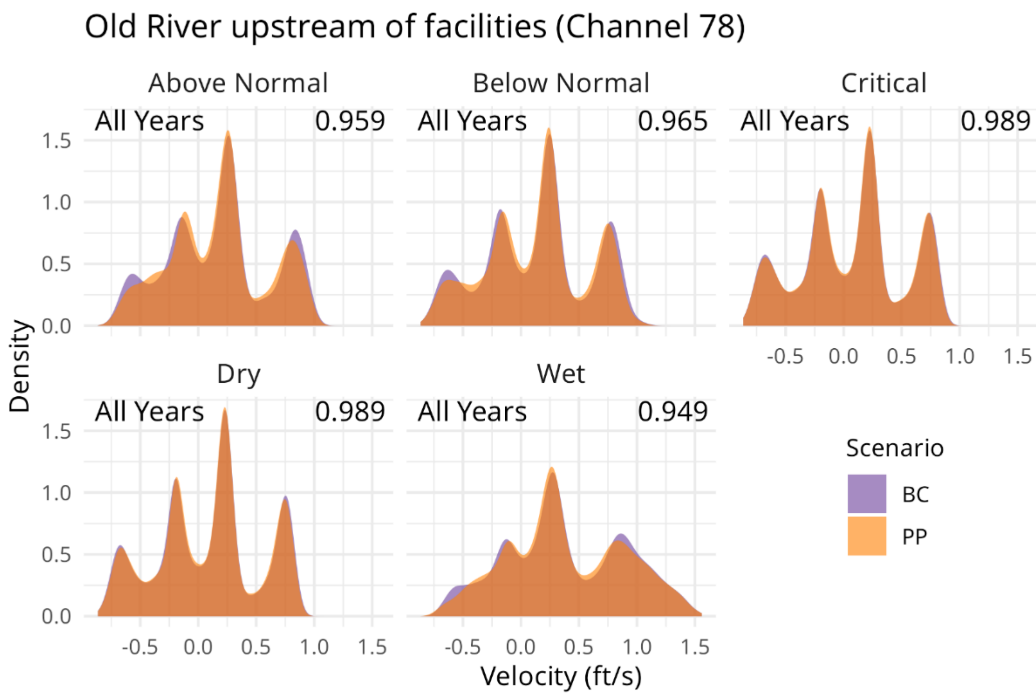
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-230. Velocity Density Distribution for San Joaquin River near Jersey Point, May.



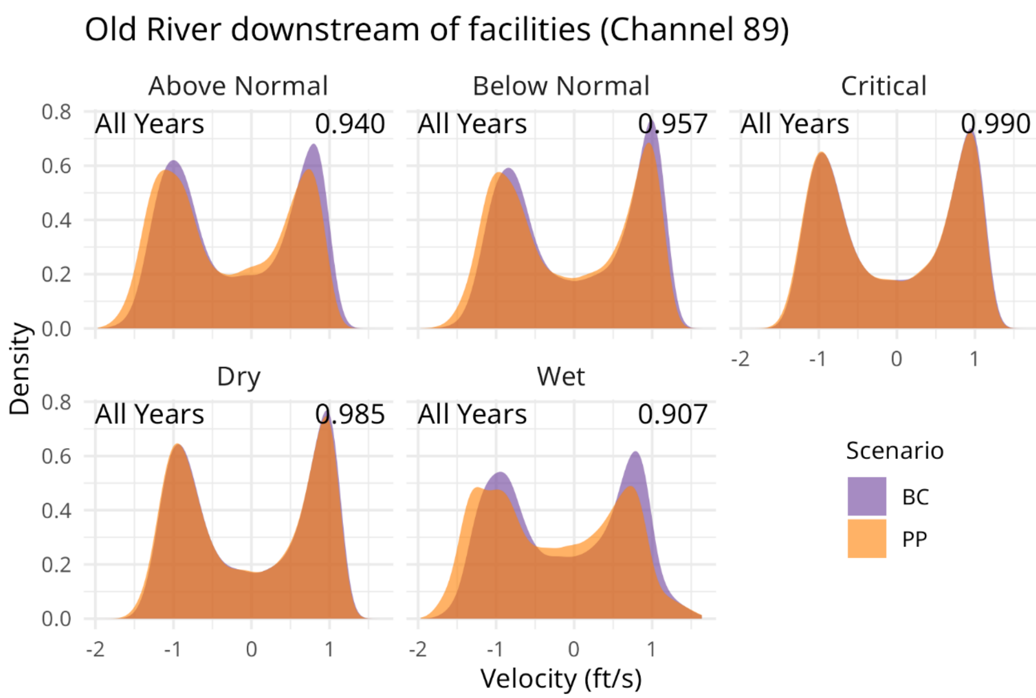
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-231. Velocity Density Distribution for Old River near Head of Old River, May.



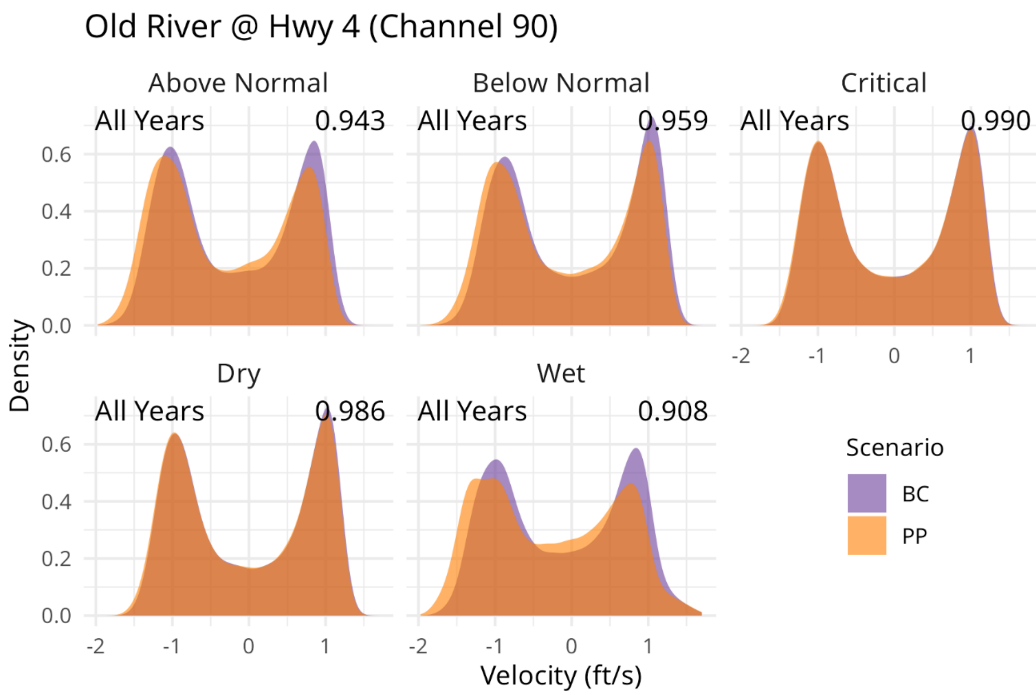
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-232. Velocity Density Distribution for Old River Upstream of the South Delta Export Facilities, May.



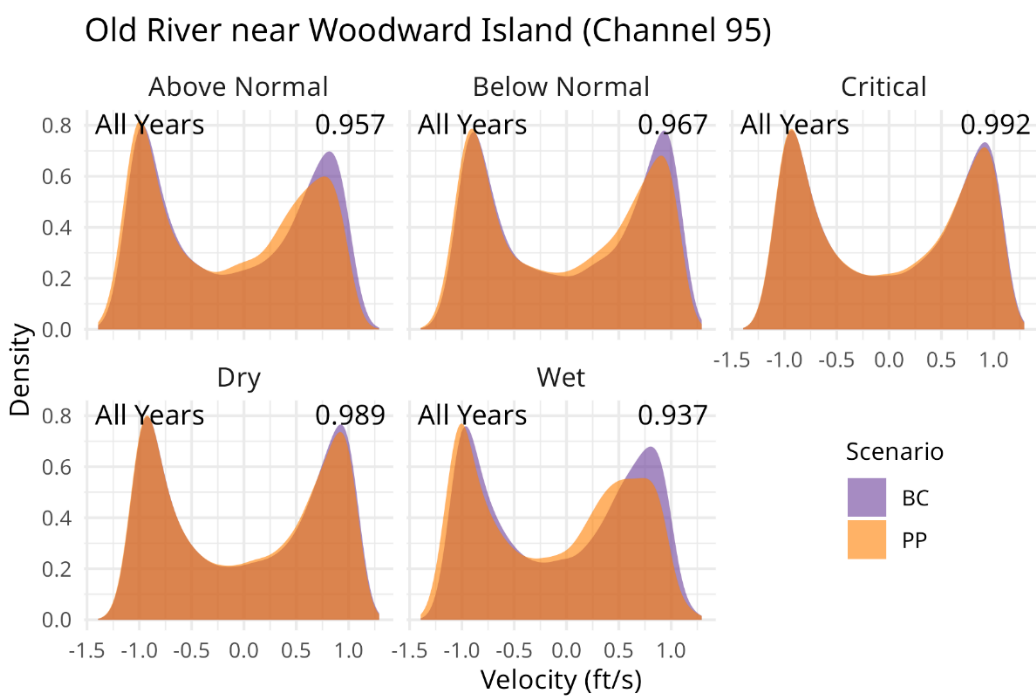
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-233. Velocity Density Distribution for Old River Downstream of the South Delta Export Facilities, May.



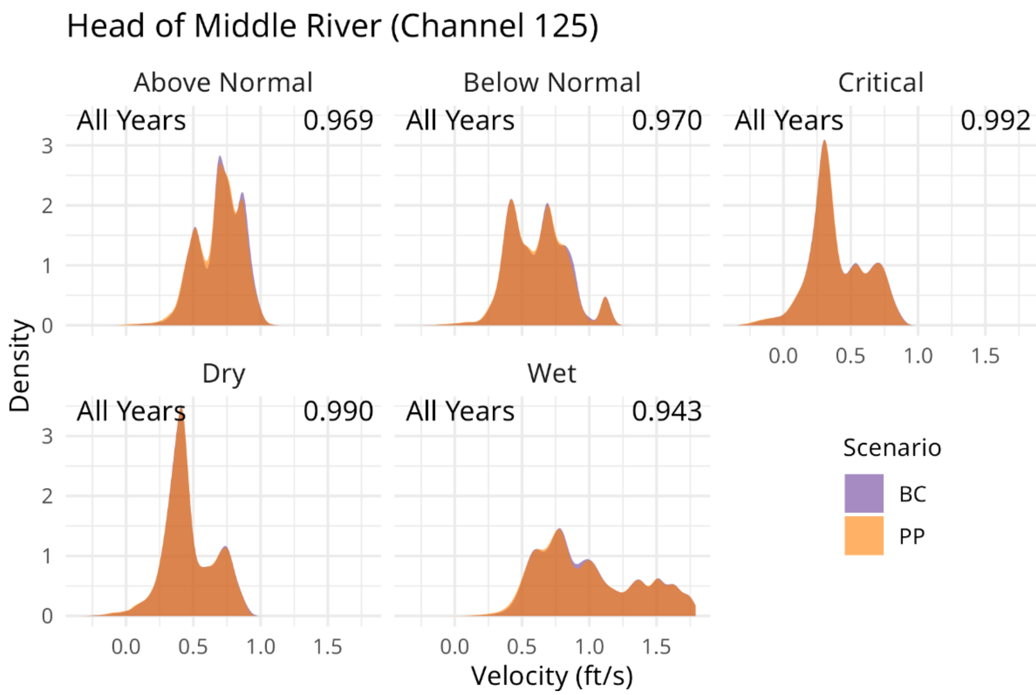
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-234. Velocity Density Distribution for Old River at Highway 4, May.



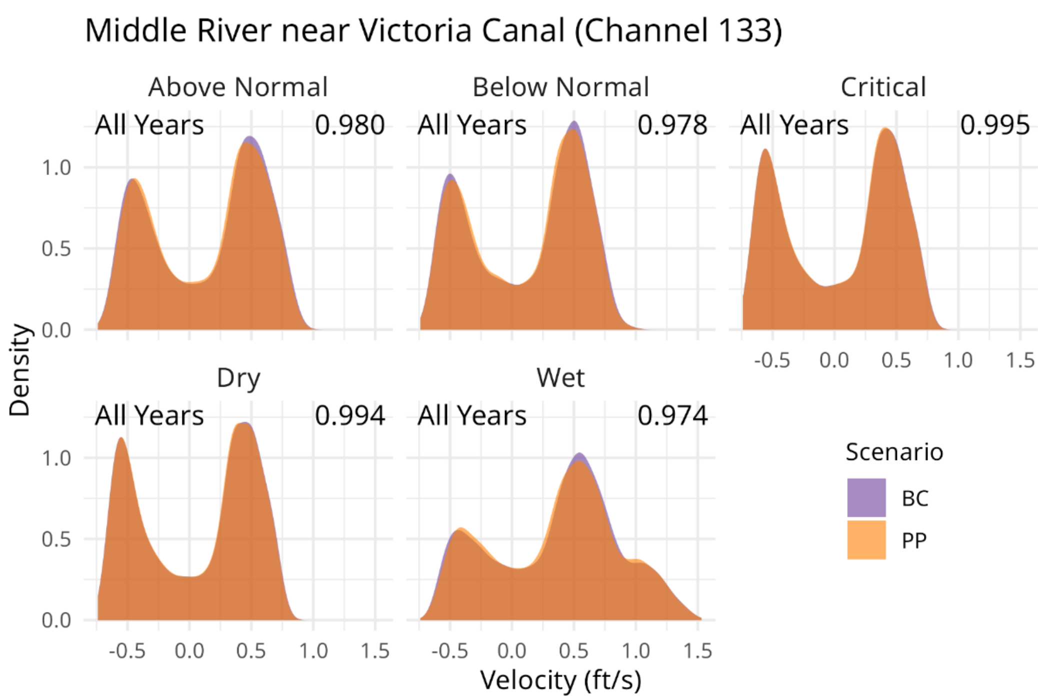
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-235. Velocity Density Distribution for Old River near Woodward Island, May.



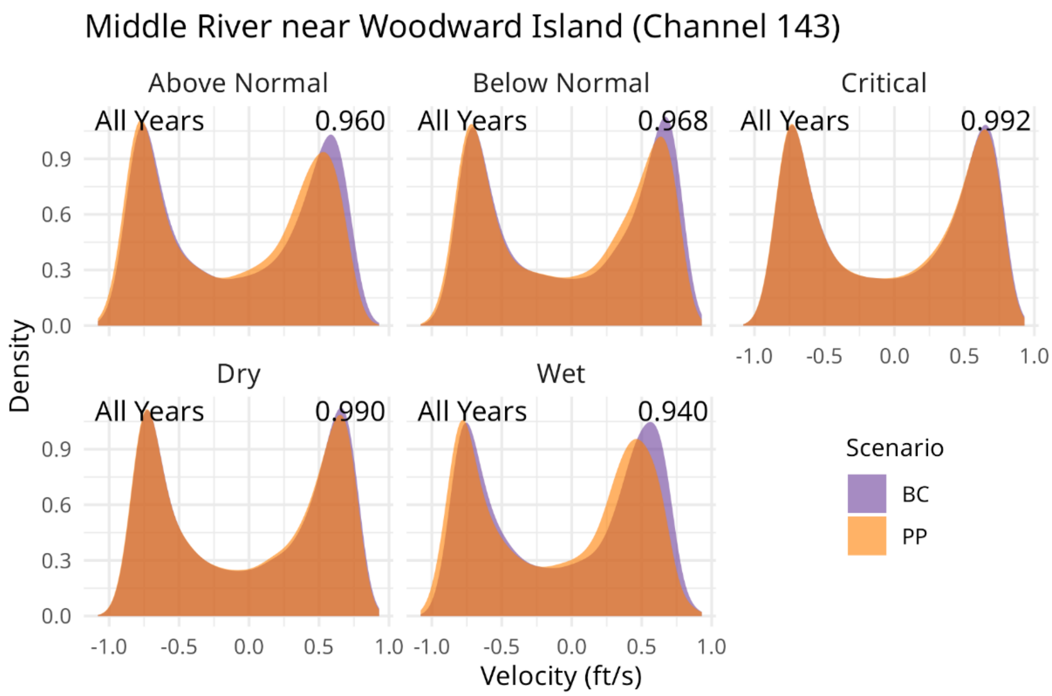
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-236. Velocity Density Distribution for Head of Middle River, May.



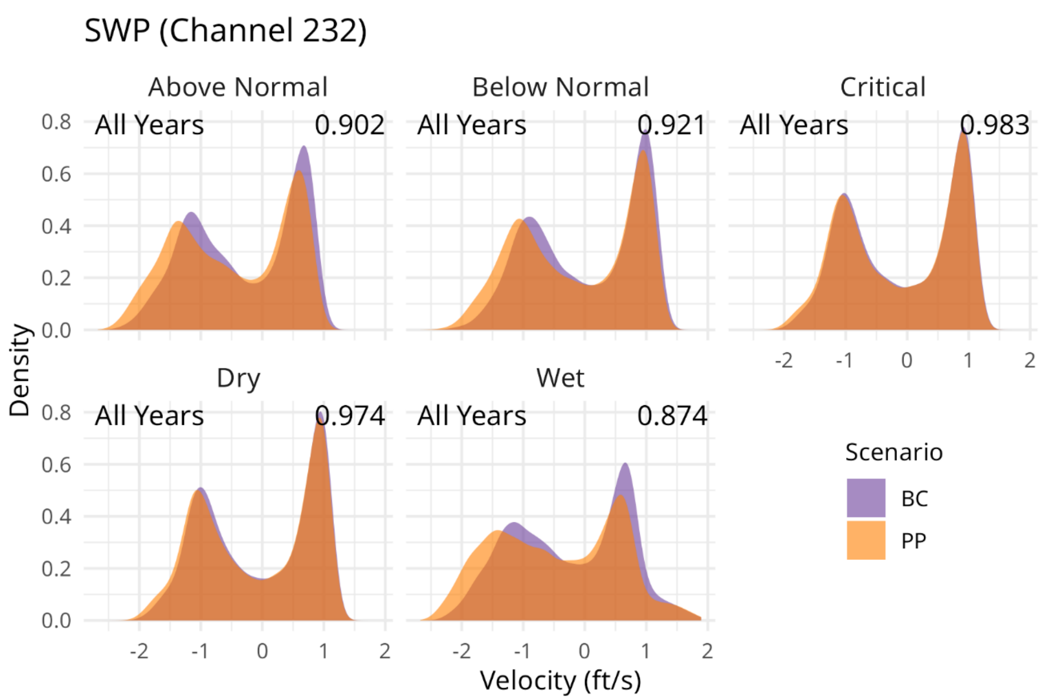
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-237. Velocity Density Distribution for Middle River near Victoria Canal, May.



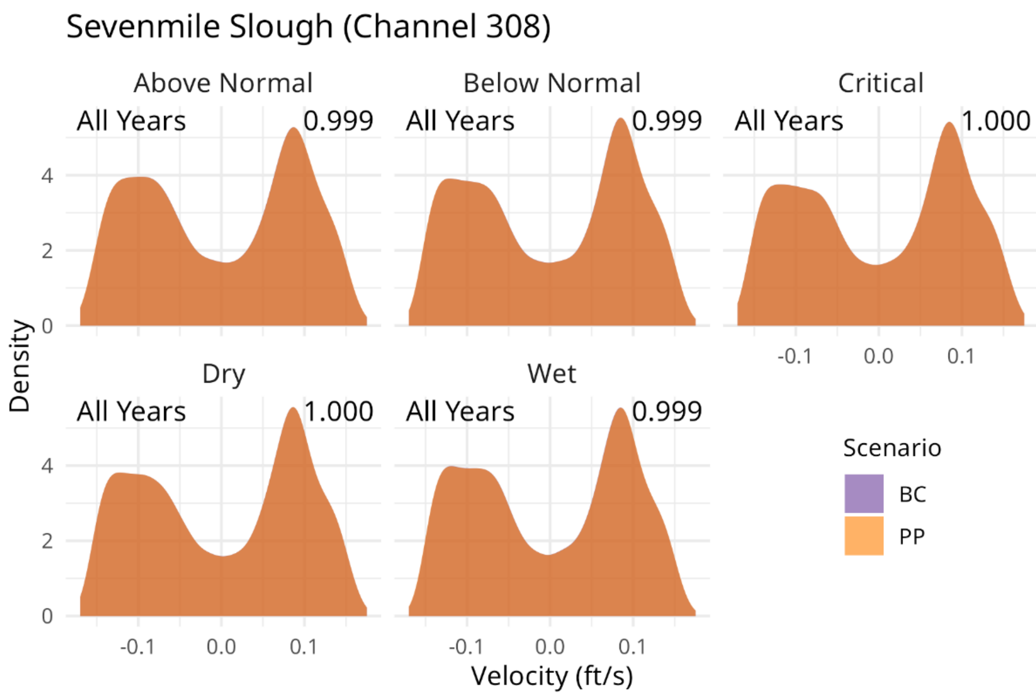
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-238. Velocity Density Distribution for Middle River near Woodward Island, May.



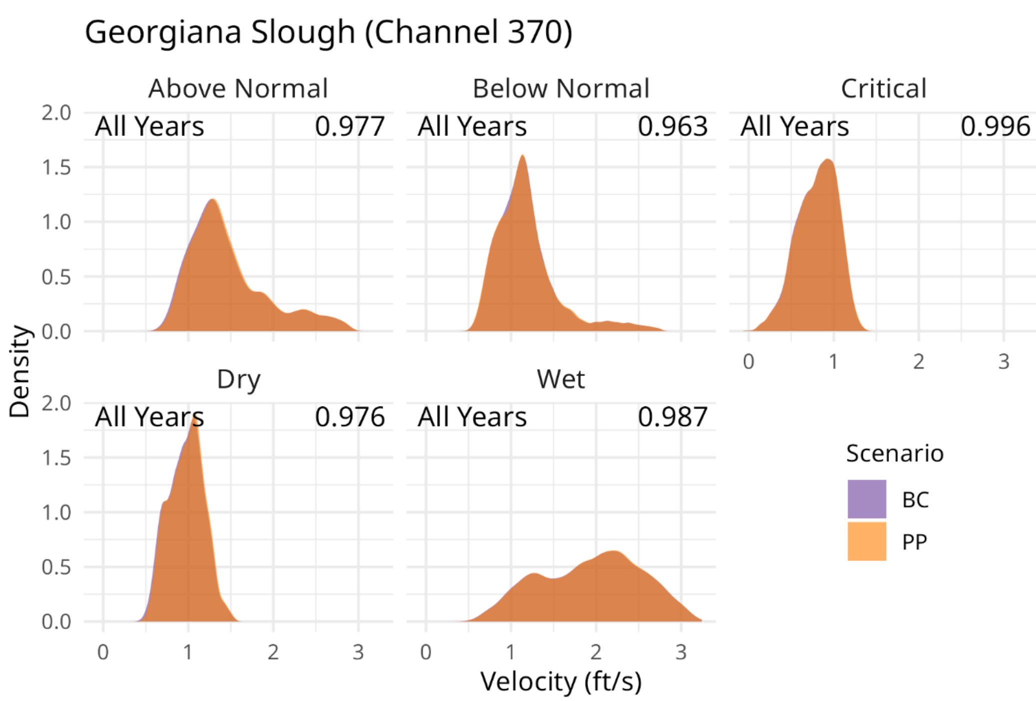
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-239. Velocity Density Distribution for State Water Project, May.



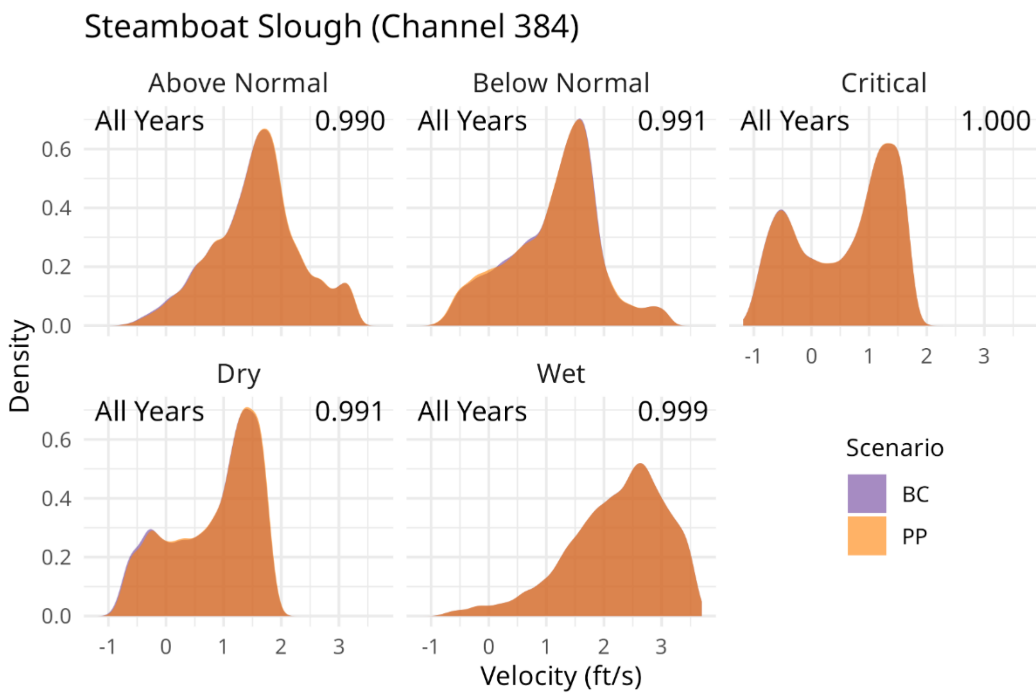
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-240. Velocity Density Distribution for Sevenmile Slough, May.



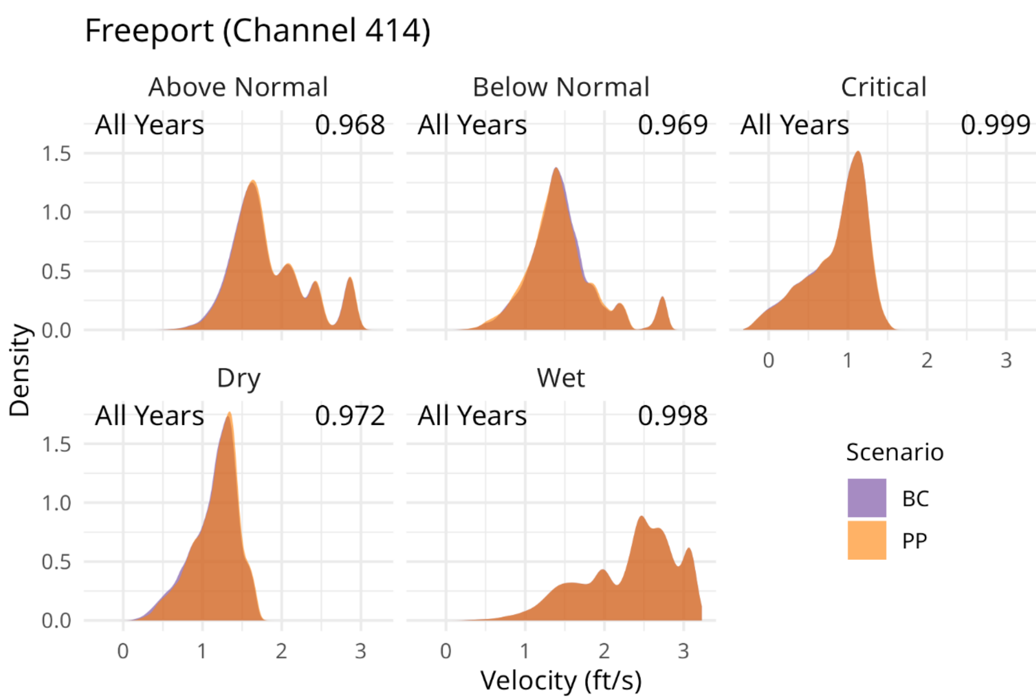
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-241. Velocity Density Distribution for Georgiana Slough, May.



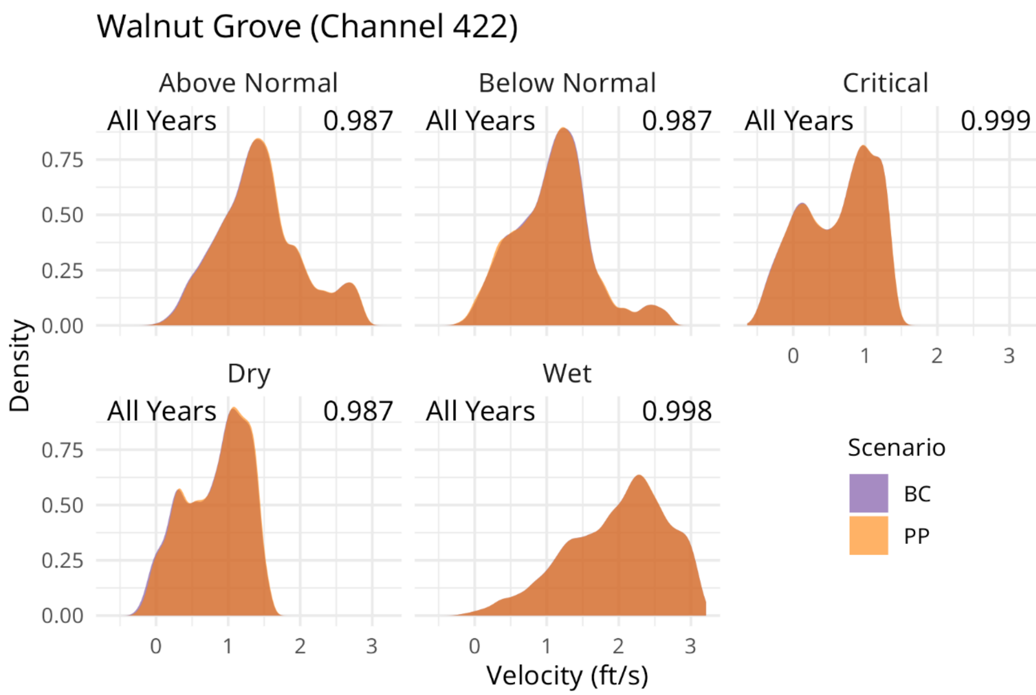
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-242. Velocity Density Distribution for Steamboat Slough, May.



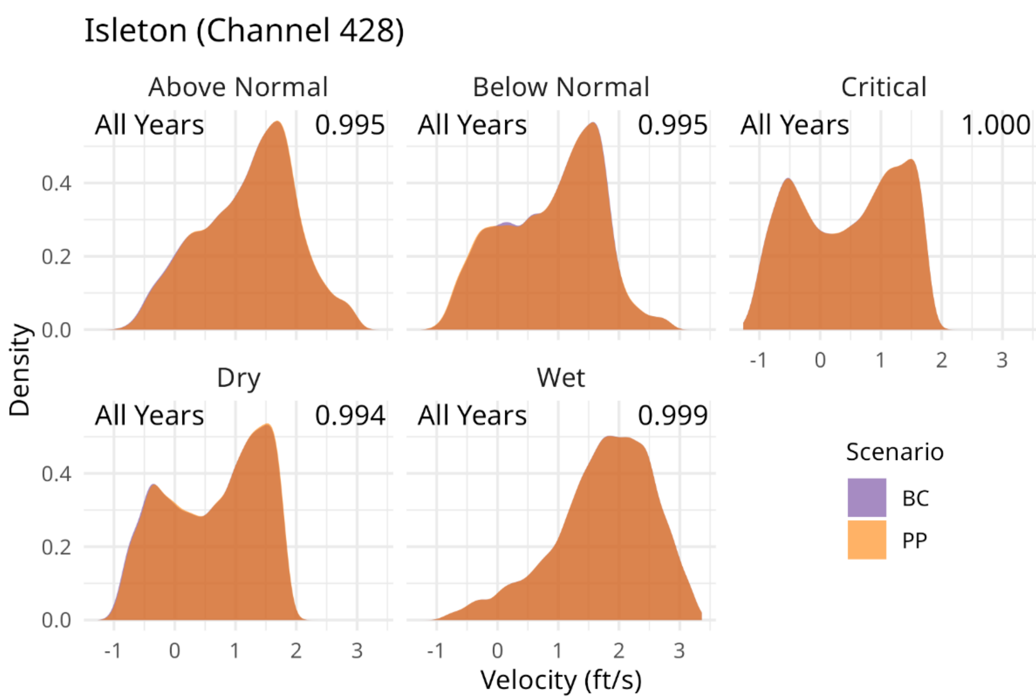
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-243. Velocity Density Distribution for Sacramento River at Freeport, May.



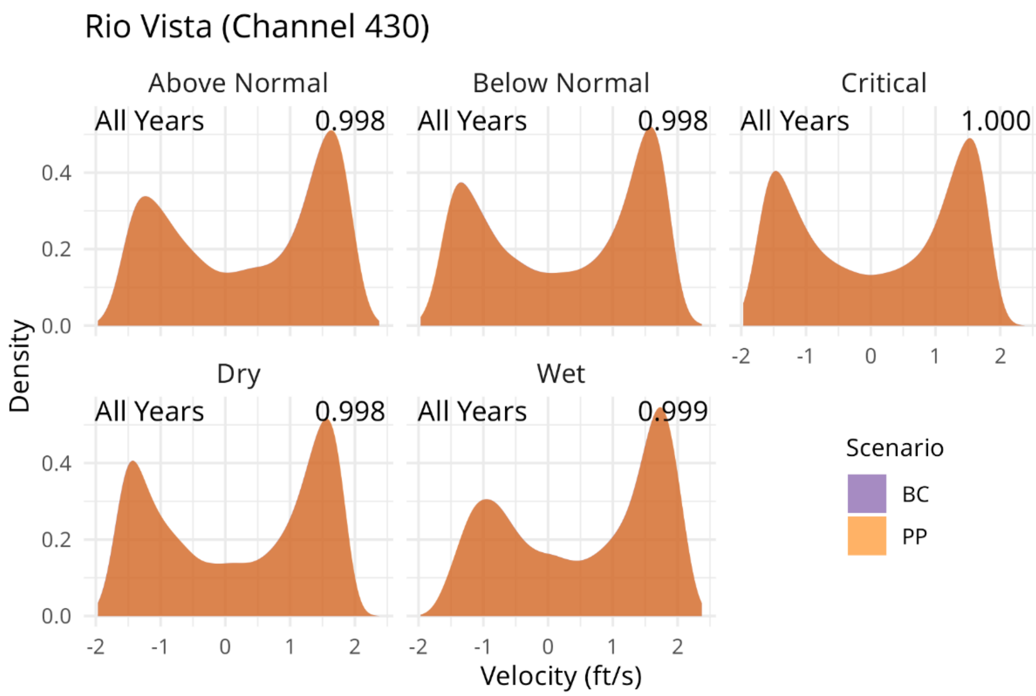
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-244. Velocity Density Distribution for Sacramento River at Walnut Grove, May.



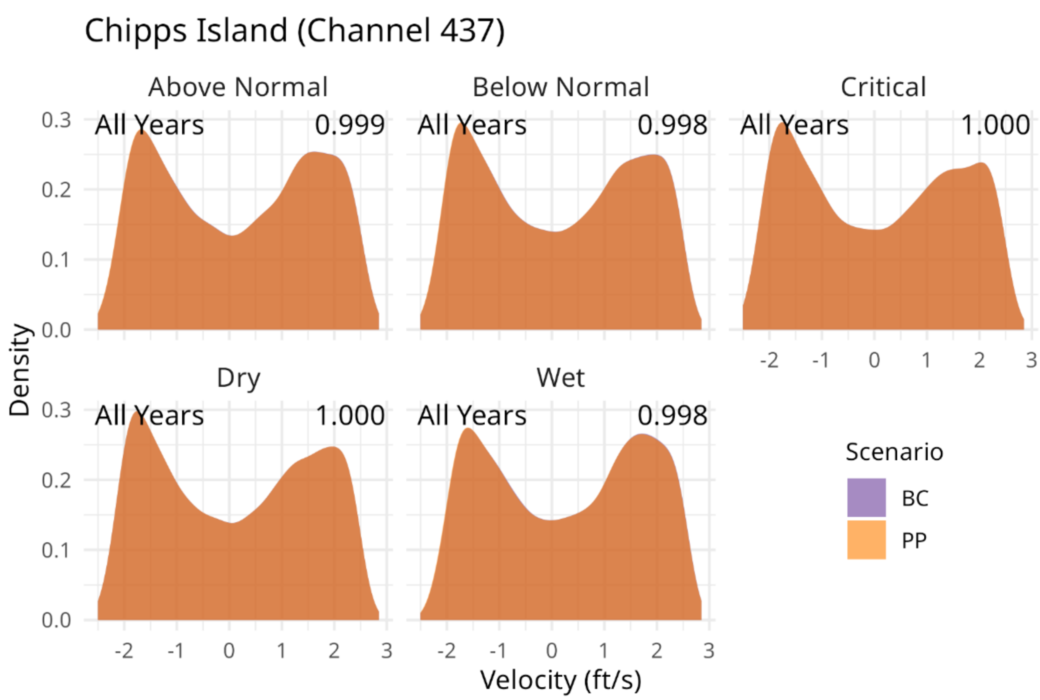
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-245. Velocity Density Distribution for Sacramento River at Isleton, May.



Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

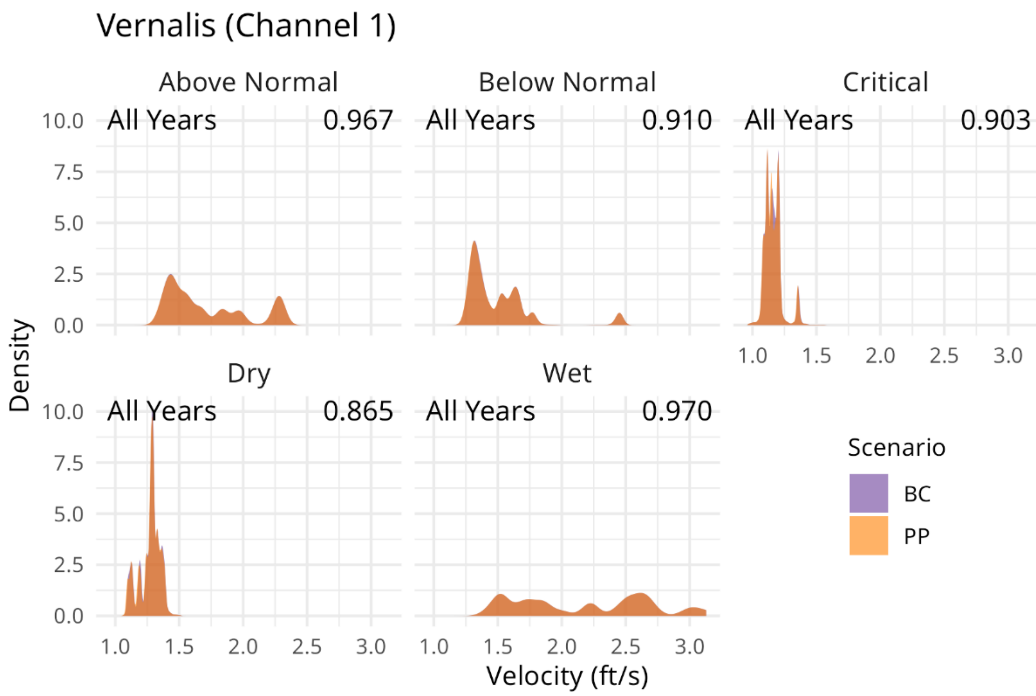
Figure 6B-246. Velocity Density Distribution for Sacramento River at Rio Vista, May.



Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

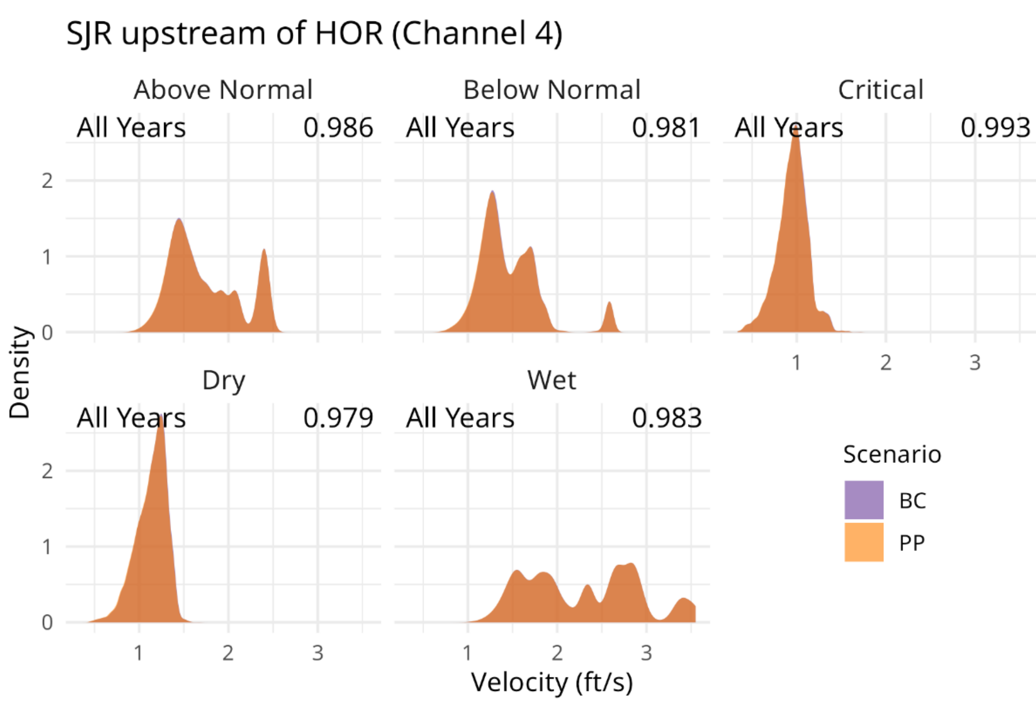
Figure 6B-247. Velocity Density Distribution for Sacramento River at Chipps Island, May.

June



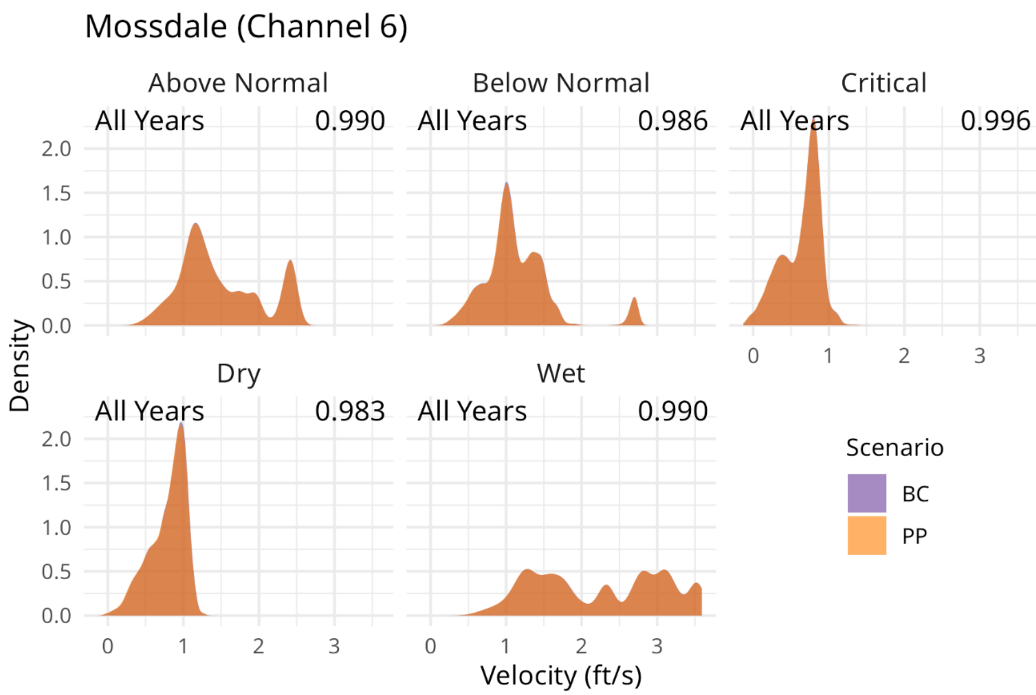
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-248. Velocity Density Distribution for San Joaquin River at Vernalis, June.



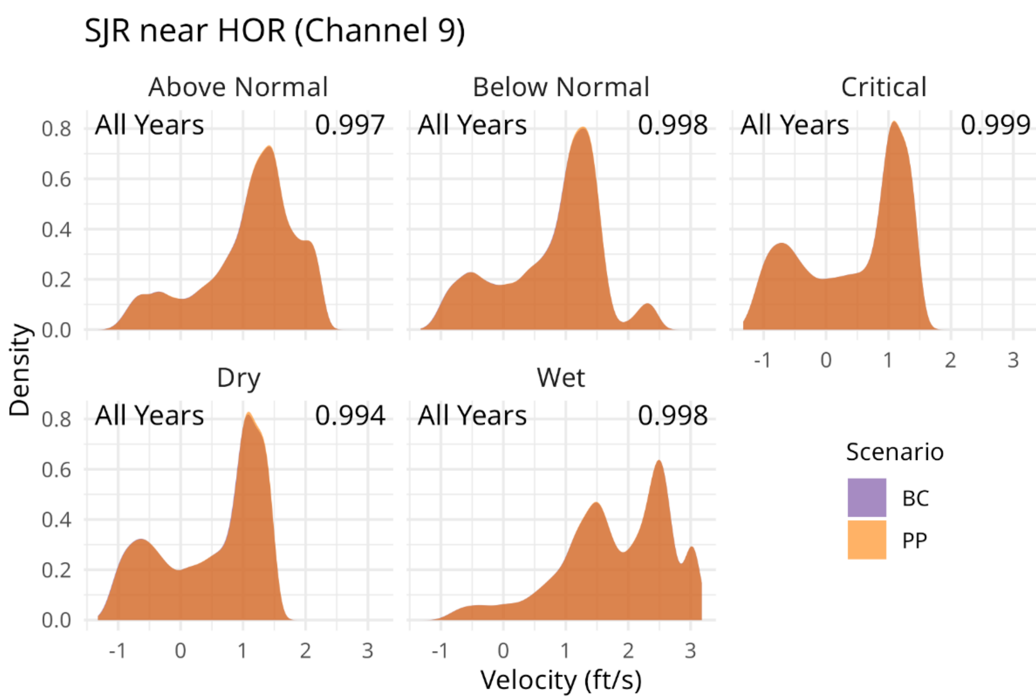
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-249. Velocity Density Distribution for San Joaquin River upstream of Head of Old River, June.



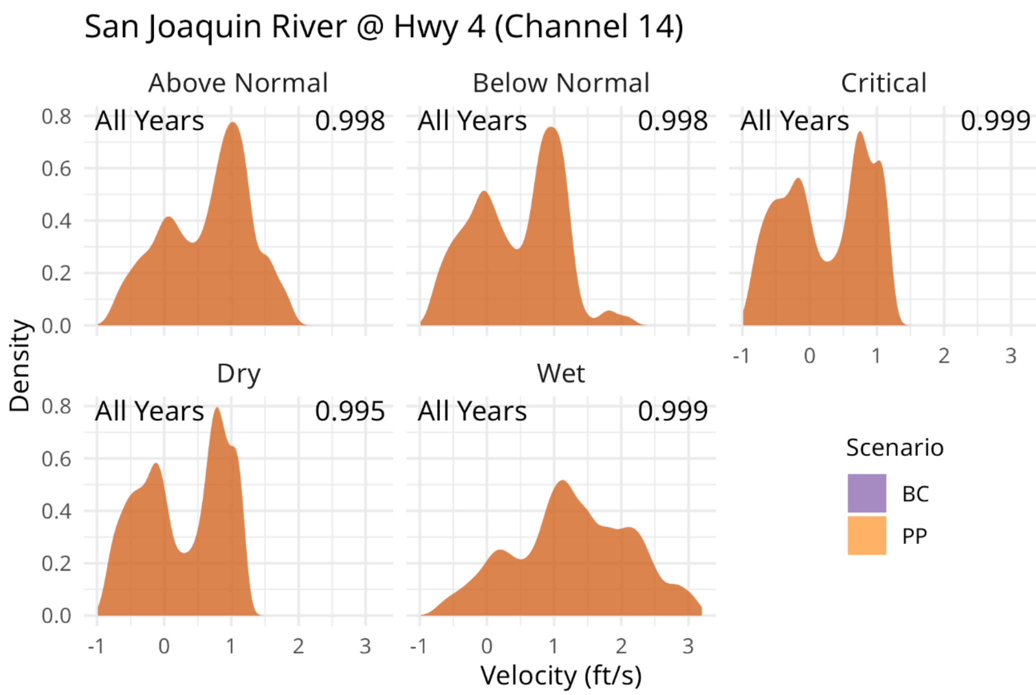
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-250. Velocity Density Distribution for San Joaquin River at Mossdale, June.



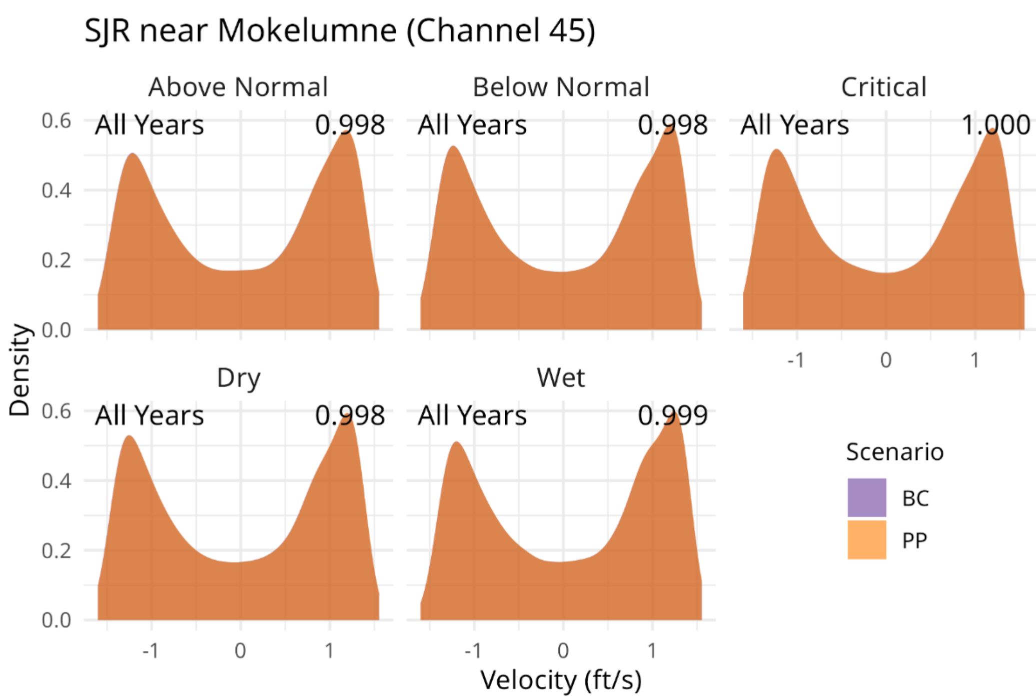
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-251. Velocity Density Distribution for San Joaquin River near Head of Old River, June.



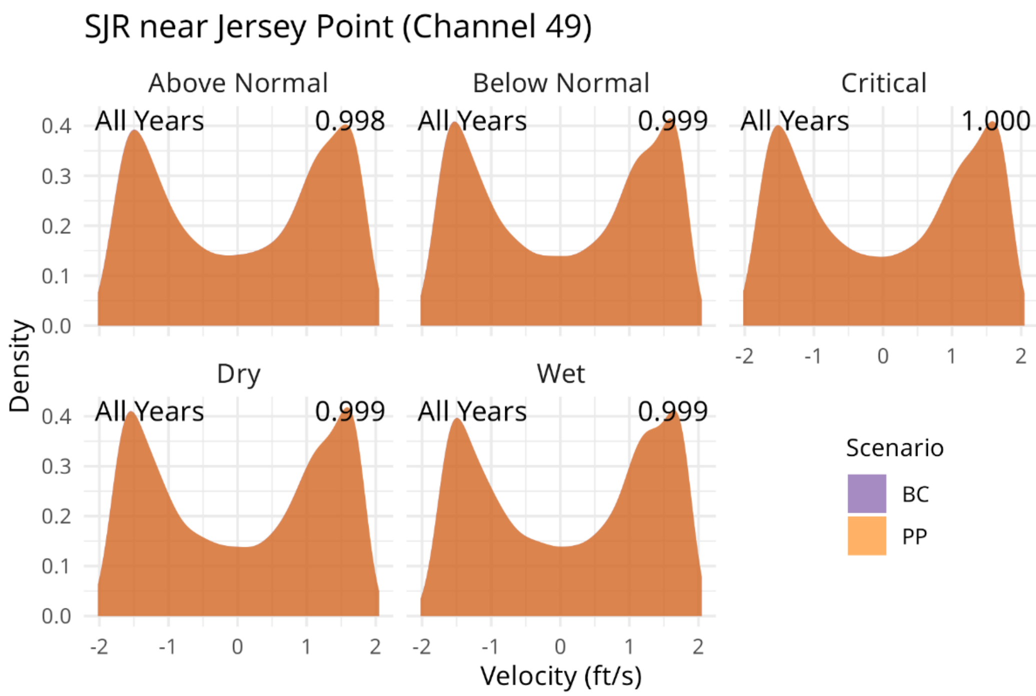
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-252. Velocity Density Distribution for San Joaquin River at Highway 4, June.



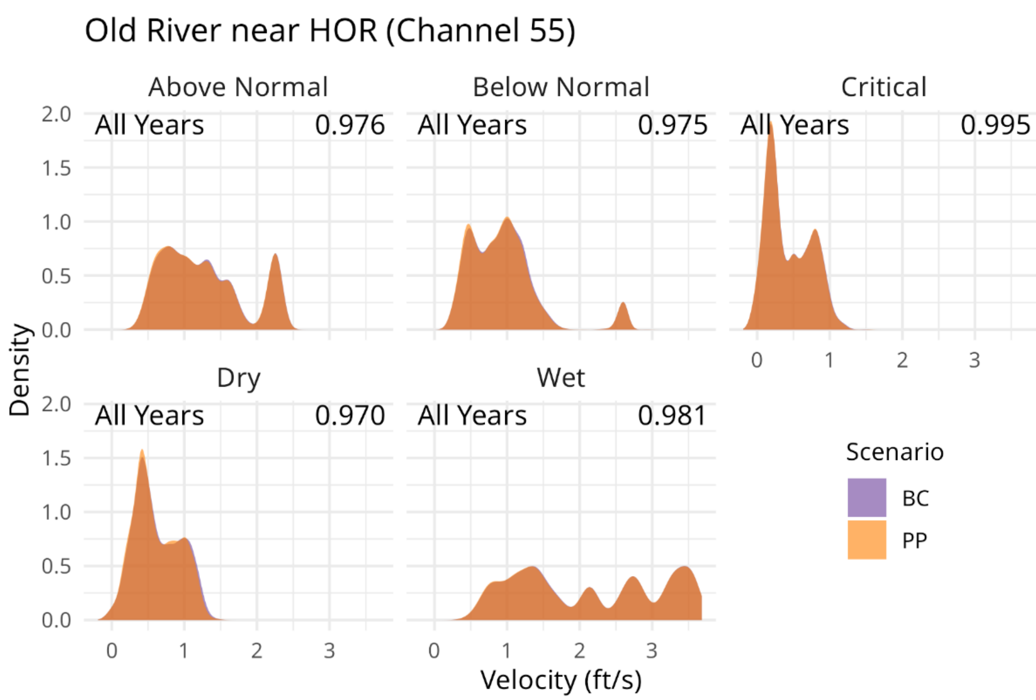
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-253. Velocity Density Distribution for San Joaquin River near Mokelumne River, June.



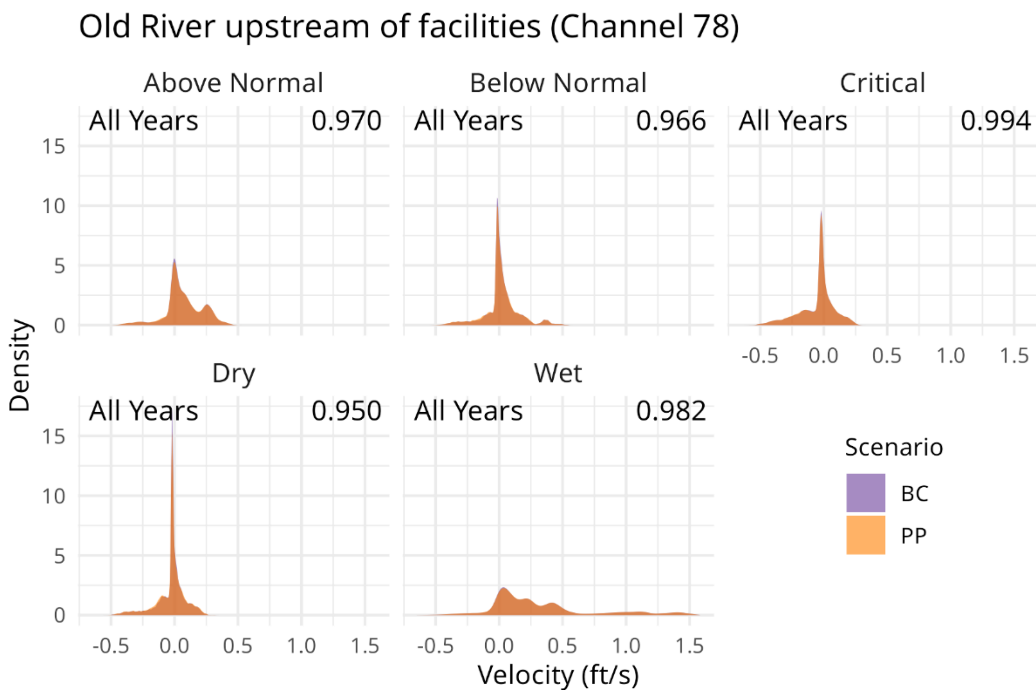
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-254. Velocity Density Distribution for San Joaquin River near Jersey Point, June.



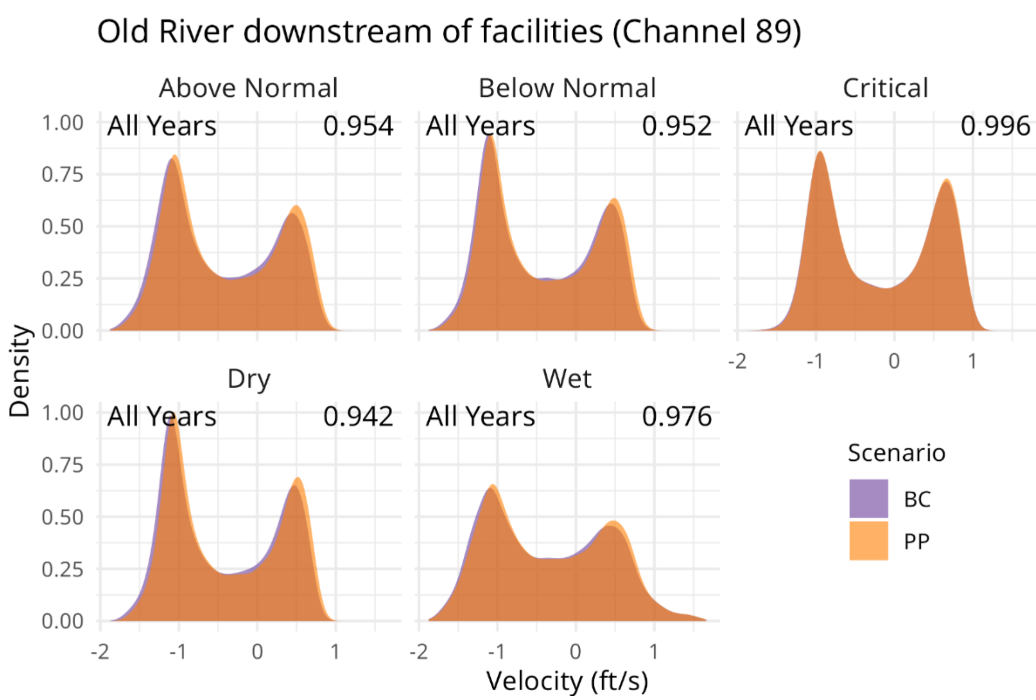
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-255. Velocity Density Distribution for Old River near Head of Old River, June.



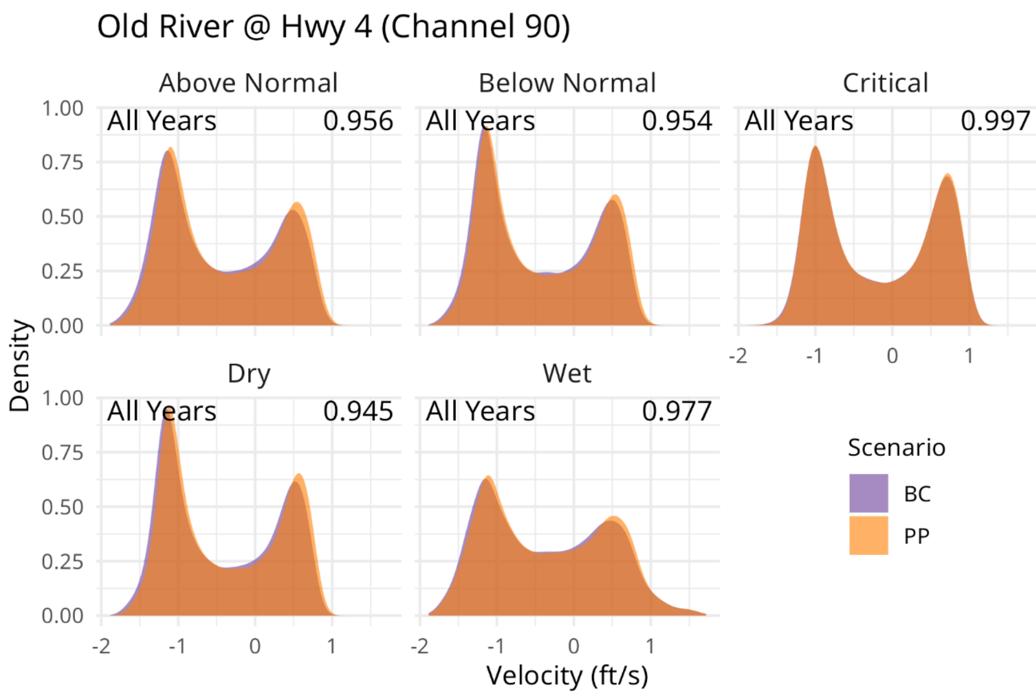
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-256. Velocity Density Distribution for Old River Upstream of the South Delta Export Facilities, June.



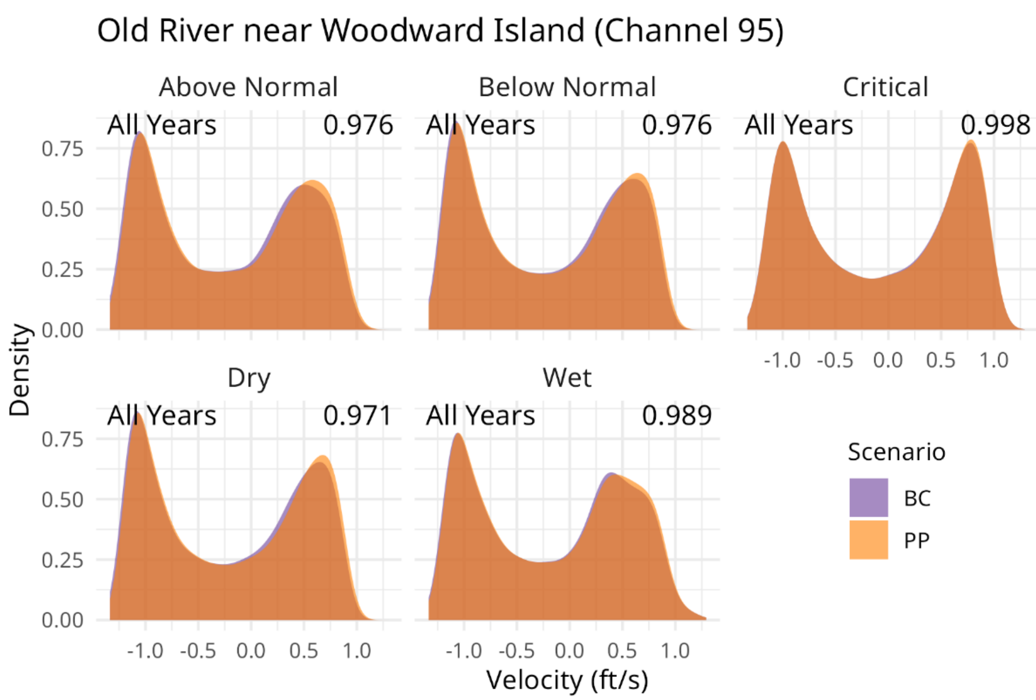
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-257. Velocity Density Distribution for Old River Downstream of the South Delta Export Facilities, June.



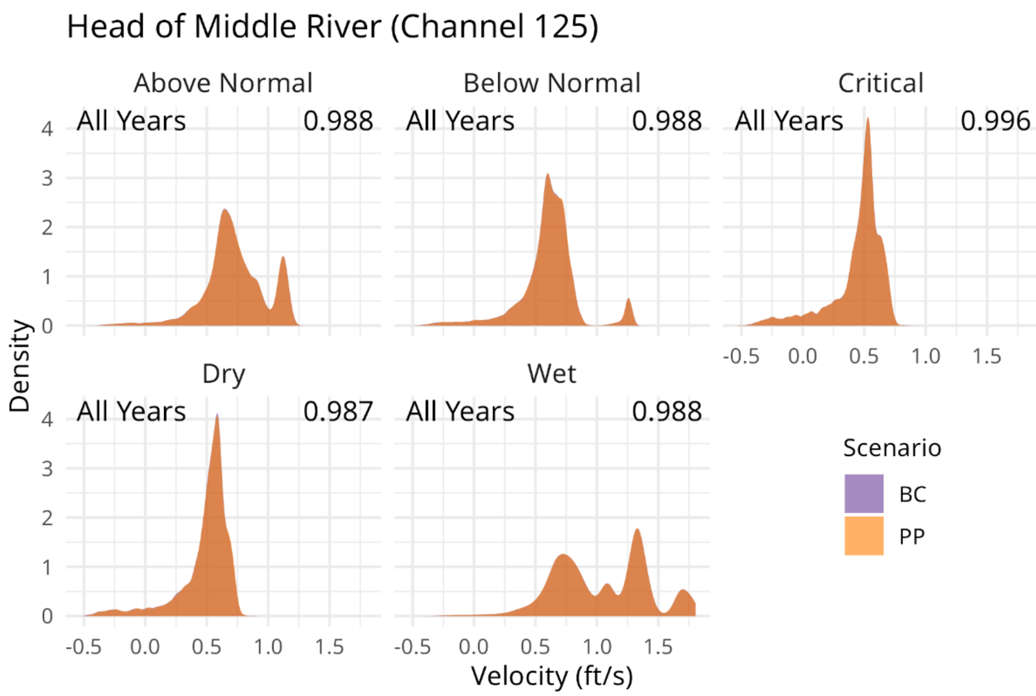
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-258. Velocity Density Distribution for Old River at Highway 4, June.



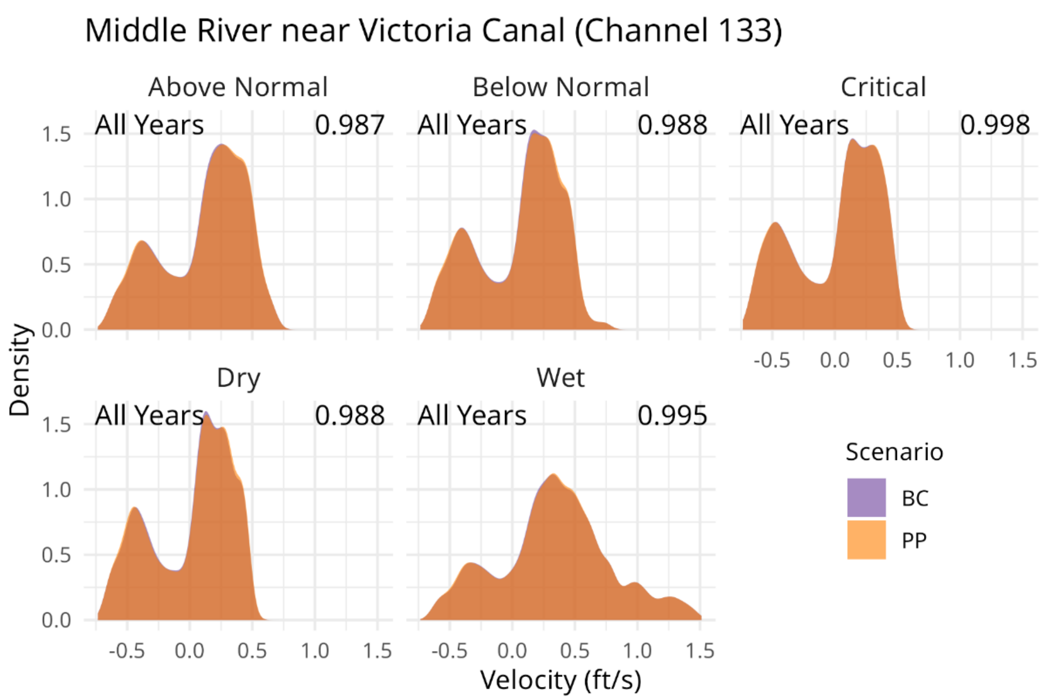
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-259. Velocity Density Distribution for Old River near Woodward Island, June.



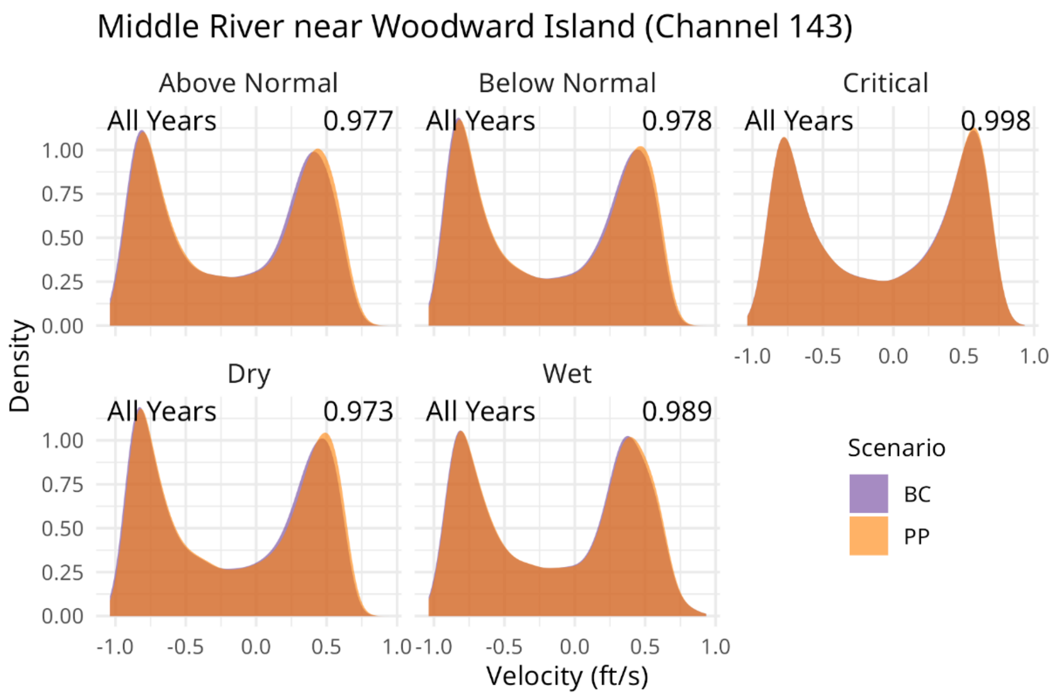
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-260. Velocity Density Distribution for Head of Middle River, June.



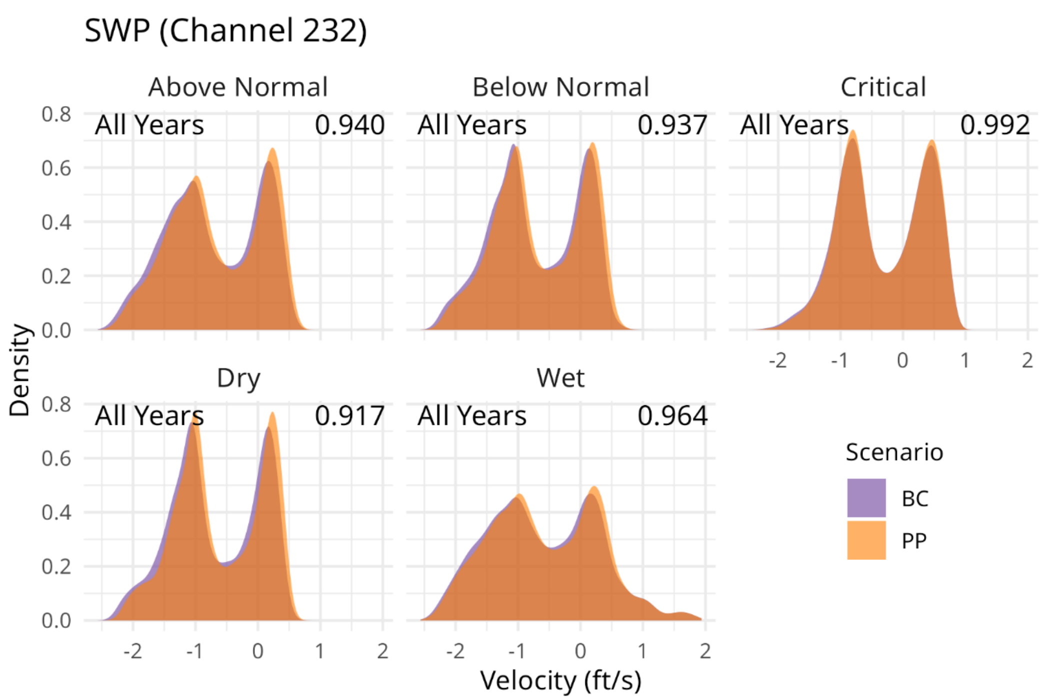
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-261. Velocity Density Distribution for Middle River near Victoria Canal, June.



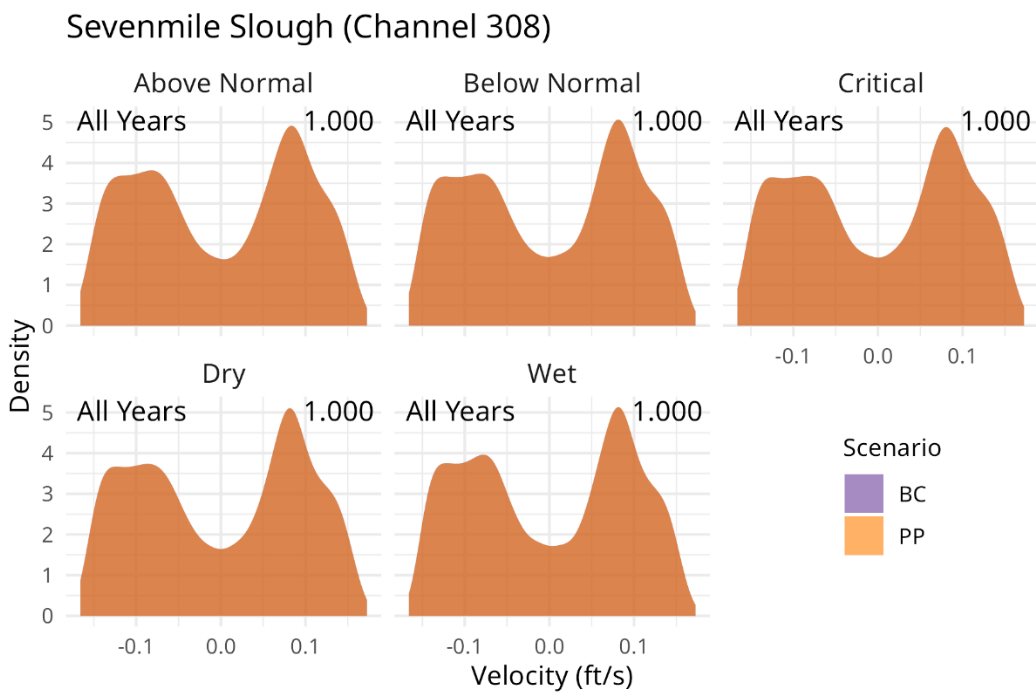
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-262. Velocity Density Distribution for Middle River near Woodward Island, June.



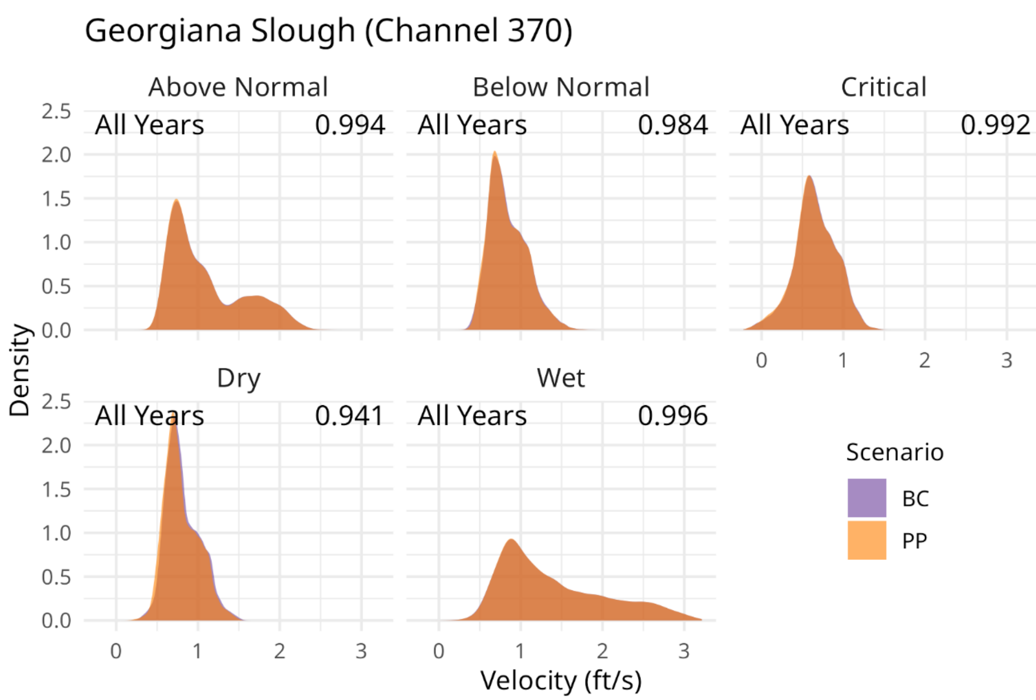
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-263. Velocity Density Distribution for State Water Project, June.



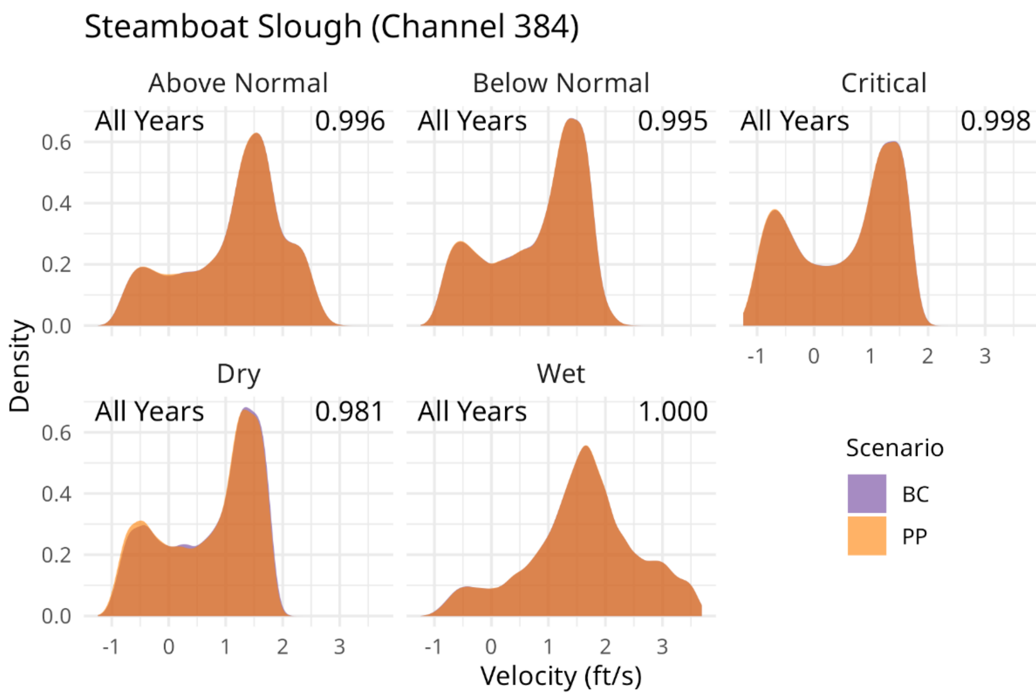
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-264. Velocity Density Distribution for Sevenmile Slough, June.



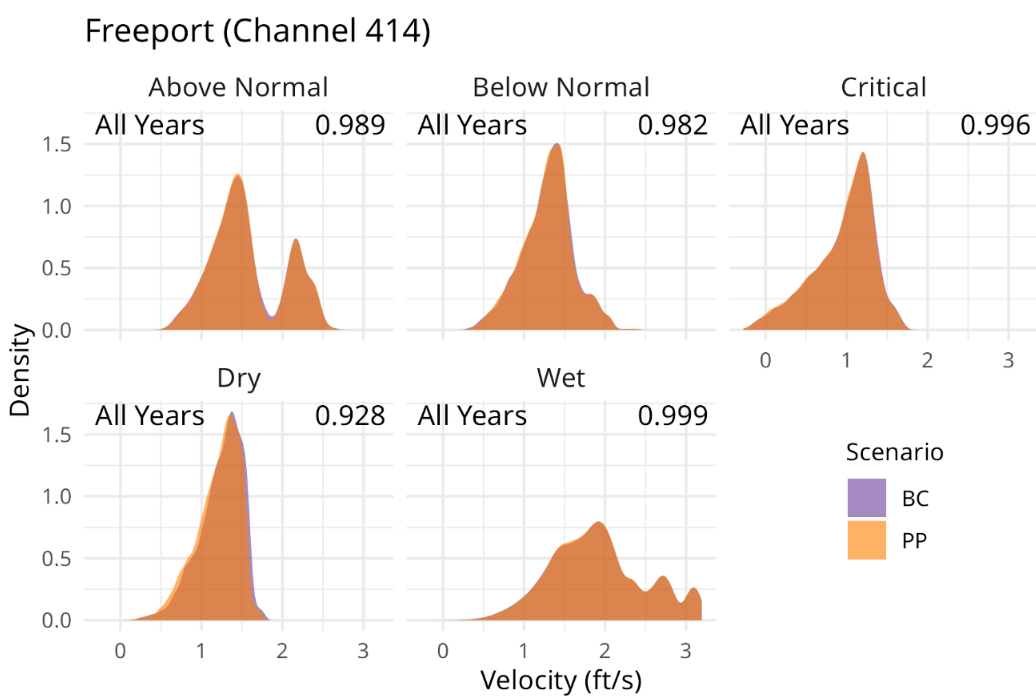
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-265. Velocity Density Distribution for Georgiana Slough, June.



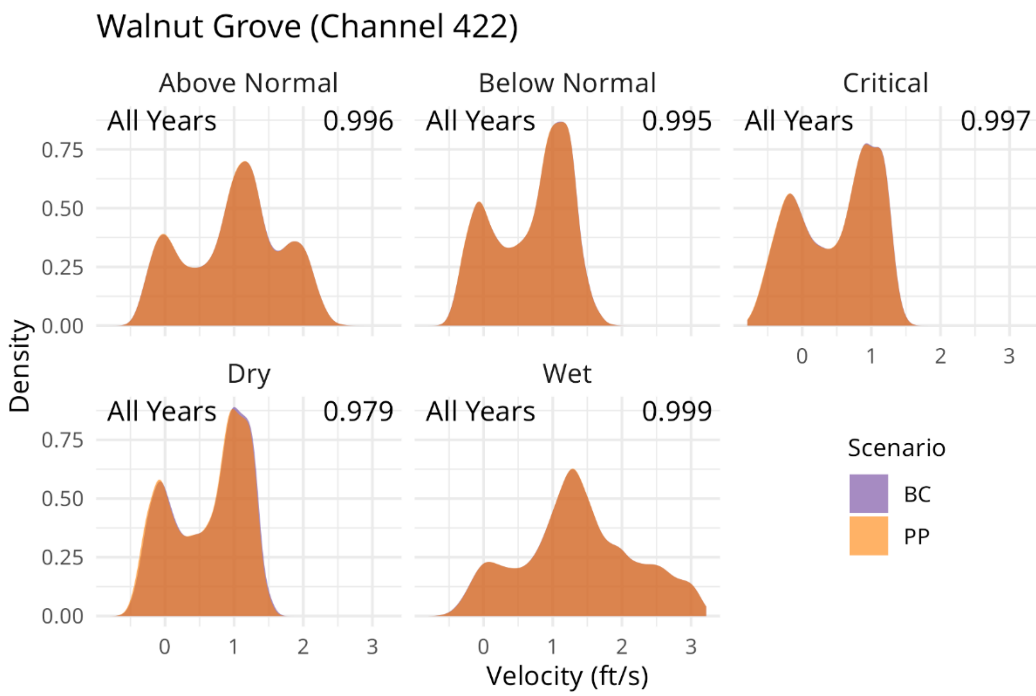
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-266. Velocity Density Distribution for Steamboat Slough, June.



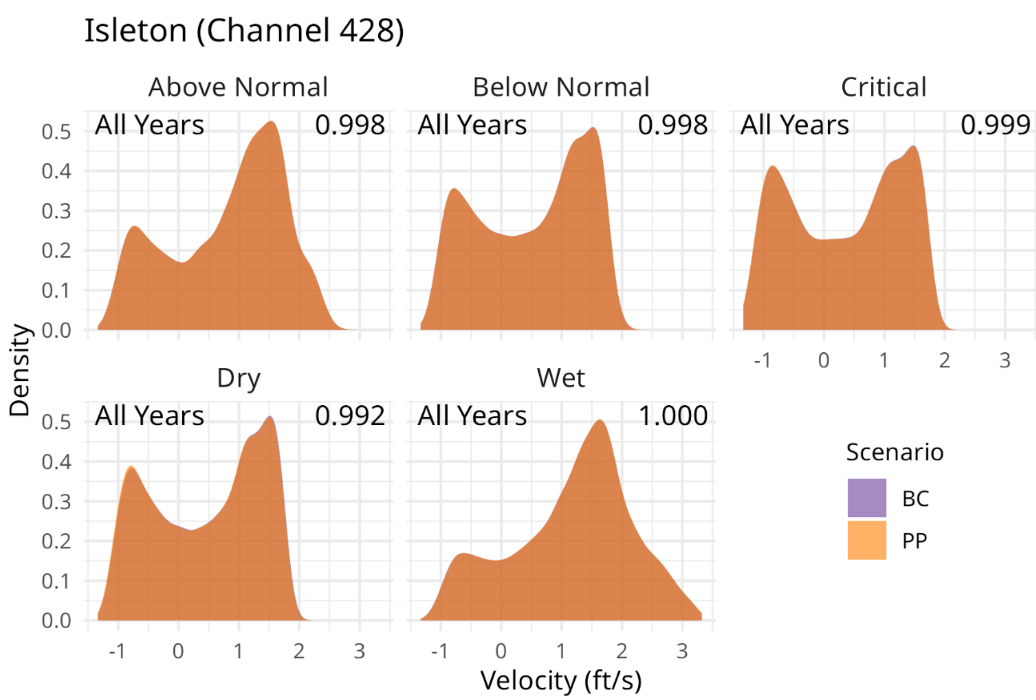
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-267. Velocity Density Distribution for Sacramento River at Freeport, June.



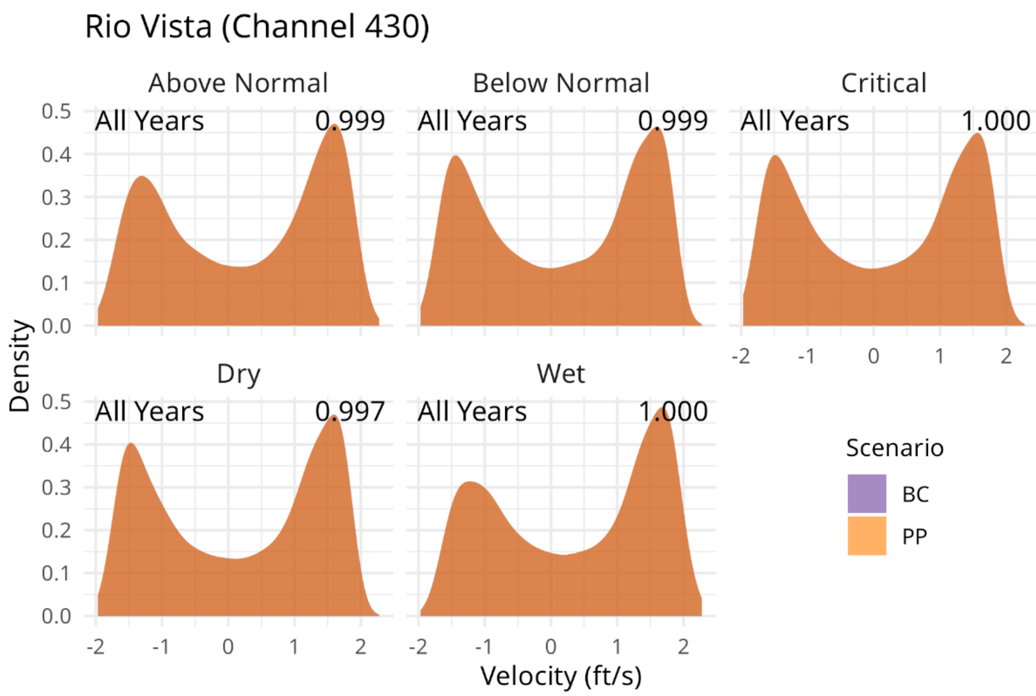
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-268. Velocity Density Distribution for Sacramento River at Walnut Grove, June.



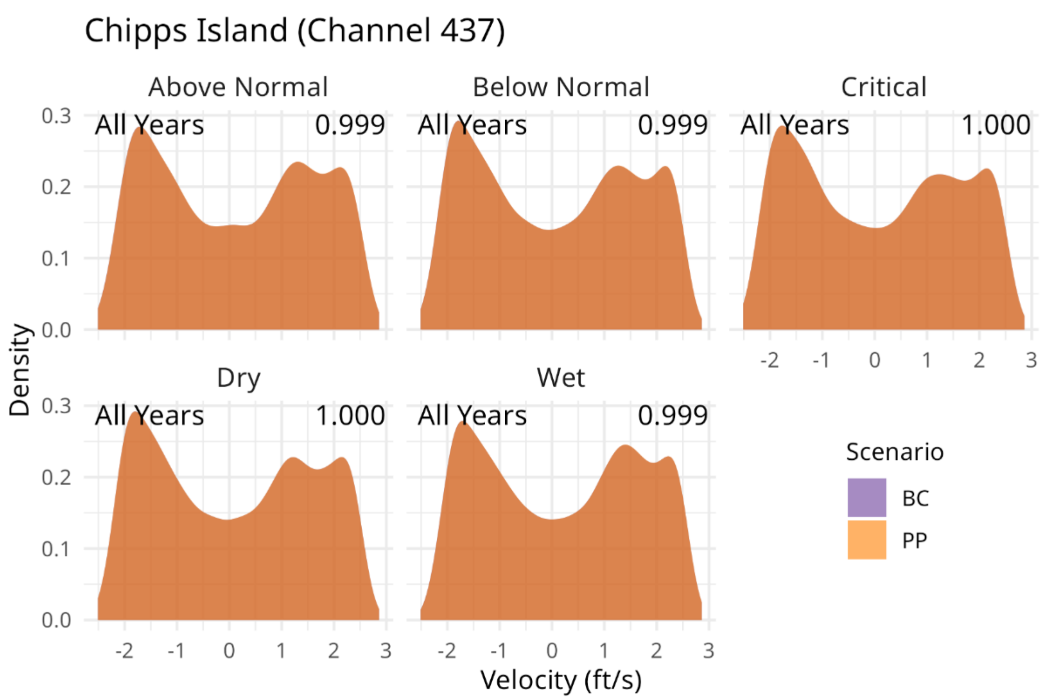
Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-269. Velocity Density Distribution for Sacramento River at Isleton, June.



Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-270. Velocity Density Distribution for Sacramento River at Rio Vista, June.



Note: The number on each plot represents the median overlap of density distribution between Baseline Conditions (BC) and Proposed Project (PP) for a given water year type.

Figure 6B-271. Velocity Density Distribution for Sacramento River at Chipps Island, June.

Velocity—Tabulated Means by Month and Water Year Type

Table 6B-20. Mean September Velocity for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Location, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on DSM2-HYDRO Modeling.

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River at Vernalis	1	Wet	1.523	1.522 (0.0%)
San Joaquin River at Vernalis	1	Above Normal	1.297	1.296 (0.0%)
San Joaquin River at Vernalis	1	Below Normal	1.221	1.218 (-0.2%)
San Joaquin River at Vernalis	1	Dry	1.136	1.132 (-0.4%)
San Joaquin River at Vernalis	1	Critically Dry	0.999	0.996 (-0.4%)
San Joaquin River upstream of Head of Old River	4	Wet	1.493	1.495 (0.1%)
San Joaquin River upstream of Head of Old River	4	Above Normal	1.185	1.187 (0.2%)
San Joaquin River upstream of Head of Old River	4	Below Normal	1.073	1.068 (-0.5%)
San Joaquin River upstream of Head of Old River	4	Dry	0.926	0.918 (-0.9%)
San Joaquin River upstream of Head of Old River	4	Critically Dry	0.696	0.691 (-0.8%)
San Joaquin River at Mossdale	6	Wet	1.192	1.194 (0.1%)
San Joaquin River at Mossdale	6	Above Normal	0.839	0.841 (0.2%)
San Joaquin River at Mossdale	6	Below Normal	0.736	0.732 (-0.6%)
San Joaquin River at Mossdale	6	Dry	0.612	0.605 (-1.1%)
San Joaquin River at Mossdale	6	Critically Dry	0.442	0.438 (-0.9%)
San Joaquin River near Head of Old River	9	Wet	0.738	0.728 (-1.4%)
San Joaquin River near Head of Old River	9	Above Normal	0.445	0.433 (-2.7%)
San Joaquin River near Head of Old River	9	Below Normal	0.335	0.335 (0.0%)
San Joaquin River near Head of Old River	9	Dry	0.333	0.332 (-0.3%)
San Joaquin River near Head of Old River	9	Critically Dry	0.289	0.286 (-0.8%)
San Joaquin River at Highway 4	14	Wet	0.419	0.413 (-1.4%)
San Joaquin River at Highway 4	14	Above Normal	0.249	0.242 (-2.5%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River at Highway 4	14	Below Normal	0.191	0.191 (0.0%)
San Joaquin River at Highway 4	14	Dry	0.190	0.190 (-0.3%)
San Joaquin River at Highway 4	14	Critically Dry	0.169	0.168 (-0.7%)
San Joaquin River near Mokelumne River	45	Wet	0.014	0.006 (-54.3%)
San Joaquin River near Mokelumne River	45	Above Normal	0.018	0.013 (-23.0%)
San Joaquin River near Mokelumne River	45	Below Normal	-0.016	-0.015 (7.9%)
San Joaquin River near Mokelumne River	45	Dry	0.003	0.004 (31.2%)
San Joaquin River near Mokelumne River	45	Critically Dry	0.013	0.013 (-0.6%)
San Joaquin River near Jersey Point	49	Wet	0.047	0.040 (-14.6%)
San Joaquin River near Jersey Point	49	Above Normal	0.050	0.047 (-5.6%)
San Joaquin River near Jersey Point	49	Below Normal	0.014	0.015 (8.8%)
San Joaquin River near Jersey Point	49	Dry	0.031	0.032 (3.5%)
San Joaquin River near Jersey Point	49	Critically Dry	0.039	0.039 (-0.2%)
Old River near Head of Old River	55	Wet	1.063	1.077 (1.3%)
Old River near Head of Old River	55	Above Normal	0.744	0.759 (2.0%)
Old River near Head of Old River	55	Below Normal	0.702	0.696 (-0.9%)
Old River near Head of Old River	55	Dry	0.514	0.505 (-1.7%)
Old River near Head of Old River	55	Critically Dry	0.317	0.314 (-1.0%)
Old River upstream of the south Delta export facilities	78	Wet	0.065	0.065 (-0.5%)
Old River upstream of the south Delta export facilities	78	Above Normal	0.020	0.020 (4.2%)
Old River upstream of the south Delta export facilities	78	Below Normal	0.017	0.017 (-3.9%)
Old River upstream of the south Delta export facilities	78	Dry	-0.004	-0.005 (-29.1%)
Old River upstream of the south Delta export facilities	78	Critically Dry	-0.033	-0.033 (-1.0%)
Old River downstream of the south Delta export facilities	89	Wet	-0.858	-0.976 (-13.8%)
Old River downstream of the south Delta export facilities	89	Above Normal	-0.742	-0.845 (-13.9%)
Old River downstream of the south Delta export facilities	89	Below Normal	-0.956	-0.939 (1.8%)
Old River downstream of the south Delta export facilities	89	Dry	-0.549	-0.539 (1.8%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Old River downstream of the south Delta export facilities	89	Critically Dry	-0.317	-0.318 (-0.3%)
Old River at Highway 4	90	Wet	-0.859	-0.979 (-14.0%)
Old River at Highway 4	90	Above Normal	-0.744	-0.848 (-14.0%)
Old River at Highway 4	90	Below Normal	-0.960	-0.942 (1.8%)
Old River at Highway 4	90	Dry	-0.548	-0.539 (1.8%)
Old River at Highway 4	90	Critically Dry	-0.314	-0.315 (-0.3%)
Old River near Woodward Island	95	Wet	-0.431	-0.494 (-14.5%)
Old River near Woodward Island	95	Above Normal	-0.372	-0.426 (-14.6%)
Old River near Woodward Island	95	Below Normal	-0.485	-0.476 (1.9%)
Old River near Woodward Island	95	Dry	-0.270	-0.265 (1.9%)
Old River near Woodward Island	95	Critically Dry	-0.149	-0.149 (-0.4%)
Head of Middle River	125	Wet	0.550	0.551 (0.2%)
Head of Middle River	125	Above Normal	0.414	0.415 (0.4%)
Head of Middle River	125	Below Normal	0.366	0.364 (-0.4%)
Head of Middle River	125	Dry	0.339	0.339 (-0.2%)
Head of Middle River	125	Critically Dry	0.312	0.310 (-0.5%)
Middle River near Victoria Canal	133	Wet	0.097	0.096 (-0.6%)
Middle River near Victoria Canal	133	Above Normal	0.053	0.053 (-0.7%)
Middle River near Victoria Canal	133	Below Normal	0.039	0.039 (-0.8%)
Middle River near Victoria Canal	133	Dry	0.032	0.032 (-0.3%)
Middle River near Victoria Canal	133	Critically Dry	0.023	0.023 (-1.7%)
Middle River near Woodward Island	143	Wet	-0.305	-0.346 (-13.4%)
Middle River near Woodward Island	143	Above Normal	-0.268	-0.303 (-13.0%)
Middle River near Woodward Island	143	Below Normal	-0.342	-0.336 (1.7%)
Middle River near Woodward Island	143	Dry	-0.205	-0.202 (1.6%)
Middle River near Woodward Island	143	Critically Dry	-0.125	-0.125 (-0.3%)
State Water Project	232	Wet	-1.338	-1.523 (-13.8%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
State Water Project	232	Above Normal	-1.158	-1.317 (-13.7%)
State Water Project	232	Below Normal	-1.489	-1.462 (1.8%)
State Water Project	232	Dry	-0.862	-0.847 (1.7%)
State Water Project	232	Critically Dry	-0.506	-0.508 (-0.3%)
Sevenmile Slough	308	Wet	0.000	0.000 (-1.9%)
Sevenmile Slough	308	Above Normal	0.000	0.000 (3.9%)
Sevenmile Slough	308	Below Normal	0.000	0.000 (-58.9%)
Sevenmile Slough	308	Dry	0.000	0.000 (2.4%)
Sevenmile Slough	308	Critically Dry	-0.001	0.000 (0.1%)
Georgiana Slough	370	Wet	1.026	1.062 (3.4%)
Georgiana Slough	370	Above Normal	0.998	1.057 (5.9%)
Georgiana Slough	370	Below Normal	0.872	0.869 (-0.3%)
Georgiana Slough	370	Dry	0.700	0.703 (0.3%)
Georgiana Slough	370	Critically Dry	0.586	0.586 (0.0%)
Steamboat Slough	384	Wet	1.166	1.232 (5.7%)
Steamboat Slough	384	Above Normal	1.126	1.246 (10.7%)
Steamboat Slough	384	Below Normal	0.831	0.831 (0.0%)
Steamboat Slough	384	Dry	0.567	0.572 (0.9%)
Steamboat Slough	384	Critically Dry	0.439	0.439 (0.0%)
Sacramento River at Freeport	414	Wet	1.682	1.743 (3.6%)
Sacramento River at Freeport	414	Above Normal	1.654	1.763 (6.6%)
Sacramento River at Freeport	414	Below Normal	1.378	1.375 (-0.2%)
Sacramento River at Freeport	414	Dry	1.054	1.060 (0.6%)
Sacramento River at Freeport	414	Critically Dry	0.851	0.851 (0.0%)
Sacramento River at Walnut Grove	422	Wet	0.872	0.910 (4.4%)
Sacramento River at Walnut Grove	422	Above Normal	0.834	0.905 (8.6%)
Sacramento River at Walnut Grove	422	Below Normal	0.664	0.664 (-0.1%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Sacramento River at Walnut Grove	422	Dry	0.500	0.503 (0.6%)
Sacramento River at Walnut Grove	422	Critically Dry	0.404	0.404 (0.0%)
Sacramento River at Isleton	428	Wet	0.680	0.712 (4.9%)
Sacramento River at Isleton	428	Above Normal	0.647	0.711 (9.9%)
Sacramento River at Isleton	428	Below Normal	0.491	0.491 (0.0%)
Sacramento River at Isleton	428	Dry	0.359	0.362 (0.8%)
Sacramento River at Isleton	428	Critically Dry	0.288	0.288 (0.0%)
Sacramento River at Rio Vista	430	Wet	0.235	0.247 (5.0%)
Sacramento River at Rio Vista	430	Above Normal	0.224	0.246 (9.7%)
Sacramento River at Rio Vista	430	Below Normal	0.171	0.171 (-0.1%)
Sacramento River at Rio Vista	430	Dry	0.123	0.124 (0.9%)
Sacramento River at Rio Vista	430	Critically Dry	0.098	0.098 (0.1%)
Sacramento River at Chipps Island	437	Wet	0.108	0.107 (-0.7%)
Sacramento River at Chipps Island	437	Above Normal	0.106	0.103 (-2.6%)
Sacramento River at Chipps Island	437	Below Normal	0.066	0.059 (-10.5%)
Sacramento River at Chipps Island	437	Dry	0.054	0.050 (-6.5%)
Sacramento River at Chipps Island	437	Critically Dry	0.047	0.047 (0.0%)

Table 6B-21. Mean October Velocity for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Location, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on DSM2-HYDRO Modeling.

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River at Vernalis	1	Wet	1.524	1.522 (-0.2%)
San Joaquin River at Vernalis	1	Above Normal	1.419	1.417 (-0.2%)
San Joaquin River at Vernalis	1	Below Normal	1.505	1.505 (0.0%)
San Joaquin River at Vernalis	1	Dry	1.445	1.444 (-0.1%)
San Joaquin River at Vernalis	1	Critically Dry	1.296	1.299 (0.3%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River upstream of Head of Old River	4	Wet	1.514	1.510 (-0.3%)
San Joaquin River upstream of Head of Old River	4	Above Normal	1.363	1.359 (-0.3%)
San Joaquin River upstream of Head of Old River	4	Below Normal	1.488	1.489 (0.1%)
San Joaquin River upstream of Head of Old River	4	Dry	1.412	1.410 (-0.1%)
San Joaquin River upstream of Head of Old River	4	Critically Dry	1.178	1.184 (0.5%)
San Joaquin River at Mossdale	6	Wet	1.210	1.206 (-0.3%)
San Joaquin River at Mossdale	6	Above Normal	1.037	1.033 (-0.4%)
San Joaquin River at Mossdale	6	Below Normal	1.181	1.182 (0.1%)
San Joaquin River at Mossdale	6	Dry	1.088	1.086 (-0.2%)
San Joaquin River at Mossdale	6	Critically Dry	0.845	0.851 (0.6%)
San Joaquin River near Head of Old River	9	Wet	0.791	0.790 (-0.1%)
San Joaquin River near Head of Old River	9	Above Normal	0.669	0.667 (-0.3%)
San Joaquin River near Head of Old River	9	Below Normal	0.782	0.780 (-0.2%)
San Joaquin River near Head of Old River	9	Dry	0.706	0.705 (-0.1%)
San Joaquin River near Head of Old River	9	Critically Dry	0.545	0.547 (0.5%)
San Joaquin River at Highway 4	14	Wet	0.449	0.448 (-0.1%)
San Joaquin River at Highway 4	14	Above Normal	0.373	0.372 (-0.3%)
San Joaquin River at Highway 4	14	Below Normal	0.437	0.437 (-0.2%)
San Joaquin River at Highway 4	14	Dry	0.393	0.393 (-0.1%)
San Joaquin River at Highway 4	14	Critically Dry	0.304	0.305 (0.5%)
San Joaquin River near Mokelumne River	45	Wet	0.004	0.005 (20.2%)
San Joaquin River near Mokelumne River	45	Above Normal	0.016	0.016 (1.2%)
San Joaquin River near Mokelumne River	45	Below Normal	0.010	0.011 (4.9%)
San Joaquin River near Mokelumne River	45	Dry	0.010	0.011 (11.1%)
San Joaquin River near Mokelumne River	45	Critically Dry	0.013	0.013 (-2.1%)
San Joaquin River near Jersey Point	49	Wet	0.037	0.038 (2.2%)
San Joaquin River near Jersey Point	49	Above Normal	0.045	0.045 (0.6%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River near Jersey Point	49	Below Normal	0.040	0.040 (0.9%)
San Joaquin River near Jersey Point	49	Dry	0.039	0.040 (2.2%)
San Joaquin River near Jersey Point	49	Critically Dry	0.040	0.040 (-0.5%)
Old River near Head of Old River	55	Wet	1.032	1.026 (-0.6%)
Old River near Head of Old River	55	Above Normal	0.844	0.840 (-0.5%)
Old River near Head of Old River	55	Below Normal	0.982	0.984 (0.2%)
Old River near Head of Old River	55	Dry	0.890	0.888 (-0.3%)
Old River near Head of Old River	55	Critically Dry	0.655	0.660 (0.8%)
Old River upstream of the south Delta export facilities	78	Wet	0.095	0.094 (-0.9%)
Old River upstream of the south Delta export facilities	78	Above Normal	0.067	0.066 (-0.6%)
Old River upstream of the south Delta export facilities	78	Below Normal	0.088	0.088 (0.6%)
Old River upstream of the south Delta export facilities	78	Dry	0.075	0.074 (-0.5%)
Old River upstream of the south Delta export facilities	78	Critically Dry	0.040	0.041 (1.9%)
Old River downstream of the south Delta export facilities	89	Wet	-0.671	-0.657 (2.1%)
Old River downstream of the south Delta export facilities	89	Above Normal	-0.442	-0.441 (0.3%)
Old River downstream of the south Delta export facilities	89	Below Normal	-0.577	-0.583 (-1.0%)
Old River downstream of the south Delta export facilities	89	Dry	-0.535	-0.530 (1.0%)
Old River downstream of the south Delta export facilities	89	Critically Dry	-0.331	-0.334 (-0.9%)
Old River at Highway 4	90	Wet	-0.672	-0.658 (2.1%)
Old River at Highway 4	90	Above Normal	-0.441	-0.439 (0.3%)
Old River at Highway 4	90	Below Normal	-0.578	-0.584 (-1.1%)
Old River at Highway 4	90	Dry	-0.535	-0.530 (1.0%)
Old River at Highway 4	90	Critically Dry	-0.329	-0.332 (-0.9%)
Old River near Woodward Island	95	Wet	-0.333	-0.326 (2.2%)
Old River near Woodward Island	95	Above Normal	-0.213	-0.212 (0.3%)
Old River near Woodward Island	95	Below Normal	-0.284	-0.288 (-1.1%)
Old River near Woodward Island	95	Dry	-0.263	-0.260 (1.0%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Old River near Woodward Island	95	Critically Dry	-0.155	-0.157 (-1.0%)
Head of Middle River	125	Wet	0.522	0.522 (-0.1%)
Head of Middle River	125	Above Normal	0.464	0.463 (-0.1%)
Head of Middle River	125	Below Normal	0.512	0.512 (0.0%)
Head of Middle River	125	Dry	0.479	0.478 (-0.1%)
Head of Middle River	125	Critically Dry	0.403	0.404 (0.4%)
Middle River near Victoria Canal	133	Wet	0.117	0.117 (-0.1%)
Middle River near Victoria Canal	133	Above Normal	0.094	0.093 (-0.2%)
Middle River near Victoria Canal	133	Below Normal	0.109	0.109 (-0.1%)
Middle River near Victoria Canal	133	Dry	0.095	0.094 (-0.1%)
Middle River near Victoria Canal	133	Critically Dry	0.076	0.077 (0.4%)
Middle River near Woodward Island	143	Wet	-0.239	-0.234 (2.0%)
Middle River near Woodward Island	143	Above Normal	-0.162	-0.162 (0.2%)
Middle River near Woodward Island	143	Below Normal	-0.208	-0.210 (-1.1%)
Middle River near Woodward Island	143	Dry	-0.194	-0.192 (0.9%)
Middle River near Woodward Island	143	Critically Dry	-0.124	-0.125 (-0.9%)
State Water Project	232	Wet	-1.059	-1.037 (2.1%)
State Water Project	232	Above Normal	-0.707	-0.705 (0.3%)
State Water Project	232	Below Normal	-0.914	-0.924 (-1.0%)
State Water Project	232	Dry	-0.848	-0.840 (1.0%)
State Water Project	232	Critically Dry	-0.535	-0.539 (-0.9%)
Sevenmile Slough	308	Wet	-0.001	-0.001 (1.1%)
Sevenmile Slough	308	Above Normal	-0.001	-0.001 (0.9%)
Sevenmile Slough	308	Below Normal	-0.001	-0.001 (0.5%)
Sevenmile Slough	308	Dry	-0.001	-0.001 (0.4%)
Sevenmile Slough	308	Critically Dry	-0.001	-0.001 (0.4%)
Georgiana Slough	370	Wet	0.940	0.936 (-0.4%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Georgiana Slough	370	Above Normal	0.763	0.763 (0.0%)
Georgiana Slough	370	Below Normal	0.814	0.808 (-0.8%)
Georgiana Slough	370	Dry	0.796	0.787 (-1.2%)
Georgiana Slough	370	Critically Dry	0.673	0.677 (0.6%)
Steamboat Slough	384	Wet	0.874	0.869 (-0.6%)
Steamboat Slough	384	Above Normal	0.635	0.638 (0.5%)
Steamboat Slough	384	Below Normal	0.713	0.711 (-0.4%)
Steamboat Slough	384	Dry	0.668	0.663 (-0.7%)
Steamboat Slough	384	Critically Dry	0.486	0.490 (0.7%)
Sacramento River at Freeport	414	Wet	1.285	1.278 (-0.6%)
Sacramento River at Freeport	414	Above Normal	1.041	1.043 (0.2%)
Sacramento River at Freeport	414	Below Normal	1.143	1.149 (0.5%)
Sacramento River at Freeport	414	Dry	1.084	1.083 (-0.1%)
Sacramento River at Freeport	414	Critically Dry	0.822	0.825 (0.4%)
Sacramento River at Walnut Grove	422	Wet	0.785	0.782 (-0.4%)
Sacramento River at Walnut Grove	422	Above Normal	0.581	0.583 (0.2%)
Sacramento River at Walnut Grove	422	Below Normal	0.637	0.631 (-1.0%)
Sacramento River at Walnut Grove	422	Dry	0.611	0.603 (-1.3%)
Sacramento River at Walnut Grove	422	Critically Dry	0.480	0.484 (0.7%)
Sacramento River at Isleton	428	Wet	0.616	0.613 (-0.4%)
Sacramento River at Isleton	428	Above Normal	0.437	0.438 (0.3%)
Sacramento River at Isleton	428	Below Normal	0.483	0.479 (-1.0%)
Sacramento River at Isleton	428	Dry	0.460	0.454 (-1.2%)
Sacramento River at Isleton	428	Critically Dry	0.349	0.352 (0.8%)
Sacramento River at Rio Vista	430	Wet	0.200	0.199 (-0.4%)
Sacramento River at Rio Vista	430	Above Normal	0.143	0.144 (0.7%)
Sacramento River at Rio Vista	430	Below Normal	0.158	0.158 (-0.6%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Sacramento River at Rio Vista	430	Dry	0.149	0.148 (-0.9%)
Sacramento River at Rio Vista	430	Critically Dry	0.113	0.114 (0.7%)
Sacramento River at Chipps Island	437	Wet	0.086	0.084 (-2.2%)
Sacramento River at Chipps Island	437	Above Normal	0.071	0.071 (-0.2%)
Sacramento River at Chipps Island	437	Below Normal	0.076	0.075 (-1.6%)
Sacramento River at Chipps Island	437	Dry	0.073	0.071 (-2.8%)
Sacramento River at Chipps Island	437	Critically Dry	0.055	0.055 (-0.4%)

Table 6B-22. Mean November Velocity for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Location, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on DSM2-HYDRO Modeling.

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River at Vernalis	1	Wet	1.492	1.490 (-0.1%)
San Joaquin River at Vernalis	1	Above Normal	1.368	1.365 (-0.2%)
San Joaquin River at Vernalis	1	Below Normal	1.410	1.411 (0.1%)
San Joaquin River at Vernalis	1	Dry	1.340	1.337 (-0.2%)
San Joaquin River at Vernalis	1	Critically Dry	1.236	1.240 (0.3%)
San Joaquin River upstream of Head of Old River	4	Wet	1.477	1.475 (-0.1%)
San Joaquin River upstream of Head of Old River	4	Above Normal	1.311	1.306 (-0.3%)
San Joaquin River upstream of Head of Old River	4	Below Normal	1.379	1.380 (0.1%)
San Joaquin River upstream of Head of Old River	4	Dry	1.286	1.282 (-0.3%)
San Joaquin River upstream of Head of Old River	4	Critically Dry	1.108	1.115 (0.6%)
San Joaquin River at Mossdale	6	Wet	1.167	1.165 (-0.2%)
San Joaquin River at Mossdale	6	Above Normal	0.972	0.968 (-0.4%)
San Joaquin River at Mossdale	6	Below Normal	1.047	1.048 (0.1%)
San Joaquin River at Mossdale	6	Dry	0.941	0.937 (-0.4%)
San Joaquin River at Mossdale	6	Critically Dry	0.773	0.778 (0.7%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River near Head of Old River	9	Wet	0.705	0.703 (-0.3%)
San Joaquin River near Head of Old River	9	Above Normal	0.560	0.559 (-0.3%)
San Joaquin River near Head of Old River	9	Below Normal	0.624	0.626 (0.3%)
San Joaquin River near Head of Old River	9	Dry	0.543	0.539 (-0.7%)
San Joaquin River near Head of Old River	9	Critically Dry	0.485	0.486 (0.1%)
San Joaquin River at Highway 4	14	Wet	0.409	0.407 (-0.3%)
San Joaquin River at Highway 4	14	Above Normal	0.310	0.310 (-0.3%)
San Joaquin River at Highway 4	14	Below Normal	0.345	0.346 (0.3%)
San Joaquin River at Highway 4	14	Dry	0.298	0.296 (-0.7%)
San Joaquin River at Highway 4	14	Critically Dry	0.268	0.269 (0.1%)
San Joaquin River near Mokelumne River	45	Wet	-0.001	-0.001 (-37.0%)
San Joaquin River near Mokelumne River	45	Above Normal	-0.016	-0.016 (4.8%)
San Joaquin River near Mokelumne River	45	Below Normal	-0.009	-0.009 (0.6%)
San Joaquin River near Mokelumne River	45	Dry	-0.010	-0.010 (-2.8%)
San Joaquin River near Mokelumne River	45	Critically Dry	0.004	0.004 (16.2%)
San Joaquin River near Jersey Point	49	Wet	0.038	0.038 (-0.9%)
San Joaquin River near Jersey Point	49	Above Normal	0.017	0.018 (4.6%)
San Joaquin River near Jersey Point	49	Below Normal	0.023	0.023 (-0.4%)
San Joaquin River near Jersey Point	49	Dry	0.021	0.020 (-1.0%)
San Joaquin River near Jersey Point	49	Critically Dry	0.032	0.033 (1.5%)
Old River near Head of Old River	55	Wet	1.047	1.046 (-0.1%)
Old River near Head of Old River	55	Above Normal	0.836	0.832 (-0.5%)
Old River near Head of Old River	55	Below Normal	0.897	0.896 (-0.1%)
Old River near Head of Old River	55	Dry	0.794	0.792 (-0.3%)
Old River near Head of Old River	55	Critically Dry	0.589	0.596 (1.3%)
Old River upstream of the south Delta export facilities	78	Wet	0.100	0.100 (0.0%)
Old River upstream of the south Delta export facilities	78	Above Normal	0.063	0.062 (-1.0%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Old River upstream of the south Delta export facilities	78	Below Normal	0.073	0.072 (-0.3%)
Old River upstream of the south Delta export facilities	78	Dry	0.057	0.057 (-0.2%)
Old River upstream of the south Delta export facilities	78	Critically Dry	0.022	0.024 (6.7%)
Old River downstream of the south Delta export facilities	89	Wet	-0.867	-0.872 (-0.6%)
Old River downstream of the south Delta export facilities	89	Above Normal	-0.733	-0.724 (1.3%)
Old River downstream of the south Delta export facilities	89	Below Normal	-0.787	-0.781 (0.8%)
Old River downstream of the south Delta export facilities	89	Dry	-0.723	-0.727 (-0.6%)
Old River downstream of the south Delta export facilities	89	Critically Dry	-0.355	-0.371 (-4.4%)
Old River at Highway 4	90	Wet	-0.871	-0.876 (-0.6%)
Old River at Highway 4	90	Above Normal	-0.736	-0.726 (1.3%)
Old River at Highway 4	90	Below Normal	-0.790	-0.784 (0.8%)
Old River at Highway 4	90	Dry	-0.726	-0.731 (-0.6%)
Old River at Highway 4	90	Critically Dry	-0.354	-0.370 (-4.5%)
Old River near Woodward Island	95	Wet	-0.438	-0.441 (-0.6%)
Old River near Woodward Island	95	Above Normal	-0.368	-0.363 (1.4%)
Old River near Woodward Island	95	Below Normal	-0.397	-0.394 (0.8%)
Old River near Woodward Island	95	Dry	-0.365	-0.367 (-0.6%)
Old River near Woodward Island	95	Critically Dry	-0.170	-0.179 (-4.9%)
Head of Middle River	125	Wet	0.547	0.546 (-0.2%)
Head of Middle River	125	Above Normal	0.498	0.497 (-0.2%)
Head of Middle River	125	Below Normal	0.513	0.514 (0.1%)
Head of Middle River	125	Dry	0.486	0.484 (-0.4%)
Head of Middle River	125	Critically Dry	0.457	0.458 (0.2%)
Middle River near Victoria Canal	133	Wet	0.088	0.088 (-0.4%)
Middle River near Victoria Canal	133	Above Normal	0.045	0.044 (-0.5%)
Middle River near Victoria Canal	133	Below Normal	0.053	0.053 (0.5%)
Middle River near Victoria Canal	133	Dry	0.030	0.030 (-1.9%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Middle River near Victoria Canal	133	Critically Dry	0.018	0.019 (1.0%)
Middle River near Woodward Island	143	Wet	-0.309	-0.311 (-0.6%)
Middle River near Woodward Island	143	Above Normal	-0.264	-0.260 (1.2%)
Middle River near Woodward Island	143	Below Normal	-0.283	-0.281 (0.7%)
Middle River near Woodward Island	143	Dry	-0.261	-0.263 (-0.6%)
Middle River near Woodward Island	143	Critically Dry	-0.135	-0.141 (-4.2%)
State Water Project	232	Wet	-1.357	-1.365 (-0.6%)
State Water Project	232	Above Normal	-1.147	-1.132 (1.3%)
State Water Project	232	Below Normal	-1.230	-1.221 (0.7%)
State Water Project	232	Dry	-1.128	-1.134 (-0.6%)
State Water Project	232	Critically Dry	-0.561	-0.586 (-4.3%)
Sevenmile Slough	308	Wet	0.001	0.001 (0.1%)
Sevenmile Slough	308	Above Normal	0.000	0.000 (1.7%)
Sevenmile Slough	308	Below Normal	0.000	0.000 (-2.1%)
Sevenmile Slough	308	Dry	0.000	0.000 (0.1%)
Sevenmile Slough	308	Critically Dry	0.000	0.000 (0.4%)
Georgiana Slough	370	Wet	1.203	1.205 (0.2%)
Georgiana Slough	370	Above Normal	0.946	0.947 (0.1%)
Georgiana Slough	370	Below Normal	0.949	0.941 (-0.9%)
Georgiana Slough	370	Dry	0.868	0.872 (0.4%)
Georgiana Slough	370	Critically Dry	0.714	0.707 (-1.0%)
Steamboat Slough	384	Wet	1.193	1.196 (0.3%)
Steamboat Slough	384	Above Normal	0.818	0.821 (0.3%)
Steamboat Slough	384	Below Normal	0.851	0.839 (-1.4%)
Steamboat Slough	384	Dry	0.728	0.733 (0.6%)
Steamboat Slough	384	Critically Dry	0.506	0.510 (0.9%)
Sacramento River at Freeport	414	Wet	1.555	1.559 (0.3%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Sacramento River at Freeport	414	Above Normal	1.182	1.184 (0.2%)
Sacramento River at Freeport	414	Below Normal	1.268	1.253 (-1.2%)
Sacramento River at Freeport	414	Dry	1.152	1.157 (0.5%)
Sacramento River at Freeport	414	Critically Dry	0.830	0.849 (2.3%)
Sacramento River at Walnut Grove	422	Wet	1.073	1.076 (0.2%)
Sacramento River at Walnut Grove	422	Above Normal	0.774	0.776 (0.3%)
Sacramento River at Walnut Grove	422	Below Normal	0.777	0.768 (-1.2%)
Sacramento River at Walnut Grove	422	Dry	0.678	0.682 (0.5%)
Sacramento River at Walnut Grove	422	Critically Dry	0.517	0.512 (-0.9%)
Sacramento River at Isleton	428	Wet	0.875	0.877 (0.2%)
Sacramento River at Isleton	428	Above Normal	0.596	0.598 (0.4%)
Sacramento River at Isleton	428	Below Normal	0.601	0.593 (-1.3%)
Sacramento River at Isleton	428	Dry	0.512	0.515 (0.6%)
Sacramento River at Isleton	428	Critically Dry	0.376	0.373 (-0.6%)
Sacramento River at Rio Vista	430	Wet	0.303	0.303 (0.1%)
Sacramento River at Rio Vista	430	Above Normal	0.191	0.192 (0.3%)
Sacramento River at Rio Vista	430	Below Normal	0.197	0.194 (-1.3%)
Sacramento River at Rio Vista	430	Dry	0.165	0.165 (0.6%)
Sacramento River at Rio Vista	430	Critically Dry	0.120	0.120 (0.2%)
Sacramento River at Chipps Island	437	Wet	0.117	0.117 (-0.1%)
Sacramento River at Chipps Island	437	Above Normal	0.069	0.070 (1.0%)
Sacramento River at Chipps Island	437	Below Normal	0.075	0.075 (-1.1%)
Sacramento River at Chipps Island	437	Dry	0.063	0.063 (0.2%)
Sacramento River at Chipps Island	437	Critically Dry	0.052	0.052 (0.8%)

Table 6B-23. Mean December Velocity for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Location, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on DSM2-HYDRO Modeling.

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River at Vernalis	1	Wet	1.697	1.696 (-0.1%)
San Joaquin River at Vernalis	1	Above Normal	1.389	1.388 (-0.1%)
San Joaquin River at Vernalis	1	Below Normal	1.381	1.381 (0.0%)
San Joaquin River at Vernalis	1	Dry	1.312	1.310 (-0.2%)
San Joaquin River at Vernalis	1	Critically Dry	1.242	1.240 (-0.2%)
San Joaquin River upstream of Head of Old River	4	Wet	1.733	1.731 (-0.1%)
San Joaquin River upstream of Head of Old River	4	Above Normal	1.366	1.365 (-0.1%)
San Joaquin River upstream of Head of Old River	4	Below Normal	1.363	1.363 (0.0%)
San Joaquin River upstream of Head of Old River	4	Dry	1.275	1.269 (-0.4%)
San Joaquin River upstream of Head of Old River	4	Critically Dry	1.146	1.144 (-0.3%)
San Joaquin River at Mossdale	6	Wet	1.521	1.519 (-0.1%)
San Joaquin River at Mossdale	6	Above Normal	1.040	1.039 (-0.1%)
San Joaquin River at Mossdale	6	Below Normal	1.034	1.034 (0.0%)
San Joaquin River at Mossdale	6	Dry	0.936	0.932 (-0.5%)
San Joaquin River at Mossdale	6	Critically Dry	0.821	0.818 (-0.3%)
San Joaquin River near Head of Old River	9	Wet	0.846	0.844 (-0.2%)
San Joaquin River near Head of Old River	9	Above Normal	0.353	0.346 (-2.1%)
San Joaquin River near Head of Old River	9	Below Normal	0.349	0.347 (-0.7%)
San Joaquin River near Head of Old River	9	Dry	0.268	0.270 (0.9%)
San Joaquin River near Head of Old River	9	Critically Dry	0.266	0.264 (-0.7%)
San Joaquin River at Highway 4	14	Wet	0.558	0.557 (-0.1%)
San Joaquin River at Highway 4	14	Above Normal	0.207	0.203 (-1.9%)
San Joaquin River at Highway 4	14	Below Normal	0.204	0.203 (-0.6%)
San Joaquin River at Highway 4	14	Dry	0.160	0.161 (0.8%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River at Highway 4	14	Critically Dry	0.161	0.160 (-0.6%)
San Joaquin River near Mokelumne River	45	Wet	0.058	0.057 (-0.9%)
San Joaquin River near Mokelumne River	45	Above Normal	-0.010	-0.013 (-26.6%)
San Joaquin River near Mokelumne River	45	Below Normal	-0.011	-0.012 (-6.5%)
San Joaquin River near Mokelumne River	45	Dry	-0.016	-0.014 (10.1%)
San Joaquin River near Mokelumne River	45	Critically Dry	0.001	0.001 (6.5%)
San Joaquin River near Jersey Point	49	Wet	0.129	0.128 (-0.4%)
San Joaquin River near Jersey Point	49	Above Normal	0.034	0.031 (-7.8%)
San Joaquin River near Jersey Point	49	Below Normal	0.029	0.028 (-1.6%)
San Joaquin River near Jersey Point	49	Dry	0.024	0.025 (5.9%)
San Joaquin River near Jersey Point	49	Critically Dry	0.037	0.037 (0.9%)
Old River near Head of Old River	55	Wet	1.653	1.652 (-0.1%)
Old River near Head of Old River	55	Above Normal	1.201	1.208 (0.5%)
Old River near Head of Old River	55	Below Normal	1.187	1.189 (0.2%)
Old River near Head of Old River	55	Dry	1.103	1.093 (-0.9%)
Old River near Head of Old River	55	Critically Dry	0.924	0.923 (-0.1%)
Old River upstream of the south Delta export facilities	78	Wet	0.255	0.255 (-0.1%)
Old River upstream of the south Delta export facilities	78	Above Normal	0.156	0.157 (0.9%)
Old River upstream of the south Delta export facilities	78	Below Normal	0.150	0.149 (-0.2%)
Old River upstream of the south Delta export facilities	78	Dry	0.141	0.140 (-0.8%)
Old River upstream of the south Delta export facilities	78	Critically Dry	0.119	0.119 (-0.2%)
Old River downstream of the south Delta export facilities	89	Wet	-0.591	-0.596 (-0.9%)
Old River downstream of the south Delta export facilities	89	Above Normal	-0.673	-0.702 (-4.3%)
Old River downstream of the south Delta export facilities	89	Below Normal	-0.638	-0.648 (-1.6%)
Old River downstream of the south Delta export facilities	89	Dry	-0.642	-0.621 (3.3%)
Old River downstream of the south Delta export facilities	89	Critically Dry	-0.392	-0.394 (-0.6%)
Old River at Highway 4	90	Wet	-0.588	-0.593 (-0.9%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Old River at Highway 4	90	Above Normal	-0.672	-0.702 (-4.4%)
Old River at Highway 4	90	Below Normal	-0.637	-0.647 (-1.6%)
Old River at Highway 4	90	Dry	-0.642	-0.621 (3.3%)
Old River at Highway 4	90	Critically Dry	-0.388	-0.390 (-0.6%)
Old River near Woodward Island	95	Wet	-0.286	-0.289 (-0.9%)
Old River near Woodward Island	95	Above Normal	-0.332	-0.348 (-4.7%)
Old River near Woodward Island	95	Below Normal	-0.315	-0.320 (-1.7%)
Old River near Woodward Island	95	Dry	-0.318	-0.307 (3.5%)
Old River near Woodward Island	95	Critically Dry	-0.184	-0.186 (-0.6%)
Head of Middle River	125	Wet	0.499	0.498 (-0.1%)
Head of Middle River	125	Above Normal	0.301	0.296 (-1.6%)
Head of Middle River	125	Below Normal	0.317	0.315 (-0.5%)
Head of Middle River	125	Dry	0.286	0.289 (0.8%)
Head of Middle River	125	Critically Dry	0.299	0.298 (-0.3%)
Middle River near Victoria Canal	133	Wet	0.193	0.193 (-0.1%)
Middle River near Victoria Canal	133	Above Normal	0.070	0.069 (-1.7%)
Middle River near Victoria Canal	133	Below Normal	0.056	0.056 (-1.0%)
Middle River near Victoria Canal	133	Dry	0.048	0.048 (1.7%)
Middle River near Victoria Canal	133	Critically Dry	0.053	0.052 (-0.5%)
Middle River near Woodward Island	143	Wet	-0.210	-0.212 (-0.8%)
Middle River near Woodward Island	143	Above Normal	-0.241	-0.251 (-4.3%)
Middle River near Woodward Island	143	Below Normal	-0.229	-0.233 (-1.5%)
Middle River near Woodward Island	143	Dry	-0.231	-0.224 (3.1%)
Middle River near Woodward Island	143	Critically Dry	-0.143	-0.144 (-0.6%)
State Water Project	232	Wet	-0.949	-0.956 (-0.8%)
State Water Project	232	Above Normal	-1.062	-1.107 (-4.3%)
State Water Project	232	Below Normal	-1.004	-1.020 (-1.6%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
State Water Project	232	Dry	-1.010	-0.978 (3.2%)
State Water Project	232	Critically Dry	-0.624	-0.627 (-0.5%)
Sevenmile Slough	308	Wet	0.002	0.002 (0.0%)
Sevenmile Slough	308	Above Normal	0.002	0.002 (-1.0%)
Sevenmile Slough	308	Below Normal	0.001	0.001 (0.9%)
Sevenmile Slough	308	Dry	0.000	0.000 (1.1%)
Sevenmile Slough	308	Critically Dry	0.000	0.000 (1.1%)
Georgiana Slough	370	Wet	2.074	2.074 (0.0%)
Georgiana Slough	370	Above Normal	1.320	1.324 (0.3%)
Georgiana Slough	370	Below Normal	1.190	1.199 (0.8%)
Georgiana Slough	370	Dry	1.185	1.175 (-0.8%)
Georgiana Slough	370	Critically Dry	0.995	1.007 (1.2%)
Steamboat Slough	384	Wet	2.337	2.337 (0.0%)
Steamboat Slough	384	Above Normal	1.286	1.289 (0.3%)
Steamboat Slough	384	Below Normal	1.095	1.111 (1.4%)
Steamboat Slough	384	Dry	1.080	1.065 (-1.3%)
Steamboat Slough	384	Critically Dry	0.817	0.834 (2.1%)
Sacramento River at Freeport	414	Wet	2.387	2.386 (0.0%)
Sacramento River at Freeport	414	Above Normal	1.581	1.584 (0.2%)
Sacramento River at Freeport	414	Below Normal	1.388	1.404 (1.1%)
Sacramento River at Freeport	414	Dry	1.380	1.366 (-1.0%)
Sacramento River at Freeport	414	Critically Dry	1.125	1.145 (1.8%)
Sacramento River at Walnut Grove	422	Wet	2.092	2.092 (0.0%)
Sacramento River at Walnut Grove	422	Above Normal	1.210	1.213 (0.2%)
Sacramento River at Walnut Grove	422	Below Normal	1.053	1.065 (1.2%)
Sacramento River at Walnut Grove	422	Dry	1.040	1.028 (-1.1%)
Sacramento River at Walnut Grove	422	Critically Dry	0.822	0.837 (1.8%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Sacramento River at Isleton	428	Wet	1.842	1.842 (0.0%)
Sacramento River at Isleton	428	Above Normal	0.988	0.990 (0.2%)
Sacramento River at Isleton	428	Below Normal	0.848	0.859 (1.3%)
Sacramento River at Isleton	428	Dry	0.837	0.826 (-1.3%)
Sacramento River at Isleton	428	Critically Dry	0.639	0.651 (2.0%)
Sacramento River at Rio Vista	430	Wet	0.776	0.777 (0.0%)
Sacramento River at Rio Vista	430	Above Normal	0.338	0.339 (0.3%)
Sacramento River at Rio Vista	430	Below Normal	0.278	0.281 (1.2%)
Sacramento River at Rio Vista	430	Dry	0.270	0.267 (-1.1%)
Sacramento River at Rio Vista	430	Critically Dry	0.208	0.212 (1.7%)
Sacramento River at Chipps Island	437	Wet	0.323	0.323 (-0.1%)
Sacramento River at Chipps Island	437	Above Normal	0.127	0.125 (-1.1%)
Sacramento River at Chipps Island	437	Below Normal	0.103	0.105 (1.3%)
Sacramento River at Chipps Island	437	Dry	0.096	0.096 (-0.1%)
Sacramento River at Chipps Island	437	Critically Dry	0.082	0.083 (1.6%)

Table 6B-24. Mean January Velocity for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Location, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on DSM2-HYDRO Modeling.

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River at Vernalis	1	Wet	2.006	2.006 (0.0%)
San Joaquin River at Vernalis	1	Above Normal	1.668	1.667 (-0.1%)
San Joaquin River at Vernalis	1	Below Normal	1.502	1.501 (0.0%)
San Joaquin River at Vernalis	1	Dry	1.389	1.387 (-0.1%)
San Joaquin River at Vernalis	1	Critically Dry	1.348	1.346 (-0.1%)
San Joaquin River upstream of Head of Old River	4	Wet	2.081	2.080 (-0.1%)
San Joaquin River upstream of Head of Old River	4	Above Normal	1.696	1.694 (-0.1%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River upstream of Head of Old River	4	Below Normal	1.509	1.507 (-0.1%)
San Joaquin River upstream of Head of Old River	4	Dry	1.380	1.376 (-0.3%)
San Joaquin River upstream of Head of Old River	4	Critically Dry	1.304	1.298 (-0.5%)
San Joaquin River at Mossdale	6	Wet	1.957	1.955 (-0.1%)
San Joaquin River at Mossdale	6	Above Normal	1.441	1.439 (-0.2%)
San Joaquin River at Mossdale	6	Below Normal	1.195	1.193 (-0.2%)
San Joaquin River at Mossdale	6	Dry	1.038	1.034 (-0.4%)
San Joaquin River at Mossdale	6	Critically Dry	0.969	0.964 (-0.5%)
San Joaquin River near Head of Old River	9	Wet	1.314	1.315 (0.1%)
San Joaquin River near Head of Old River	9	Above Normal	0.778	0.779 (0.2%)
San Joaquin River near Head of Old River	9	Below Normal	0.533	0.536 (0.6%)
San Joaquin River near Head of Old River	9	Dry	0.389	0.391 (0.5%)
San Joaquin River near Head of Old River	9	Critically Dry	0.352	0.362 (2.6%)
San Joaquin River at Highway 4	14	Wet	0.900	0.900 (0.0%)
San Joaquin River at Highway 4	14	Above Normal	0.456	0.457 (0.2%)
San Joaquin River at Highway 4	14	Below Normal	0.302	0.304 (0.6%)
San Joaquin River at Highway 4	14	Dry	0.222	0.223 (0.5%)
San Joaquin River at Highway 4	14	Critically Dry	0.205	0.210 (2.4%)
San Joaquin River near Mokelumne River	45	Wet	0.121	0.122 (1.6%)
San Joaquin River near Mokelumne River	45	Above Normal	0.069	0.070 (2.0%)
San Joaquin River near Mokelumne River	45	Below Normal	0.022	0.024 (8.3%)
San Joaquin River near Mokelumne River	45	Dry	0.006	0.008 (25.7%)
San Joaquin River near Mokelumne River	45	Critically Dry	0.002	0.007 (189.4%)
San Joaquin River near Jersey Point	49	Wet	0.228	0.230 (0.8%)
San Joaquin River near Jersey Point	49	Above Normal	0.142	0.144 (1.0%)
San Joaquin River near Jersey Point	49	Below Normal	0.068	0.070 (2.7%)
San Joaquin River near Jersey Point	49	Dry	0.045	0.046 (3.1%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River near Jersey Point	49	Critically Dry	0.039	0.043 (10.9%)
Old River near Head of Old River	55	Wet	2.007	2.002 (-0.2%)
Old River near Head of Old River	55	Above Normal	1.503	1.497 (-0.4%)
Old River near Head of Old River	55	Below Normal	1.272	1.265 (-0.6%)
Old River near Head of Old River	55	Dry	1.135	1.126 (-0.7%)
Old River near Head of Old River	55	Critically Dry	1.069	1.052 (-1.7%)
Old River upstream of the south Delta export facilities	78	Wet	0.368	0.366 (-0.4%)
Old River upstream of the south Delta export facilities	78	Above Normal	0.212	0.211 (-0.5%)
Old River upstream of the south Delta export facilities	78	Below Normal	0.163	0.162 (-0.6%)
Old River upstream of the south Delta export facilities	78	Dry	0.143	0.141 (-1.1%)
Old River upstream of the south Delta export facilities	78	Critically Dry	0.134	0.132 (-1.8%)
Old River downstream of the south Delta export facilities	89	Wet	-0.357	-0.337 (5.6%)
Old River downstream of the south Delta export facilities	89	Above Normal	-0.435	-0.420 (3.5%)
Old River downstream of the south Delta export facilities	89	Below Normal	-0.423	-0.404 (4.5%)
Old River downstream of the south Delta export facilities	89	Dry	-0.426	-0.408 (4.4%)
Old River downstream of the south Delta export facilities	89	Critically Dry	-0.401	-0.356 (11.1%)
Old River at Highway 4	90	Wet	-0.352	-0.332 (5.7%)
Old River at Highway 4	90	Above Normal	-0.429	-0.414 (3.5%)
Old River at Highway 4	90	Below Normal	-0.419	-0.399 (4.6%)
Old River at Highway 4	90	Dry	-0.423	-0.404 (4.5%)
Old River at Highway 4	90	Critically Dry	-0.397	-0.352 (11.4%)
Old River near Woodward Island	95	Wet	-0.159	-0.149 (6.5%)
Old River near Woodward Island	95	Above Normal	-0.203	-0.195 (3.9%)
Old River near Woodward Island	95	Below Normal	-0.200	-0.189 (5.0%)
Old River near Woodward Island	95	Dry	-0.203	-0.193 (5.0%)
Old River near Woodward Island	95	Critically Dry	-0.189	-0.166 (12.5%)
Head of Middle River	125	Wet	0.720	0.721 (0.1%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Head of Middle River	125	Above Normal	0.452	0.453 (0.4%)
Head of Middle River	125	Below Normal	0.384	0.386 (0.6%)
Head of Middle River	125	Dry	0.348	0.351 (0.6%)
Head of Middle River	125	Critically Dry	0.336	0.343 (2.1%)
Middle River near Victoria Canal	133	Wet	0.318	0.318 (0.0%)
Middle River near Victoria Canal	133	Above Normal	0.162	0.162 (0.3%)
Middle River near Victoria Canal	133	Below Normal	0.095	0.096 (0.9%)
Middle River near Victoria Canal	133	Dry	0.070	0.070 (1.0%)
Middle River near Victoria Canal	133	Critically Dry	0.064	0.067 (3.5%)
Middle River near Woodward Island	143	Wet	-0.124	-0.118 (5.6%)
Middle River near Woodward Island	143	Above Normal	-0.158	-0.153 (3.3%)
Middle River near Woodward Island	143	Below Normal	-0.155	-0.148 (4.2%)
Middle River near Woodward Island	143	Dry	-0.157	-0.150 (4.2%)
Middle River near Woodward Island	143	Critically Dry	-0.148	-0.132 (10.5%)
State Water Project	232	Wet	-0.610	-0.579 (5.0%)
State Water Project	232	Above Normal	-0.709	-0.686 (3.3%)
State Water Project	232	Below Normal	-0.678	-0.649 (4.3%)
State Water Project	232	Dry	-0.680	-0.651 (4.3%)
State Water Project	232	Critically Dry	-0.639	-0.571 (10.7%)
Sevenmile Slough	308	Wet	0.002	0.002 (0.6%)
Sevenmile Slough	308	Above Normal	0.001	0.001 (1.5%)
Sevenmile Slough	308	Below Normal	0.000	0.000 (500.2%)
Sevenmile Slough	308	Dry	0.000	0.000 (0.7%)
Sevenmile Slough	308	Critically Dry	0.000	0.000 (5.5%)
Georgiana Slough	370	Wet	2.467	2.467 (0.0%)
Georgiana Slough	370	Above Normal	2.157	2.156 (0.0%)
Georgiana Slough	370	Below Normal	1.436	1.437 (0.1%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Georgiana Slough	370	Dry	1.180	1.172 (-0.6%)
Georgiana Slough	370	Critically Dry	1.051	1.050 (-0.1%)
Steamboat Slough	384	Wet	2.863	2.864 (0.0%)
Steamboat Slough	384	Above Normal	2.469	2.469 (0.0%)
Steamboat Slough	384	Below Normal	1.493	1.496 (0.2%)
Steamboat Slough	384	Dry	1.098	1.088 (-1.0%)
Steamboat Slough	384	Critically Dry	0.921	0.923 (0.2%)
Sacramento River at Freeport	414	Wet	2.763	2.764 (0.0%)
Sacramento River at Freeport	414	Above Normal	2.481	2.481 (0.0%)
Sacramento River at Freeport	414	Below Normal	1.756	1.759 (0.1%)
Sacramento River at Freeport	414	Dry	1.414	1.402 (-0.8%)
Sacramento River at Freeport	414	Critically Dry	1.228	1.230 (0.2%)
Sacramento River at Walnut Grove	422	Wet	2.542	2.542 (0.0%)
Sacramento River at Walnut Grove	422	Above Normal	2.200	2.199 (0.0%)
Sacramento River at Walnut Grove	422	Below Normal	1.377	1.379 (0.2%)
Sacramento River at Walnut Grove	422	Dry	1.053	1.044 (-0.8%)
Sacramento River at Walnut Grove	422	Critically Dry	0.902	0.903 (0.1%)
Sacramento River at Isleton	428	Wet	2.270	2.271 (0.0%)
Sacramento River at Isleton	428	Above Normal	1.947	1.947 (0.0%)
Sacramento River at Isleton	428	Below Normal	1.151	1.154 (0.2%)
Sacramento River at Isleton	428	Dry	0.850	0.842 (-0.9%)
Sacramento River at Isleton	428	Critically Dry	0.712	0.714 (0.3%)
Sacramento River at Rio Vista	430	Wet	1.196	1.196 (0.0%)
Sacramento River at Rio Vista	430	Above Normal	0.809	0.809 (0.0%)
Sacramento River at Rio Vista	430	Below Normal	0.381	0.382 (0.2%)
Sacramento River at Rio Vista	430	Dry	0.265	0.263 (-0.9%)
Sacramento River at Rio Vista	430	Critically Dry	0.227	0.227 (0.2%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Sacramento River at Chipps Island	437	Wet	0.514	0.515 (0.2%)
Sacramento River at Chipps Island	437	Above Normal	0.341	0.342 (0.3%)
Sacramento River at Chipps Island	437	Below Normal	0.158	0.160 (0.9%)
Sacramento River at Chipps Island	437	Dry	0.109	0.110 (0.8%)
Sacramento River at Chipps Island	437	Critically Dry	0.095	0.099 (3.9%)

Table 6B-25. Mean February Velocity for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Location, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on DSM2-HYDRO Modeling.

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River at Vernalis	1	Wet	2.296	2.296 (0.0%)
San Joaquin River at Vernalis	1	Above Normal	1.908	1.908 (0.0%)
San Joaquin River at Vernalis	1	Below Normal	1.739	1.739 (0.0%)
San Joaquin River at Vernalis	1	Dry	1.468	1.466 (-0.1%)
San Joaquin River at Vernalis	1	Critically Dry	1.432	1.431 (-0.1%)
San Joaquin River upstream of Head of Old River	4	Wet	2.448	2.447 (0.0%)
San Joaquin River upstream of Head of Old River	4	Above Normal	1.984	1.983 (0.0%)
San Joaquin River upstream of Head of Old River	4	Below Normal	1.798	1.797 (-0.1%)
San Joaquin River upstream of Head of Old River	4	Dry	1.483	1.478 (-0.4%)
San Joaquin River upstream of Head of Old River	4	Critically Dry	1.426	1.423 (-0.2%)
San Joaquin River at Mossdale	6	Wet	2.423	2.423 (0.0%)
San Joaquin River at Mossdale	6	Above Normal	1.822	1.821 (-0.1%)
San Joaquin River at Mossdale	6	Below Normal	1.577	1.575 (-0.1%)
San Joaquin River at Mossdale	6	Dry	1.150	1.144 (-0.5%)
San Joaquin River at Mossdale	6	Critically Dry	1.093	1.090 (-0.3%)
San Joaquin River near Head of Old River	9	Wet	1.822	1.822 (0.0%)
San Joaquin River near Head of Old River	9	Above Normal	1.180	1.181 (0.1%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River near Head of Old River	9	Below Normal	0.933	0.937 (0.3%)
San Joaquin River near Head of Old River	9	Dry	0.489	0.500 (2.2%)
San Joaquin River near Head of Old River	9	Critically Dry	0.452	0.456 (0.7%)
San Joaquin River at Highway 4	14	Wet	1.309	1.309 (0.0%)
San Joaquin River at Highway 4	14	Above Normal	0.776	0.777 (0.1%)
San Joaquin River at Highway 4	14	Below Normal	0.556	0.558 (0.3%)
San Joaquin River at Highway 4	14	Dry	0.276	0.283 (2.2%)
San Joaquin River at Highway 4	14	Critically Dry	0.260	0.262 (0.8%)
San Joaquin River near Mokelumne River	45	Wet	0.160	0.160 (-0.3%)
San Joaquin River near Mokelumne River	45	Above Normal	0.097	0.100 (3.7%)
San Joaquin River near Mokelumne River	45	Below Normal	0.053	0.056 (4.8%)
San Joaquin River near Mokelumne River	45	Dry	0.025	0.031 (22.7%)
San Joaquin River near Mokelumne River	45	Critically Dry	0.014	0.016 (17.8%)
San Joaquin River near Jersey Point	49	Wet	0.293	0.293 (-0.2%)
San Joaquin River near Jersey Point	49	Above Normal	0.178	0.181 (1.9%)
San Joaquin River near Jersey Point	49	Below Normal	0.108	0.111 (2.1%)
San Joaquin River near Jersey Point	49	Dry	0.071	0.077 (7.7%)
San Joaquin River near Jersey Point	49	Critically Dry	0.053	0.056 (5.0%)
Old River near Head of Old River	55	Wet	2.467	2.466 (0.0%)
Old River near Head of Old River	55	Above Normal	1.876	1.871 (-0.2%)
Old River near Head of Old River	55	Below Normal	1.623	1.615 (-0.5%)
Old River near Head of Old River	55	Dry	1.229	1.207 (-1.7%)
Old River near Head of Old River	55	Critically Dry	1.177	1.168 (-0.7%)
Old River upstream of the south Delta export facilities	78	Wet	0.504	0.504 (0.0%)
Old River upstream of the south Delta export facilities	78	Above Normal	0.319	0.317 (-0.5%)
Old River upstream of the south Delta export facilities	78	Below Normal	0.237	0.235 (-0.7%)
Old River upstream of the south Delta export facilities	78	Dry	0.170	0.167 (-2.1%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Old River upstream of the south Delta export facilities	78	Critically Dry	0.165	0.164 (-0.7%)
Old River downstream of the south Delta export facilities	89	Wet	-0.308	-0.313 (-1.6%)
Old River downstream of the south Delta export facilities	89	Above Normal	-0.390	-0.353 (9.5%)
Old River downstream of the south Delta export facilities	89	Below Normal	-0.433	-0.403 (6.9%)
Old River downstream of the south Delta export facilities	89	Dry	-0.427	-0.366 (14.3%)
Old River downstream of the south Delta export facilities	89	Critically Dry	-0.420	-0.398 (5.4%)
Old River at Highway 4	90	Wet	-0.302	-0.307 (-1.7%)
Old River at Highway 4	90	Above Normal	-0.383	-0.346 (9.7%)
Old River at Highway 4	90	Below Normal	-0.428	-0.397 (7.1%)
Old River at Highway 4	90	Dry	-0.423	-0.361 (14.6%)
Old River at Highway 4	90	Critically Dry	-0.416	-0.393 (5.5%)
Old River near Woodward Island	95	Wet	-0.131	-0.134 (-2.0%)
Old River near Woodward Island	95	Above Normal	-0.175	-0.156 (11.1%)
Old River near Woodward Island	95	Below Normal	-0.201	-0.185 (7.8%)
Old River near Woodward Island	95	Dry	-0.200	-0.168 (16.2%)
Old River near Woodward Island	95	Critically Dry	-0.196	-0.184 (6.1%)
Head of Middle River	125	Wet	0.947	0.947 (0.0%)
Head of Middle River	125	Above Normal	0.608	0.609 (0.2%)
Head of Middle River	125	Below Normal	0.474	0.476 (0.6%)
Head of Middle River	125	Dry	0.285	0.295 (3.3%)
Head of Middle River	125	Critically Dry	0.274	0.277 (1.1%)
Middle River near Victoria Canal	133	Wet	0.481	0.481 (0.0%)
Middle River near Victoria Canal	133	Above Normal	0.299	0.298 (-0.4%)
Middle River near Victoria Canal	133	Below Normal	0.215	0.216 (0.3%)
Middle River near Victoria Canal	133	Dry	0.146	0.148 (1.6%)
Middle River near Victoria Canal	133	Critically Dry	0.138	0.138 (0.7%)
Middle River near Woodward Island	143	Wet	-0.101	-0.102 (-1.6%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Middle River near Woodward Island	143	Above Normal	-0.137	-0.124 (9.6%)
Middle River near Woodward Island	143	Below Normal	-0.154	-0.144 (6.7%)
Middle River near Woodward Island	143	Dry	-0.154	-0.133 (13.9%)
Middle River near Woodward Island	143	Critically Dry	-0.151	-0.143 (5.2%)
State Water Project	232	Wet	-0.550	-0.557 (-1.3%)
State Water Project	232	Above Normal	-0.658	-0.601 (8.6%)
State Water Project	232	Below Normal	-0.712	-0.667 (6.4%)
State Water Project	232	Dry	-0.697	-0.603 (13.5%)
State Water Project	232	Critically Dry	-0.685	-0.651 (5.0%)
Sevenmile Slough	308	Wet	0.000	0.000 (-4.7%)
Sevenmile Slough	308	Above Normal	0.001	0.001 (0.4%)
Sevenmile Slough	308	Below Normal	0.000	0.000 (-1.9%)
Sevenmile Slough	308	Dry	0.000	0.000 (8.2%)
Sevenmile Slough	308	Critically Dry	-0.001	-0.001 (-0.4%)
Georgiana Slough	370	Wet	2.802	2.802 (0.0%)
Georgiana Slough	370	Above Normal	2.283	2.281 (-0.1%)
Georgiana Slough	370	Below Normal	1.699	1.690 (-0.5%)
Georgiana Slough	370	Dry	1.436	1.428 (-0.5%)
Georgiana Slough	370	Critically Dry	1.156	1.165 (0.8%)
Steamboat Slough	384	Wet	3.297	3.297 (0.0%)
Steamboat Slough	384	Above Normal	2.660	2.658 (-0.1%)
Steamboat Slough	384	Below Normal	1.861	1.849 (-0.7%)
Steamboat Slough	384	Dry	1.487	1.481 (-0.4%)
Steamboat Slough	384	Critically Dry	1.085	1.100 (1.3%)
Sacramento River at Freeport	414	Wet	3.064	3.063 (0.0%)
Sacramento River at Freeport	414	Above Normal	2.624	2.623 (0.0%)
Sacramento River at Freeport	414	Below Normal	2.027	2.016 (-0.5%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Sacramento River at Freeport	414	Dry	1.743	1.738 (-0.3%)
Sacramento River at Freeport	414	Critically Dry	1.397	1.414 (1.2%)
Sacramento River at Walnut Grove	422	Wet	2.913	2.913 (0.0%)
Sacramento River at Walnut Grove	422	Above Normal	2.359	2.358 (-0.1%)
Sacramento River at Walnut Grove	422	Below Normal	1.683	1.673 (-0.6%)
Sacramento River at Walnut Grove	422	Dry	1.371	1.366 (-0.4%)
Sacramento River at Walnut Grove	422	Critically Dry	1.037	1.049 (1.2%)
Sacramento River at Isleton	428	Wet	2.635	2.635 (0.0%)
Sacramento River at Isleton	428	Above Normal	2.099	2.098 (-0.1%)
Sacramento River at Isleton	428	Below Normal	1.451	1.442 (-0.6%)
Sacramento River at Isleton	428	Dry	1.152	1.148 (-0.4%)
Sacramento River at Isleton	428	Critically Dry	0.836	0.847 (1.3%)
Sacramento River at Rio Vista	430	Wet	1.482	1.481 (0.0%)
Sacramento River at Rio Vista	430	Above Normal	0.918	0.917 (-0.2%)
Sacramento River at Rio Vista	430	Below Normal	0.536	0.532 (-0.8%)
Sacramento River at Rio Vista	430	Dry	0.385	0.383 (-0.4%)
Sacramento River at Rio Vista	430	Critically Dry	0.269	0.272 (1.2%)
Sacramento River at Chipps Island	437	Wet	0.643	0.643 (-0.1%)
Sacramento River at Chipps Island	437	Above Normal	0.399	0.401 (0.4%)
Sacramento River at Chipps Island	437	Below Normal	0.235	0.236 (0.4%)
Sacramento River at Chipps Island	437	Dry	0.163	0.165 (1.4%)
Sacramento River at Chipps Island	437	Critically Dry	0.114	0.118 (3.1%)

Table 6B-26. Mean March Velocity for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Location, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on DSM2-HYDRO Modeling.

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River at Vernalis	1	Wet	2.296	2.296 (0.0%)
San Joaquin River at Vernalis	1	Above Normal	1.908	1.908 (0.0%)
San Joaquin River at Vernalis	1	Below Normal	1.739	1.739 (0.0%)
San Joaquin River at Vernalis	1	Dry	1.468	1.466 (-0.1%)
San Joaquin River at Vernalis	1	Critically Dry	1.432	1.431 (-0.1%)
San Joaquin River upstream of Head of Old River	4	Wet	2.448	2.447 (0.0%)
San Joaquin River upstream of Head of Old River	4	Above Normal	1.984	1.983 (0.0%)
San Joaquin River upstream of Head of Old River	4	Below Normal	1.798	1.797 (-0.1%)
San Joaquin River upstream of Head of Old River	4	Dry	1.483	1.478 (-0.4%)
San Joaquin River upstream of Head of Old River	4	Critically Dry	1.426	1.423 (-0.2%)
San Joaquin River at Mossdale	6	Wet	2.423	2.423 (0.0%)
San Joaquin River at Mossdale	6	Above Normal	1.822	1.821 (-0.1%)
San Joaquin River at Mossdale	6	Below Normal	1.577	1.575 (-0.1%)
San Joaquin River at Mossdale	6	Dry	1.150	1.144 (-0.5%)
San Joaquin River at Mossdale	6	Critically Dry	1.093	1.090 (-0.3%)
San Joaquin River near Head of Old River	9	Wet	1.822	1.822 (0.0%)
San Joaquin River near Head of Old River	9	Above Normal	1.180	1.181 (0.1%)
San Joaquin River near Head of Old River	9	Below Normal	0.933	0.937 (0.3%)
San Joaquin River near Head of Old River	9	Dry	0.489	0.500 (2.2%)
San Joaquin River near Head of Old River	9	Critically Dry	0.452	0.456 (0.7%)
San Joaquin River at Highway 4	14	Wet	1.309	1.309 (0.0%)
San Joaquin River at Highway 4	14	Above Normal	0.776	0.777 (0.1%)
San Joaquin River at Highway 4	14	Below Normal	0.556	0.558 (0.3%)
San Joaquin River at Highway 4	14	Dry	0.276	0.283 (2.2%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River at Highway 4	14	Critically Dry	0.260	0.262 (0.8%)
San Joaquin River near Mokelumne River	45	Wet	0.160	0.160 (-0.3%)
San Joaquin River near Mokelumne River	45	Above Normal	0.097	0.100 (3.7%)
San Joaquin River near Mokelumne River	45	Below Normal	0.053	0.056 (4.8%)
San Joaquin River near Mokelumne River	45	Dry	0.025	0.031 (22.7%)
San Joaquin River near Mokelumne River	45	Critically Dry	0.014	0.016 (17.8%)
San Joaquin River near Jersey Point	49	Wet	0.293	0.293 (-0.2%)
San Joaquin River near Jersey Point	49	Above Normal	0.178	0.181 (1.9%)
San Joaquin River near Jersey Point	49	Below Normal	0.108	0.111 (2.1%)
San Joaquin River near Jersey Point	49	Dry	0.071	0.077 (7.7%)
San Joaquin River near Jersey Point	49	Critically Dry	0.053	0.056 (5.0%)
Old River near Head of Old River	55	Wet	2.467	2.466 (0.0%)
Old River near Head of Old River	55	Above Normal	1.876	1.871 (-0.2%)
Old River near Head of Old River	55	Below Normal	1.623	1.615 (-0.5%)
Old River near Head of Old River	55	Dry	1.229	1.207 (-1.7%)
Old River near Head of Old River	55	Critically Dry	1.177	1.168 (-0.7%)
Old River upstream of the south Delta export facilities	78	Wet	0.504	0.504 (0.0%)
Old River upstream of the south Delta export facilities	78	Above Normal	0.319	0.317 (-0.5%)
Old River upstream of the south Delta export facilities	78	Below Normal	0.237	0.235 (-0.7%)
Old River upstream of the south Delta export facilities	78	Dry	0.170	0.167 (-2.1%)
Old River upstream of the south Delta export facilities	78	Critically Dry	0.165	0.164 (-0.7%)
Old River downstream of the south Delta export facilities	89	Wet	-0.308	-0.313 (-1.6%)
Old River downstream of the south Delta export facilities	89	Above Normal	-0.390	-0.353 (9.5%)
Old River downstream of the south Delta export facilities	89	Below Normal	-0.433	-0.403 (6.9%)
Old River downstream of the south Delta export facilities	89	Dry	-0.427	-0.366 (14.3%)
Old River downstream of the south Delta export facilities	89	Critically Dry	-0.420	-0.398 (5.4%)
Old River at Highway 4	90	Wet	-0.302	-0.307 (-1.7%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Old River at Highway 4	90	Above Normal	-0.383	-0.346 (9.7%)
Old River at Highway 4	90	Below Normal	-0.428	-0.397 (7.1%)
Old River at Highway 4	90	Dry	-0.423	-0.361 (14.6%)
Old River at Highway 4	90	Critically Dry	-0.416	-0.393 (5.5%)
Old River near Woodward Island	95	Wet	-0.131	-0.134 (-2.0%)
Old River near Woodward Island	95	Above Normal	-0.175	-0.156 (11.1%)
Old River near Woodward Island	95	Below Normal	-0.201	-0.185 (7.8%)
Old River near Woodward Island	95	Dry	-0.200	-0.168 (16.2%)
Old River near Woodward Island	95	Critically Dry	-0.196	-0.184 (6.1%)
Head of Middle River	125	Wet	0.947	0.947 (0.0%)
Head of Middle River	125	Above Normal	0.608	0.609 (0.2%)
Head of Middle River	125	Below Normal	0.474	0.476 (0.6%)
Head of Middle River	125	Dry	0.285	0.295 (3.3%)
Head of Middle River	125	Critically Dry	0.274	0.277 (1.1%)
Middle River near Victoria Canal	133	Wet	0.481	0.481 (0.0%)
Middle River near Victoria Canal	133	Above Normal	0.299	0.298 (-0.4%)
Middle River near Victoria Canal	133	Below Normal	0.215	0.216 (0.3%)
Middle River near Victoria Canal	133	Dry	0.146	0.148 (1.6%)
Middle River near Victoria Canal	133	Critically Dry	0.138	0.138 (0.7%)
Middle River near Woodward Island	143	Wet	-0.101	-0.102 (-1.6%)
Middle River near Woodward Island	143	Above Normal	-0.137	-0.124 (9.6%)
Middle River near Woodward Island	143	Below Normal	-0.154	-0.144 (6.7%)
Middle River near Woodward Island	143	Dry	-0.154	-0.133 (13.9%)
Middle River near Woodward Island	143	Critically Dry	-0.151	-0.143 (5.2%)
State Water Project	232	Wet	-0.550	-0.557 (-1.3%)
State Water Project	232	Above Normal	-0.658	-0.601 (8.6%)
State Water Project	232	Below Normal	-0.712	-0.667 (6.4%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
State Water Project	232	Dry	-0.697	-0.603 (13.5%)
State Water Project	232	Critically Dry	-0.685	-0.651 (5.0%)
Sevenmile Slough	308	Wet	0.000	0.000 (-4.7%)
Sevenmile Slough	308	Above Normal	0.001	0.001 (0.4%)
Sevenmile Slough	308	Below Normal	0.000	0.000 (-1.9%)
Sevenmile Slough	308	Dry	0.000	0.000 (8.2%)
Sevenmile Slough	308	Critically Dry	-0.001	-0.001 (-0.4%)
Georgiana Slough	370	Wet	2.802	2.802 (0.0%)
Georgiana Slough	370	Above Normal	2.283	2.281 (-0.1%)
Georgiana Slough	370	Below Normal	1.699	1.690 (-0.5%)
Georgiana Slough	370	Dry	1.436	1.428 (-0.5%)
Georgiana Slough	370	Critically Dry	1.156	1.165 (0.8%)
Steamboat Slough	384	Wet	3.297	3.297 (0.0%)
Steamboat Slough	384	Above Normal	2.660	2.658 (-0.1%)
Steamboat Slough	384	Below Normal	1.861	1.849 (-0.7%)
Steamboat Slough	384	Dry	1.487	1.481 (-0.4%)
Steamboat Slough	384	Critically Dry	1.085	1.100 (1.3%)
Sacramento River at Freeport	414	Wet	3.064	3.063 (0.0%)
Sacramento River at Freeport	414	Above Normal	2.624	2.623 (0.0%)
Sacramento River at Freeport	414	Below Normal	2.027	2.016 (-0.5%)
Sacramento River at Freeport	414	Dry	1.743	1.738 (-0.3%)
Sacramento River at Freeport	414	Critically Dry	1.397	1.414 (1.2%)
Sacramento River at Walnut Grove	422	Wet	2.913	2.913 (0.0%)
Sacramento River at Walnut Grove	422	Above Normal	2.359	2.358 (-0.1%)
Sacramento River at Walnut Grove	422	Below Normal	1.683	1.673 (-0.6%)
Sacramento River at Walnut Grove	422	Dry	1.371	1.366 (-0.4%)
Sacramento River at Walnut Grove	422	Critically Dry	1.037	1.049 (1.2%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Sacramento River at Isleton	428	Wet	2.635	2.635 (0.0%)
Sacramento River at Isleton	428	Above Normal	2.099	2.098 (-0.1%)
Sacramento River at Isleton	428	Below Normal	1.451	1.442 (-0.6%)
Sacramento River at Isleton	428	Dry	1.152	1.148 (-0.4%)
Sacramento River at Isleton	428	Critically Dry	0.836	0.847 (1.3%)
Sacramento River at Rio Vista	430	Wet	1.482	1.481 (0.0%)
Sacramento River at Rio Vista	430	Above Normal	0.918	0.917 (-0.2%)
Sacramento River at Rio Vista	430	Below Normal	0.536	0.532 (-0.8%)
Sacramento River at Rio Vista	430	Dry	0.385	0.383 (-0.4%)
Sacramento River at Rio Vista	430	Critically Dry	0.269	0.272 (1.2%)
Sacramento River at Chipps Island	437	Wet	0.643	0.643 (-0.1%)
Sacramento River at Chipps Island	437	Above Normal	0.399	0.401 (0.4%)
Sacramento River at Chipps Island	437	Below Normal	0.235	0.236 (0.4%)
Sacramento River at Chipps Island	437	Dry	0.163	0.165 (1.4%)
Sacramento River at Chipps Island	437	Critically Dry	0.114	0.118 (3.1%)

Table 6B-27. Mean April Velocity for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Location, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on DSM2-HYDRO Modeling.

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River at Vernalis	1	Wet	2.459	2.459 (0.0%)
San Joaquin River at Vernalis	1	Above Normal	2.094	2.094 (0.0%)
San Joaquin River at Vernalis	1	Below Normal	1.907	1.906 (0.0%)
San Joaquin River at Vernalis	1	Dry	1.572	1.571 (-0.1%)
San Joaquin River at Vernalis	1	Critically Dry	1.469	1.469 (0.0%)
San Joaquin River upstream of Head of Old River	4	Wet	2.655	2.655 (0.0%)
San Joaquin River upstream of Head of Old River	4	Above Normal	2.223	2.225 (0.1%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River upstream of Head of Old River	4	Below Normal	2.009	2.009 (0.0%)
San Joaquin River upstream of Head of Old River	4	Dry	1.629	1.628 (-0.1%)
San Joaquin River upstream of Head of Old River	4	Critically Dry	1.480	1.480 (0.0%)
San Joaquin River at Mossdale	6	Wet	2.755	2.755 (0.0%)
San Joaquin River at Mossdale	6	Above Normal	2.165	2.168 (0.1%)
San Joaquin River at Mossdale	6	Below Normal	1.855	1.856 (0.0%)
San Joaquin River at Mossdale	6	Dry	1.321	1.319 (-0.1%)
San Joaquin River at Mossdale	6	Critically Dry	1.150	1.150 (0.0%)
San Joaquin River near Head of Old River	9	Wet	2.194	2.192 (-0.1%)
San Joaquin River near Head of Old River	9	Above Normal	1.605	1.602 (-0.2%)
San Joaquin River near Head of Old River	9	Below Normal	1.298	1.294 (-0.3%)
San Joaquin River near Head of Old River	9	Dry	0.738	0.736 (-0.3%)
San Joaquin River near Head of Old River	9	Critically Dry	0.589	0.585 (-0.6%)
San Joaquin River at Highway 4	14	Wet	1.617	1.616 (-0.1%)
San Joaquin River at Highway 4	14	Above Normal	1.014	1.013 (-0.2%)
San Joaquin River at Highway 4	14	Below Normal	0.787	0.784 (-0.4%)
San Joaquin River at Highway 4	14	Dry	0.410	0.408 (-0.3%)
San Joaquin River at Highway 4	14	Critically Dry	0.330	0.328 (-0.6%)
San Joaquin River near Mokelumne River	45	Wet	0.154	0.152 (-1.3%)
San Joaquin River near Mokelumne River	45	Above Normal	0.091	0.086 (-5.9%)
San Joaquin River near Mokelumne River	45	Below Normal	0.083	0.079 (-4.7%)
San Joaquin River near Mokelumne River	45	Dry	0.046	0.046 (-0.3%)
San Joaquin River near Mokelumne River	45	Critically Dry	0.032	0.031 (-3.9%)
San Joaquin River near Jersey Point	49	Wet	0.216	0.214 (-0.9%)
San Joaquin River near Jersey Point	49	Above Normal	0.135	0.130 (-3.8%)
San Joaquin River near Jersey Point	49	Below Normal	0.119	0.115 (-3.0%)
San Joaquin River near Jersey Point	49	Dry	0.078	0.078 (0.1%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River near Jersey Point	49	Critically Dry	0.063	0.061 (-2.0%)
Old River near Head of Old River	55	Wet	2.821	2.824 (0.1%)
Old River near Head of Old River	55	Above Normal	2.149	2.160 (0.5%)
Old River near Head of Old River	55	Below Normal	1.794	1.802 (0.4%)
Old River near Head of Old River	55	Dry	1.258	1.258 (0.0%)
Old River near Head of Old River	55	Critically Dry	1.118	1.123 (0.4%)
Old River upstream of the south Delta export facilities	78	Wet	0.543	0.543 (0.0%)
Old River upstream of the south Delta export facilities	78	Above Normal	0.309	0.310 (0.4%)
Old River upstream of the south Delta export facilities	78	Below Normal	0.239	0.239 (0.2%)
Old River upstream of the south Delta export facilities	78	Dry	0.153	0.153 (0.0%)
Old River upstream of the south Delta export facilities	78	Critically Dry	0.136	0.135 (0.0%)
Old River downstream of the south Delta export facilities	89	Wet	-0.018	-0.039 (-117.7%)
Old River downstream of the south Delta export facilities	89	Above Normal	-0.021	-0.081 (-282.7%)
Old River downstream of the south Delta export facilities	89	Below Normal	0.110	0.065 (-41.1%)
Old River downstream of the south Delta export facilities	89	Dry	-0.011	-0.015 (-38.9%)
Old River downstream of the south Delta export facilities	89	Critically Dry	-0.027	-0.039 (-47.1%)
Old River at Highway 4	90	Wet	-0.011	-0.032 (-191.9%)
Old River at Highway 4	90	Above Normal	-0.014	-0.075 (-415.4%)
Old River at Highway 4	90	Below Normal	0.118	0.073 (-38.5%)
Old River at Highway 4	90	Dry	-0.003	-0.007 (-121.1%)
Old River at Highway 4	90	Critically Dry	-0.020	-0.032 (-64.2%)
Old River near Woodward Island	95	Wet	0.018	0.007 (-62.8%)
Old River near Woodward Island	95	Above Normal	0.013	-0.019 (-246.3%)
Old River near Woodward Island	95	Below Normal	0.082	0.058 (-29.1%)
Old River near Woodward Island	95	Dry	0.017	0.015 (-12.1%)
Old River near Woodward Island	95	Critically Dry	0.008	0.002 (-79.5%)
Head of Middle River	125	Wet	1.134	1.133 (-0.1%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Head of Middle River	125	Above Normal	0.801	0.800 (-0.2%)
Head of Middle River	125	Below Normal	0.683	0.682 (-0.3%)
Head of Middle River	125	Dry	0.474	0.474 (-0.2%)
Head of Middle River	125	Critically Dry	0.433	0.432 (-0.4%)
Middle River near Victoria Canal	133	Wet	0.508	0.508 (-0.2%)
Middle River near Victoria Canal	133	Above Normal	0.269	0.268 (-0.4%)
Middle River near Victoria Canal	133	Below Normal	0.202	0.200 (-0.6%)
Middle River near Victoria Canal	133	Dry	0.113	0.112 (-0.2%)
Middle River near Victoria Canal	133	Critically Dry	0.094	0.094 (-1.0%)
Middle River near Woodward Island	143	Wet	-0.003	-0.010 (-253.2%)
Middle River near Woodward Island	143	Above Normal	-0.013	-0.033 (-163.7%)
Middle River near Woodward Island	143	Below Normal	0.035	0.019 (-46.2%)
Middle River near Woodward Island	143	Dry	-0.010	-0.012 (-15.0%)
Middle River near Woodward Island	143	Critically Dry	-0.016	-0.021 (-27.5%)
State Water Project	232	Wet	-0.100	-0.132 (-32.0%)
State Water Project	232	Above Normal	-0.077	-0.167 (-117.8%)
State Water Project	232	Below Normal	0.135	0.066 (-51.3%)
State Water Project	232	Dry	-0.041	-0.048 (-15.4%)
State Water Project	232	Critically Dry	-0.063	-0.082 (-29.9%)
Sevenmile Slough	308	Wet	-0.002	-0.002 (-0.3%)
Sevenmile Slough	308	Above Normal	-0.001	-0.001 (-3.5%)
Sevenmile Slough	308	Below Normal	0.000	0.000 (-10.5%)
Sevenmile Slough	308	Dry	0.000	0.000 (-9.0%)
Sevenmile Slough	308	Critically Dry	0.000	0.000 (-2.1%)
Georgiana Slough	370	Wet	2.170	2.171 (0.1%)
Georgiana Slough	370	Above Normal	1.587	1.601 (0.8%)
Georgiana Slough	370	Below Normal	1.194	1.215 (1.8%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Georgiana Slough	370	Dry	1.002	1.012 (1.0%)
Georgiana Slough	370	Critically Dry	0.875	0.876 (0.1%)
Steamboat Slough	384	Wet	2.524	2.523 (0.0%)
Steamboat Slough	384	Above Normal	1.776	1.790 (0.8%)
Steamboat Slough	384	Below Normal	1.213	1.240 (2.2%)
Steamboat Slough	384	Dry	0.878	0.893 (1.6%)
Steamboat Slough	384	Critically Dry	0.663	0.662 (-0.1%)
Sacramento River at Freeport	414	Wet	2.504	2.504 (0.0%)
Sacramento River at Freeport	414	Above Normal	1.995	2.006 (0.6%)
Sacramento River at Freeport	414	Below Normal	1.509	1.535 (1.7%)
Sacramento River at Freeport	414	Dry	1.204	1.219 (1.2%)
Sacramento River at Freeport	414	Critically Dry	0.979	0.978 (-0.1%)
Sacramento River at Walnut Grove	422	Wet	2.242	2.242 (0.0%)
Sacramento River at Walnut Grove	422	Above Normal	1.602	1.615 (0.8%)
Sacramento River at Walnut Grove	422	Below Normal	1.136	1.159 (2.0%)
Sacramento River at Walnut Grove	422	Dry	0.869	0.881 (1.4%)
Sacramento River at Walnut Grove	422	Critically Dry	0.696	0.696 (-0.1%)
Sacramento River at Isleton	428	Wet	2.015	2.014 (0.0%)
Sacramento River at Isleton	428	Above Normal	1.379	1.391 (0.8%)
Sacramento River at Isleton	428	Below Normal	0.944	0.964 (2.1%)
Sacramento River at Isleton	428	Dry	0.690	0.701 (1.6%)
Sacramento River at Isleton	428	Critically Dry	0.530	0.529 (-0.1%)
Sacramento River at Rio Vista	430	Wet	0.730	0.730 (-0.1%)
Sacramento River at Rio Vista	430	Above Normal	0.421	0.425 (0.8%)
Sacramento River at Rio Vista	430	Below Normal	0.282	0.287 (2.1%)
Sacramento River at Rio Vista	430	Dry	0.202	0.205 (1.5%)
Sacramento River at Rio Vista	430	Critically Dry	0.153	0.153 (-0.1%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Sacramento River at Chipps Island	437	Wet	0.364	0.363 (-0.4%)
Sacramento River at Chipps Island	437	Above Normal	0.219	0.217 (-1.0%)
Sacramento River at Chipps Island	437	Below Normal	0.166	0.166 (-0.3%)
Sacramento River at Chipps Island	437	Dry	0.117	0.118 (0.8%)
Sacramento River at Chipps Island	437	Critically Dry	0.092	0.091 (-0.9%)

Table 6B-28. Mean May Velocity for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Location, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on DSM2-HYDRO Modeling.

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River at Vernalis	1	Wet	2.274	2.273 (0.0%)
San Joaquin River at Vernalis	1	Above Normal	1.923	1.923 (0.0%)
San Joaquin River at Vernalis	1	Below Normal	1.759	1.758 (0.0%)
San Joaquin River at Vernalis	1	Dry	1.469	1.468 (-0.1%)
San Joaquin River at Vernalis	1	Critically Dry	1.320	1.320 (0.0%)
San Joaquin River upstream of Head of Old River	4	Wet	2.444	2.447 (0.1%)
San Joaquin River upstream of Head of Old River	4	Above Normal	2.035	2.039 (0.2%)
San Joaquin River upstream of Head of Old River	4	Below Normal	1.830	1.833 (0.2%)
San Joaquin River upstream of Head of Old River	4	Dry	1.473	1.474 (0.0%)
San Joaquin River upstream of Head of Old River	4	Critically Dry	1.250	1.251 (0.1%)
San Joaquin River at Mossdale	6	Wet	2.455	2.460 (0.2%)
San Joaquin River at Mossdale	6	Above Normal	1.890	1.896 (0.3%)
San Joaquin River at Mossdale	6	Below Normal	1.610	1.614 (0.3%)
San Joaquin River at Mossdale	6	Dry	1.139	1.139 (0.0%)
San Joaquin River at Mossdale	6	Critically Dry	0.911	0.912 (0.1%)
San Joaquin River near Head of Old River	9	Wet	1.881	1.870 (-0.6%)
San Joaquin River near Head of Old River	9	Above Normal	1.305	1.290 (-1.1%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River near Head of Old River	9	Below Normal	1.051	1.038 (-1.3%)
San Joaquin River near Head of Old River	9	Dry	0.585	0.577 (-1.4%)
San Joaquin River near Head of Old River	9	Critically Dry	0.419	0.413 (-1.6%)
San Joaquin River at Highway 4	14	Wet	1.328	1.320 (-0.6%)
San Joaquin River at Highway 4	14	Above Normal	0.772	0.762 (-1.3%)
San Joaquin River at Highway 4	14	Below Normal	0.620	0.611 (-1.5%)
San Joaquin River at Highway 4	14	Dry	0.326	0.321 (-1.5%)
San Joaquin River at Highway 4	14	Critically Dry	0.239	0.236 (-1.6%)
San Joaquin River near Mokelumne River	45	Wet	0.116	0.103 (-11.4%)
San Joaquin River near Mokelumne River	45	Above Normal	0.057	0.047 (-18.5%)
San Joaquin River near Mokelumne River	45	Below Normal	0.060	0.051 (-15.7%)
San Joaquin River near Mokelumne River	45	Dry	0.035	0.032 (-7.2%)
San Joaquin River near Mokelumne River	45	Critically Dry	0.024	0.021 (-9.6%)
San Joaquin River near Jersey Point	49	Wet	0.166	0.153 (-7.9%)
San Joaquin River near Jersey Point	49	Above Normal	0.099	0.088 (-10.4%)
San Joaquin River near Jersey Point	49	Below Normal	0.096	0.087 (-9.9%)
San Joaquin River near Jersey Point	49	Dry	0.067	0.065 (-3.4%)
San Joaquin River near Jersey Point	49	Critically Dry	0.053	0.051 (-4.2%)
Old River near Head of Old River	55	Wet	2.481	2.505 (1.0%)
Old River near Head of Old River	55	Above Normal	1.844	1.874 (1.6%)
Old River near Head of Old River	55	Below Normal	1.541	1.566 (1.6%)
Old River near Head of Old River	55	Dry	1.096	1.105 (0.8%)
Old River near Head of Old River	55	Critically Dry	0.898	0.906 (0.9%)
Old River upstream of the south Delta export facilities	78	Wet	0.384	0.386 (0.5%)
Old River upstream of the south Delta export facilities	78	Above Normal	0.172	0.173 (0.8%)
Old River upstream of the south Delta export facilities	78	Below Normal	0.137	0.137 (0.1%)
Old River upstream of the south Delta export facilities	78	Dry	0.085	0.085 (0.4%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Old River upstream of the south Delta export facilities	78	Critically Dry	0.069	0.069 (0.5%)
Old River downstream of the south Delta export facilities	89	Wet	-0.120	-0.260 (-116.4%)
Old River downstream of the south Delta export facilities	89	Above Normal	-0.171	-0.285 (-67.0%)
Old River downstream of the south Delta export facilities	89	Below Normal	0.035	-0.062 (-278.2%)
Old River downstream of the south Delta export facilities	89	Dry	-0.012	-0.040 (-244.9%)
Old River downstream of the south Delta export facilities	89	Critically Dry	-0.033	-0.056 (-71.1%)
Old River at Highway 4	90	Wet	-0.115	-0.256 (-123.3%)
Old River at Highway 4	90	Above Normal	-0.165	-0.280 (-69.7%)
Old River at Highway 4	90	Below Normal	0.042	-0.055 (-230.1%)
Old River at Highway 4	90	Dry	-0.005	-0.033 (-623.5%)
Old River at Highway 4	90	Critically Dry	-0.026	-0.050 (-90.4%)
Old River near Woodward Island	95	Wet	-0.040	-0.113 (-185.4%)
Old River near Woodward Island	95	Above Normal	-0.069	-0.129 (-88.2%)
Old River near Woodward Island	95	Below Normal	0.040	-0.011 (-126.9%)
Old River near Woodward Island	95	Dry	0.015	0.000 (-101.9%)
Old River near Woodward Island	95	Critically Dry	0.004	-0.009 (-339.2%)
Head of Middle River	125	Wet	0.994	0.987 (-0.7%)
Head of Middle River	125	Above Normal	0.698	0.690 (-1.3%)
Head of Middle River	125	Below Normal	0.620	0.613 (-1.1%)
Head of Middle River	125	Dry	0.466	0.463 (-0.7%)
Head of Middle River	125	Critically Dry	0.399	0.396 (-0.7%)
Middle River near Victoria Canal	133	Wet	0.360	0.357 (-1.0%)
Middle River near Victoria Canal	133	Above Normal	0.145	0.139 (-3.9%)
Middle River near Victoria Canal	133	Below Normal	0.121	0.117 (-3.7%)
Middle River near Victoria Canal	133	Dry	0.058	0.057 (-3.1%)
Middle River near Victoria Canal	133	Critically Dry	0.044	0.043 (-3.3%)
Middle River near Woodward Island	143	Wet	-0.046	-0.094 (-103.9%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Middle River near Woodward Island	143	Above Normal	-0.071	-0.110 (-56.3%)
Middle River near Woodward Island	143	Below Normal	0.005	-0.029 (-660.9%)
Middle River near Woodward Island	143	Dry	-0.013	-0.023 (-78.5%)
Middle River near Woodward Island	143	Critically Dry	-0.020	-0.029 (-40.6%)
State Water Project	232	Wet	-0.238	-0.450 (-89.3%)
State Water Project	232	Above Normal	-0.291	-0.465 (-59.7%)
State Water Project	232	Below Normal	0.030	-0.117 (-494.3%)
State Water Project	232	Dry	-0.034	-0.078 (-125.8%)
State Water Project	232	Critically Dry	-0.067	-0.102 (-53.3%)
Sevenmile Slough	308	Wet	0.000	0.000 (-14.8%)
Sevenmile Slough	308	Above Normal	0.001	0.001 (-4.1%)
Sevenmile Slough	308	Below Normal	0.001	0.001 (-6.4%)
Sevenmile Slough	308	Dry	0.001	0.001 (-1.0%)
Sevenmile Slough	308	Critically Dry	0.001	0.001 (-0.2%)
Georgiana Slough	370	Wet	1.932	1.939 (0.3%)
Georgiana Slough	370	Above Normal	1.462	1.477 (1.0%)
Georgiana Slough	370	Below Normal	1.176	1.179 (0.2%)
Georgiana Slough	370	Dry	0.969	0.982 (1.4%)
Georgiana Slough	370	Critically Dry	0.801	0.806 (0.6%)
Steamboat Slough	384	Wet	2.221	2.221 (0.0%)
Steamboat Slough	384	Above Normal	1.568	1.581 (0.8%)
Steamboat Slough	384	Below Normal	1.156	1.149 (-0.6%)
Steamboat Slough	384	Dry	0.812	0.829 (2.1%)
Steamboat Slough	384	Critically Dry	0.570	0.573 (0.5%)
Sacramento River at Freeport	414	Wet	2.310	2.310 (0.0%)
Sacramento River at Freeport	414	Above Normal	1.825	1.837 (0.7%)
Sacramento River at Freeport	414	Below Normal	1.468	1.461 (-0.5%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Sacramento River at Freeport	414	Dry	1.150	1.169 (1.7%)
Sacramento River at Freeport	414	Critically Dry	0.861	0.866 (0.5%)
Sacramento River at Walnut Grove	422	Wet	1.983	1.984 (0.0%)
Sacramento River at Walnut Grove	422	Above Normal	1.432	1.444 (0.8%)
Sacramento River at Walnut Grove	422	Below Normal	1.093	1.089 (-0.4%)
Sacramento River at Walnut Grove	422	Dry	0.817	0.831 (1.8%)
Sacramento River at Walnut Grove	422	Critically Dry	0.610	0.614 (0.5%)
Sacramento River at Isleton	428	Wet	1.749	1.749 (0.0%)
Sacramento River at Isleton	428	Above Normal	1.213	1.223 (0.8%)
Sacramento River at Isleton	428	Below Normal	0.896	0.891 (-0.6%)
Sacramento River at Isleton	428	Dry	0.636	0.649 (1.9%)
Sacramento River at Isleton	428	Critically Dry	0.454	0.456 (0.5%)
Sacramento River at Rio Vista	430	Wet	0.544	0.544 (0.0%)
Sacramento River at Rio Vista	430	Above Normal	0.361	0.364 (0.8%)
Sacramento River at Rio Vista	430	Below Normal	0.265	0.264 (-0.5%)
Sacramento River at Rio Vista	430	Dry	0.183	0.187 (2.0%)
Sacramento River at Rio Vista	430	Critically Dry	0.131	0.132 (0.5%)
Sacramento River at Chipps Island	437	Wet	0.275	0.267 (-3.0%)
Sacramento River at Chipps Island	437	Above Normal	0.178	0.172 (-3.1%)
Sacramento River at Chipps Island	437	Below Normal	0.148	0.141 (-4.3%)
Sacramento River at Chipps Island	437	Dry	0.104	0.104 (-0.3%)
Sacramento River at Chipps Island	437	Critically Dry	0.080	0.079 (-1.5%)

Table 6B-29. Mean June Velocity for Baseline Conditions and Proposed Project Scenarios Grouped by Water Year Type and Location, and Differences between the Scenarios (Proposed Project minus Baseline Conditions) Expressed as a Percentage Difference (parentheses), Based on DSM2-HYDRO Modeling.

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River at Vernalis	1	Wet	2.170	2.170 (0.0%)
San Joaquin River at Vernalis	1	Above Normal	1.713	1.712 (0.0%)
San Joaquin River at Vernalis	1	Below Normal	1.497	1.496 (-0.1%)
San Joaquin River at Vernalis	1	Dry	1.273	1.271 (-0.2%)
San Joaquin River at Vernalis	1	Critically Dry	1.163	1.162 (-0.1%)
San Joaquin River upstream of Head of Old River	4	Wet	2.293	2.292 (-0.1%)
San Joaquin River upstream of Head of Old River	4	Above Normal	1.737	1.734 (-0.1%)
San Joaquin River upstream of Head of Old River	4	Below Normal	1.457	1.453 (-0.3%)
San Joaquin River upstream of Head of Old River	4	Dry	1.139	1.133 (-0.5%)
San Joaquin River upstream of Head of Old River	4	Critically Dry	0.953	0.950 (-0.4%)
San Joaquin River at Mossdale	6	Wet	2.240	2.238 (-0.1%)
San Joaquin River at Mossdale	6	Above Normal	1.492	1.489 (-0.2%)
San Joaquin River at Mossdale	6	Below Normal	1.144	1.141 (-0.3%)
San Joaquin River at Mossdale	6	Dry	0.793	0.789 (-0.6%)
San Joaquin River at Mossdale	6	Critically Dry	0.636	0.633 (-0.4%)
San Joaquin River near Head of Old River	9	Wet	1.780	1.781 (0.1%)
San Joaquin River near Head of Old River	9	Above Normal	1.086	1.090 (0.3%)
San Joaquin River near Head of Old River	9	Below Normal	0.772	0.776 (0.6%)
San Joaquin River near Head of Old River	9	Dry	0.488	0.496 (1.7%)
San Joaquin River near Head of Old River	9	Critically Dry	0.440	0.443 (0.6%)
San Joaquin River at Highway 4	14	Wet	1.274	1.274 (0.0%)
San Joaquin River at Highway 4	14	Above Normal	0.649	0.651 (0.3%)
San Joaquin River at Highway 4	14	Below Normal	0.446	0.448 (0.6%)
San Joaquin River at Highway 4	14	Dry	0.271	0.275 (1.7%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
San Joaquin River at Highway 4	14	Critically Dry	0.247	0.248 (0.6%)
San Joaquin River near Mokelumne River	45	Wet	0.082	0.084 (2.8%)
San Joaquin River near Mokelumne River	45	Above Normal	0.034	0.038 (11.9%)
San Joaquin River near Mokelumne River	45	Below Normal	0.024	0.027 (13.6%)
San Joaquin River near Mokelumne River	45	Dry	0.015	0.018 (19.0%)
San Joaquin River near Mokelumne River	45	Critically Dry	0.024	0.025 (4.1%)
San Joaquin River near Jersey Point	49	Wet	0.121	0.123 (1.9%)
San Joaquin River near Jersey Point	49	Above Normal	0.068	0.072 (5.7%)
San Joaquin River near Jersey Point	49	Below Normal	0.052	0.055 (5.8%)
San Joaquin River near Jersey Point	49	Dry	0.044	0.047 (5.6%)
San Joaquin River near Jersey Point	49	Critically Dry	0.051	0.052 (1.7%)
Old River near Head of Old River	55	Wet	2.130	2.126 (-0.2%)
Old River near Head of Old River	55	Above Normal	1.277	1.268 (-0.6%)
Old River near Head of Old River	55	Below Normal	0.942	0.932 (-1.1%)
Old River near Head of Old River	55	Dry	0.622	0.606 (-2.6%)
Old River near Head of Old River	55	Critically Dry	0.434	0.428 (-1.5%)
Old River upstream of the south Delta export facilities	78	Wet	0.320	0.319 (-0.1%)
Old River upstream of the south Delta export facilities	78	Above Normal	0.071	0.071 (-0.3%)
Old River upstream of the south Delta export facilities	78	Below Normal	0.017	0.016 (-7.7%)
Old River upstream of the south Delta export facilities	78	Dry	-0.025	-0.028 (-9.0%)
Old River upstream of the south Delta export facilities	78	Critically Dry	-0.049	-0.050 (-2.3%)
Old River downstream of the south Delta export facilities	89	Wet	-0.363	-0.338 (6.9%)
Old River downstream of the south Delta export facilities	89	Above Normal	-0.448	-0.399 (11.0%)
Old River downstream of the south Delta export facilities	89	Below Normal	-0.451	-0.409 (9.3%)
Old River downstream of the south Delta export facilities	89	Dry	-0.434	-0.380 (12.5%)
Old River downstream of the south Delta export facilities	89	Critically Dry	-0.195	-0.177 (9.6%)
Old River at Highway 4	90	Wet	-0.359	-0.334 (7.1%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Old River at Highway 4	90	Above Normal	-0.446	-0.396 (11.2%)
Old River at Highway 4	90	Below Normal	-0.449	-0.407 (9.4%)
Old River at Highway 4	90	Dry	-0.432	-0.378 (12.6%)
Old River at Highway 4	90	Critically Dry	-0.192	-0.173 (9.8%)
Old River near Woodward Island	95	Wet	-0.169	-0.155 (7.8%)
Old River near Woodward Island	95	Above Normal	-0.217	-0.192 (11.9%)
Old River near Woodward Island	95	Below Normal	-0.220	-0.198 (10.0%)
Old River near Woodward Island	95	Dry	-0.211	-0.183 (13.5%)
Old River near Woodward Island	95	Critically Dry	-0.086	-0.076 (11.5%)
Head of Middle River	125	Wet	1.041	1.040 (0.0%)
Head of Middle River	125	Above Normal	0.728	0.728 (0.0%)
Head of Middle River	125	Below Normal	0.605	0.606 (0.2%)
Head of Middle River	125	Dry	0.485	0.487 (0.5%)
Head of Middle River	125	Critically Dry	0.446	0.446 (0.1%)
Middle River near Victoria Canal	133	Wet	0.342	0.342 (0.0%)
Middle River near Victoria Canal	133	Above Normal	0.111	0.111 (0.4%)
Middle River near Victoria Canal	133	Below Normal	0.057	0.058 (1.4%)
Middle River near Victoria Canal	133	Dry	0.012	0.013 (12.4%)
Middle River near Victoria Canal	133	Critically Dry	0.008	0.008 (4.7%)
Middle River near Woodward Island	143	Wet	-0.131	-0.122 (6.5%)
Middle River near Woodward Island	143	Above Normal	-0.169	-0.152 (9.9%)
Middle River near Woodward Island	143	Below Normal	-0.172	-0.158 (8.4%)
Middle River near Woodward Island	143	Dry	-0.168	-0.149 (11.3%)
Middle River near Woodward Island	143	Critically Dry	-0.083	-0.076 (8.1%)
State Water Project	232	Wet	-0.601	-0.562 (6.4%)
State Water Project	232	Above Normal	-0.708	-0.633 (10.6%)
State Water Project	232	Below Normal	-0.707	-0.643 (9.1%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
State Water Project	232	Dry	-0.677	-0.595 (12.2%)
State Water Project	232	Critically Dry	-0.310	-0.282 (9.2%)
Sevenmile Slough	308	Wet	0.000	0.000 (37.4%)
Sevenmile Slough	308	Above Normal	0.001	0.001 (4.3%)
Sevenmile Slough	308	Below Normal	0.001	0.001 (4.8%)
Sevenmile Slough	308	Dry	0.000	0.000 (-3.4%)
Sevenmile Slough	308	Critically Dry	0.001	0.001 (1.6%)
Georgiana Slough	370	Wet	1.403	1.403 (0.0%)
Georgiana Slough	370	Above Normal	1.106	1.098 (-0.7%)
Georgiana Slough	370	Below Normal	0.846	0.837 (-1.1%)
Georgiana Slough	370	Dry	0.816	0.789 (-3.3%)
Georgiana Slough	370	Critically Dry	0.659	0.648 (-1.7%)
Steamboat Slough	384	Wet	1.599	1.602 (0.2%)
Steamboat Slough	384	Above Normal	1.144	1.136 (-0.8%)
Steamboat Slough	384	Below Normal	0.795	0.784 (-1.4%)
Steamboat Slough	384	Dry	0.731	0.692 (-5.3%)
Steamboat Slough	384	Critically Dry	0.536	0.525 (-2.0%)
Sacramento River at Freeport	414	Wet	1.912	1.914 (0.1%)
Sacramento River at Freeport	414	Above Normal	1.569	1.559 (-0.6%)
Sacramento River at Freeport	414	Below Normal	1.293	1.279 (-1.1%)
Sacramento River at Freeport	414	Dry	1.238	1.189 (-4.0%)
Sacramento River at Freeport	414	Critically Dry	0.961	0.943 (-1.8%)
Sacramento River at Walnut Grove	422	Wet	1.366	1.368 (0.1%)
Sacramento River at Walnut Grove	422	Above Normal	0.995	0.990 (-0.6%)
Sacramento River at Walnut Grove	422	Below Normal	0.676	0.668 (-1.1%)
Sacramento River at Walnut Grove	422	Dry	0.631	0.606 (-4.0%)
Sacramento River at Walnut Grove	422	Critically Dry	0.487	0.478 (-1.8%)

Location	DSM2 Channel	Water Year Type	Baseline Conditions	Proposed Project
Sacramento River at Isleton	428	Wet	1.160	1.161 (0.1%)
Sacramento River at Isleton	428	Above Normal	0.804	0.800 (-0.5%)
Sacramento River at Isleton	428	Below Normal	0.510	0.505 (-1.1%)
Sacramento River at Isleton	428	Dry	0.470	0.450 (-4.3%)
Sacramento River at Isleton	428	Critically Dry	0.358	0.352 (-1.8%)
Sacramento River at Rio Vista	430	Wet	0.362	0.362 (0.1%)
Sacramento River at Rio Vista	430	Above Normal	0.246	0.244 (-0.6%)
Sacramento River at Rio Vista	430	Below Normal	0.162	0.160 (-1.2%)
Sacramento River at Rio Vista	430	Dry	0.150	0.143 (-4.7%)
Sacramento River at Rio Vista	430	Critically Dry	0.114	0.111 (-1.8%)
Sacramento River at Chipps Island	437	Wet	0.193	0.194 (0.8%)
Sacramento River at Chipps Island	437	Above Normal	0.125	0.127 (1.6%)
Sacramento River at Chipps Island	437	Below Normal	0.090	0.091 (1.4%)
Sacramento River at Chipps Island	437	Dry	0.081	0.081 (-0.7%)
Sacramento River at Chipps Island	437	Critically Dry	0.075	0.075 (-0.1%)

6B.3.2 Flow into Junctions

6B.3.2.1 Methods

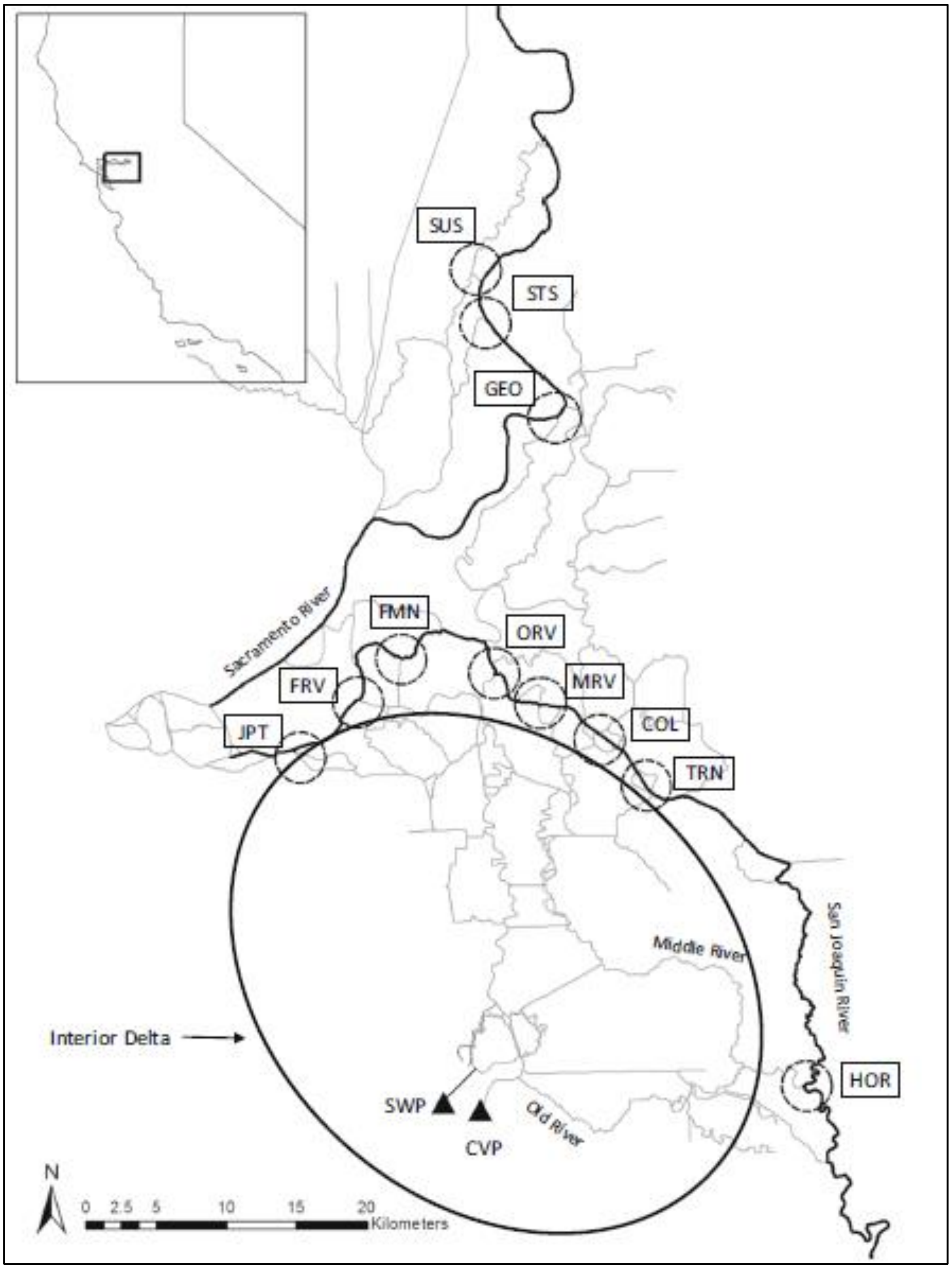
Many routes can potentially be used by fish migrating through the Delta and survival through these routes can be significantly different (Perry et al. 2010). Thus, routing of fish at junctions and how routing could be affected by project operations has the potential to influence through-Delta survival. In general, routes that keep fish in the mainstem Sacramento and San Joaquin rivers are superior to routes leading into the interior Delta (Hankin et al. 2010; Perry et al. 2010), although some recent findings for the San Joaquin River have not supported this generality (Buchanan et al. 2013). Perry (2010) found that the routing of fish into the interior delta through the combined junction of Georgiana Slough and the Delta Cross Channel (DCC) was a function of the total flow entering the interior delta through both of those junctions. This is the function represented in Figure 6.7 within Perry (2010). This function indicated that the slope of the relationship was less than 1.

Cavallo et al. (2015) performed a meta-analysis of routing at six Delta junctions and found that the proportion of flow entering a junction explained 70 percent of the variation in routing. Similar to the Perry (2010) study, the slope of this relationship was less than 1, suggesting fish move into junctions at a rate less than the proportion of flow. Both of these studies present strong evidence that routing at junctions is a function of the proportion of flow into that junction.

For the present analysis, flow routing into junctions was based on the proportion of flow entering a junction away from the mainstem, from DSM2-HYDRO outputs. Fifteen-minute data were used to calculate the daily proportion of flow that enters the junction, following the methods of Cavallo et al. (2015). The daily value calculated from the 15-minute data was used to calculate summary statistics (box plots) for each month (December–June) and water year-type by modeled scenario.

Flow into a number of junctions of interest with respect to movement in the north Delta and toward the south Delta was analyzed: Sutter Slough, Steamboat Slough, DCC, Georgiana Slough, the head of Old River, Turner Cut, Columbia Cut, the mouth of Middle River, the mouth of Old River, Fisherman's Cut, False River, and Jersey Point (Figure 6B-272).

The combined evidence from the literature strongly indicates routing is a function of flow. Thus, it can be assumed routing of fish into a junction will increase as the proportion of flow entering the junction increases. However, the slope of the relationship will be less than 1 based on the available studies (Perry 2010; Cavallo et al. 2015).

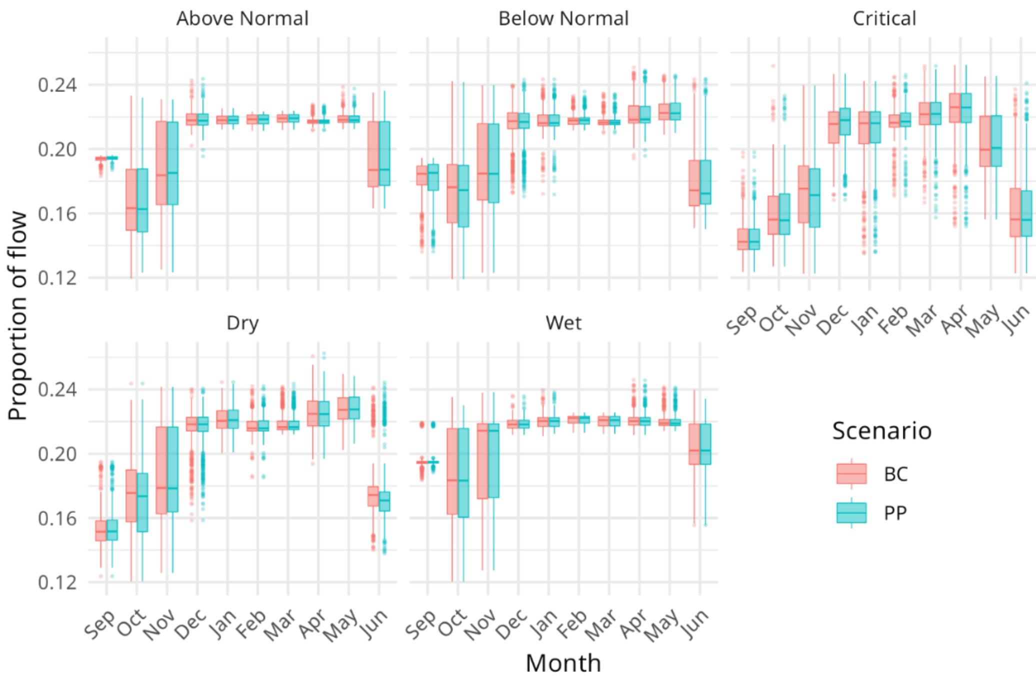


Source: Cavallo et al. 2015. Note: Junction abbreviations include Sutter Slough (SUS), Steamboat Slough (STS), Georgiana Slough (GEO), the head of Old River (HOR), Turner Cut (TRN), Columbia Cut (COL), the mouth of Middle River (MRV), the mouth of Old River (ORV), Fisherman's Cut (FMN), False River (FRV), and Jersey Point (JPT). Also analyzed but not shown on the map was the Delta Cross Channel, immediately adjacent to GEO.

Figure 6B-272. Map of Junctions Analyzed for Flow Entry Based on DSM2-HYDRO Outputs

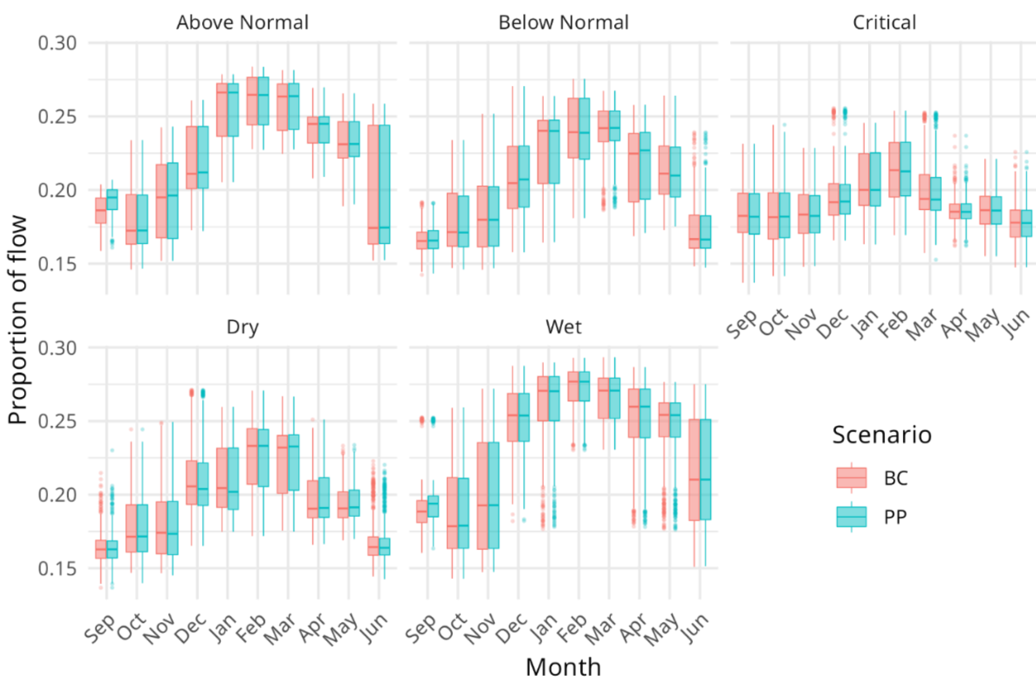
6B.3.2.2 Results

Tabulated results of the analysis are presented and discussed in Chapter 6. Additional plots of results are presented in Figure 6B-273 through Figure 6B-284.



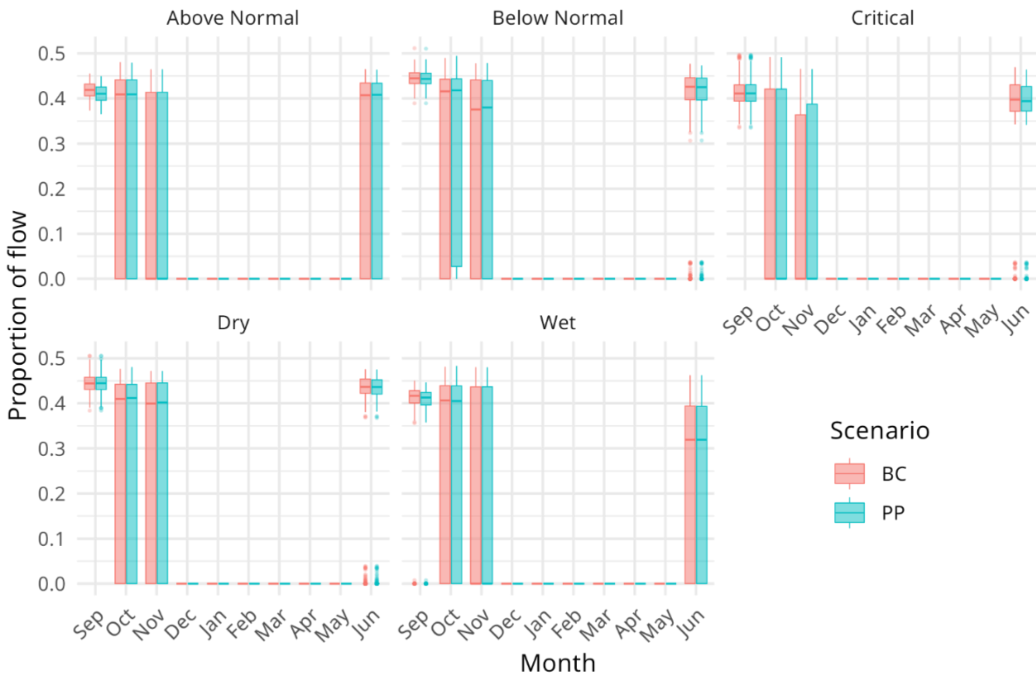
Note: Boxes represent median (horizontal line) and 25th/75th percentiles; whiskers represent 5th/95th percentiles; points represent additional observations outside this range. BC = Baseline Conditions; PP = Proposed Project.

Figure 6B-273. Proportion of Flow Entering Sutter Slough from DSM2-HYDRO Modeling Data



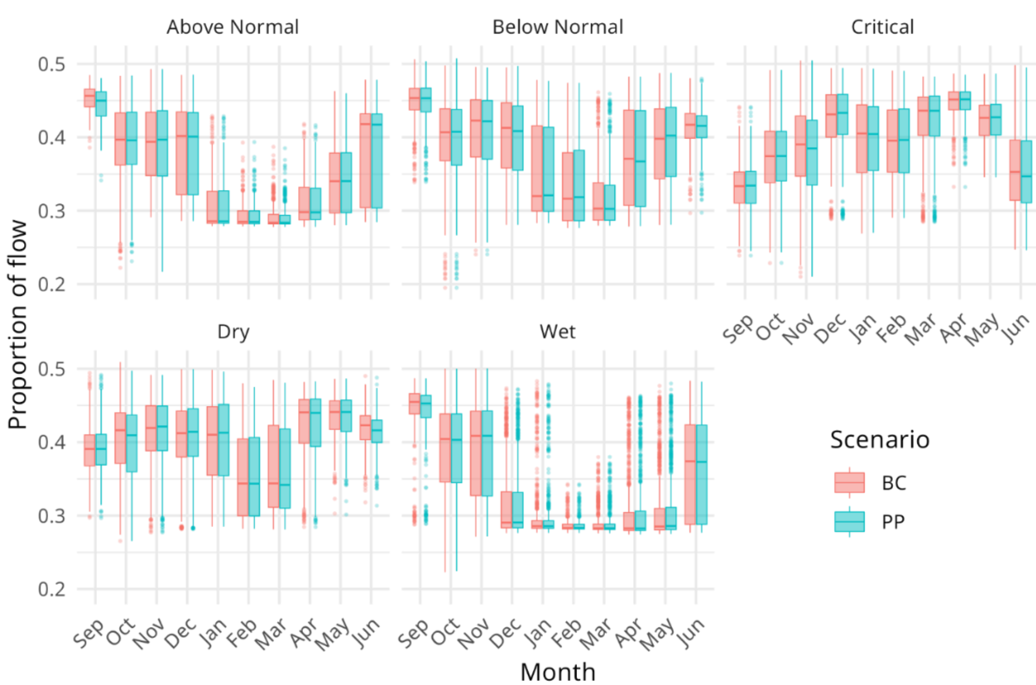
Note: Boxes represent median (horizontal line) and 25th/75th percentiles; whiskers represent 5th/95th percentiles; points represent additional observations outside this range. BC = Baseline Conditions; PP = Proposed Project.

Figure 6B-274. Proportion of Flow Entering Steamboat Slough from DSM2-HYDRO Modeling Data



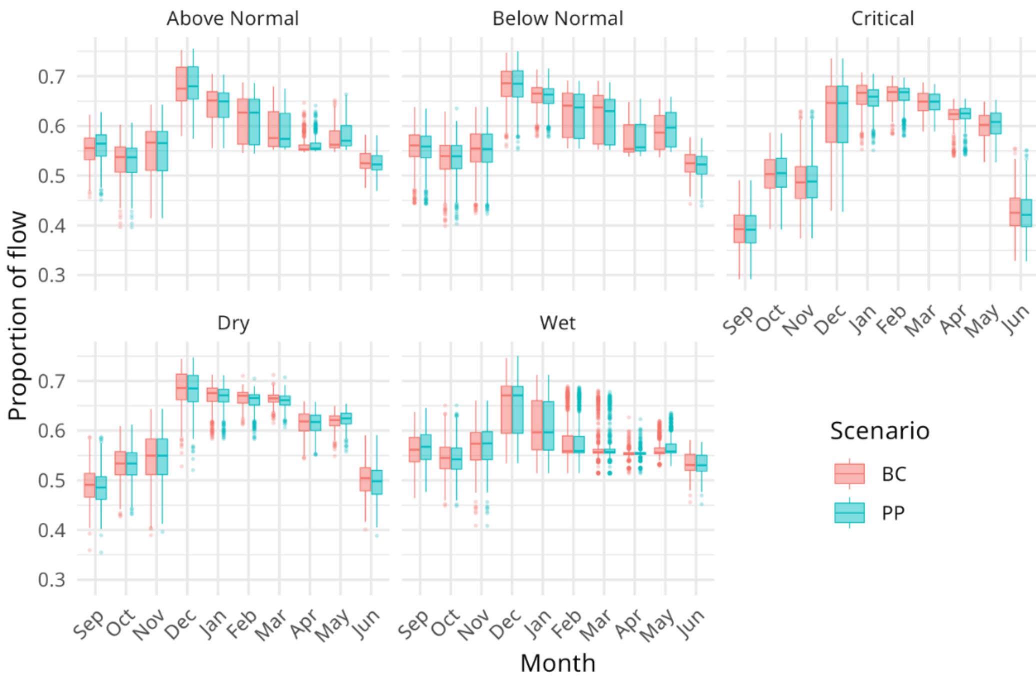
Note: Boxes represent median (horizontal line) and 25th/75th percentiles; whiskers represent 5th/95th percentiles; points represent additional observations outside this range. BC = Baseline Conditions; PP = Proposed Project.

Figure 6B-275. Proportion of Flow Entering the Delta Cross Channel from DSM2-HYDRO Modeling Data



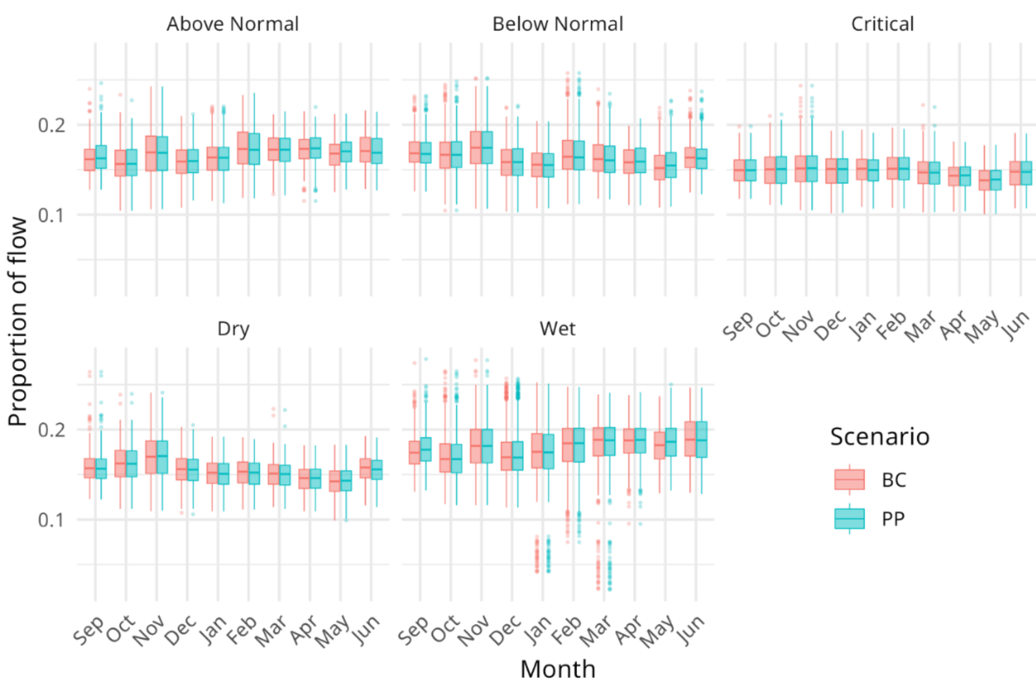
Note: Boxes represent median (horizontal line) and 25th/75th percentiles; whiskers represent 5th/95th percentiles; points represent additional observations outside this range. BC = Baseline Conditions; PP = Proposed Project.

Figure 6B-276. Proportion of Flow Entering Georgiana Slough from DSM2-HYDRO Modeling Data



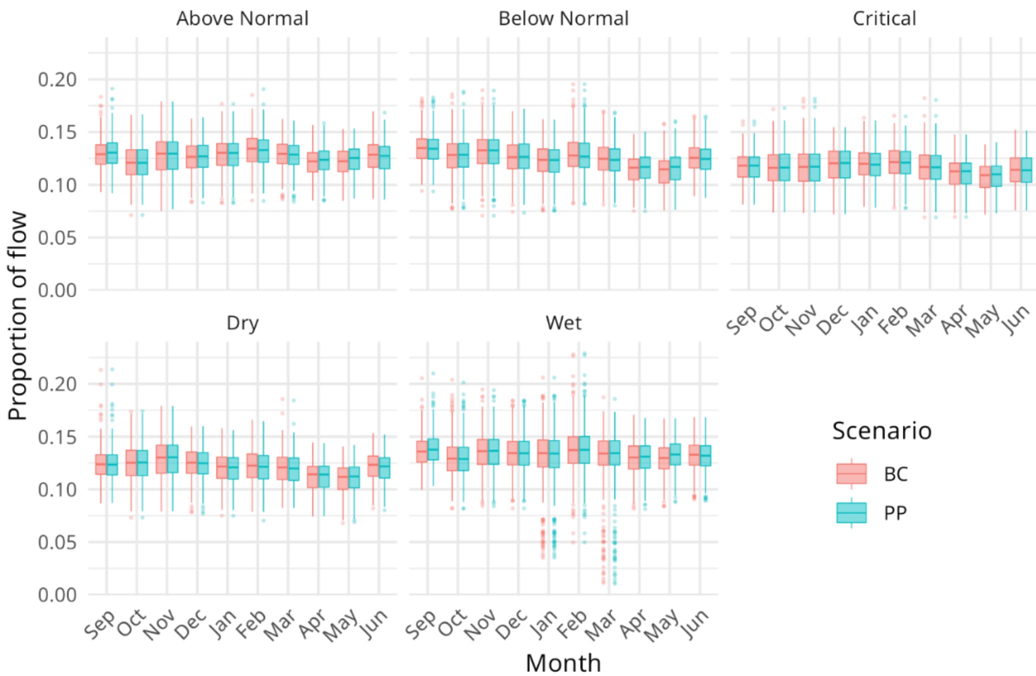
Note: Boxes represent median (horizontal line) and 25th/75th percentiles; whiskers represent 5th/95th percentiles; points represent additional observations outside this range. BC = Baseline Conditions; PP = Proposed Project.

Figure 6B-277. Proportion of Flow Entering Head of Old River from DSM2-HYDRO Modeling Data



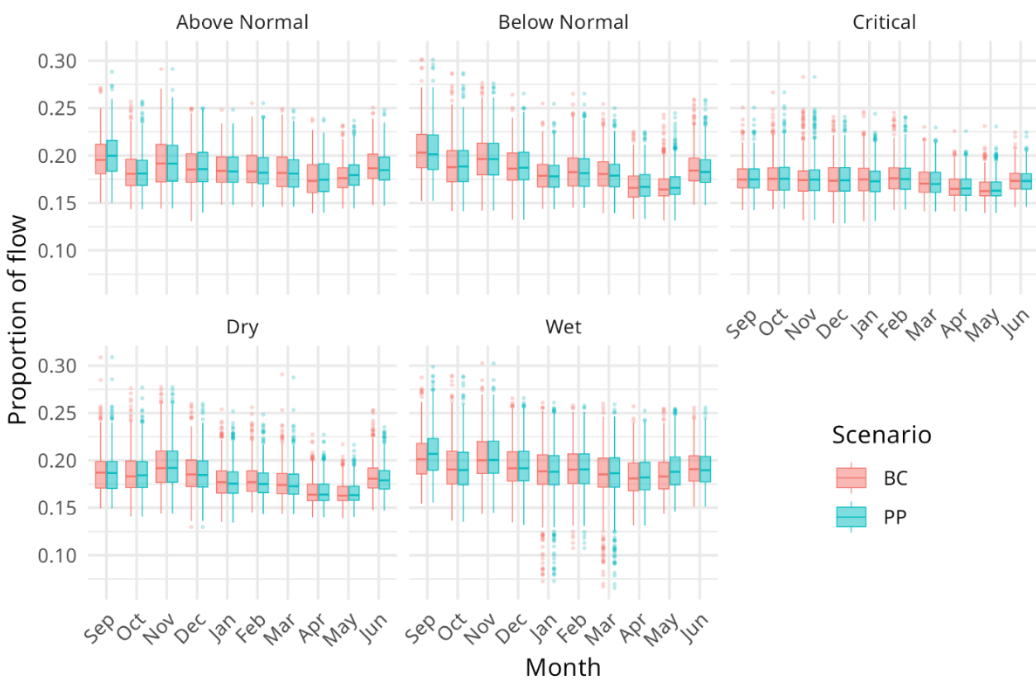
Note: Boxes represent median (horizontal line) and 25th/75th percentiles; whiskers represent 5th/95th percentiles; points represent additional observations outside this range. BC = Baseline Conditions; PP = Proposed Project.

Figure 6B-278. Proportion of Flow Entering Turner Cut from DSM2-HYDRO Modeling Data



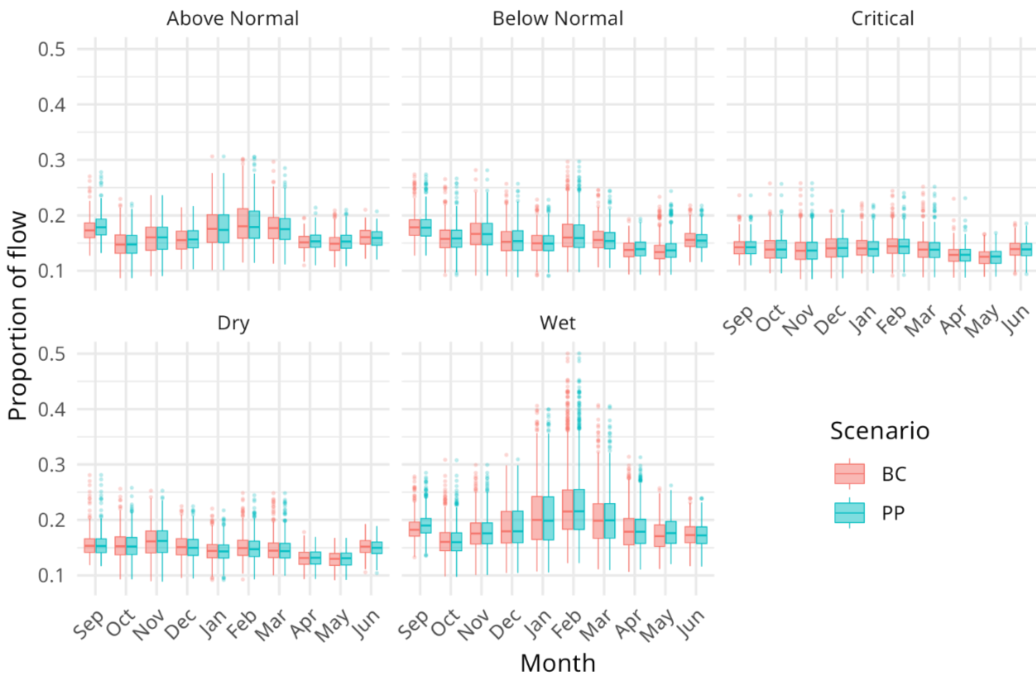
Note: Boxes represent median (horizontal line) and 25th/75th percentiles; whiskers represent 5th/95th percentiles; points represent additional observations outside this range. BC = Baseline Conditions; PP = Proposed Project.

Figure 6B-279. Proportion of Flow Entering Columbia Cut from DSM2-HYDRO Modeling Data



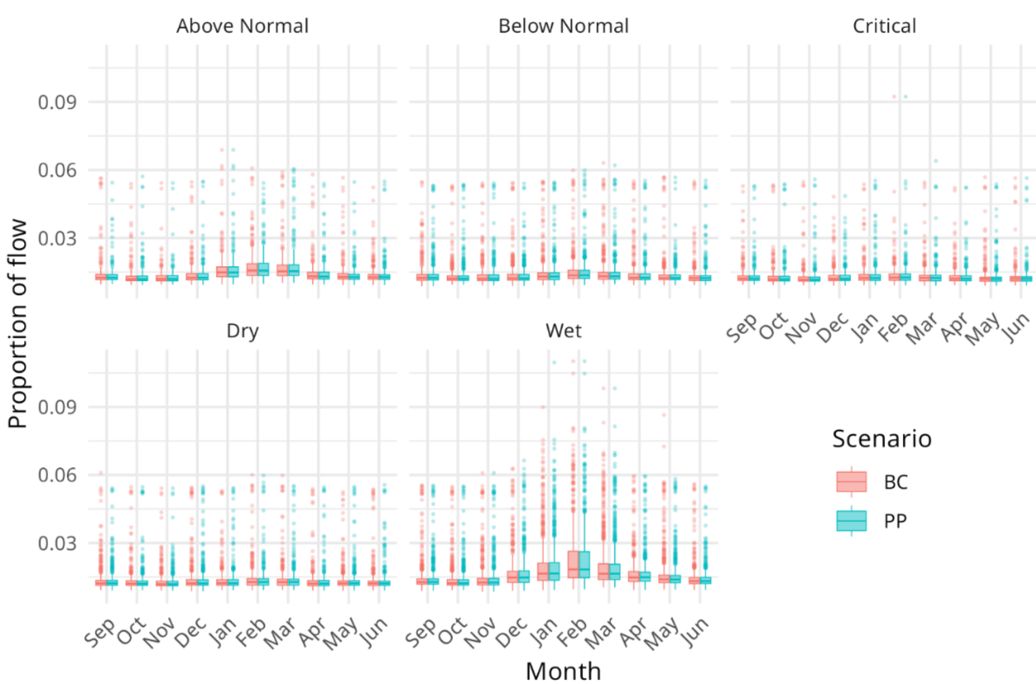
Note: Boxes represent median (horizontal line) and 25th/75th percentiles; whiskers represent 5th/95th percentiles; points represent additional observations outside this range. BC = Baseline Conditions; PP = Proposed Project.

Figure 6B-280. Proportion of Flow Entering the Mouth of Middle River from DSM2-HYDRO Modeling Data



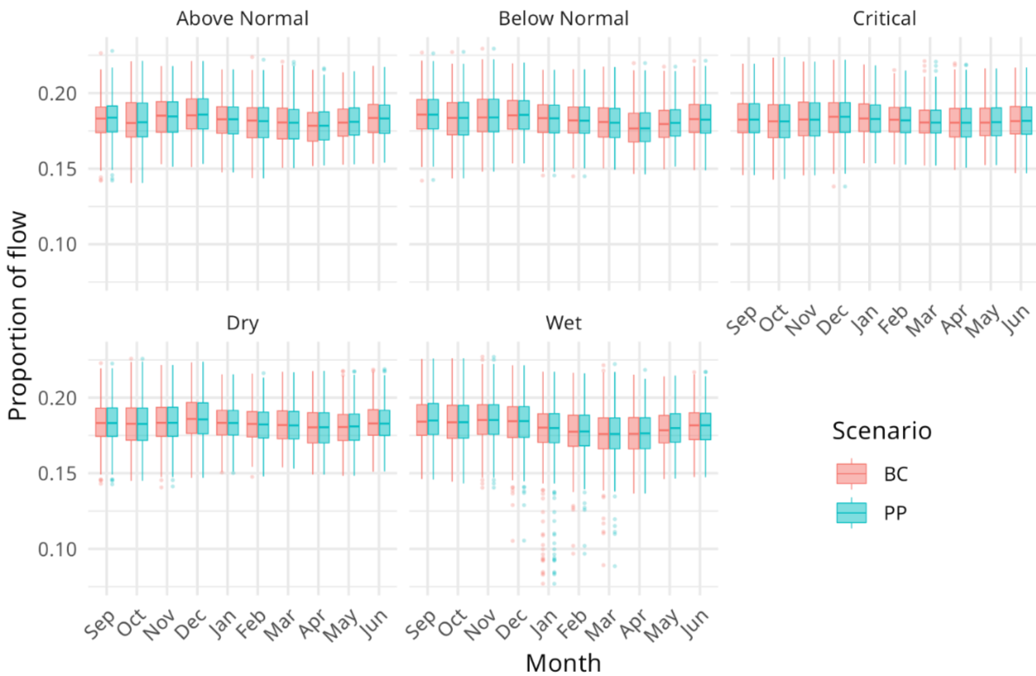
Note: Boxes represent median (horizontal line) and 25th/75th percentiles; whiskers represent 5th/95th percentiles; points represent additional observations outside this range. BC = Baseline Conditions; PP = Proposed Project.

Figure 6B-281. Proportion of Flow Entering the Mouth of Old River from DSM2-HYDRO Modeling Data



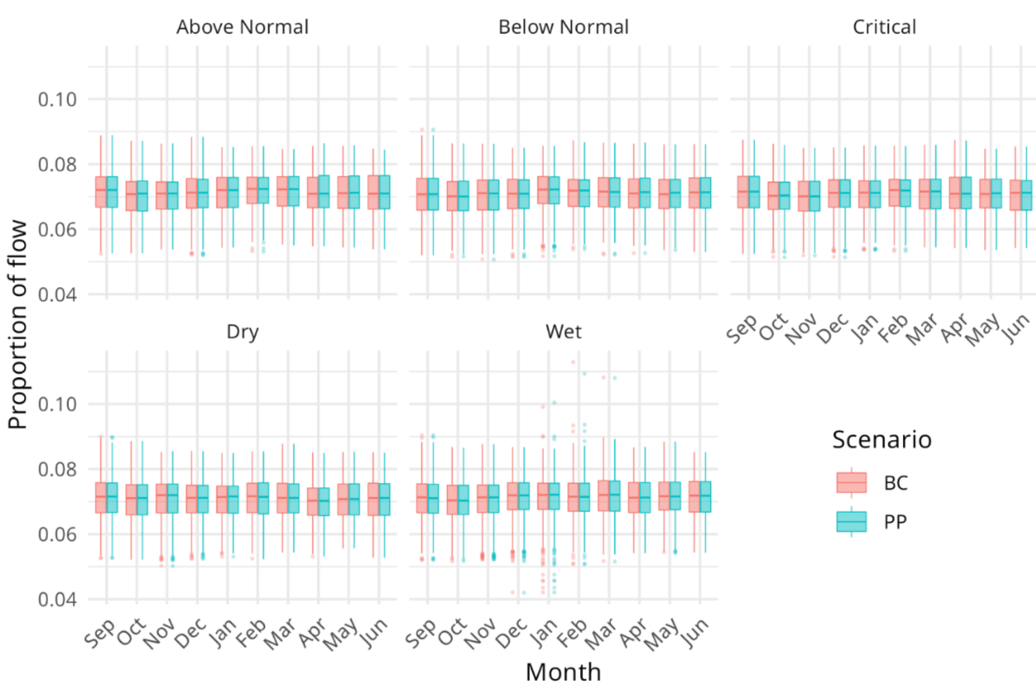
Note: Boxes represent median (horizontal line) and 25th/75th percentiles; whiskers represent 5th/95th percentiles; points represent additional observations outside this range. BC = Baseline Conditions; PP = Proposed Project.

Figure 6B-282. Proportion of Flow Entering Fisherman's Cut from DSM2-HYDRO Modeling Data



Note: Boxes represent median (horizontal line) and 25th/75th percentiles; whiskers represent 5th/95th percentiles; points represent additional observations outside this range. BC = Baseline Conditions; PP = Proposed Project.

Figure 6B-283. Proportion of Flow Entering False River from DSM2-HYDRO Modeling Data



Note: Boxes represent median (horizontal line) and 25th/75th percentiles; whiskers represent 5th/95th percentiles; points represent additional observations outside this range. BC = Baseline Conditions; PP = Proposed Project.

Figure 6B-284. Proportion of Flow Entering Jersey Point from DSM2-HYDRO Modeling Data

6B.4 Delta Passage Model[3]

The DPM simulates migration of Chinook Salmon smolts entering the Delta from the Sacramento River at Fremont Weir, and estimates survival to Chipps Island. The DPM uses available time-series data and values taken from empirical studies or other sources to parameterize model relationships and inform uncertainty, thereby using the greatest amount of data available to dynamically simulate responses of smolt survival to changes in water management. The DPM contains relationships derived from studies of all four runs of Chinook Salmon. Relationships for individual runs were not developed due to sample size limitations for some runs and the model assumes all migrating Chinook Salmon smolts will respond similarly to Delta conditions. Delta entry timing for each run, based on length-at-date size criteria is unique for each run based on collections in the Sacramento trawl. The DPM results presented here reflect the most current version of the model, which continues to be reviewed and refined, and for which a sensitivity analysis has been completed to examine various aspects of uncertainty related to the model's inputs and parameters.

Although studies have shown considerable variation in emigrant size, with Central Valley Chinook Salmon migrating as fry, parr, and smolts (Brandes and McLain 2001; Williams 2001), the DPM relies predominantly on data from acoustic-tagging studies of smolt-sized (≥80 mm) fish, and therefore should be applied cautiously to pre-smolt migrants. Salmon juveniles less than 70 mm are more likely to exhibit rearing behavior in the Delta (Kjelson et al. 1982) and thus likely will be represented poorly by the DPM. It has been assumed that the downstream emigration of fry, when spawning grounds are well upstream, is probably a dispersal mechanism that helps distribute fry among suitable rearing habitats. However, even when rearing habitat does not appear to be a limiting factor, downstream movement of fry still may be observed, suggesting that fry emigration is a viable alternative life-history strategy (Healey 1980; Healey and Jordan 1982; Miller et al. 2010). Unfortunately, survival data are lacking for small (fry-sized) juvenile emigrants because of the difficulty of tagging such small individuals. Therefore, the DPM should be viewed as a smolt survival model only, with its survival relationships generally having been derived from larger juveniles (≥80 mm), with the fate of pre-smolt emigrants not incorporated into model results.

The version of the DPM described here has undergone substantial revisions based on a large amount of telemetry data that has become available since the original version of the model was constructed. Initial model structure was modified based on comments received through the Bay-Delta Conservation Plan preliminary proposal anadromous team meetings and in particular through feedback received during a workshop held on August 24, 2010, a two-day workshop held June 23–24, 2011, and since then from various meetings of a workgroup consisting of agency biologists and consultants. The current version builds on this breadth of input and resolves many of the uncertainties identified in previous reviews. This documentation reflects the most recent version of the DPM.

[3] Although this description mentions all four runs of Central Valley Chinook Salmon, only the results for winter-run and spring-run were reported for this DEIR.

Survival and routing estimates generated by the DPM are not intended to predict future outcomes. Instead, the DPM is a decision support tool that compares the effects of different water management options on smolt migration survival, with accompanying estimates of uncertainty. The DPM is a tool to compare different scenarios and is not intended to predict actual through-Delta survival under current or future conditions. It is possible that underlying relationships (e.g., flow-survival, export-survival) that are used to inform the DPM will change in the future. Just as this latest update was completed to incorporate newly available data, it may be necessary to re-examine the relationships as new information becomes available.

6B.4.1 Methods

6B.4.1.1 Model Overview

The DPM is based on migratory pathways and reach-specific mortality as Chinook Salmon smolts travel through a simplified network of reaches and junctions (Figure 6B-285). The biological functionality of the DPM is based on releases of acoustically tagged Chinook Salmon performed between 2007 and 2019. The previous version of the DPM primarily relied on releases of large (>140 mm) acoustically tagged late-fall-run Chinook Salmon performed by Perry (2010) and coded wire tag releases of late-fall run reported by Newman and Brandes (2010). There was considerable uncertainty about the transferability of those relationships to other runs that migrate at different times of year and at smaller sizes. The revised model is based on acoustically tagged winter-run, spring-run, fall-run and late-fall-run individuals (≥80 mm) released in the upper reaches of the Sacramento River and within the Delta. These releases are primarily comprised of hatchery fish. However, wild spring- and fall-run salmon are included in the data set. These releases cover a wide range of environmental conditions including extreme drought in 2014 and 2015 and high flow years. Uncertainty is explicitly modeled in the DPM by incorporating environmental stochasticity and estimation error whenever available. Some model functions (e.g., flow-survival estimates) are randomly sampled from a distribution of values based on model coefficients; 500 iterations of the model were run for each scenario to generate 500 sets of outputs, each reflecting different random sampling from distributions of the different functions in the model.

The major model functions in the DPM are as follows.

1. Delta Entry Timing, which models the temporal distribution of smolts entering the Delta for each race of Chinook Salmon.
2. Fish Behavior at Junctions, which models fish movement as they approach river junctions.
3. Migration Speed, which models reach-specific smolt migration speed and travel time.
4. Route-Specific Survival, which models route-specific survival response to non-flow factors.
5. Flow-Dependent Survival, which models reach-specific survival response to flow.
6. Export-Dependent Survival, which models survival response to water export levels in the Interior Delta reach (see Table 6B-30 for reach description).

Functional relationships are described in detail in Section 6B.4.1.5, "Model Functions."

6B.4.1.2 Model Timestep

The DPM operates on a daily timestep using simulated daily average flows and south Delta exports as model inputs. The DPM does not attempt to represent sub-daily flows or diel salmon smolt behavior in response to the interaction of tides, flows, and specific channel features. The DPM is intended to represent the net outcome of migration and mortality occurring over one day, not three-dimensional movements occurring over minutes or hours (e.g., Blake and Horn 2003). It is acknowledged that finer scale modeling with a shorter timestep may match the biological processes governing fish movement better than a daily timestep (e.g., because of diel activity patterns; Plumb et al. 2015) and that sub-daily differences in flow proportions into junctions make daily estimates somewhat coarse (Cavallo et al. 2015).

6B.4.1.3 Spatial Framework

The DPM is composed of ten reaches and three junctions (Figure 6B-285; Table 6B-30) selected to represent primary salmonid migration corridors for fish originating from the Sacramento River basin where high-quality data were available for fish and hydrodynamics. For simplification, Sutter Slough and Steamboat Slough are combined as the reach SS; and Georgiana Slough and DCC are a combined junction. Sacramento Chinook Salmon that enter the DCC migrate through the forks of the Mokelumne River and fish entering Georgiana Slough migrate only through that route. The Interior Delta reach can be entered from the Mokelumne River or Georgiana Slough route. The entire Interior Delta region is treated as a single model reach. The three distributary junctions (channel splits) depicted in the DPM are (A) Sacramento River at Fremont Weir (head of Yolo Bypass), (B) Sacramento River at head of Sutter and Steamboat Sloughs, and (C) Sacramento River at the combined junction with Georgiana Slough and DCC (Figure 6B-285; Table 6B-30).

Table 6B-30. Description of Modeled Reaches and Junctions in the Delta Passage Model

Reach/ Junction [a]	Description	Approximate Reach Length (km)	Final Receiver Name/Location
Verona	Sacramento River Between Fremont Weir and Freeport	57	Freeport
Sac_1	Sacramento River Between Freeport and the combined junction of Steamboat and Sutter Slough	19	Sacramento River Below Steamboat Slough
Sac_2	Sacramento River from Sutter/Steamboat Sloughs junction to junction with Delta Cross Channel/Georgiana Slough	11	Sacramento River Below Georgiana Slough
Sac_3	Sacramento River from Below Georgiana Slough to Chipps Island	46	Chipps Island
SS	Steamboat and Sutter Sloughs from their junction with the Sacramento River to Chipps Island	51	Chipps Island
Yolo Bypass	Fremont weir to Highway 84 Ferry	NA	Highway 84 Ferry
Sac_4 (Yolo fish only)	Highway 84 to Chipps Island	30	Chipps Island

Reach/ Junction [a]	Description	Approximate Reach Length (km)	Final Receiver Name/Location
Georgiana Slough	Georgiana Slough from the junction with the Sacramento River to the base of the Mokelumne River	25	Mokelumne Base
Mokelumne	Confluence of the DCC to Mokelumne Base/SF Mokelumne	25	Mokelumne Base/South Fork Mokelumne
Interior Delta	Confluence of Mokelumne and San Joaquin Rivers to Chipps Island	NA	Chipps Island
A	Junction of Yolo Bypass and Sacramento River	NA	NA
B	Combined junction of Sutter Slough and Steamboat Slough with the Sacramento River	NA	NA
C	Combined junction of the Delta Cross Channel and Georgiana Slough with the Sacramento River	NA	NA

km = kilometers.

[a] Yolo and interior Delta reach lengths are not defined because multiple migration pathways are possible.

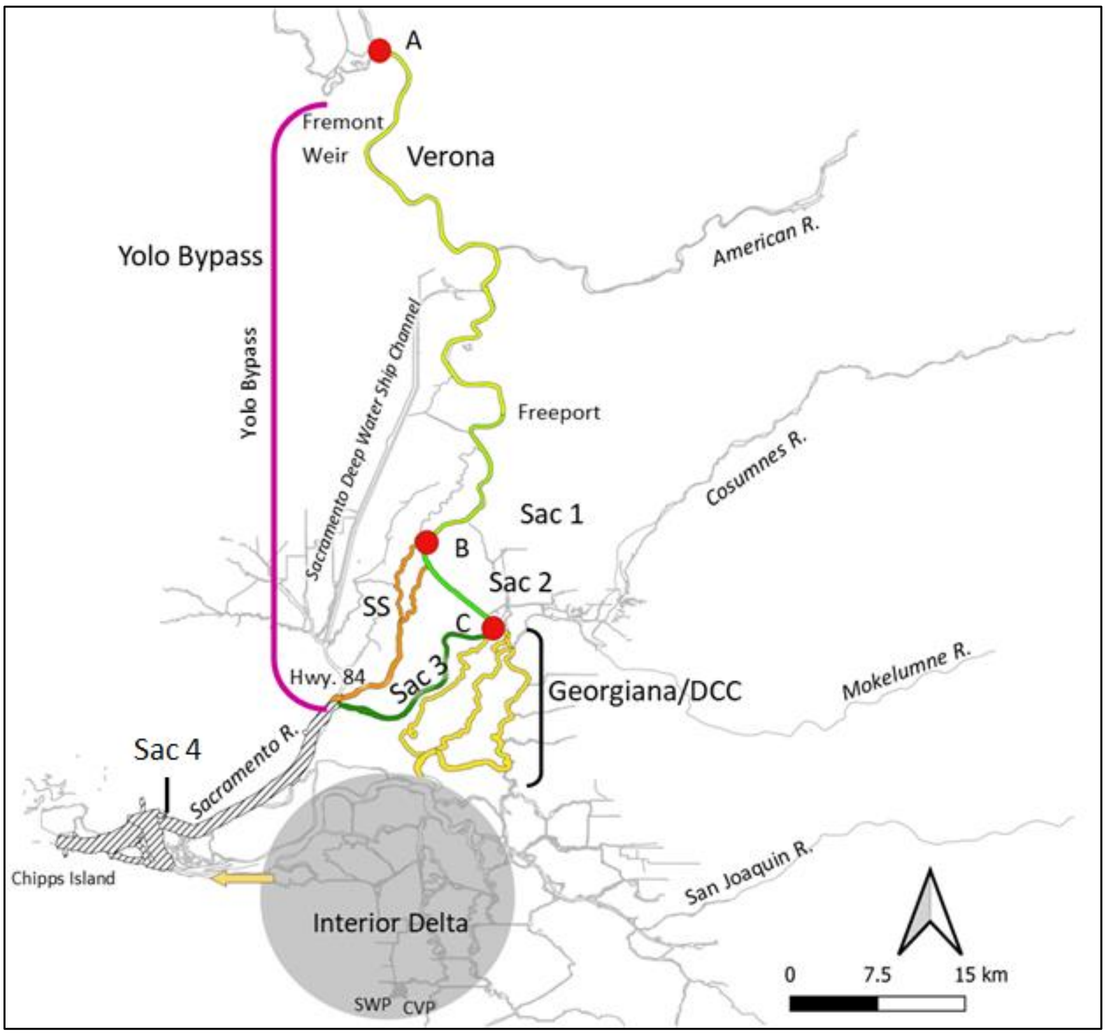


Figure 6B-285. Map of the Sacramento–San Joaquin Delta Showing the Modeled Reaches and Junctions of the Delta Applied in the Delta Passage Model

6B.4.1.4 Flow Input Data

Water movement through the Delta as an input to the DPM is derived from daily (tidally averaged) flow output produced by the hydrology module of the DSM2-HYDRO (California Department of Water Resources 2021) or from CalSim 3.

The nodes in the DSM2-HYDRO and CalSim 3 models that were used to provide flow for specific reaches in the DPM are shown in Table 6B-31.

Table 6B-31. Delta Passage Model Reaches and Associated Output Locations from DSM2-HYDRO and CalSim 3 Models

DPM Reach or Model Component	DSM2 Output Locations	CalSim 3 Node
Sac1	rsac155	–
Sac2	rsac128	–
Sac3	rsac123	–
Sac4	rsac101, Channel 398 (Yolo only)	–
Yolo	–	d160a+d166aa
Verona	–	C160a
SS	slsbt011	–
Geo/DCC	dcc+georg_sl	–
South Delta Export Flow	Clifton Court Forebay + Delta Mendota Canal	–
Sacramento River flow at Fremont Weir	–	C129a

6B.4.1.5 Model Functions

Delta Entry Timing

Catch data for emigrating juvenile smolts for four Central Valley Chinook Salmon runs were used to inform the daily proportion of juveniles entering the Delta for each run (Table 6B-32). Because the DPM models the survival of smolt-sized juvenile salmon, pre-smolts were removed from catch data before creating entry timing distributions. The lower 95th percentile of the range of salmon fork lengths visually identified as smolts by the U.S. Fish and Wildlife Service (USFWS) in Sacramento trawls was used to determine the lower length cutoff for smolts. A lower fork length cutoff of 70 mm for smolts was applied, and all catch data of fish smaller than 70 mm were eliminated. To isolate wild production, all fish identified as having an adipose-fin clip (hatchery production) were eliminated, recognizing that most (75 percent) of the fall-run hatchery fish released upstream of Sacramento are not marked. Daily catch data for each brood year were divided by total annual catch to determine the daily proportion of smolts entering the DPM for each run (Figure 6B-286). Sampling was not conducted daily at most stations and catch was not expanded for fish caught but not measured. Finally, a generic probability density function was fit to the data using the package “sm” in R software (R Core Team 2023). The R fitting procedure estimated the best-fit probability distribution of the daily proportion of fish entering the DPM.

For the current analysis, the most recent data from the Sacramento trawl survey were added to the data used in previous versions of the DPM to determine if entry distributions had shifted since the original fitting. Only late-fall-run Chinook Salmon exhibited substantial change from the original fit and the entry distribution for that race was updated (Figure 6B-286).

Table 6B-32. Sampling Gear Used to Create Juvenile Delta Entry Timing Distributions for Each Central Valley Run of Chinook Salmon

Chinook Salmon Run	Gear	Agency	Brood Years
Sacramento River Winter Run	Trawls at Sacramento	USFWS	1995–2009
Sacramento River Spring Run	Trawls at Sacramento	USFWS	1995–2005
Sacramento River Fall Run	Trawls at Sacramento	USFWS	1995–2005
Sacramento River Late Fall Run	Trawls at Sacramento	USFWS	1995–2018

USFWS = U.S. Fish and Wildlife Service.

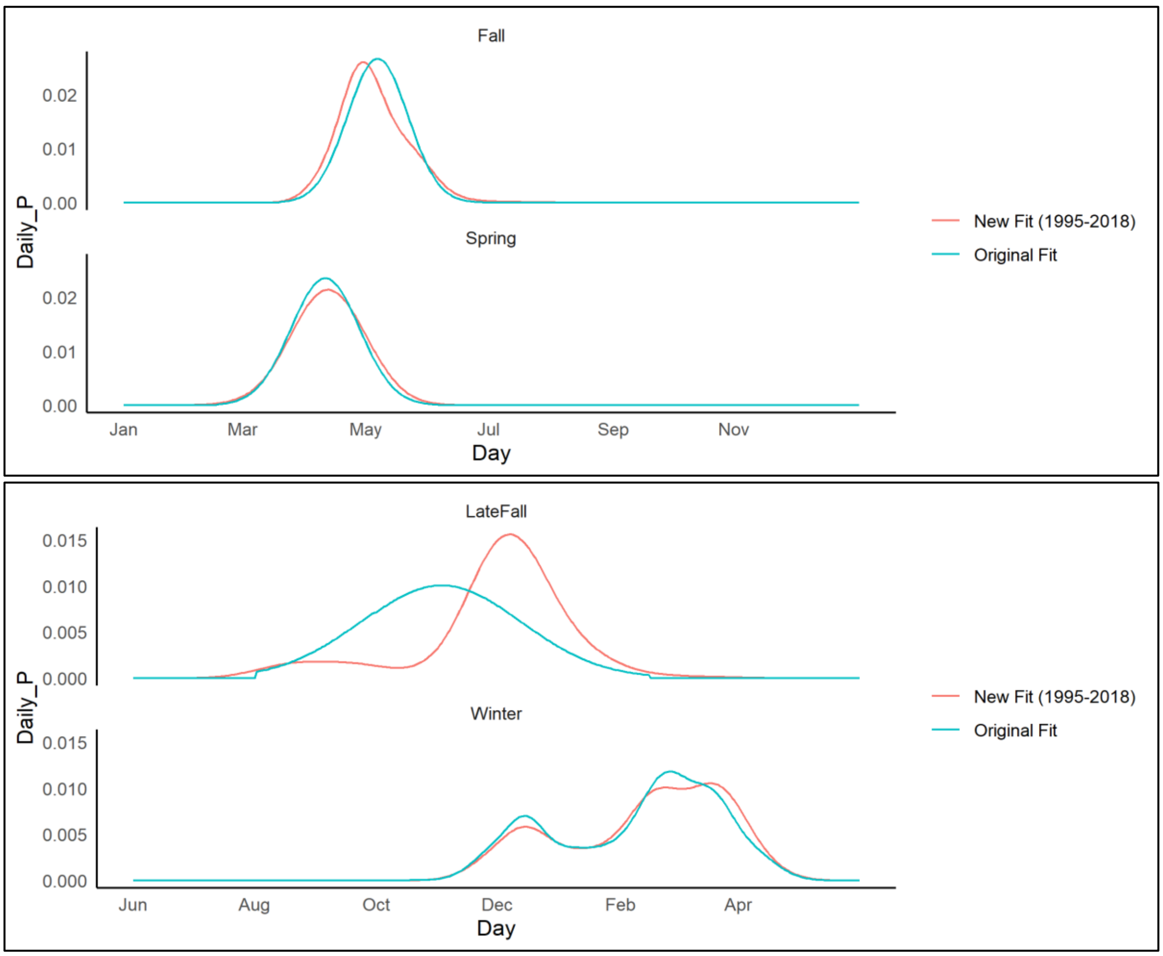


Figure 6B-286. Delta Entry Distributions (Daily_P = Daily Proportion) for Chinook Salmon Smolts Applied in the Delta Passage Model for Sacramento River Winter-Run, Central Valley Spring-Run (Sacramento River), Central Valley Fall-Run (Sacramento River), and Central Valley Late Fall–Run

Migration Speed

The DPM assumes a net daily movement of smolts in the downstream direction. The rate of smolt movement in the DPM affects the timing of arrival at Delta junctions and reaches, which can affect route selection and survival as flow conditions or water project operations change.

Smolt movement in all reaches except Yolo Bypass and the Interior Delta is a function of reach-specific length and migration speed as observed from acoustic-tagging results. Reach-specific length (kilometers [km]) is divided by reach migration speed (km/day) the day smolts enter the reach to calculate the number of days smolts will take to travel through the reach.

For north Delta reaches Verona, Sac1, Sac2, SS, Georgiana Slough, and Mokelumne, mean migration speed through the reach is predicted as a function of flow. Many studies have found a positive relationship between juvenile Chinook Salmon migration rate and flow in the Columbia River Basin (Raymond 1968; Berggren and Filardo 1993; Schreck et al. 1994), with Berggren and Filardo (1993) finding a logarithmic relationship for Snake River yearling Chinook Salmon. Ordinary least squares regression was used to test for a logarithmic relationship between reach-specific migration speed (km/day) and average daily reach-specific flow (cubic meters per second) for the first day smolts entered a particular reach for reaches where acoustic-tagging data was available (Sac1, Sac2, Sac3, Sac4, Georgiana Slough, Mokelumne, and SS):

$$Speed = \beta_0 \ln(flow) + \beta_1;$$

where β_0 is the slope parameter and β_1 is the intercept.

Individual smolt reach-specific travel times were calculated from detection histories of releases of acoustically tagged smolts conducted in December and January for three consecutive winters (2006/2007, 2007/2008, and 2008/2009) (Perry 2010). Reach-specific migration speed (km/day) for each smolt was calculated by dividing reach length by travel days. Flow data were queried from the California Department of Water Resources (DWR) California Data Exchange website.

Migration speed was significantly related to flow for reaches Sac1 (df = 450, F = 164.36, $P < 0.001$), Sac2 (df = 292, F = 4.17, P = 0.042), and Geo/DCC (df = 84, F = 13.74, $P < 0.001$). Migration speed increased as flow increased for all three reaches (Table 6B-33, Figure 6B-287). Therefore, for reaches Sac1, Sac2, and Geo/DCC, the regression coefficients shown in Table 6B-33 are used to calculate the expected average migration rate given the input flow for the reach and the associated standard error of the regressions is used to inform a normal probability distribution that is sampled from the day smolts enter the reach to determine their migration speed throughout the reach. The minimum migration speed for each reach is set at the minimum reach-specific migration speed observed from the acoustic-tagging data. The flow-migration rate relationship that was used for Sac1 also was applied for the Verona reach.

Table 6B-33. Sample Size (N), Slope (β_0), and Intercept (β_1) Parameter Estimates with Associated Standard Error (in Parenthesis) for the Relationship between Migration Speed and Flow for Reaches Sac1, Sac2, and Geo/DCC

Reach	N	β_0	β_1
Sac1	452	21.34 (1.66)	-105.98 (9.31)
Sac2	294	3.25 (1.59)	-8.00 (8.46)
Geo/DCC	86	11.08 (2.99)	-33.52 (12.90)

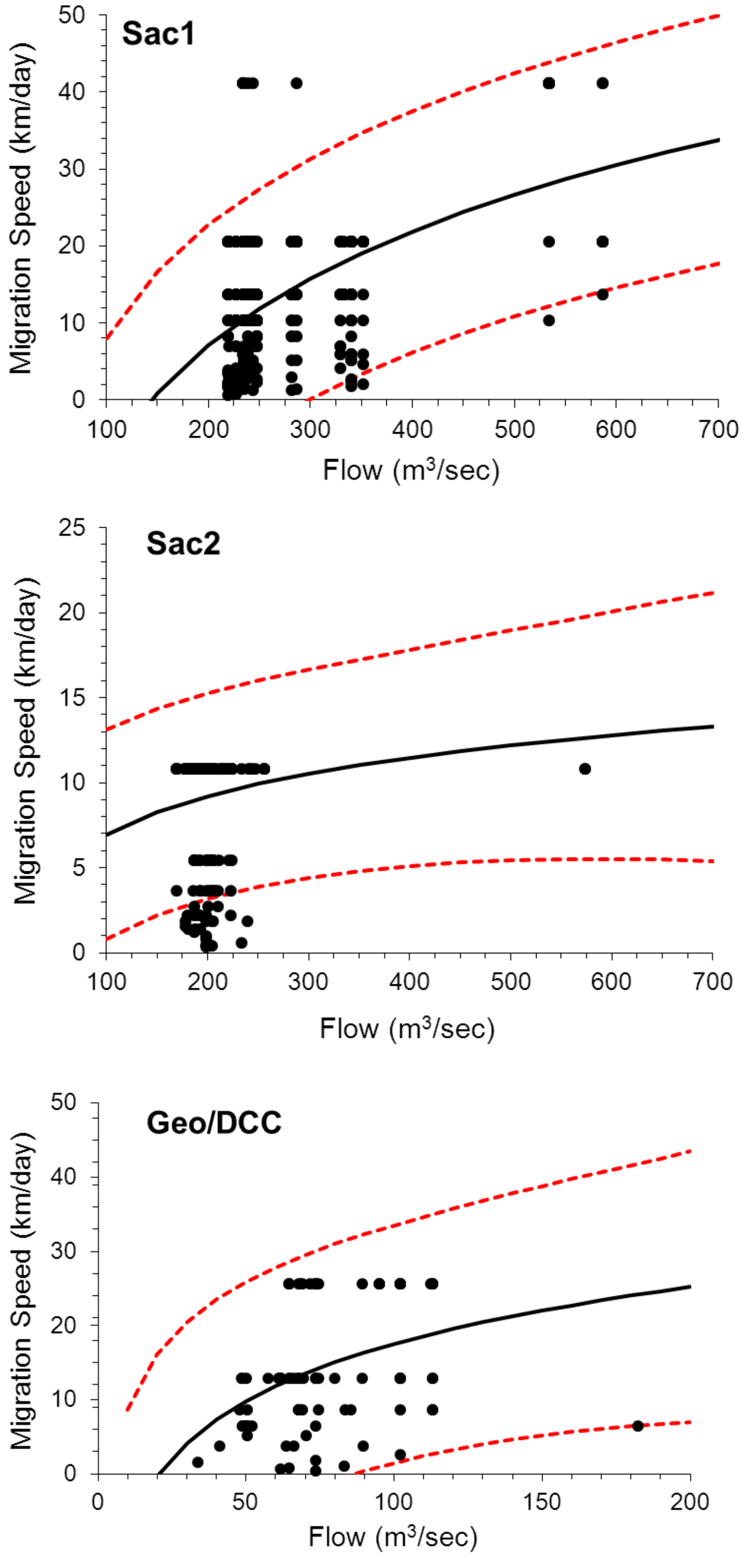


Figure 6B-287. Reach-Specific Migration Speed (km/day) as a Function of Flow (m3/s) Applied in Reaches Sac1, Sac2, and Geo/DCC

No significant relationship between migration speed and flow was found for reaches Sac3 (df = 100, F = 1.13, P =0.29), Sac4 (df = 60, F = 0.33, P = 0.57), and SS (df = 28, F = 0.86, P = 0.36). Therefore, for these reaches the observed mean migration speed and associated standard deviation is used to inform a normal probability distribution that is sampled from the day smolts enter the reach to determine their migration speed throughout the reach. As applied for reaches Sac1, Sac2, and Geo/DCC, the minimum migration speed for reaches Sac3, Sac4, and SS is set at the minimum reach-specific migration speed observed from the acoustic-tagging data.

Yolo Bypass travel time data from Sommer et al. (2005) for coded wire-tagged, fry-sized (mean size = 57-mm fork length) Chinook Salmon were used to inform travel time through the Yolo Bypass in the DPM. Because the DPM models the migration and survival of smolt-sized juveniles, the range of the shortest travel times observed across all three years (1998–2000) by Sommer et al. (2005) was used to inform the bounds of a uniform distribution of travel times (range = 4–28 days), on the assumption that smolts would spend less time rearing and would travel faster than fry. On the day smolts enter the Yolo Bypass, their travel time through the reach is calculated by sampling from this uniform distribution of travel times.

The travel time of smolts migrating through the Interior Delta in the DPM is informed by observed mean travel time (7.95 days) and associated standard deviation (6.74) from North Delta acoustic-tagging studies (Perry 2010). However, the timing of smolt passage through the Interior Delta does not affect Delta survival because there are no Delta reaches located downstream of the Interior Delta.

Fish Behavior at Junctions (Channel Splits)

Perry et al. (2010) and Cavallo et al. (2015) found that acoustically tagged smolts arriving at Delta junctions exhibited inconsistent movement patterns in relation to the flow being diverted. For Junction A (entry into the Yolo Bypass at Fremont Weir), the following relationships were used.

- Proportion of smolts entering Yolo Bypass = Fremont Weir spill/ (Fremont Weir spill + Sacramento River at Verona flows).

As noted above in Section 6B.4.1.4, “Flow Input Data,” the flow data informing Yolo Bypass entry were obtained by disaggregating CalSim 3 estimates using historical daily patterns of variability because DSM2 does not provide daily flow data for these locations.

For Junction B (Sacramento River-Sutter/Steamboat Sloughs), both Perry et al. (2010) and Cavallo et al. (2015) found that smolts consistently entered downstream distributaries in proportion to the flow being diverted. Therefore, smolts arriving at Junction B in the model move proportionally with flow according to the linear relationship found in Cavallo et al. (2015):

$$P_{SS} = -0.00203 + P_{flowSS} * 0.775344;$$

where P_{SS} is the proportion of fish entering the SS reach, and P_{flowSS} is the proportion of flow entering Sutter/Steamboat Slough distributaries from the total flow in the mainstem Sacramento River.

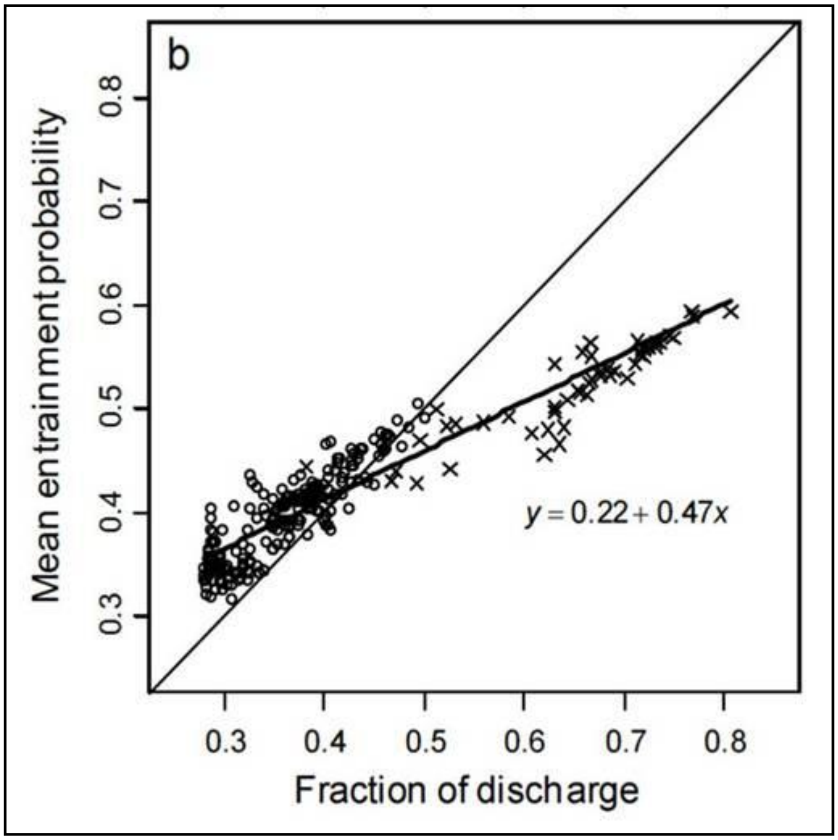
For Junction C (Sacramento River–Georgiana Slough/DCC), Perry (2010) found a linear, nonproportional relationship between flow and fish movement. His relationship for Junction C was applied in the DPM:

$$y = 0.22 + 0.47x;$$

where *y* is the proportion of fish diverted into Geo/DCC and *x* is the proportion of flow diverted into Geo/DCC (Figure 6B-288).

In the DPM, this linear function is applied to predict the daily proportion of fish movement into Geo/DCC as a function of the proportion of flow into Geo/DCC.

Flow-predicted entry in Georgiana Slough was adjusted to account for the Georgiana Slough Salmonid Migratory Barrier.[4] The barrier was assumed to reduce flow-related entry of juvenile salmon into Georgiana Slough by (1) 50 percent (based on California Department of Water Resources 2015) and (2) 67 percent (based on California Department of Water Resources 2012), for both Baseline Conditions and the Proposed Project.[5]



Circles Depict DCC Gates Closed, Crosses Depict DCC Gates Open.

Figure 6B-288. Figure from Perry (2010) Depicting the Mean Entrainment Probability (Proportion of Fish Being Diverted into Reach Geo/DCC) as a Function of Fraction of Discharge (Proportion of Flow Entering Reach Geo/DCC)

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4 Dynamic representation of barrier operations was assumed, consistent with the final Georgiana Slough Salmonid Migratory Barrier Operations Plan (California Department of Water Resources 2022), i.e., turning the barrier on and off during November 16–December 31 in association with DCC gate operations and turning the barrier on during January 1–April 30.

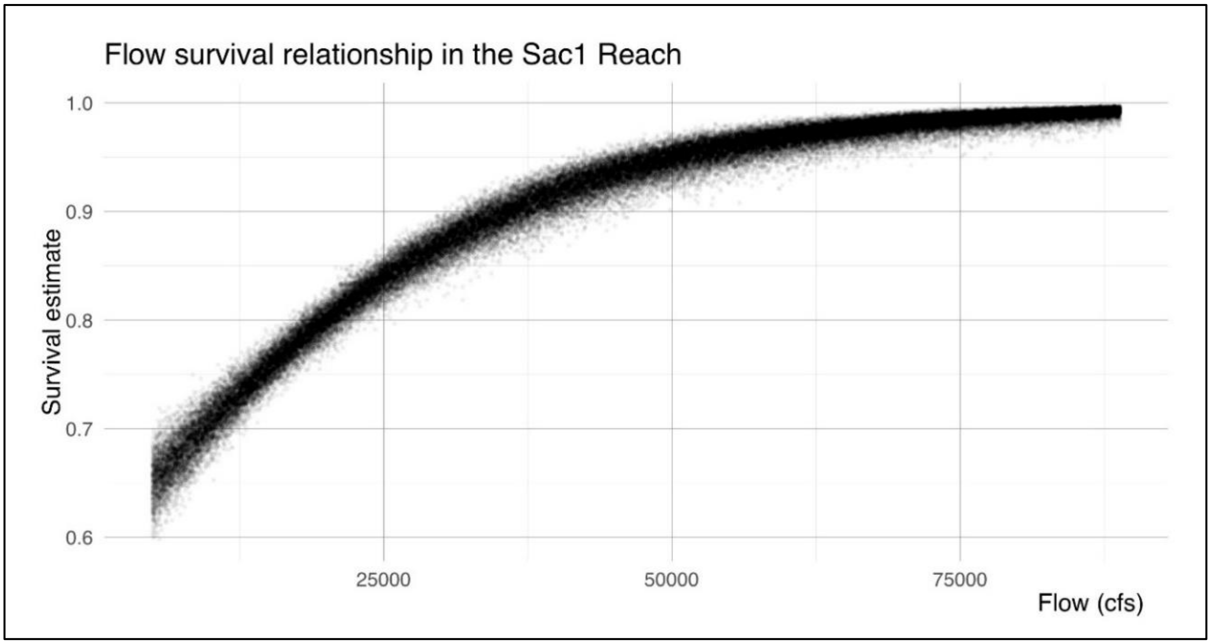
5 For example, if flow-related entry (i.e., the expected juvenile salmon entry into Georgiana Slough based on the proportion of Sacramento River mainstem flow entering Georgiana Slough) is 30 percent, operation of the barrier would reduce entry to 15 percent under the 50 percent barrier scenario and would reduce entry to 10 percent under the 67 percent barrier scenario.

Reach-Specific Survival

To update survival estimates in the DPM, a dataset of detections from >2,000 acoustically tagged (Juvenile Salmon Acoustic Telemetry System [JSATS]) fish recorded in the DPM region of the Delta from 2013 through 2019 was analyzed. To estimate survival from such a large and heterogeneous dataset (receiver combinations, monitored reaches, and release locations differed from year to year), only detections from receivers at the endpoint of reaches in the DPM were used, and binary detection histories along DPM routes were constructed. Moving downstream from receiver to receiver along a route, it was assumed that if a fish was not seen again in the route after a given receiver, the fish did not survive. The probability of being detected again downstream (assumed to be a direct proxy for survival) was then modeled as a function of an individual's detection history and time-specific covariates associated with reach entry. From this analysis, four reaches were associated with a consistent relationship between flow and survival: Sac1, Sac2, Sac3, and Sac4 (see Figure 6B-289, Figure 6B-290, Figure 6B-291, and Figure 6B-292); all other reaches had no consistent flow-survival relationship, and survival in those reaches of the DPM is drawn from a normal distribution derived from a reach-specific, intercept-only model of survival and standard deviation from the JSATS data.

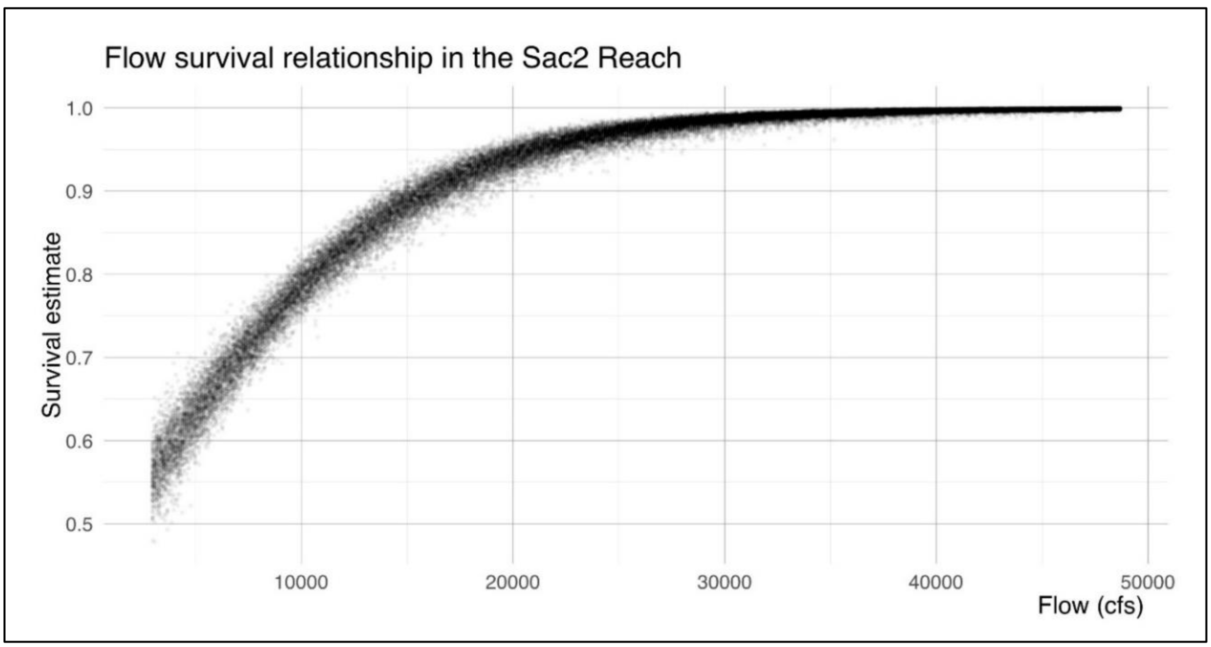
Flow-Dependent Survival

Survival through a given reach is estimated and applied the first day smolts enter that reach. For reaches where analysis of the JSATS detections supported a consistent flow-survival relationship, flow on the day fish enter the reach is used to predict survival through the entire reach even if migration through the reach takes place over more than one day. As previously described, only reaches Sac1, Sac2, Sac3, and Sac4 were associated with consistent flow-survival relationships (Figure 6B-289, Figure 6B-290, Figure 6B-291, and Figure 6B-292).



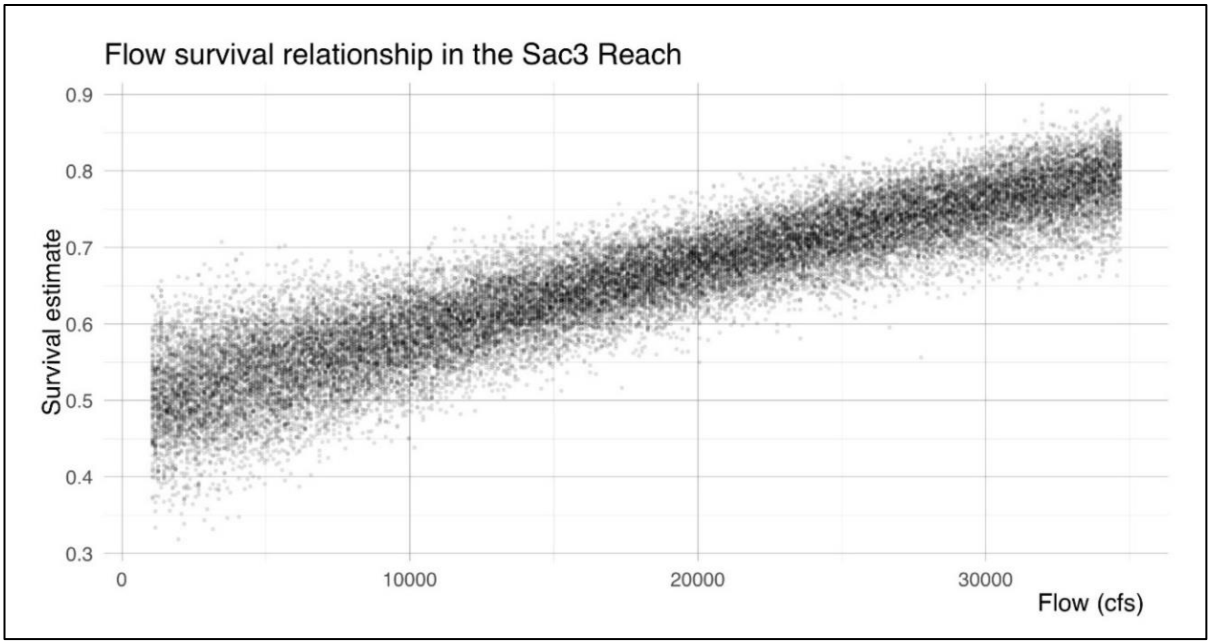
Note: Plot shows model predictions of simulated data across the observed flow range.

Figure 6B-289. Relationship between Sacramento River Discharge and Survival Through the Delta Passage Model Sac1 Reach Modeled with JSATS Releases of Multiple Runs of Juvenile Chinook Salmon



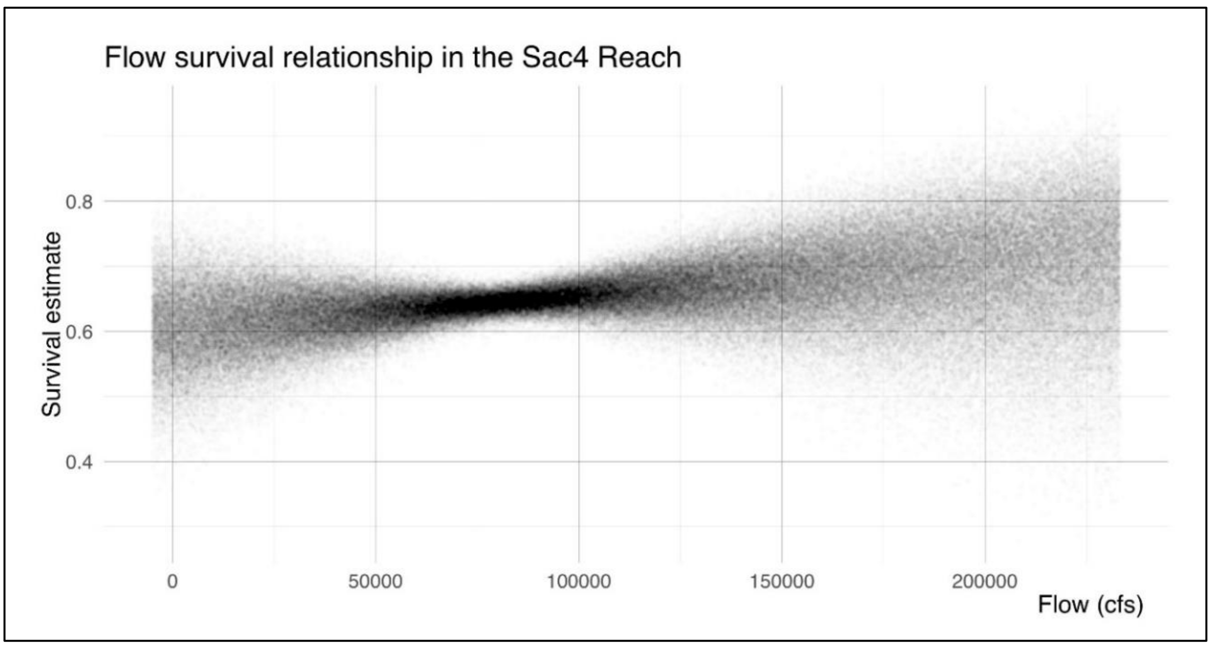
Note: Plot shows model predictions of simulated data across the observed flow range.

Figure 6B-290. Relationship between Sacramento River Discharge and Survival Through the Delta Passage Model Sac2 Reach Modeled with JSATS Releases of Multiple Runs of Juvenile Chinook Salmon



Note: Plot shows model predictions of simulated data across the observed flow range.

Figure 6B-291. Relationship between Sacramento River Discharge and Survival Through the Delta Passage Model Sac3 Reach Modeled with JSATS Releases of Multiple Runs of Juvenile Chinook Salmon



Note: Plot shows model predictions of simulated data across the observed flow range.

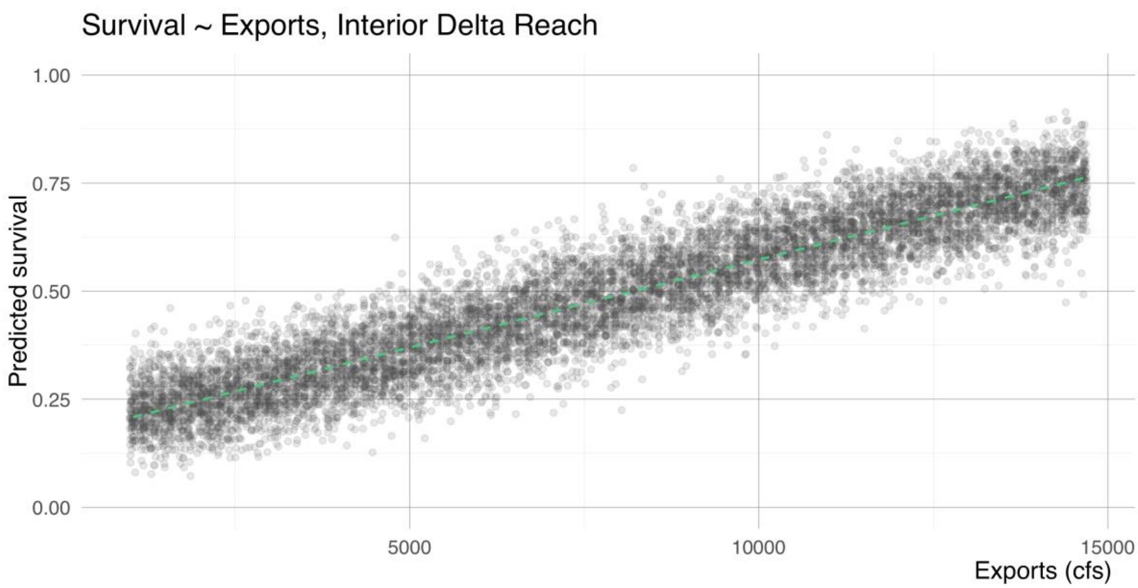
Figure 6B-292. Relationship between Sacramento River Discharge and Survival through the Delta Passage Model Sac4 Reach Modeled with JSATS Releases of Multiple Runs of Juvenile Chinook Salmon

Export-Dependent Survival

An export-survival relationship was only tested for fish entering the interior Delta from the Mokelumne River and Georgiana Slough. Hydrodynamic data for exports covering the period of JSATS detection data (2013–2019) was queried from Dayflow (California Natural Resources Agency 2021). A model that included exports and Sacramento River at Freeport flow was also tested. Exports observed over the data period ranged from 1,038 to 14,650 cfs.

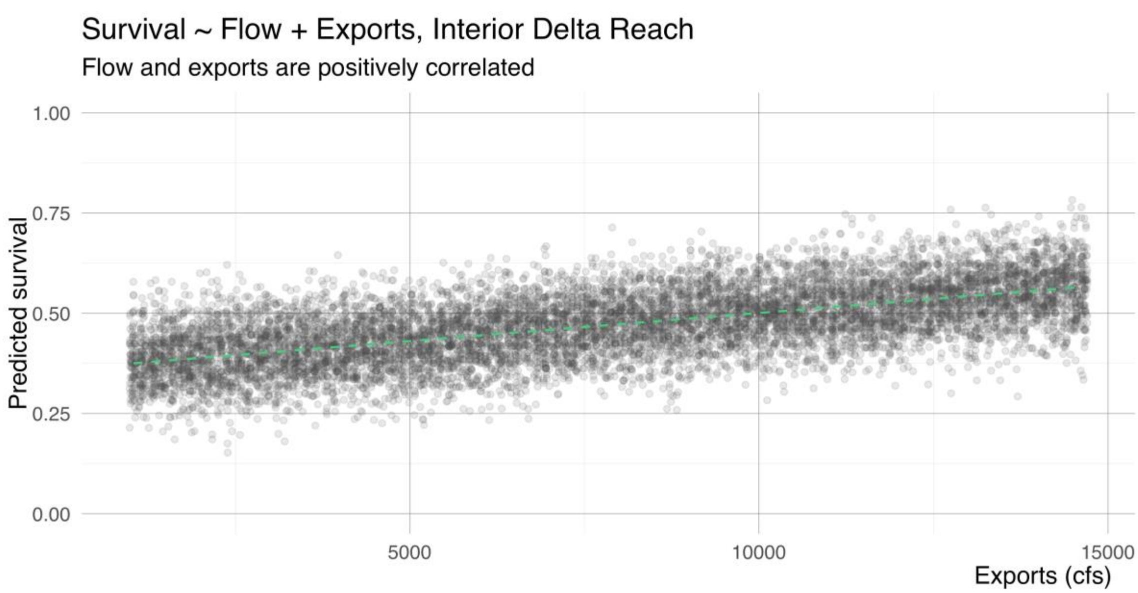
For the model that included exports only, the coefficient for the export effect was positive and well supported, indicating higher survival probabilities with greater exports (Figure 6B-293). In the model including both exports and flow, the export coefficient remained positive but was not well supported, with a mean effect that included zero in the distribution (Figure 6B-294). This positive effect of exports may seem contradictory based on coded wire tag studies used in the previous model version that includes a weak, yet negative effect (Newman and Brandes 2010). The effect of exports on Sacramento River-origin Chinook Salmon was a source of uncertainty identified in the previous version. Hydrodynamic analysis indicates that there is little effect of exports on hydrodynamics in the Sacramento River (Cavallo et al. 2015) and only fish entering the interior Delta, and the Old-Middle River corridor specifically, are likely to be exposed to the hydrodynamic effects of exports (see, for example, U.S. Bureau of Reclamation 2019, Appendix H, p. 4). Previous studies of export effects relied on the relative survival of coded wire tagged salmon released into Georgiana Slough relative to the Sacramento River (Newman and Brandes 2010). Thus, export effects in the coded wire tag studies are not directly estimated for fish in the area of interest. In previous workshops and comments, it was suggested that modeling potential effects of exports on individually tagged fish would be a superior approach. The JSATS data analyzed here represents the best data set available and cover a wide range of export conditions. Thus, the data strongly suggest the absence of a negative effect of exports on survival of Sacramento River-origin Chinook Salmon that enter the interior Delta.

Based on the above analysis, for juvenile Chinook Salmon entering the Interior Delta route, the DPM uses the export value (in cfs) on the day the fish enters the reach to apply the effect of exports from the JSATS model accounting for Sacramento River flow (Figure 6B-294) to predict survival through the entire Interior Delta reach (even if migration through the reach takes place over more than one day); the Sacramento River flow at Freeport for the same day is also included in the estimate, per the relationship shown in Figure 6B-294. The model does not explicitly include salvage (including collection, handling, trucking, and release) at the south Delta exports facilities; to the extent that salvage of JSATS-tagged fish entering the interior Delta occurred and these fish reached Chipps Island, this would be reflected in survival estimates for the interior Delta reach.



Note: Plot shows model predictions of simulated data across the observed flow range. The coefficient for the effect of exports was well supported with a credible interval that did not include zero.

Figure 6B-293. Relationship between South Delta Exports and Survival through the Delta Passage Model Interior Delta Reach Modeled with JSATS Releases of Multiple Runs of Juvenile Chinook Salmon



Note: Plot shows model predictions of simulated data across the observed flow range. When flow is included in the model, the effect of exports on survival remains positive but is no longer well supported (compared to Figure 6B-293).

Figure 6B-294. Relationship between South Delta Exports and Survival through the Delta Passage Model Interior Delta Reach When Sacramento River at Freeport Discharge was Held at Its Mean Value, Modeled with JSATS Releases of Multiple Runs of Juvenile Chinook Salmon

6B.4.2 Results

Results are presented and discussed in Chapter 6.

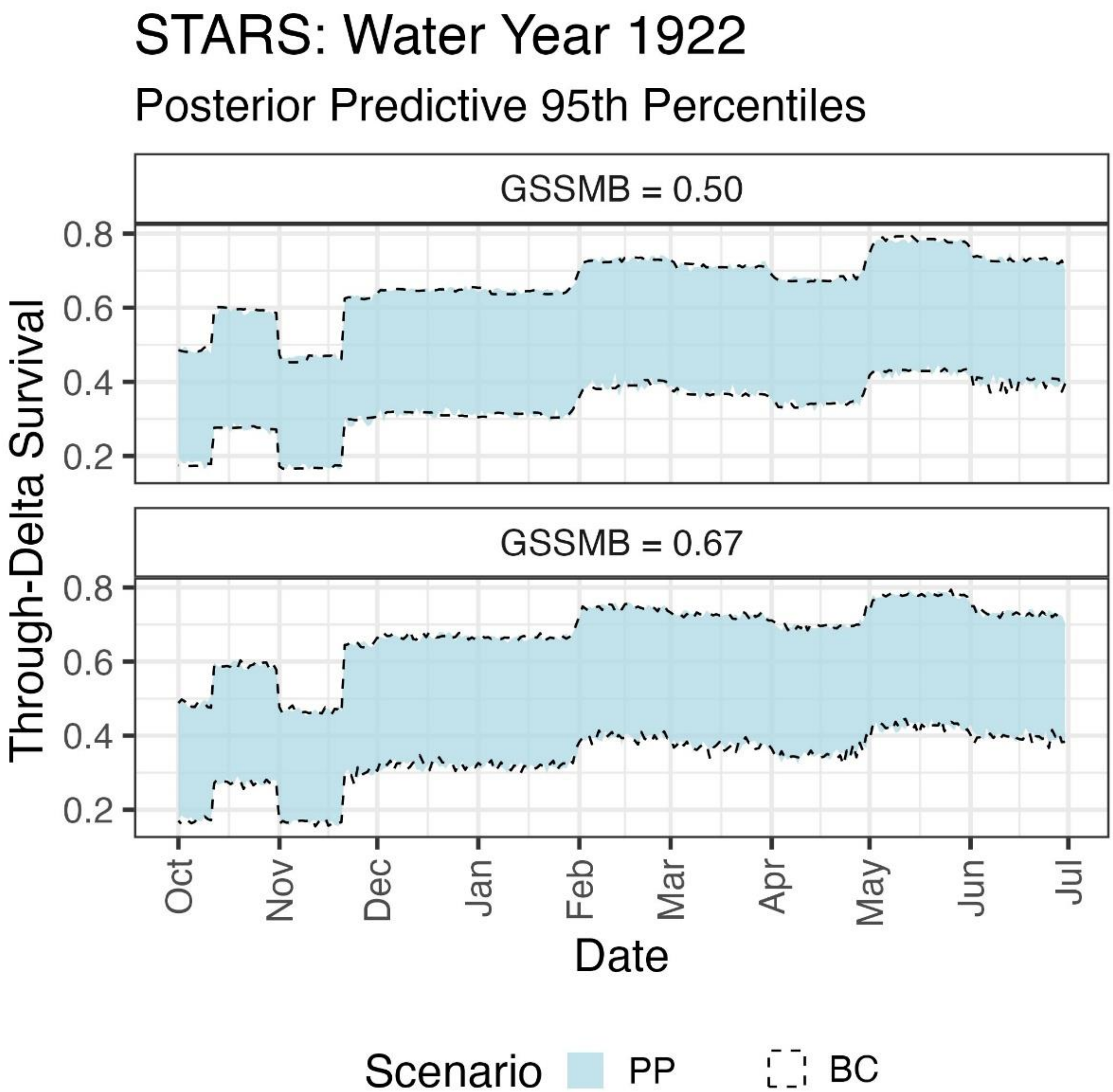
6B.5 Survival, Travel Time, and Routing Analysis (STARS, Based on Perry et al. 2018)

6B.5.1 Methods

Through-Delta survival of juvenile Chinook Salmon migrating through the Delta from the Sacramento River was assessed using a version of the through-Delta survival function formulated by Perry et al. (2018), which estimates through-Delta survival as a function of daily Sacramento River flow at Freeport and DCC gate position (open or closed). This model reproduces the mean response of the STARS (Survival, Travel time, And Routing Simulation) model (Perry et al. 2020), with statistical uncertainty illustrated through incorporation of the Bayesian posterior distribution (Perry pers. comm., March 30, 2023). Daily through-Delta survival for each scenario was calculated, together with 95 percent posterior predictive intervals and the daily probability of the Proposed Project scenario survival being less than the Baseline Conditions scenario based on 1,000 random sorts of the two distributions. Results were summarized by month and water year type. All analysis was conducted in R software (R Core Team 2023). There is some uncertainty in the extent to which the relationships in the model are representative of wild-origin Chinook Salmon juveniles, given that the model was based on results from larger hatchery-origin late-fall-run Chinook Salmon juveniles; however, the results of the DPM, described above, are based on hatchery-origin Chinook Salmon juveniles that are more similar in size to wild-origin migrating juvenile Chinook Salmon (smolts).

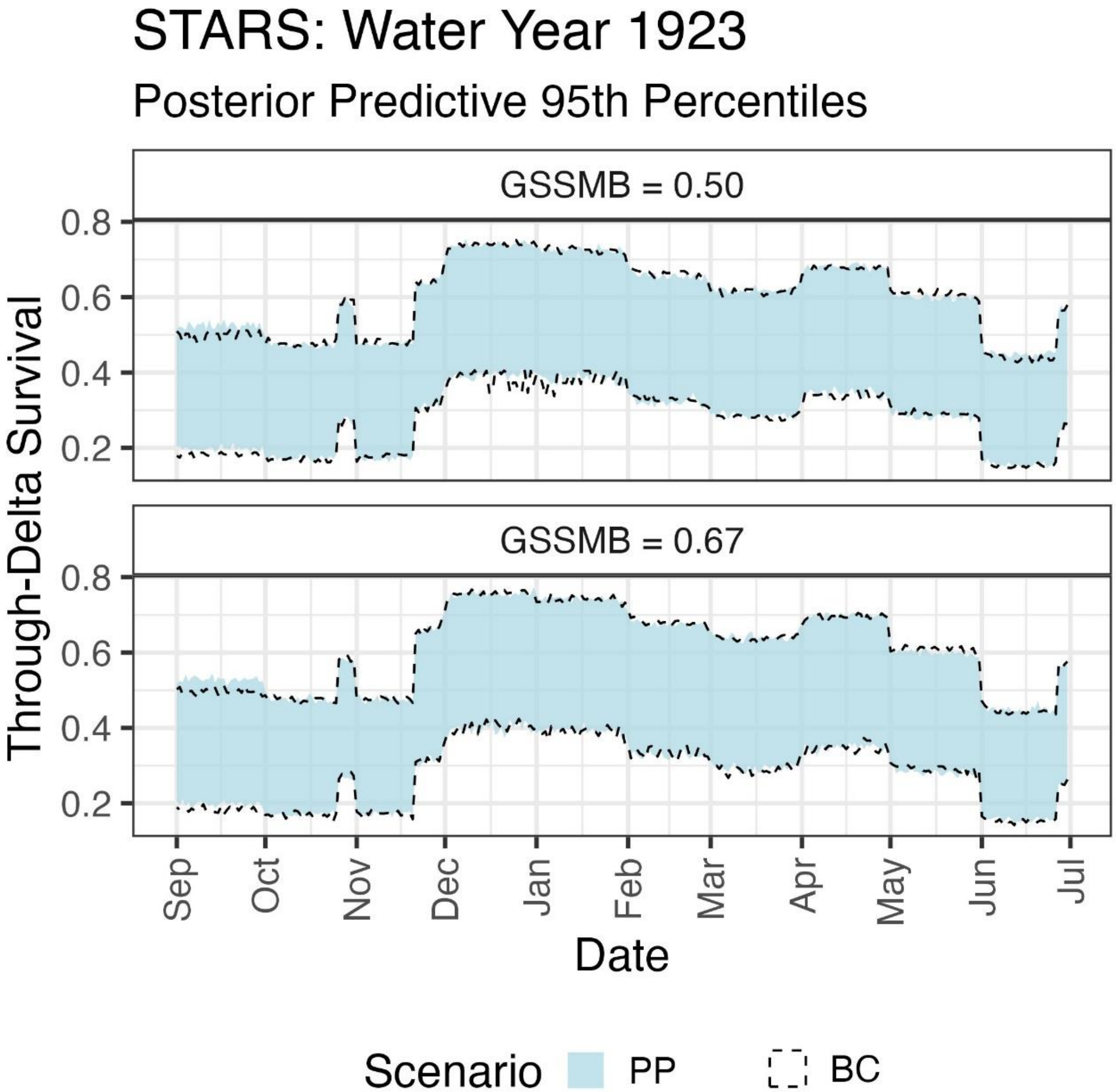
6B.5.2 Results

Results are discussed in Chapter 6. Figure 6B-295 through Figure 6B-394 provide plots of 95 percent posterior predictive intervals by water year.



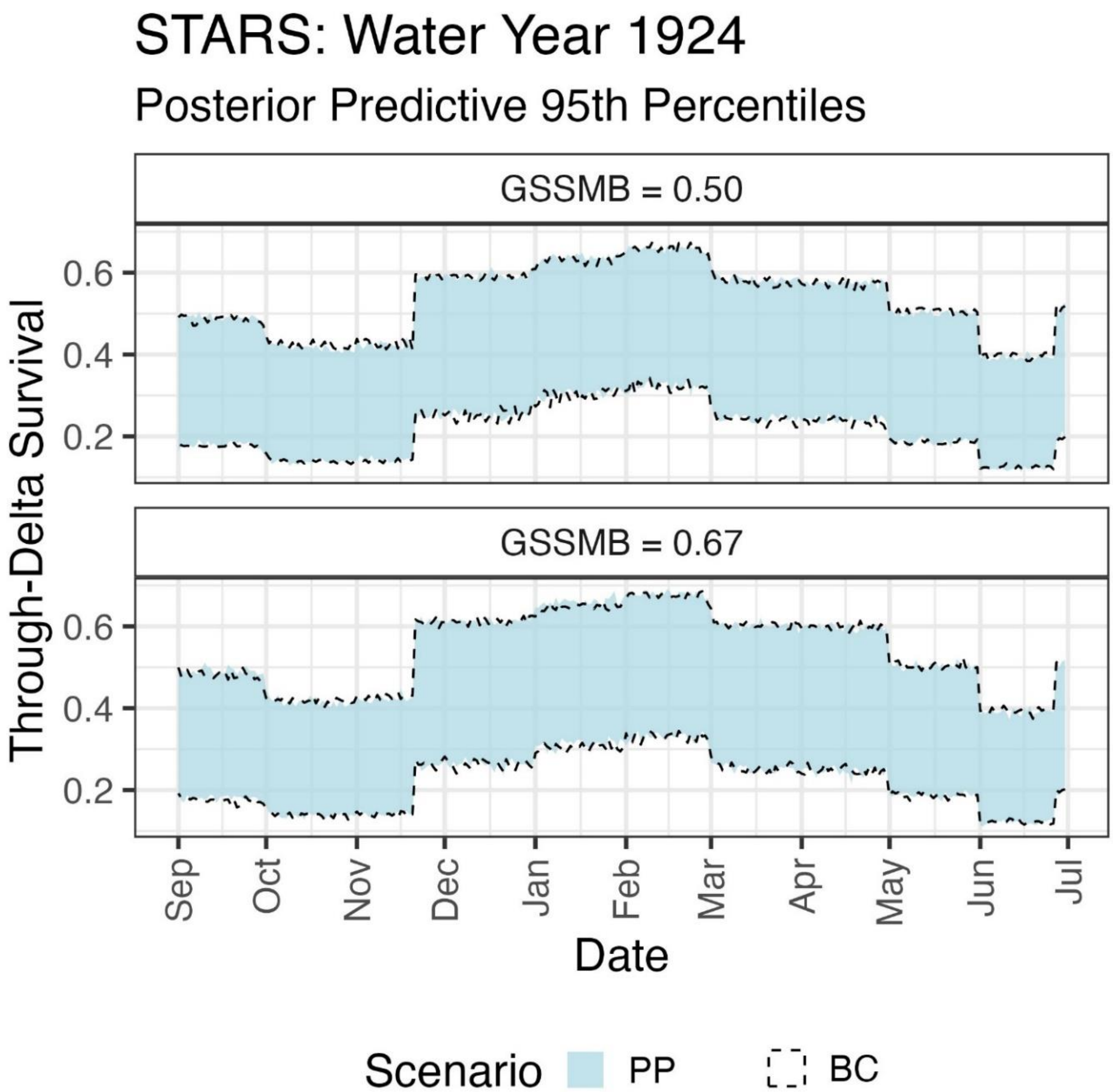
Note: September is included in following water year.

Figure 6B-295. STARS: 95% Posterior Predictive Intervals for Water Year 1922.



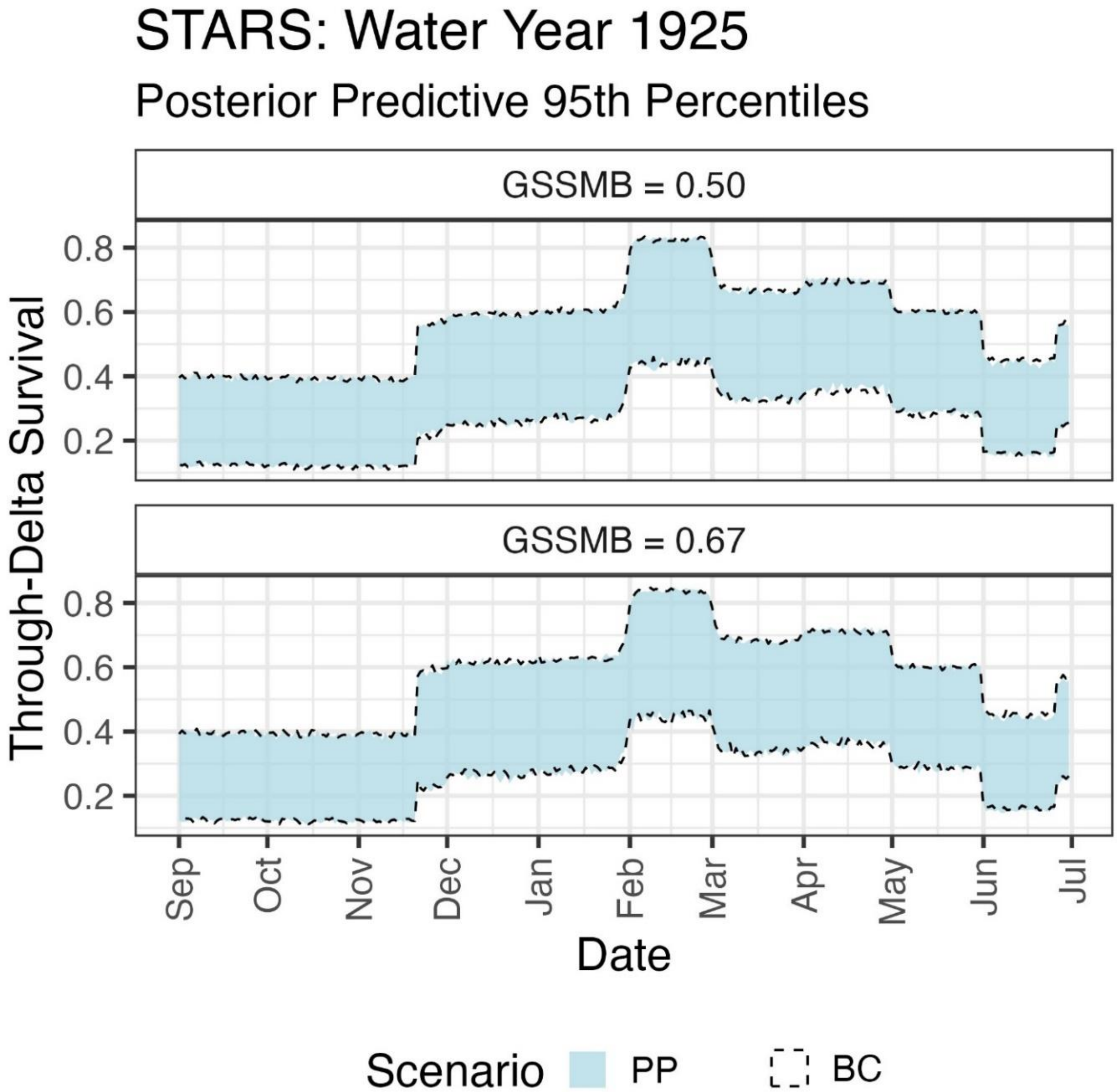
Note: September is included in following water year.

Figure 6B-296. STARS: 95% Posterior Predictive Intervals for Water Year 1923.



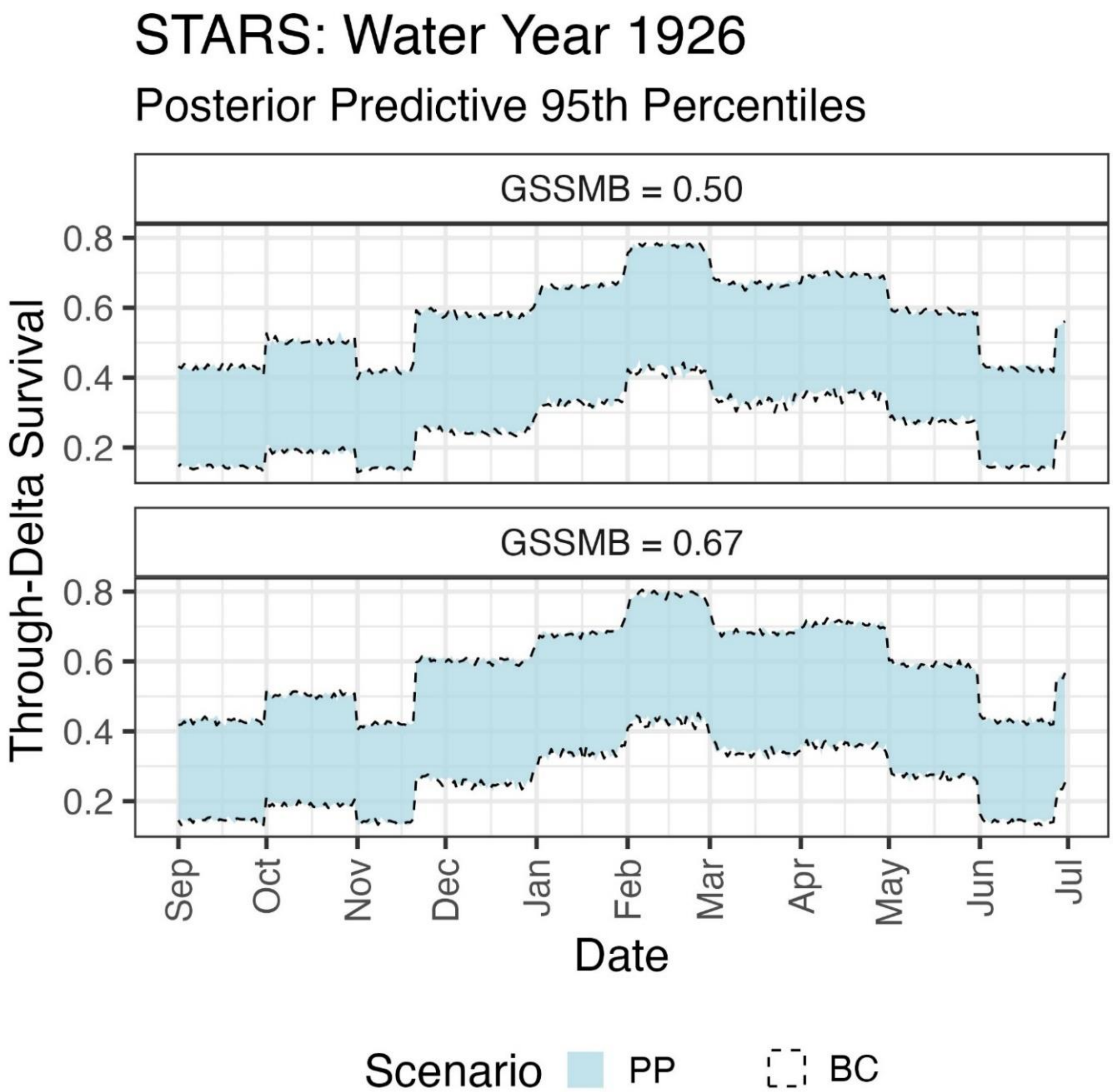
Note: September is included in following water year.

Figure 6B-297. STARS: 95% Posterior Predictive Intervals for Water Year 1924.



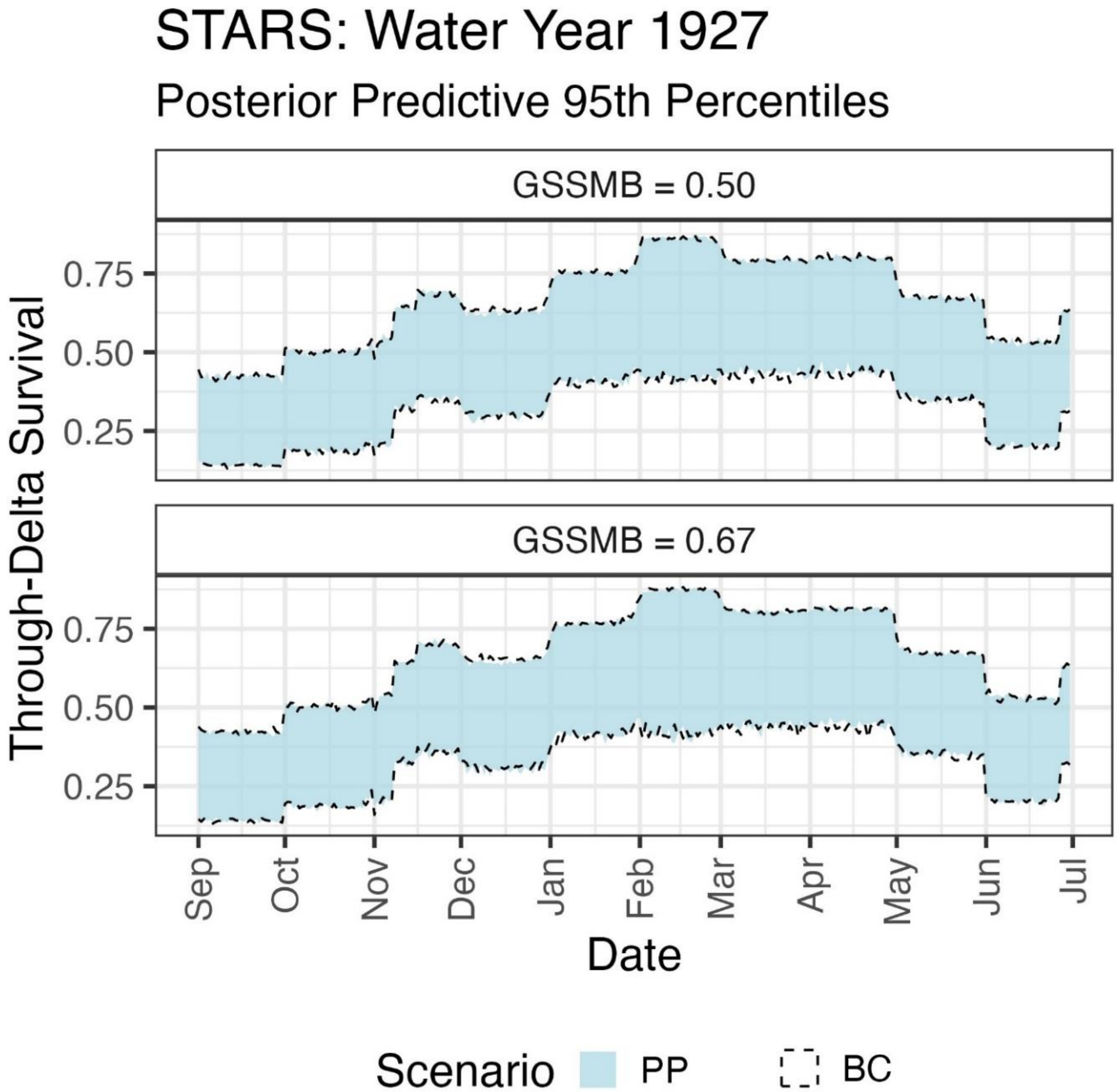
Note: September is included in following water year.

Figure 6B-298. STARS: 95% Posterior Predictive Intervals for Water Year 1925.



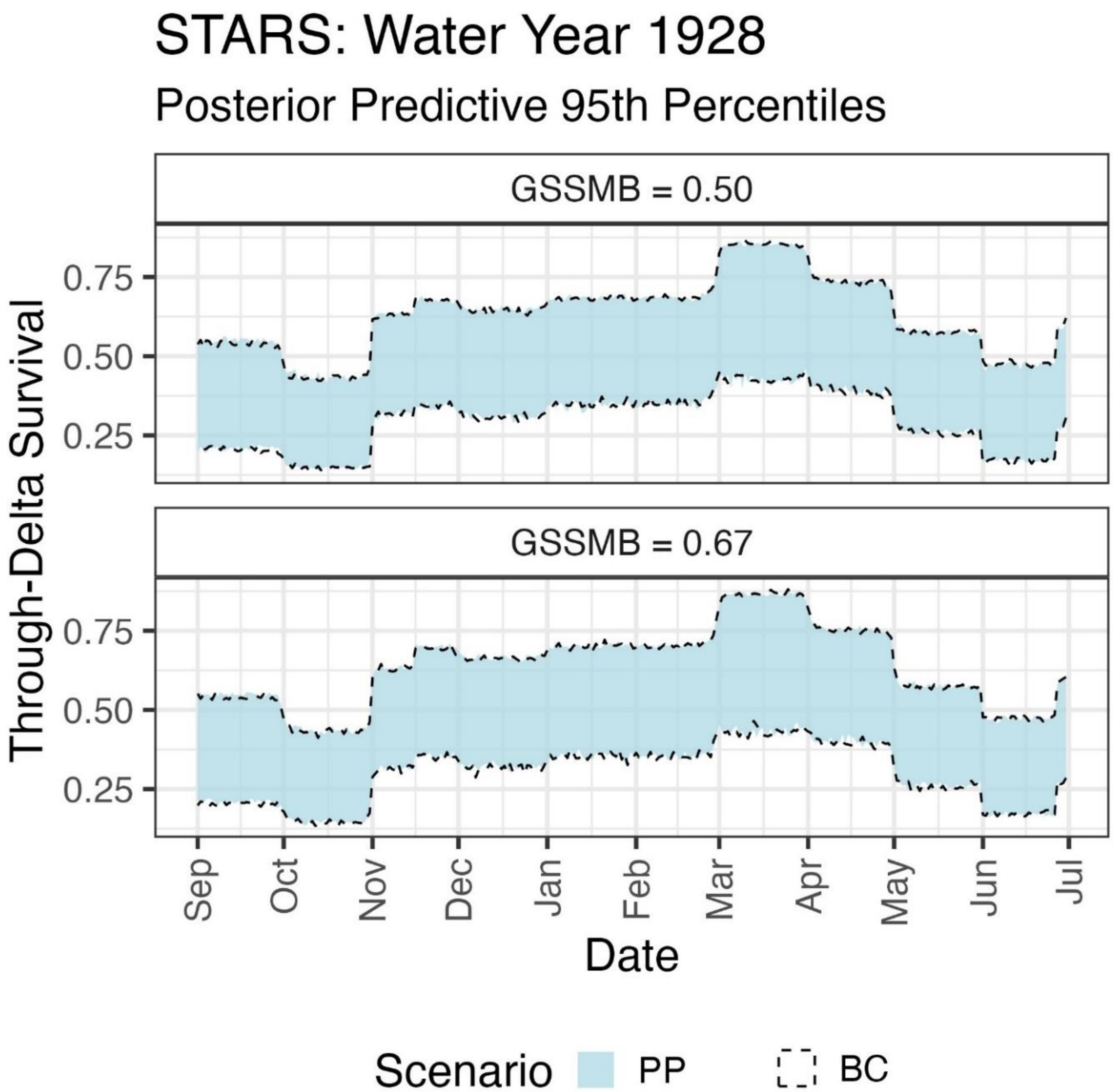
Note: September is included in following water year.

Figure 6B-299. STARS: 95% Posterior Predictive Intervals for Water Year 1926.



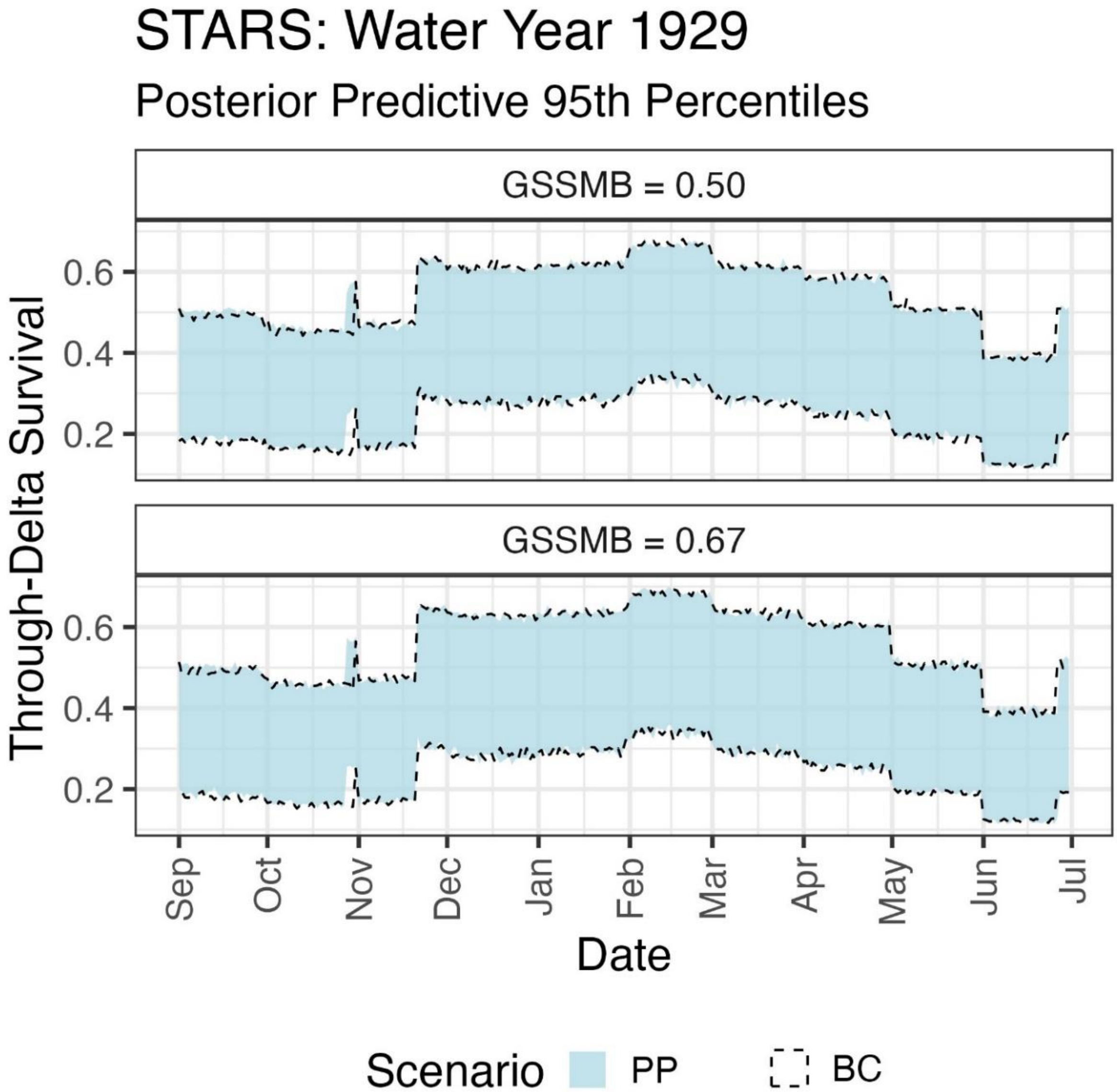
Note: September is included in following water year.

Figure 6B-300. STARS: 95% Posterior Predictive Intervals for Water Year 1927.



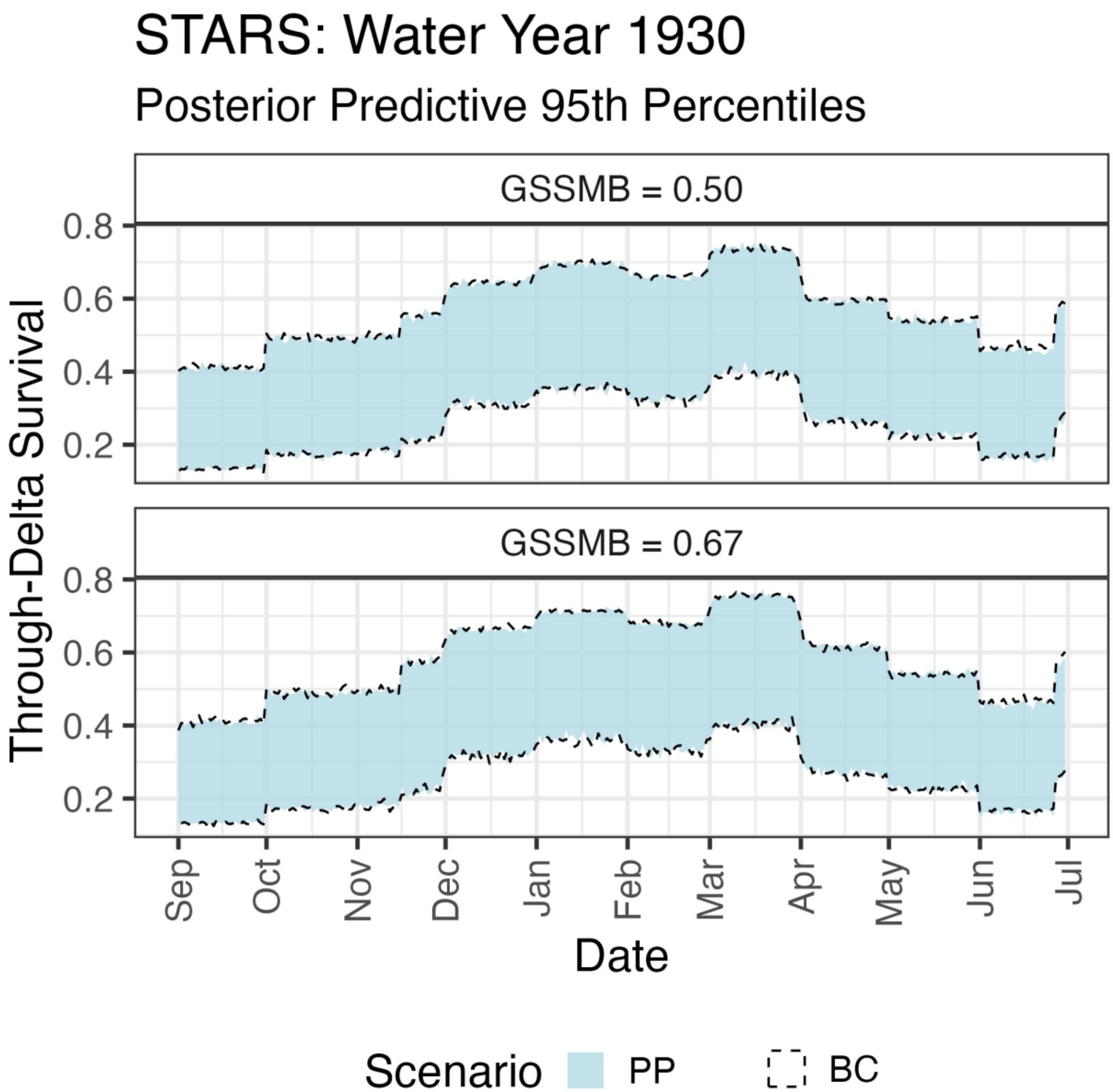
Note: September is included in following water year.

Figure 6B-301. STARS: 95% Posterior Predictive Intervals for Water Year 1928.



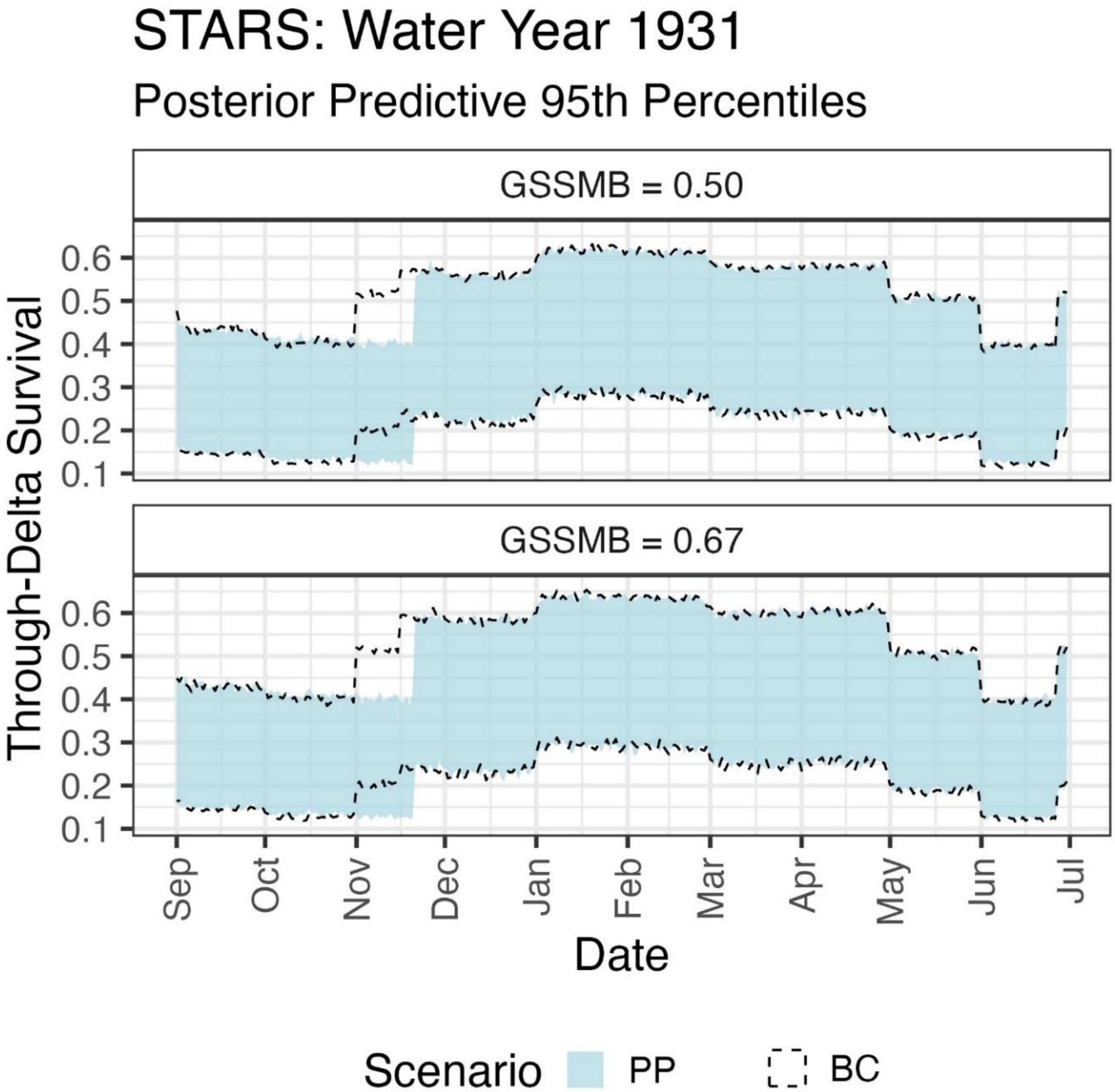
Note: September is included in following water year.

Figure 6B-302. STARS: 95% Posterior Predictive Intervals for Water Year 1929.



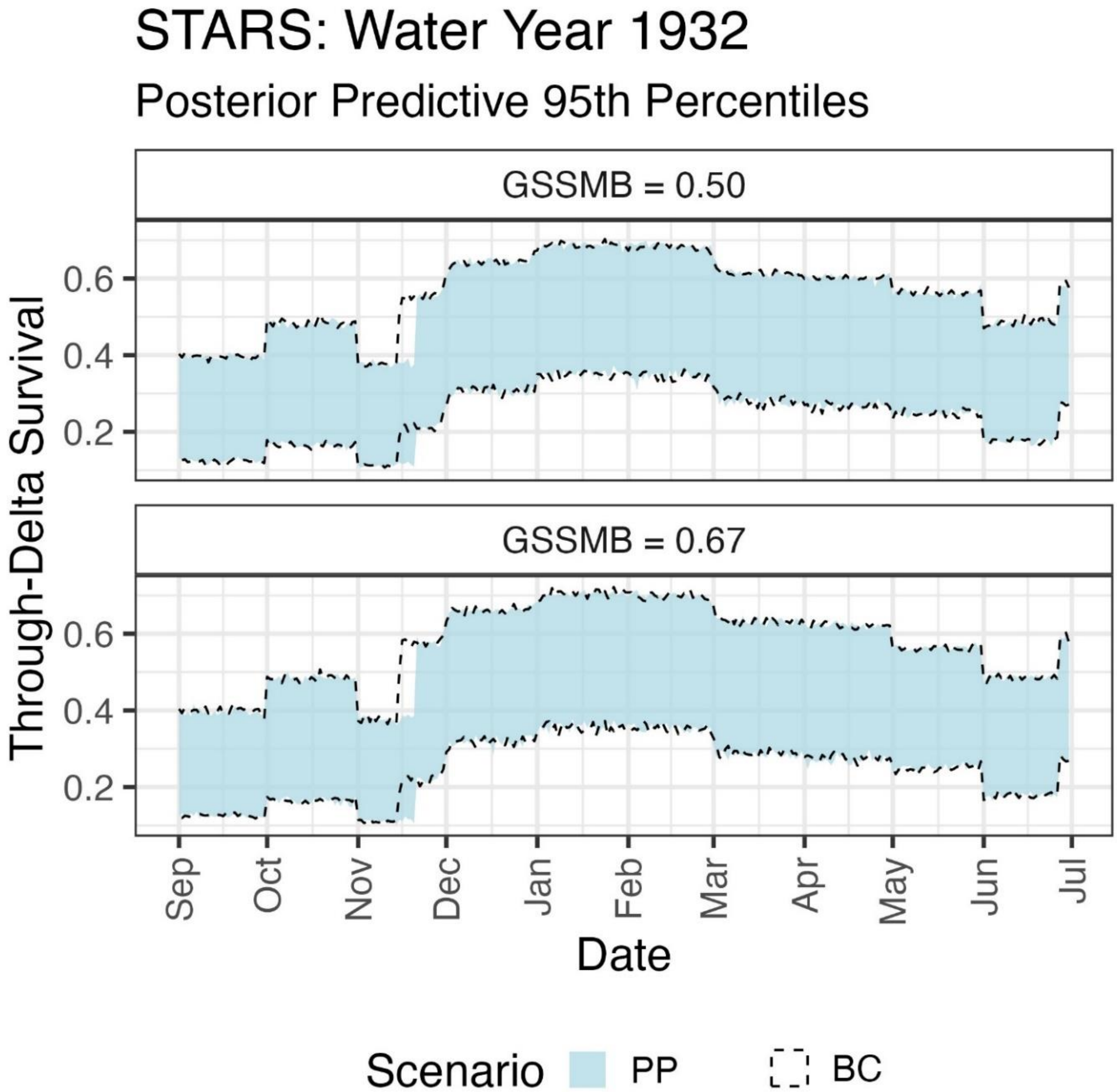
Note: September is included in following water year.

Figure 6B-303. STARS: 95% Posterior Predictive Intervals for Water Year 1930.



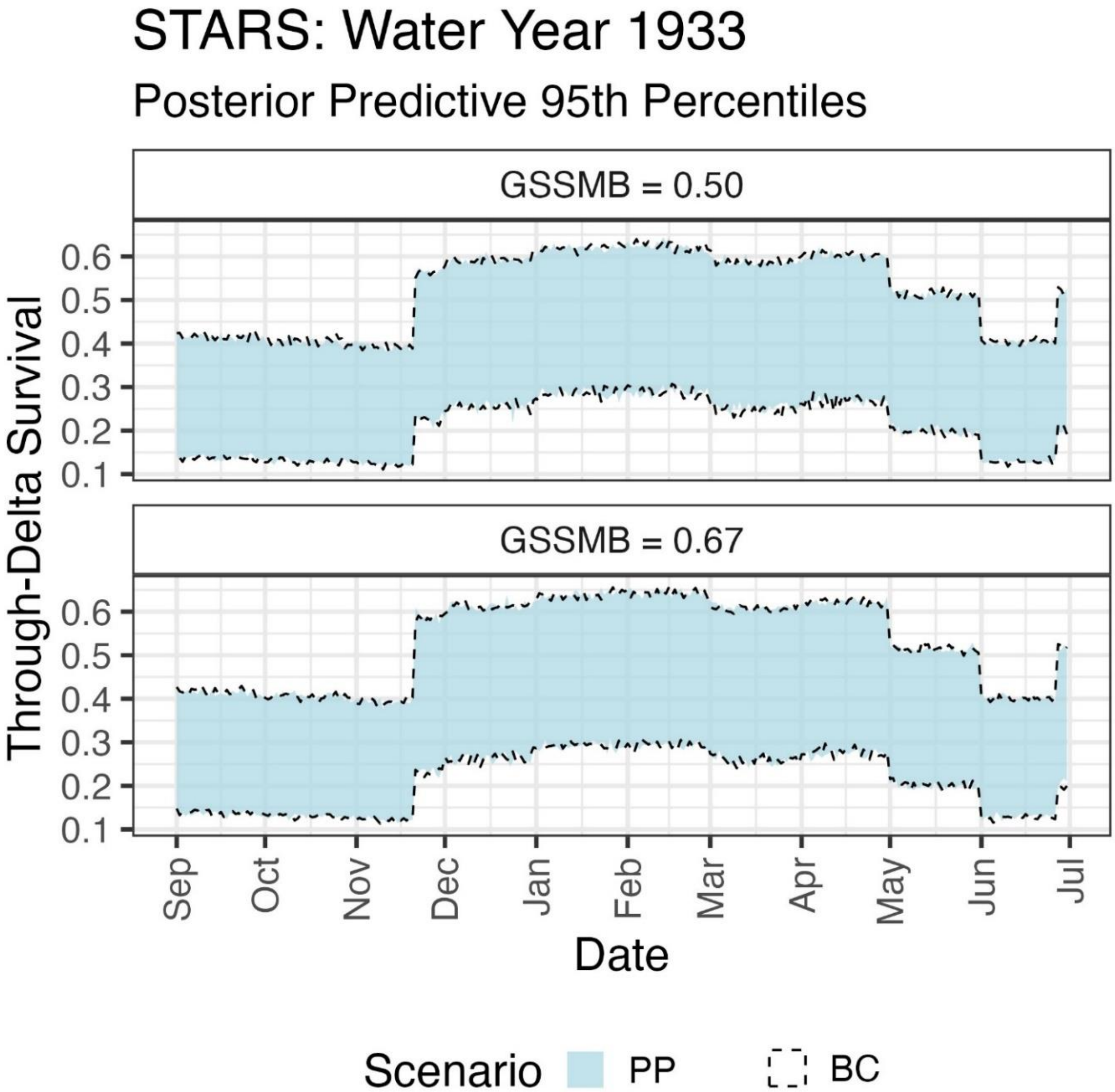
Note: September is included in following water year.

Figure 6B-304. STARS: 95% Posterior Predictive Intervals for Water Year 1931.



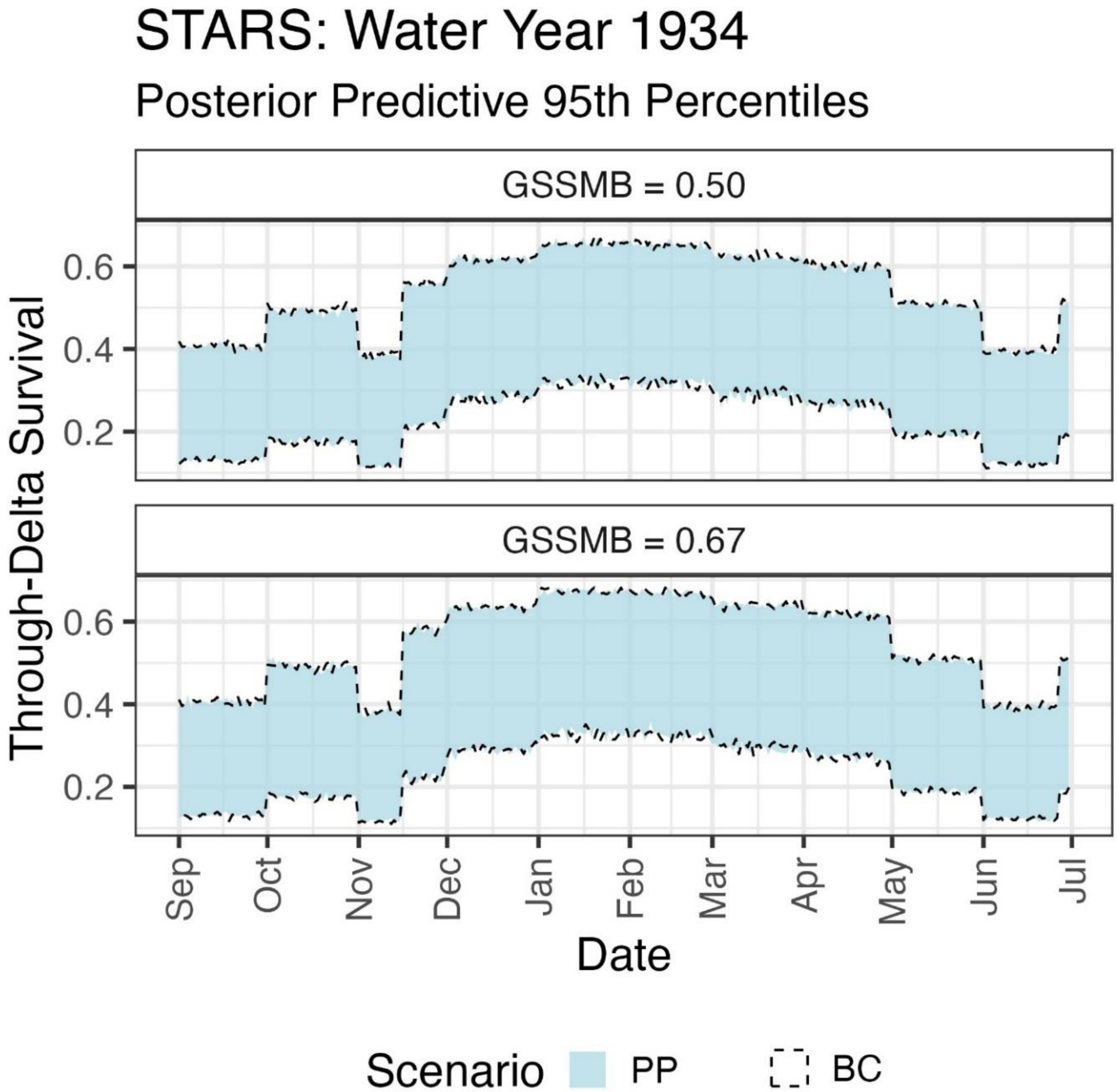
Note: September is included in following water year.

Figure 6B-305. STARS: 95% Posterior Predictive Intervals for Water Year 1932.



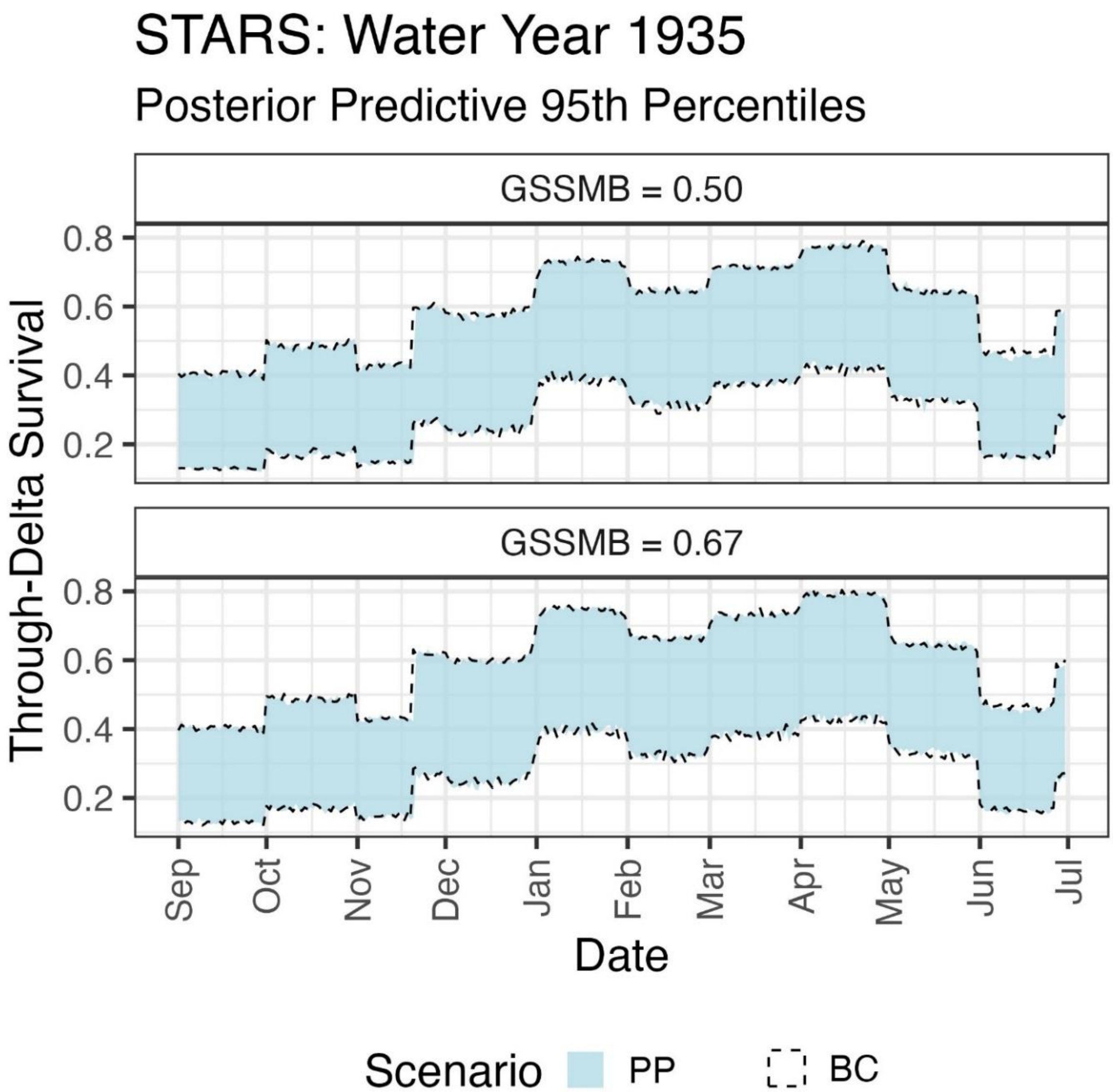
Note: September is included in following water year.

Figure 6B-306. STARS: 95% Posterior Predictive Intervals for Water Year 1933.



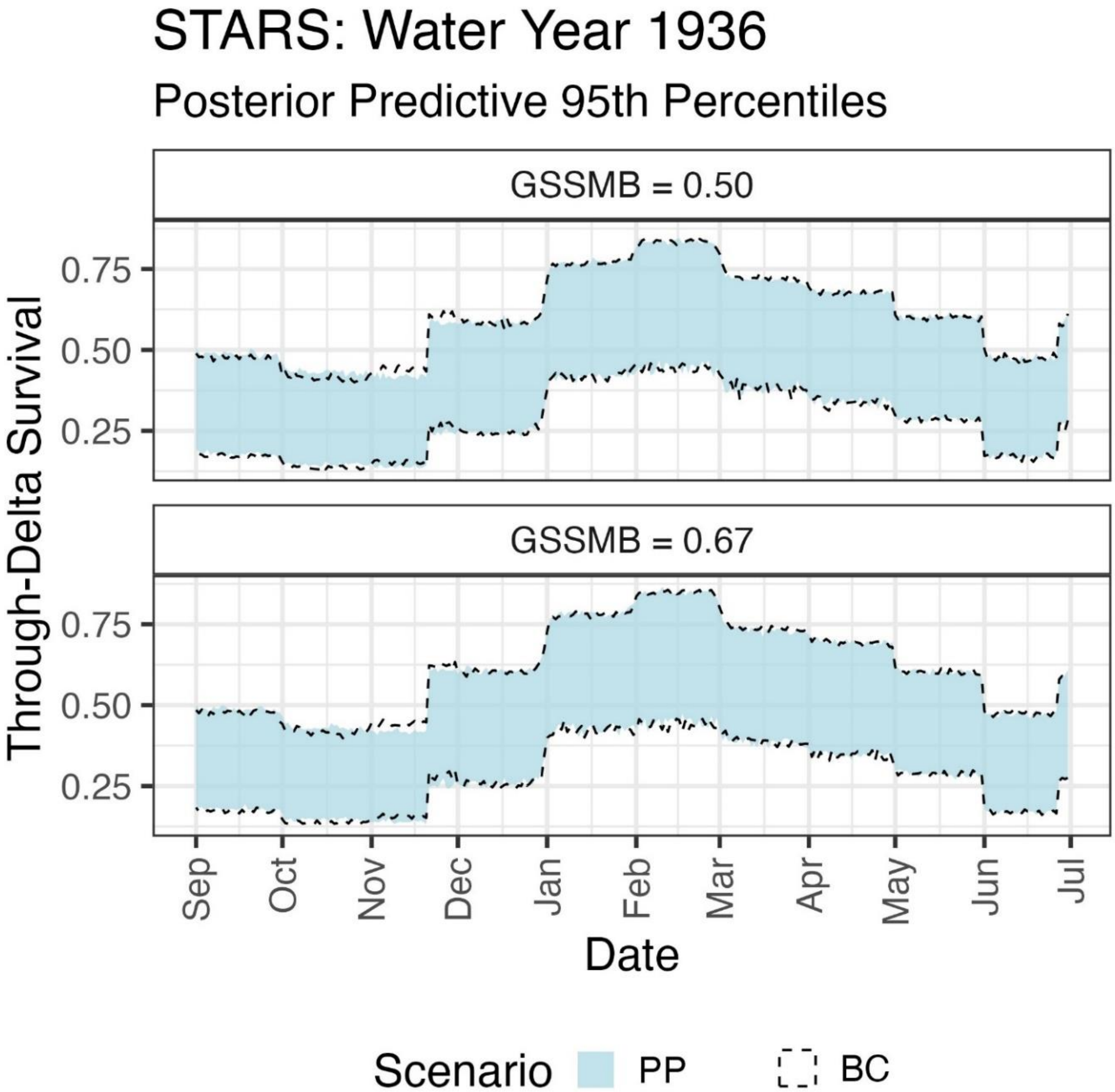
Note: September is included in following water year.

Figure 6B-307. STARS: 95% Posterior Predictive Intervals for Water Year 1934.



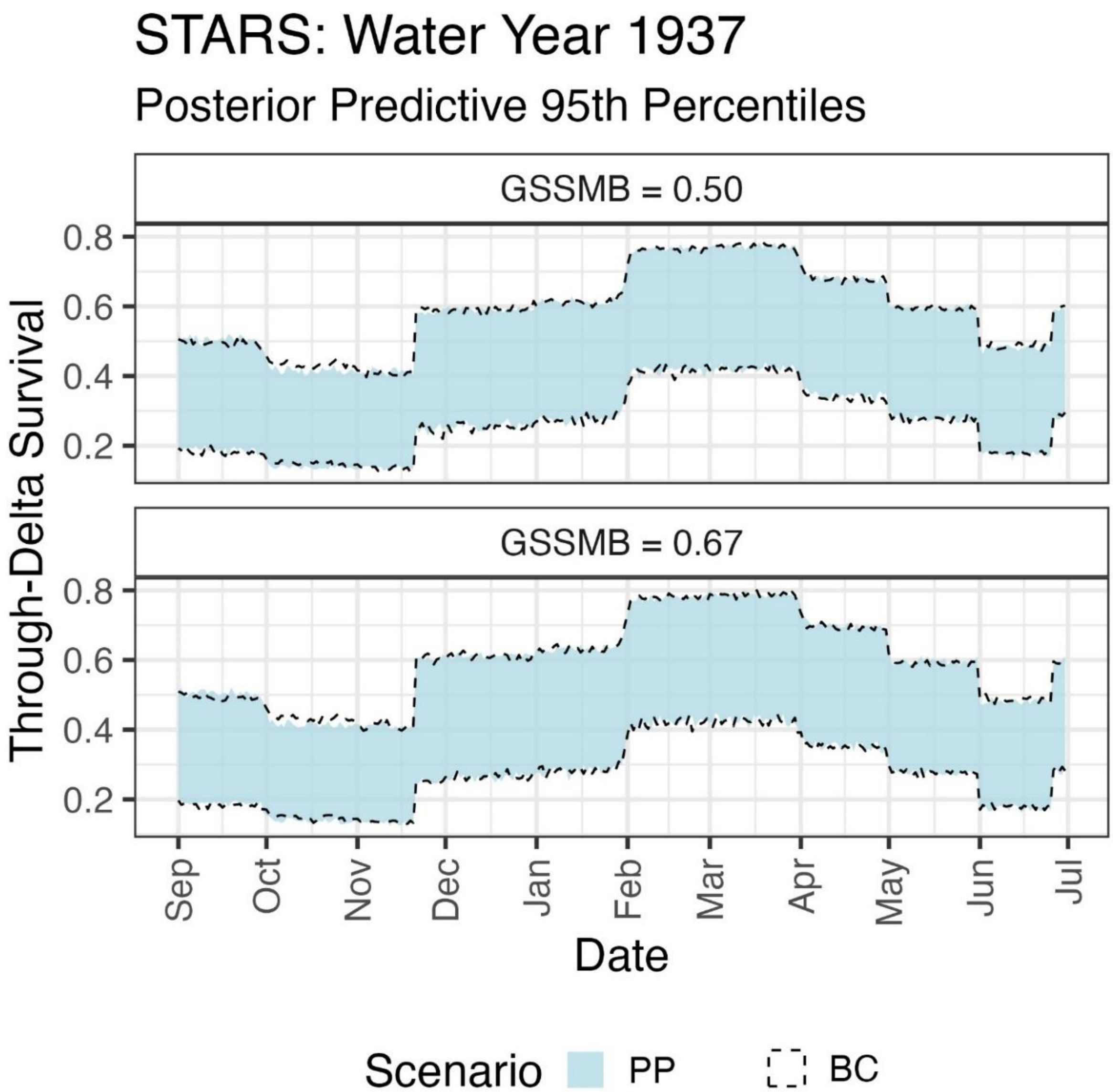
Note: September is included in following water year.

Figure 6B-308. STARS: 95% Posterior Predictive Intervals for Water Year 1935.



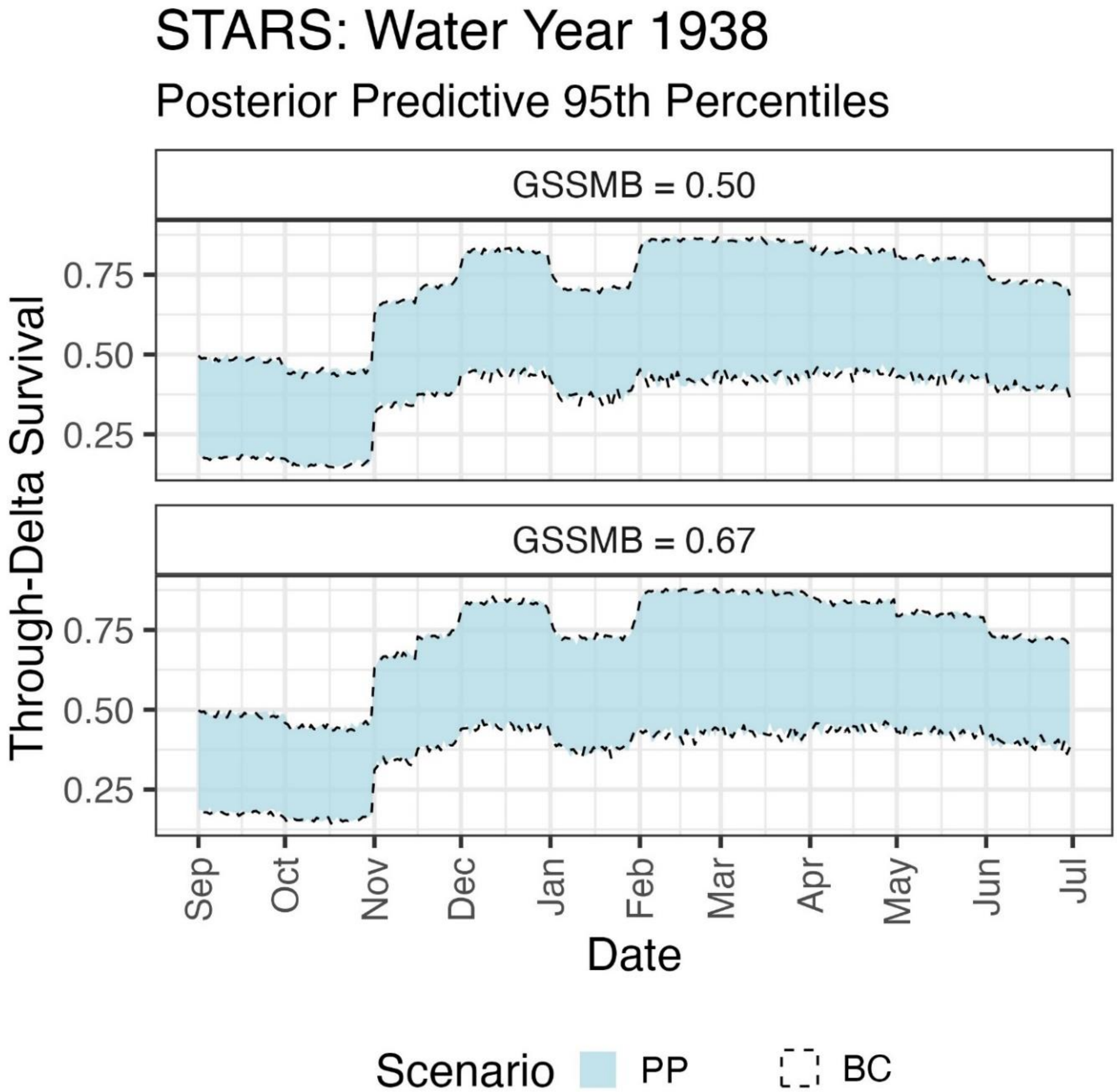
Note: September is included in following water year.

Figure 6B-309. STARS: 95% Posterior Predictive Intervals for Water Year 1936.



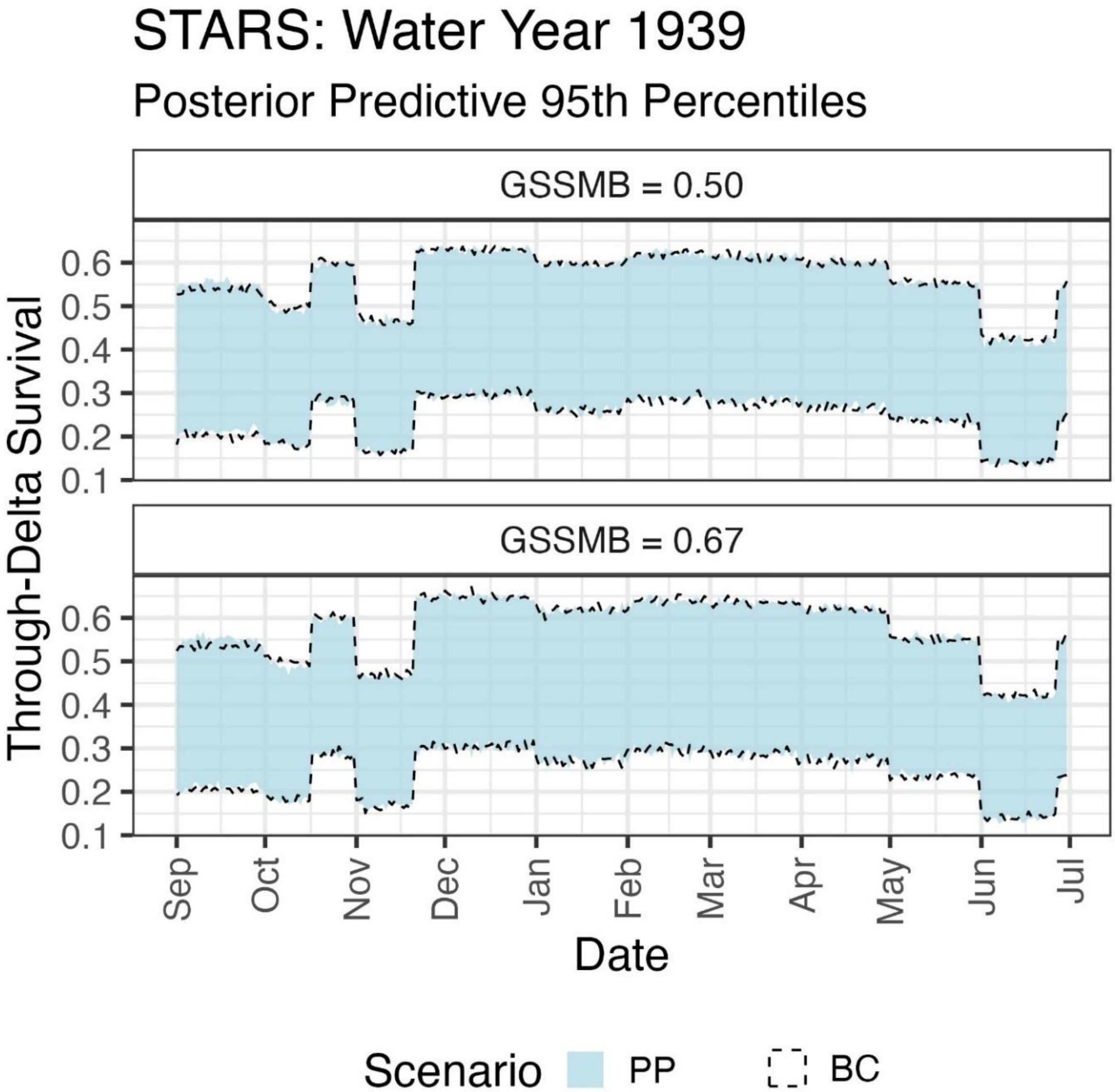
Note: September is included in following water year.

Figure 6B-310. STARS: 95% Posterior Predictive Intervals for Water Year 1937.



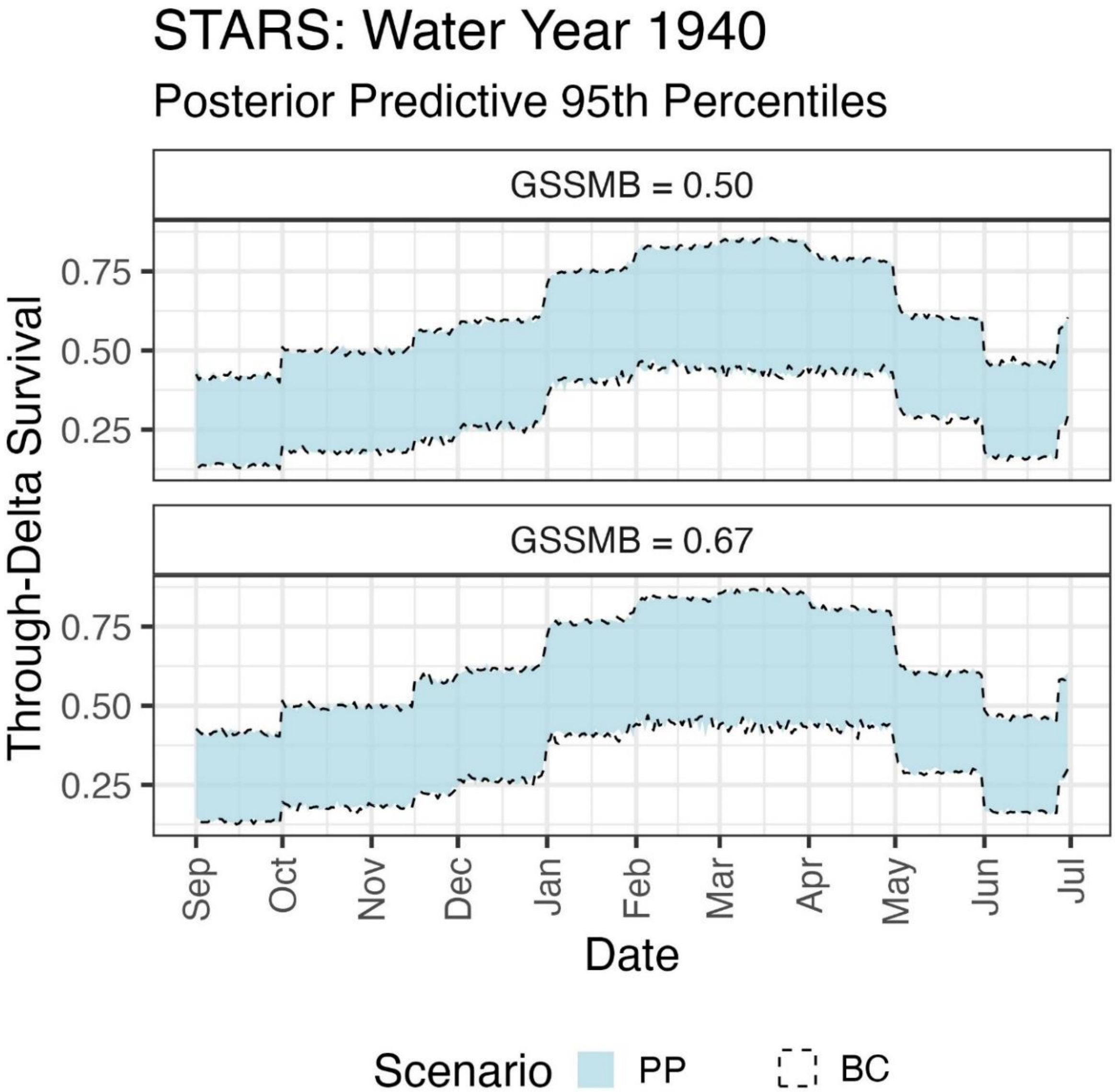
Note: September is included in following water year.

Figure 6B-311. STARS: 95% Posterior Predictive Intervals for Water Year 1938.



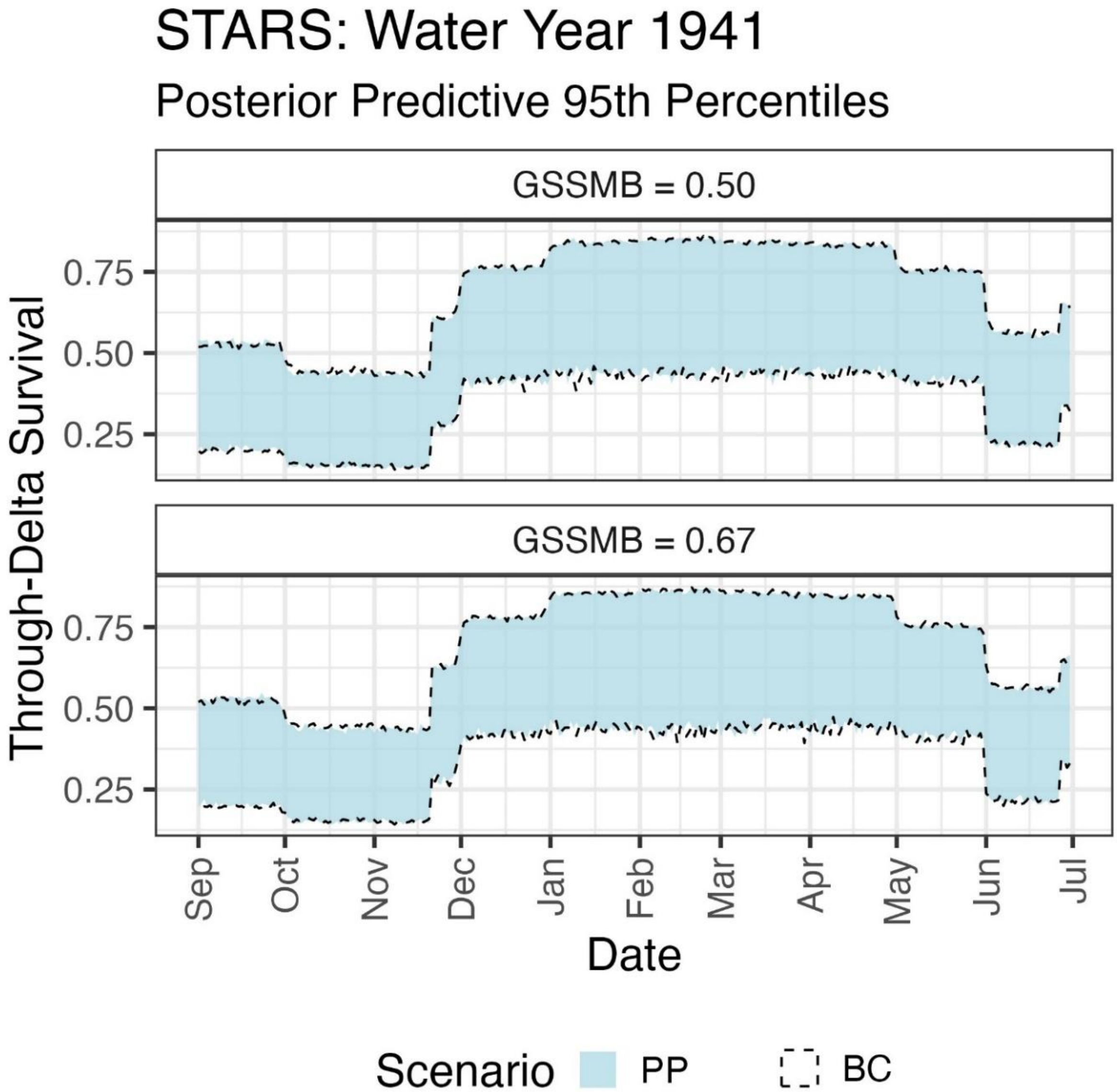
Note: September is included in following water year.

Figure 6B-312. STARS: 95% Posterior Predictive Intervals for Water Year 1939.



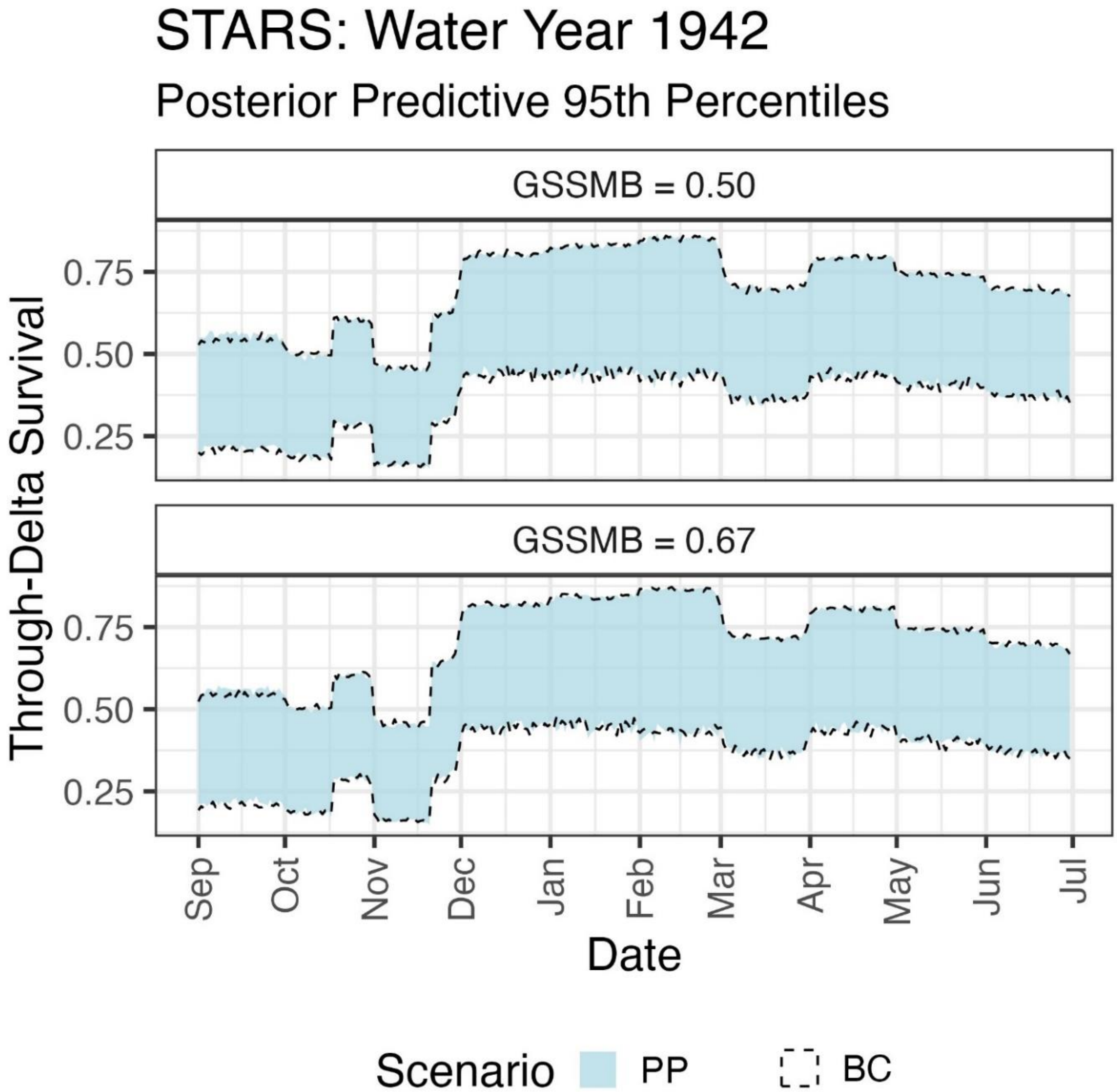
Note: September is included in following water year.

Figure 6B-313. STARS: 95% Posterior Predictive Intervals for Water Year 1940.



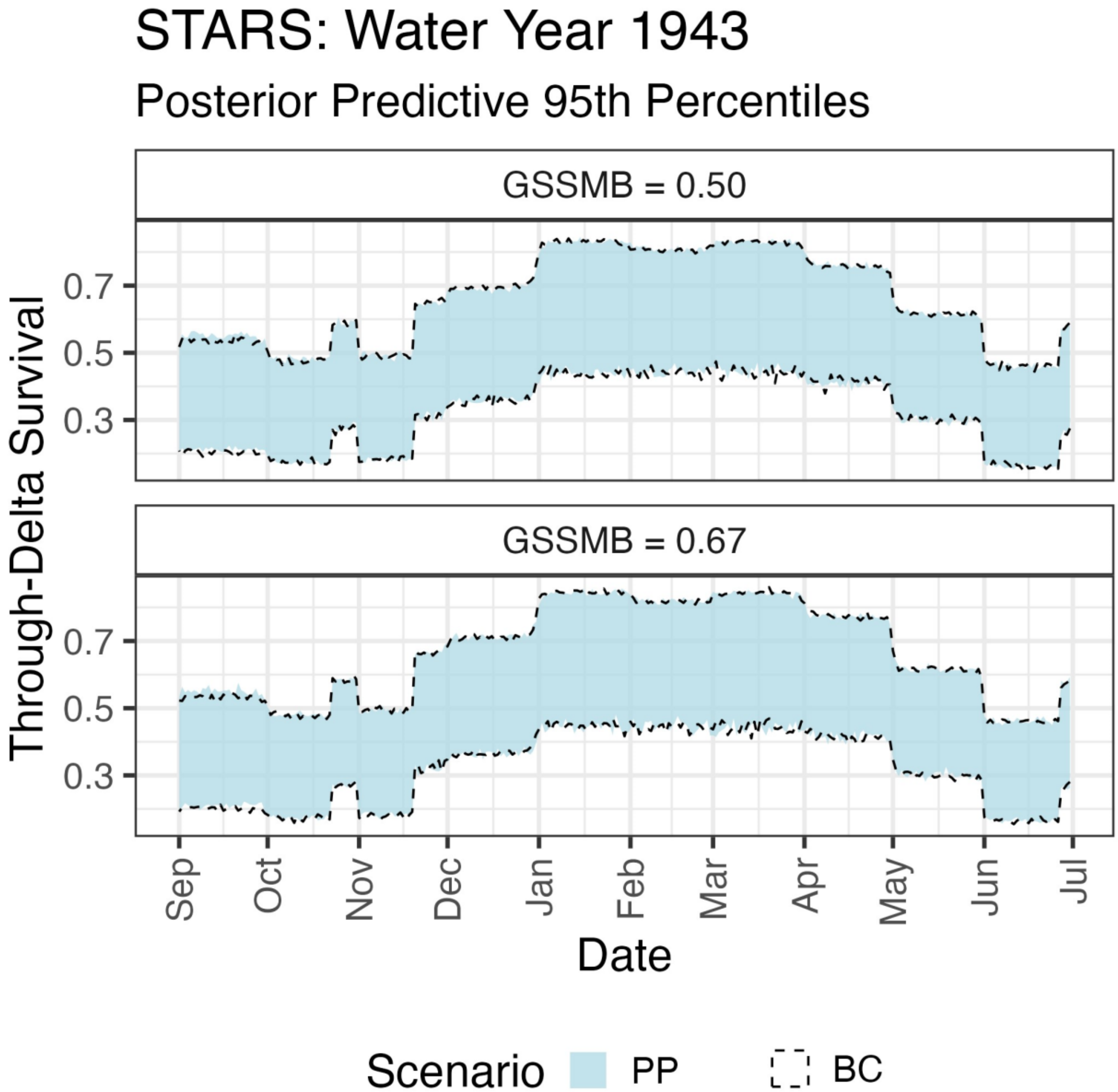
Note: September is included in following water year.

Figure 6B-314. STARS: 95% Posterior Predictive Intervals for Water Year 1941.



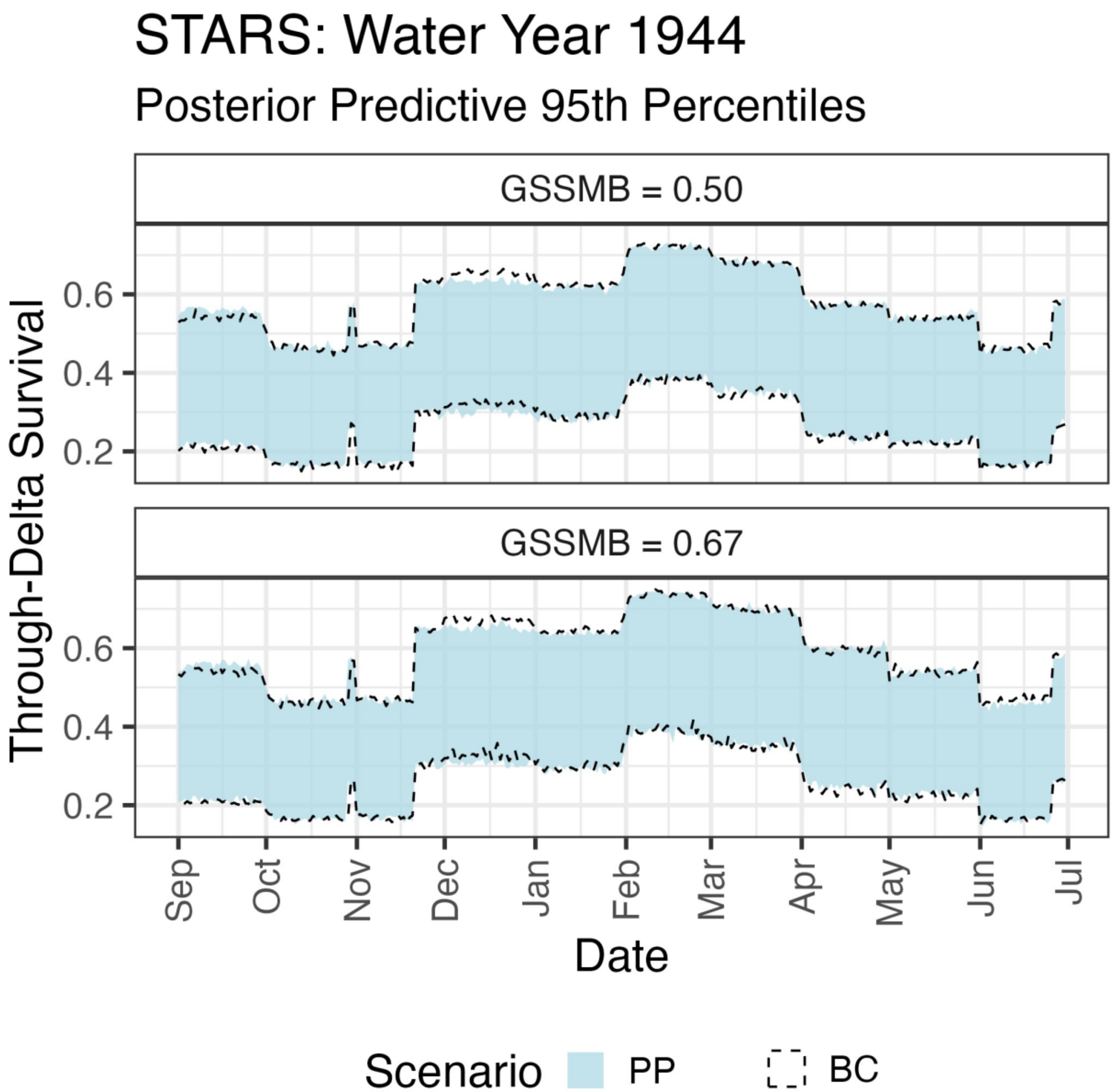
Note: September is included in following water year.

Figure 6B-315. STARS: 95% Posterior Predictive Intervals for Water Year 1942.



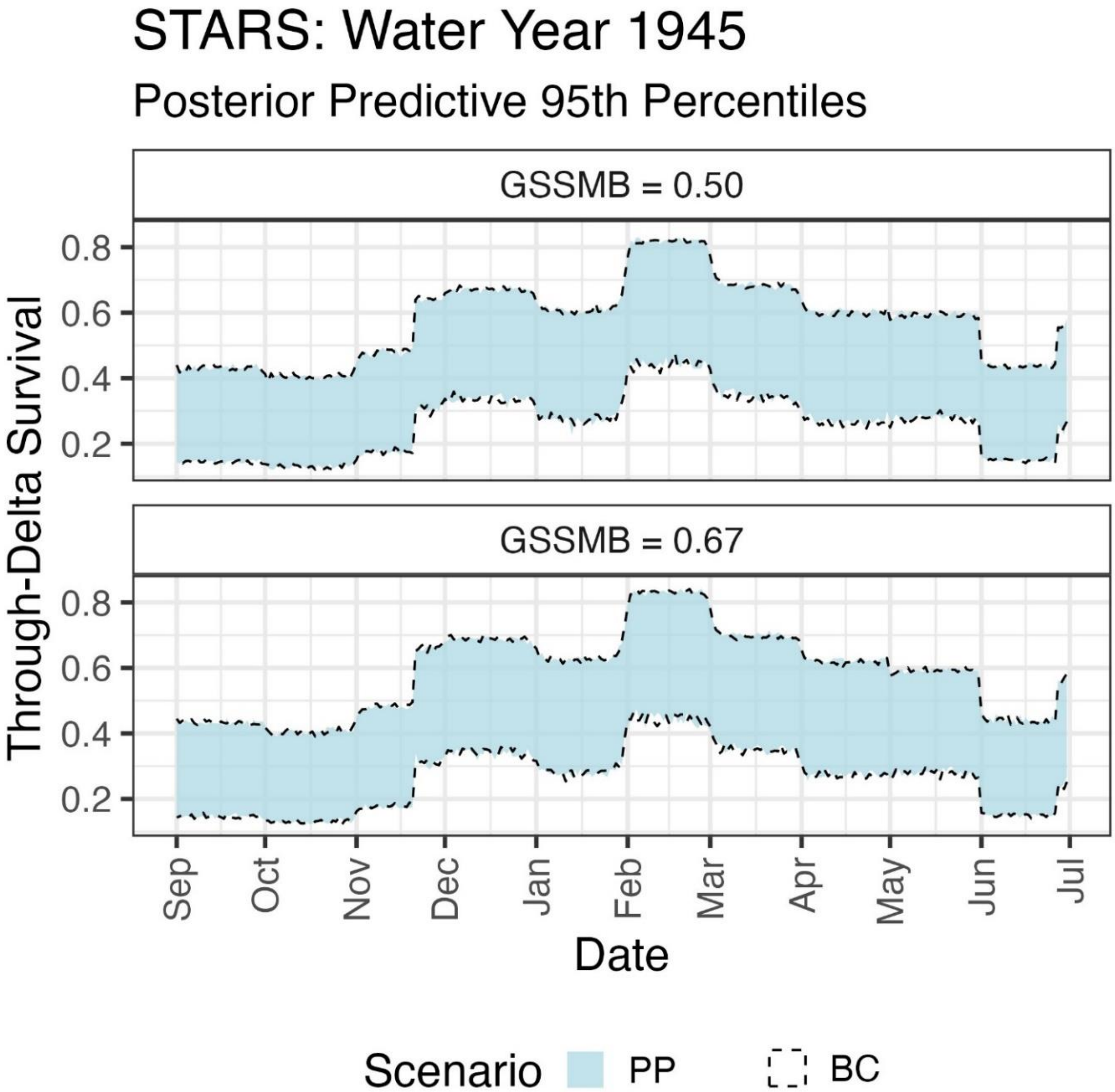
Note: September is included in following water year.

Figure 6B-316. STARS: 95% Posterior Predictive Intervals for Water Year 1943.



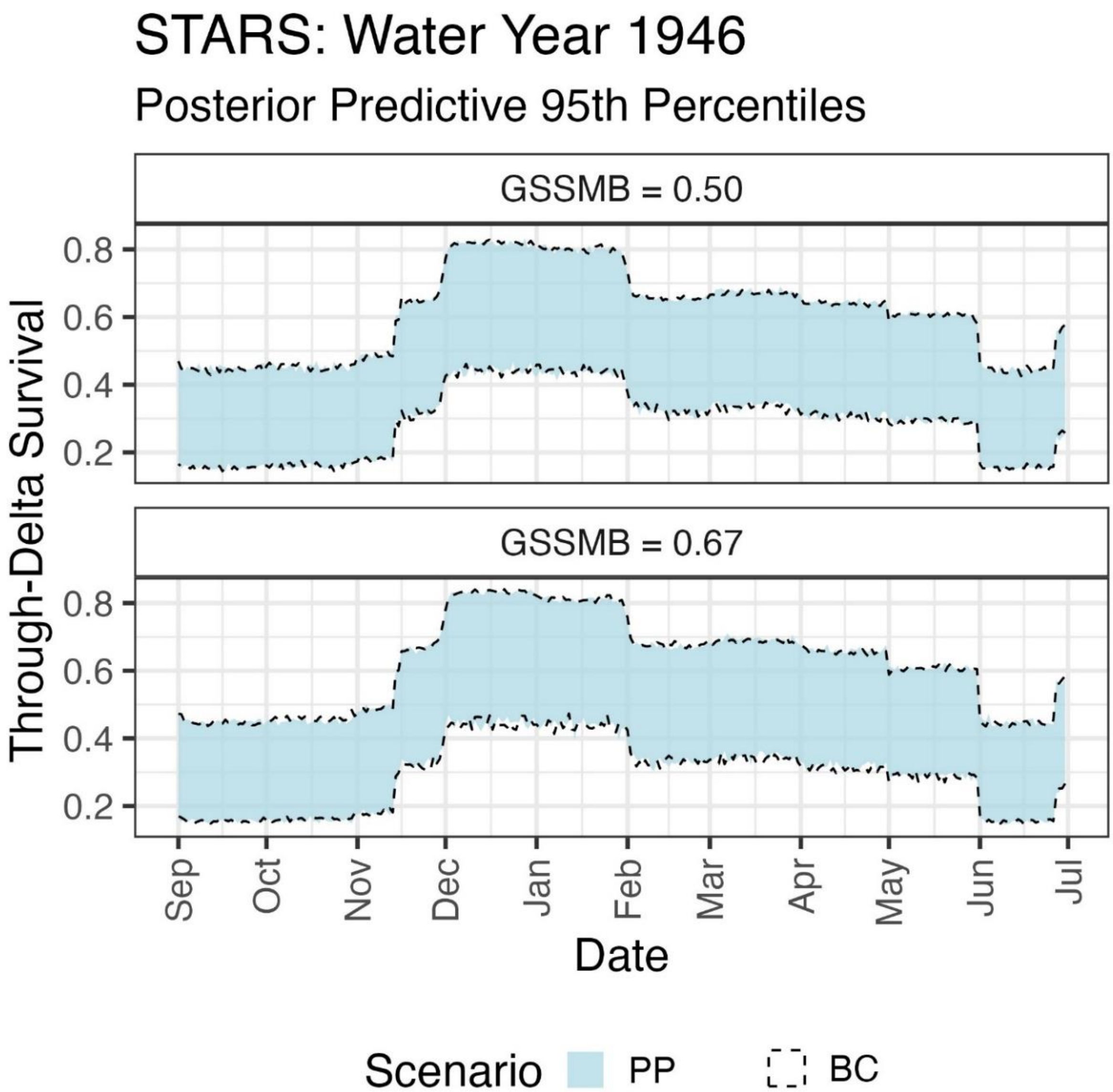
Note: September is included in following water year.

Figure 6B-317. STARS: 95% Posterior Predictive Intervals for Water Year 1944.



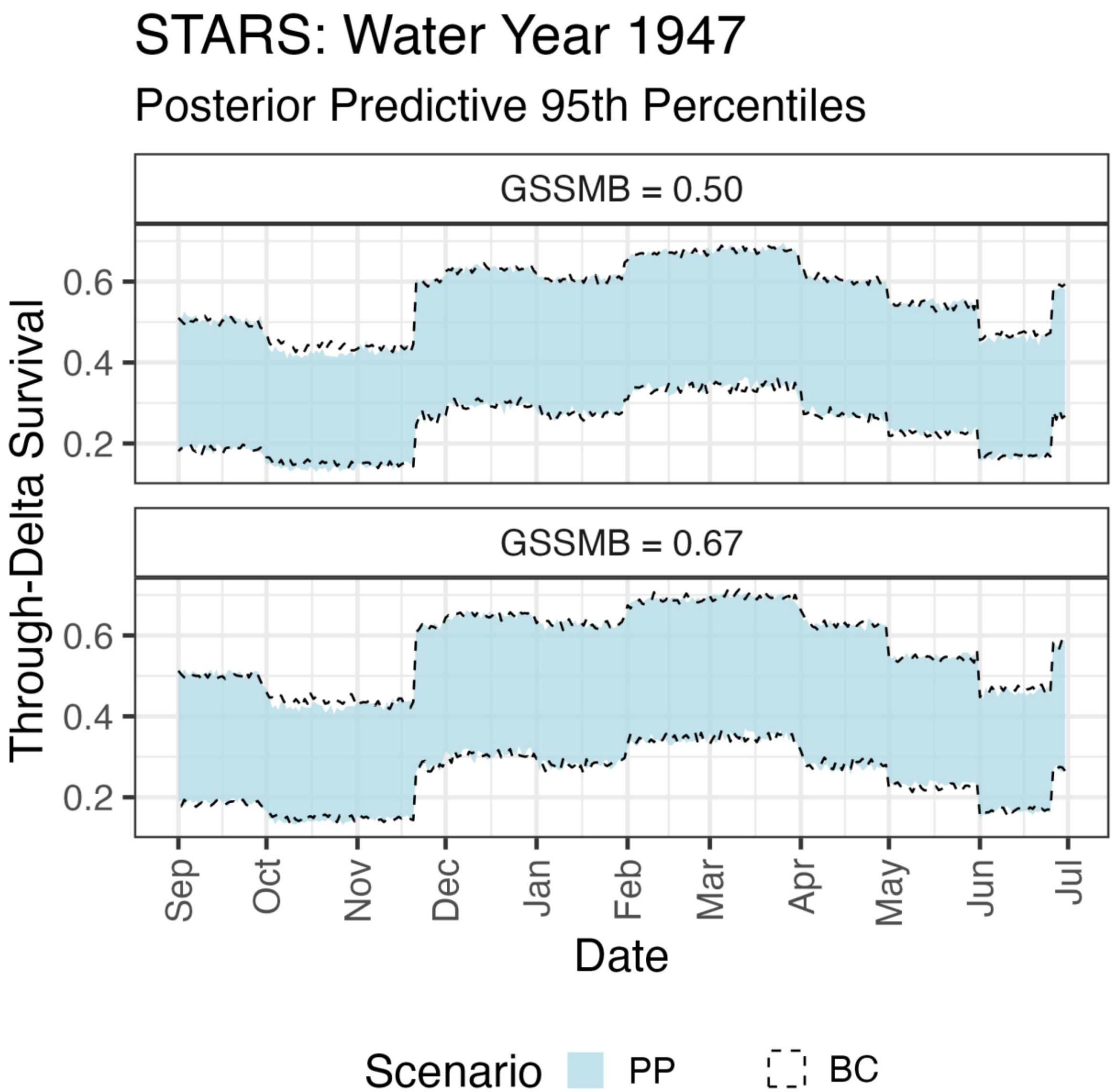
Note: September is included in following water year.

Figure 6B-318. STARS: 95% Posterior Predictive Intervals for Water Year 1945.



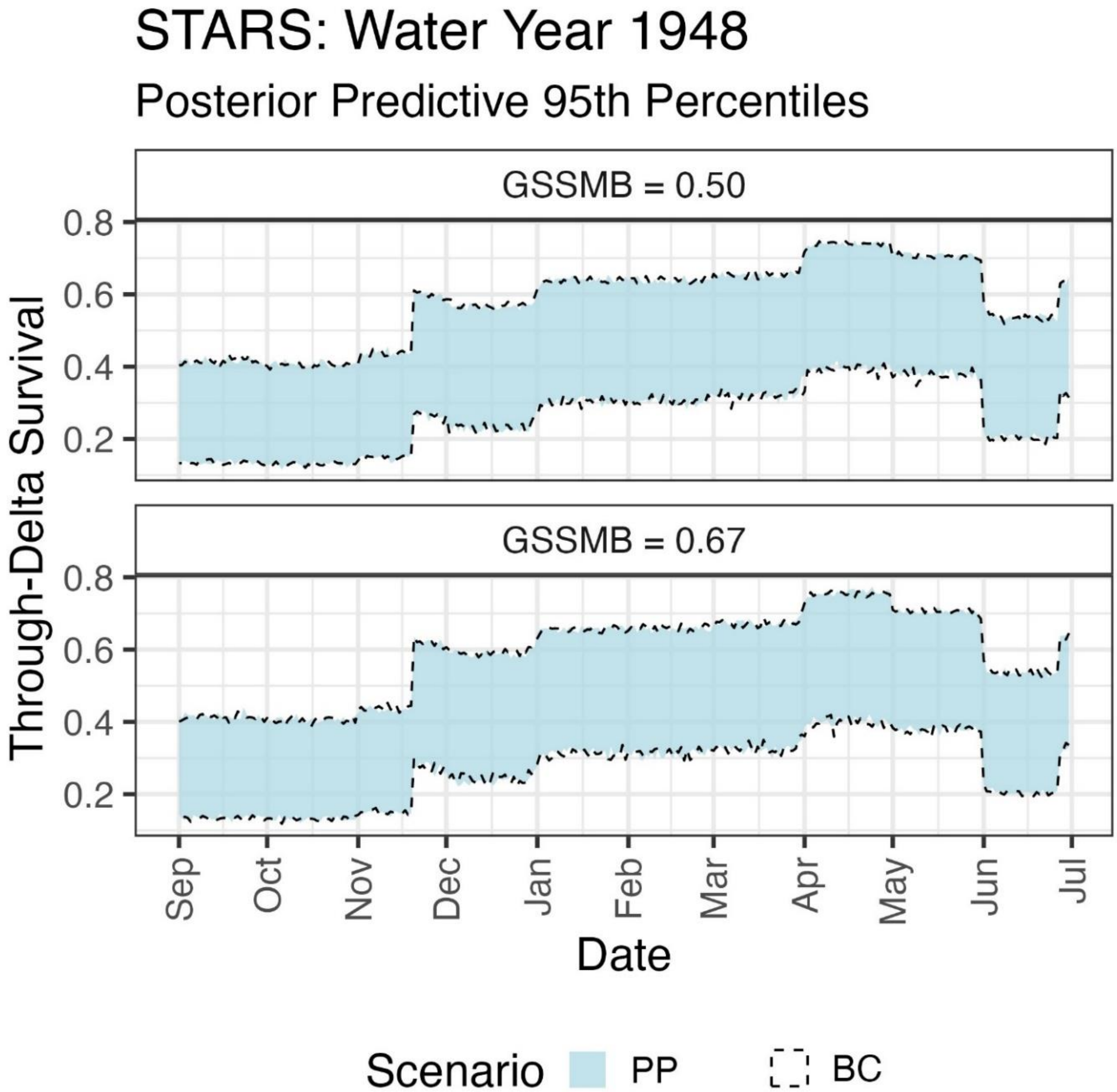
Note: September is included in following water year.

Figure 6B-319. STARS: 95% Posterior Predictive Intervals for Water Year 1946.



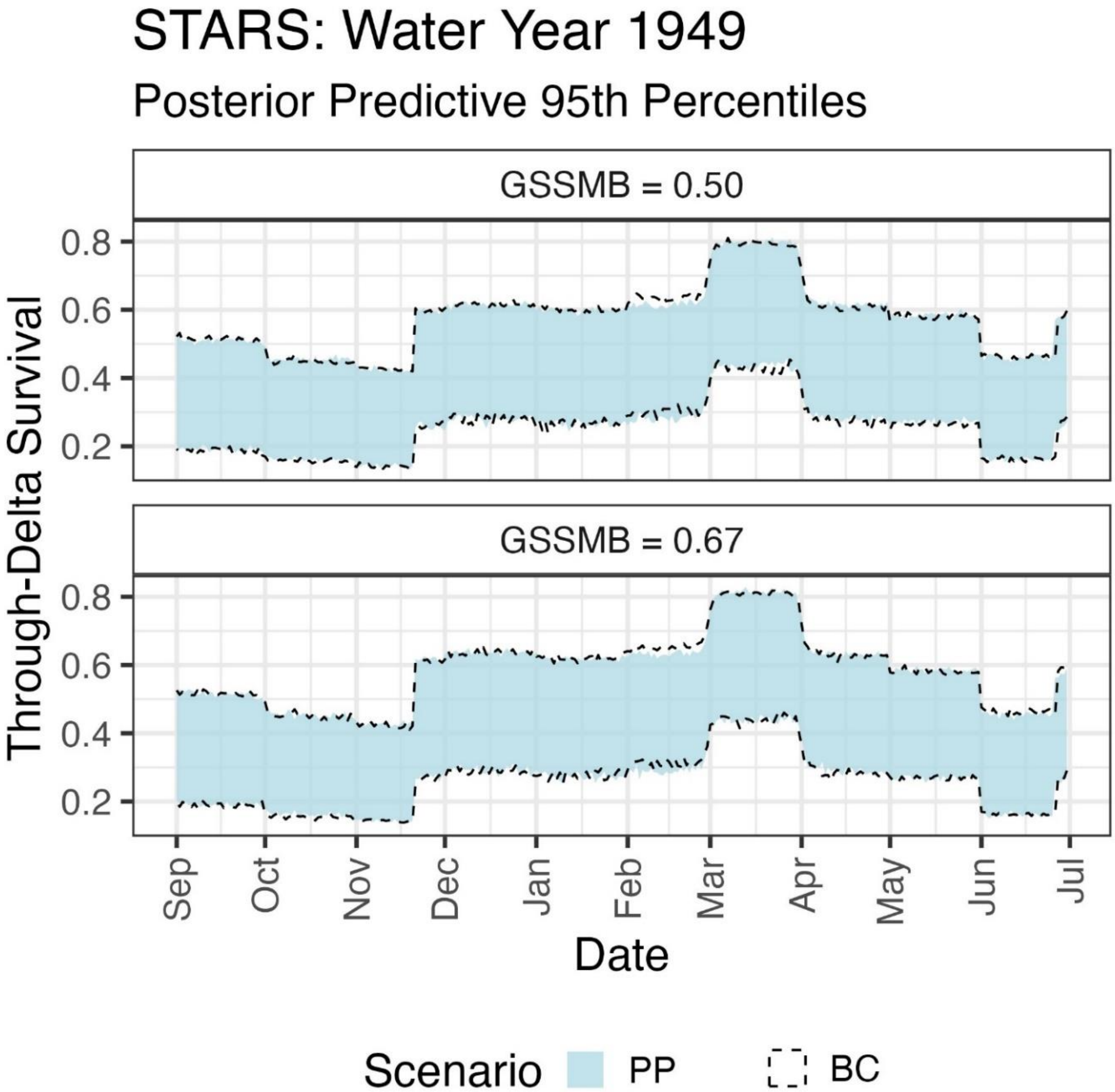
Note: September is included in following water year.

Figure 6B-320. STARS: 95% Posterior Predictive Intervals for Water Year 1947.



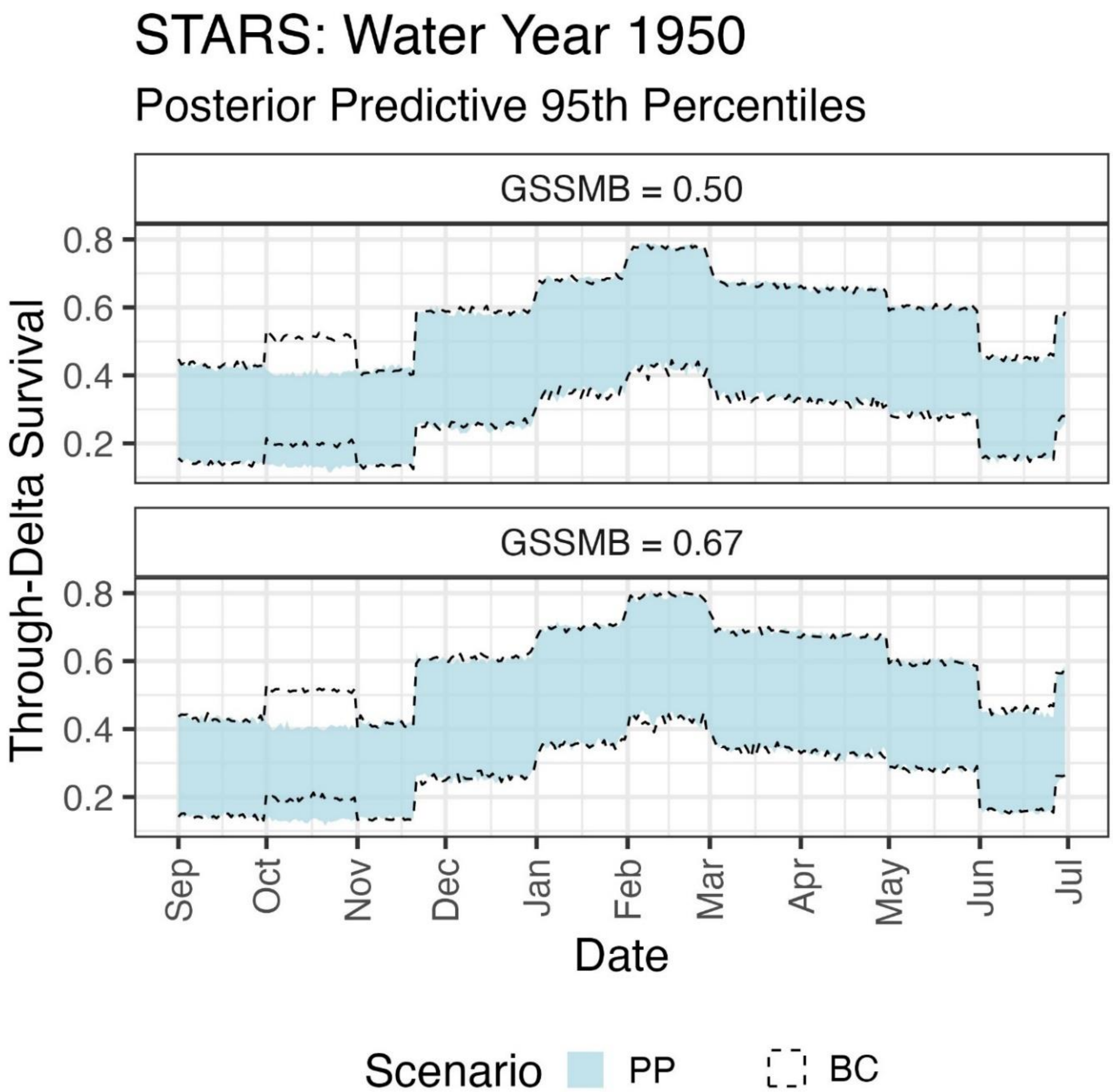
Note: September is included in following water year.

Figure 6B-321. STARS: 95% Posterior Predictive Intervals for Water Year 1948.



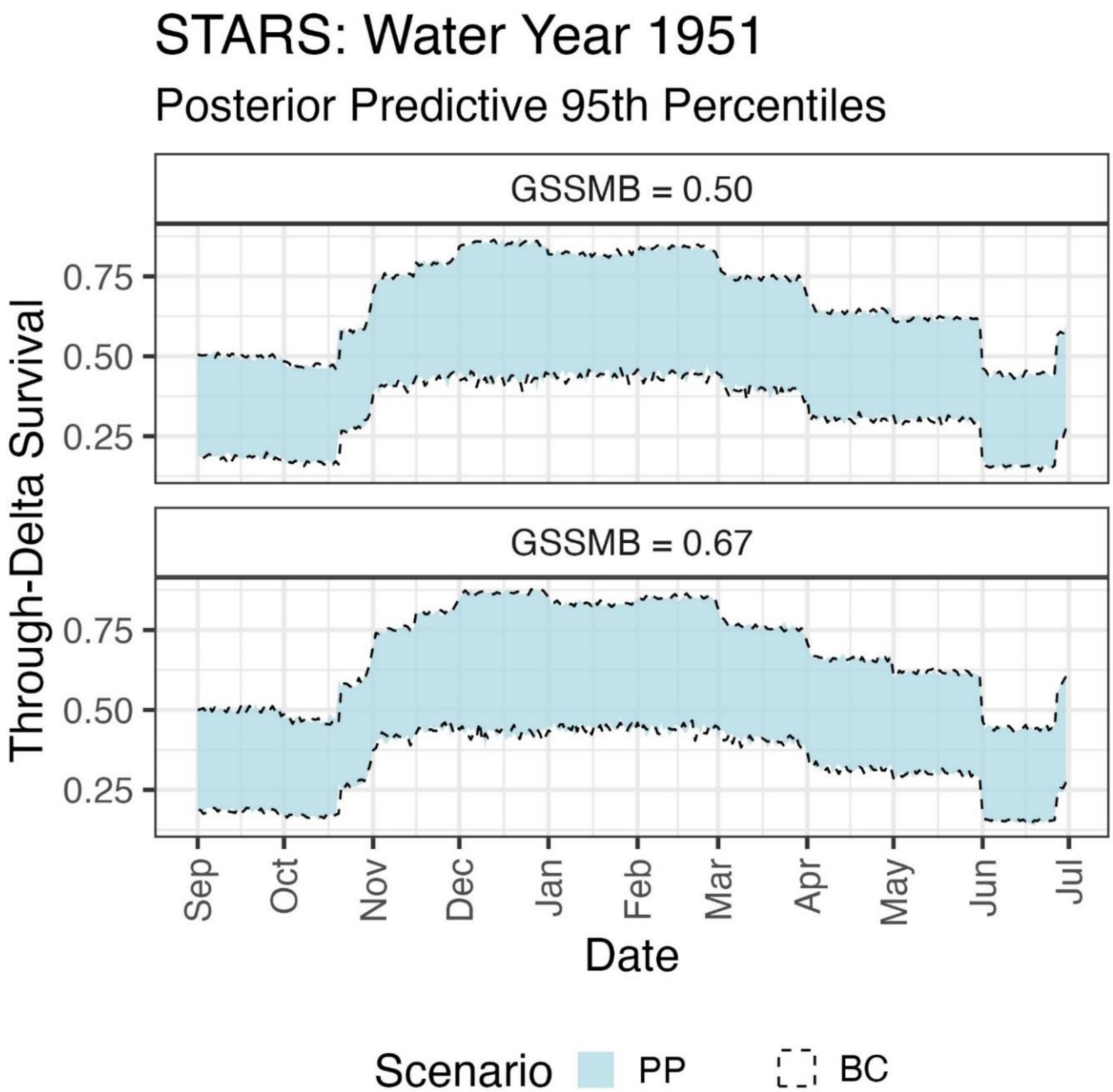
Note: September is included in following water year.

Figure 6B-322. STARS: 95% Posterior Predictive Intervals for Water Year 1949.



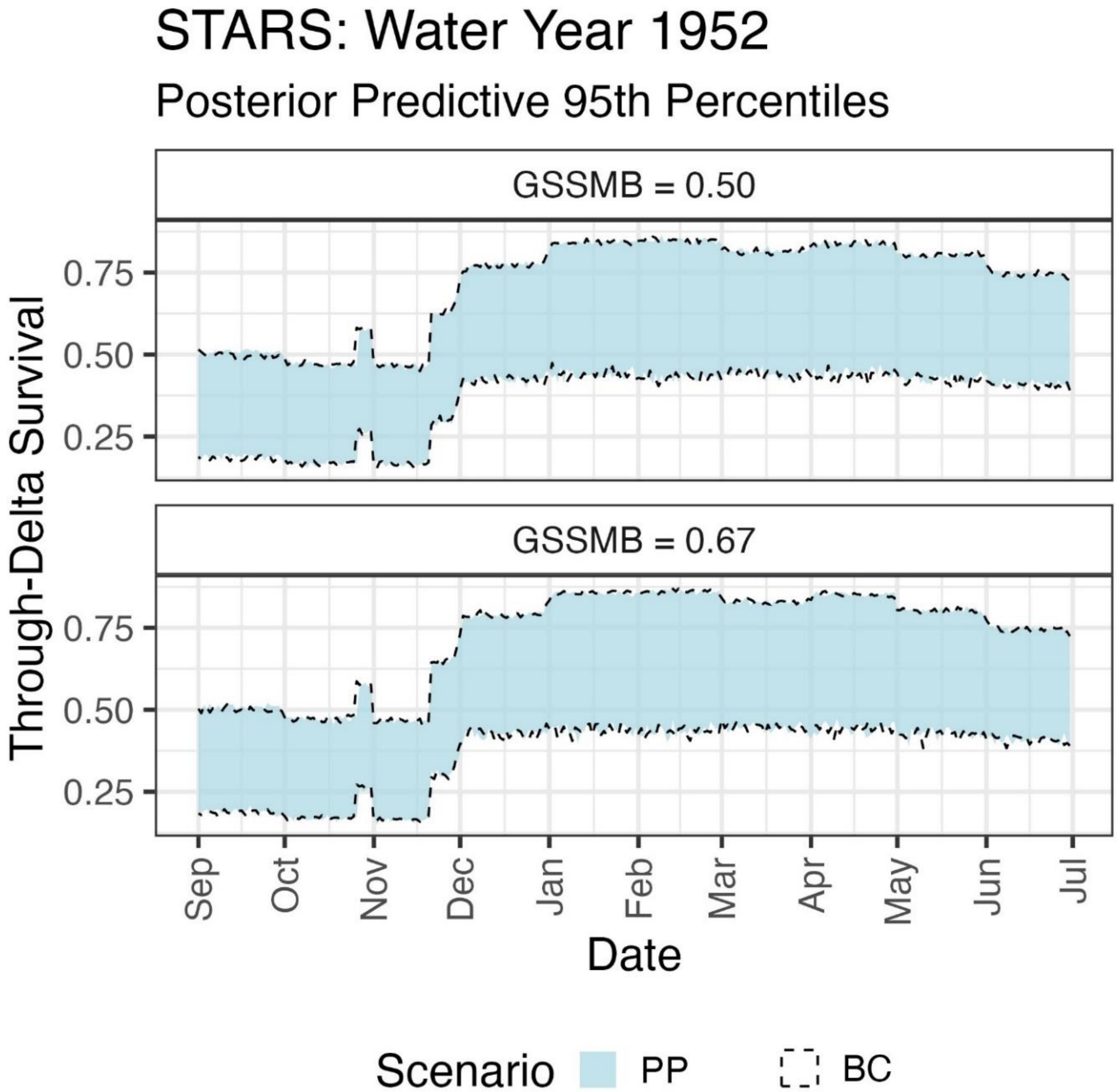
Note: September is included in following water year.

Figure 6B-323. STARS: 95% Posterior Predictive Intervals for Water Year 1950.



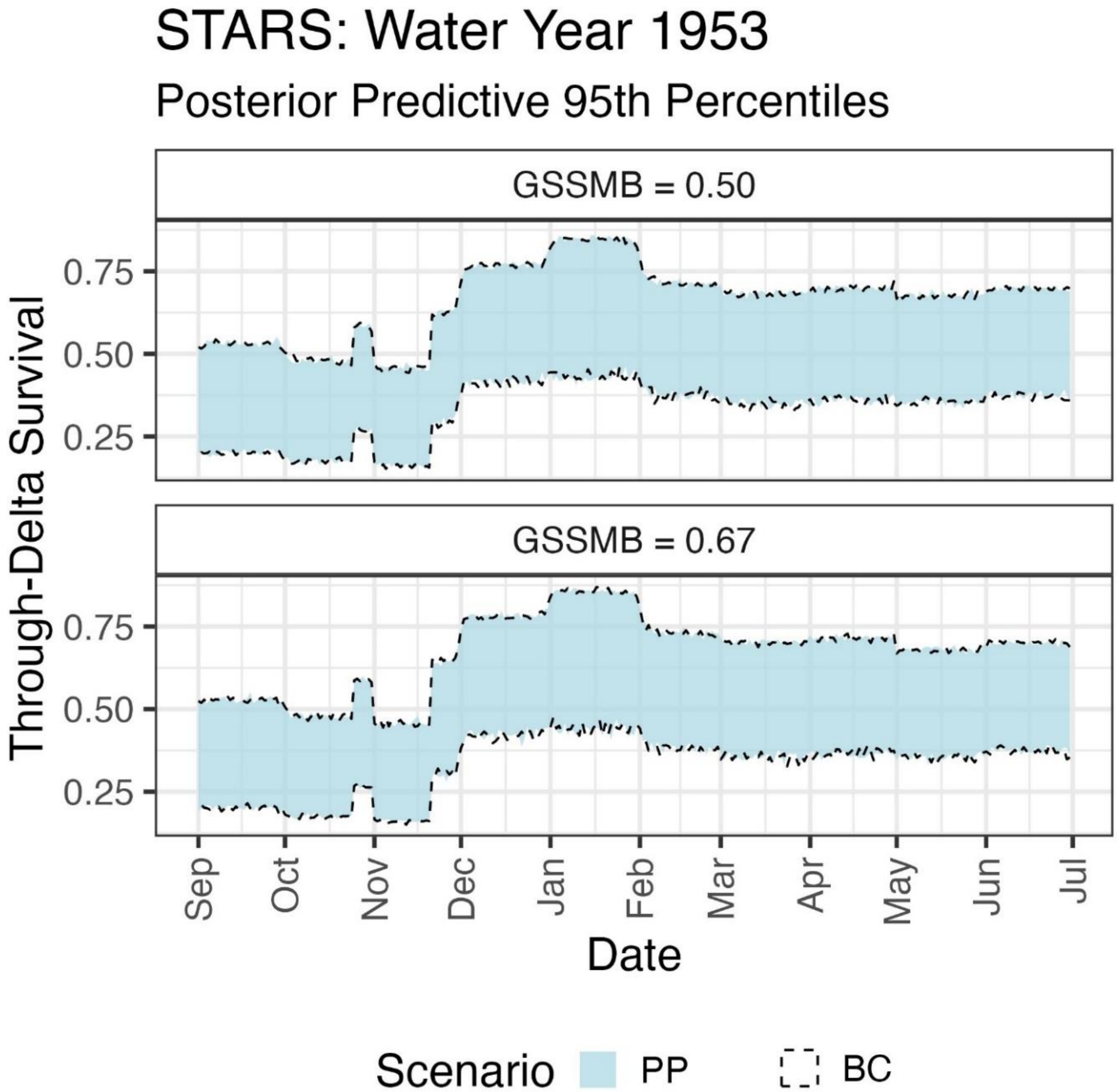
Note: September is included in following water year.

Figure 6B-324. STARS: 95% Posterior Predictive Intervals for Water Year 1951.



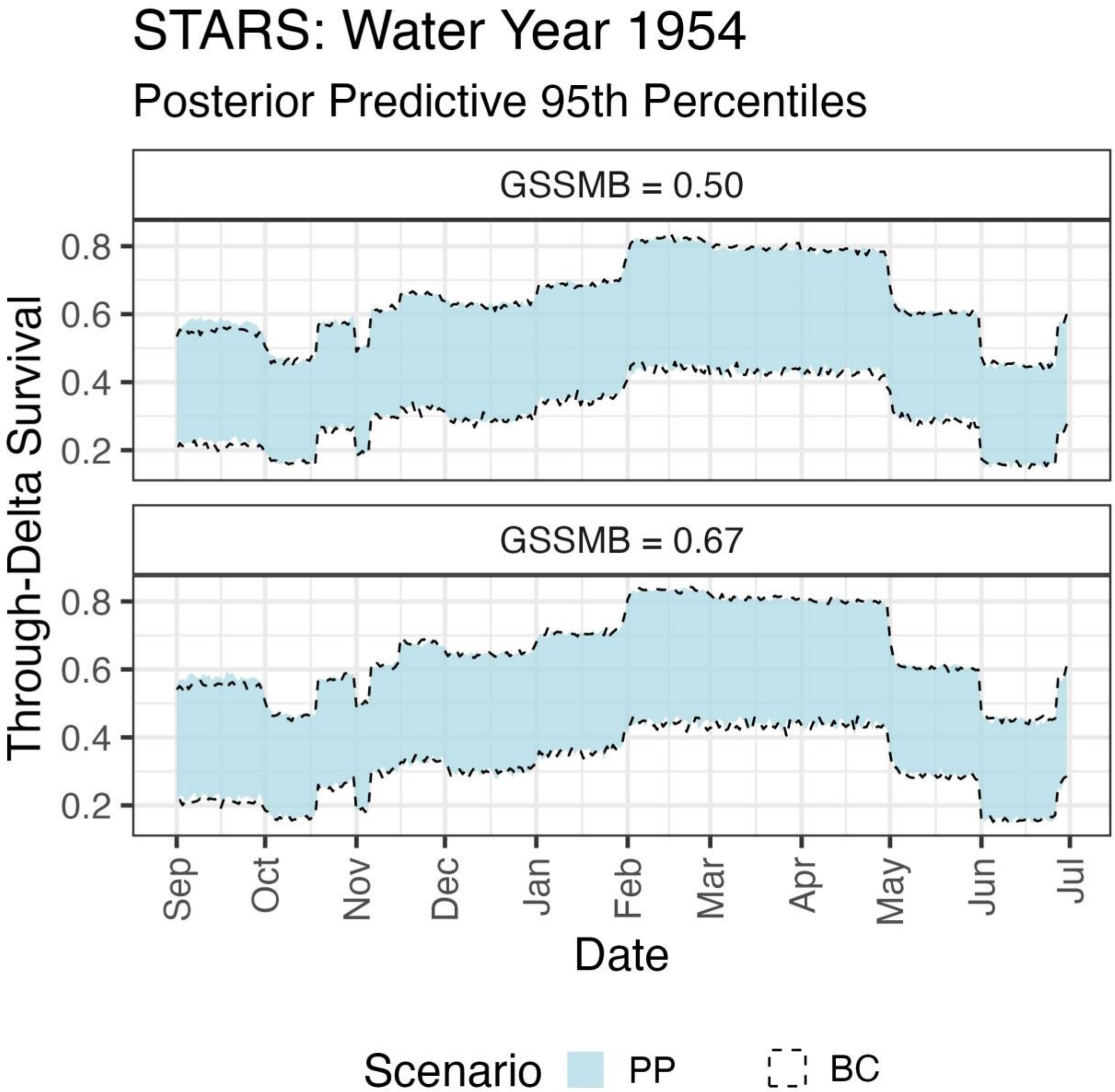
Note: September is included in following water year.

Figure 6B-325. STARS: 95% Posterior Predictive Intervals for Water Year 1952.



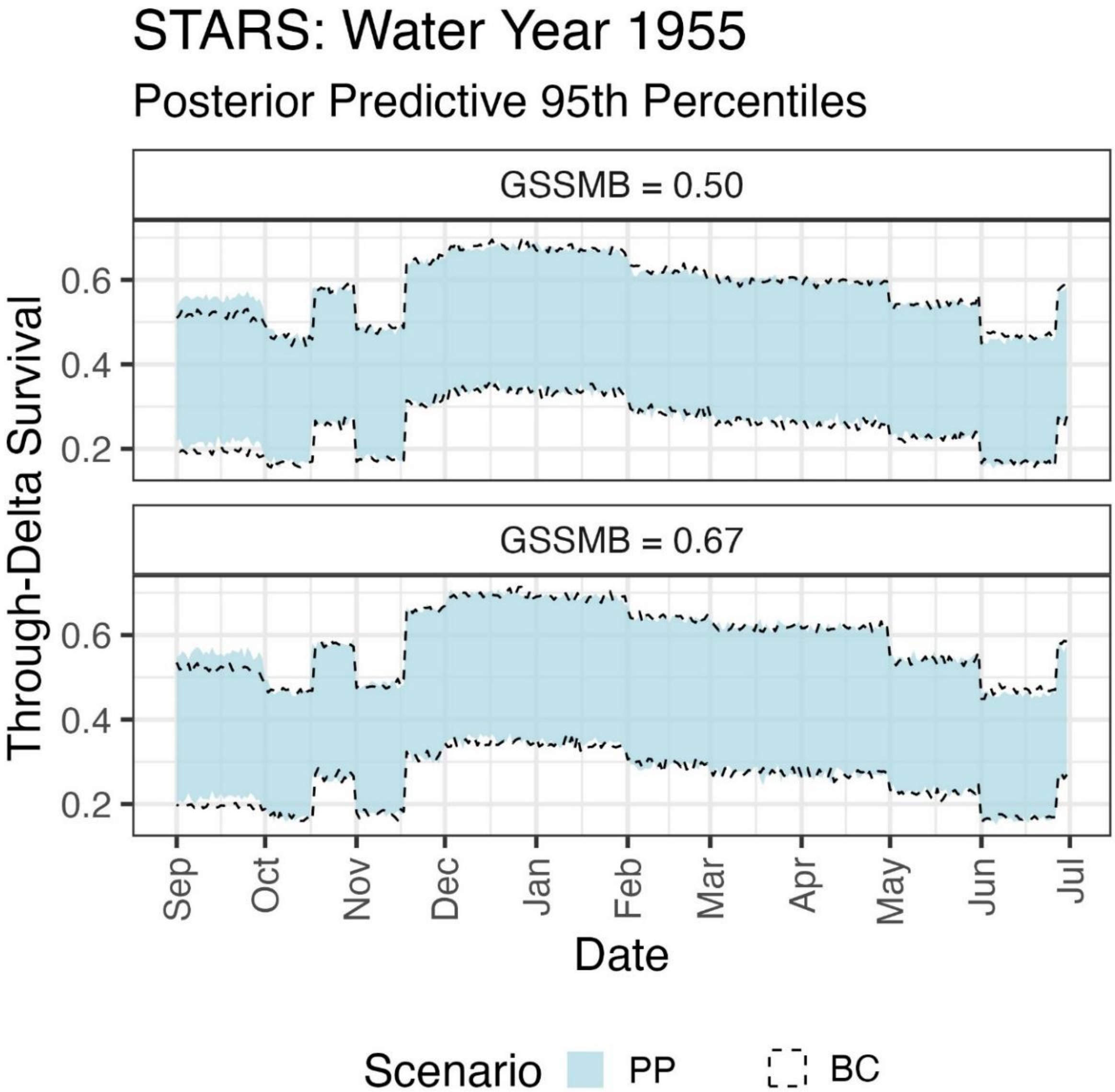
Note: September is included in following water year.

Figure 6B-326. STARS: 95% Posterior Predictive Intervals for Water Year 1953.



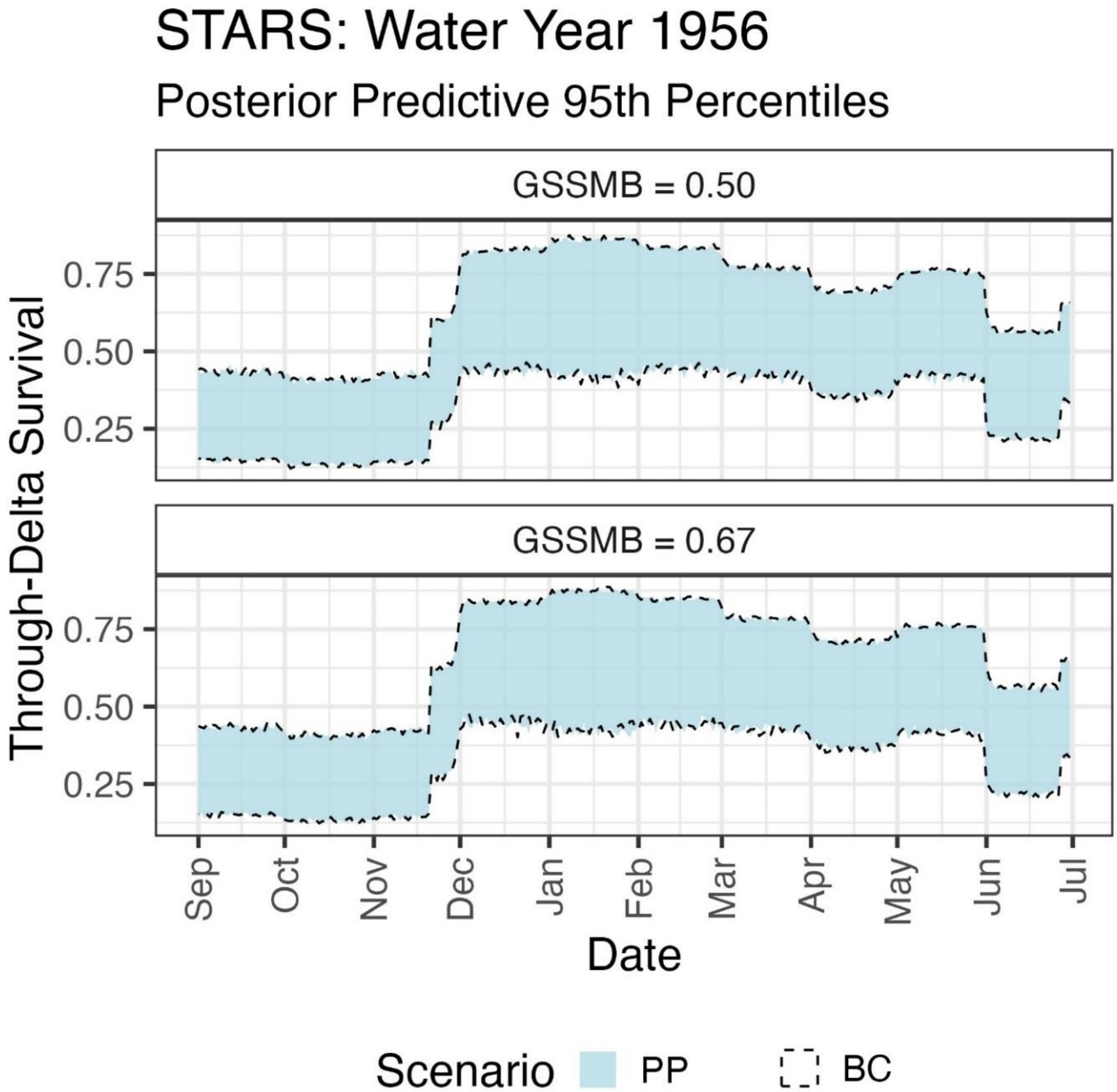
Note: September is included in following water year.

Figure 6B-327. STARS: 95% Posterior Predictive Intervals for Water Year 1954.



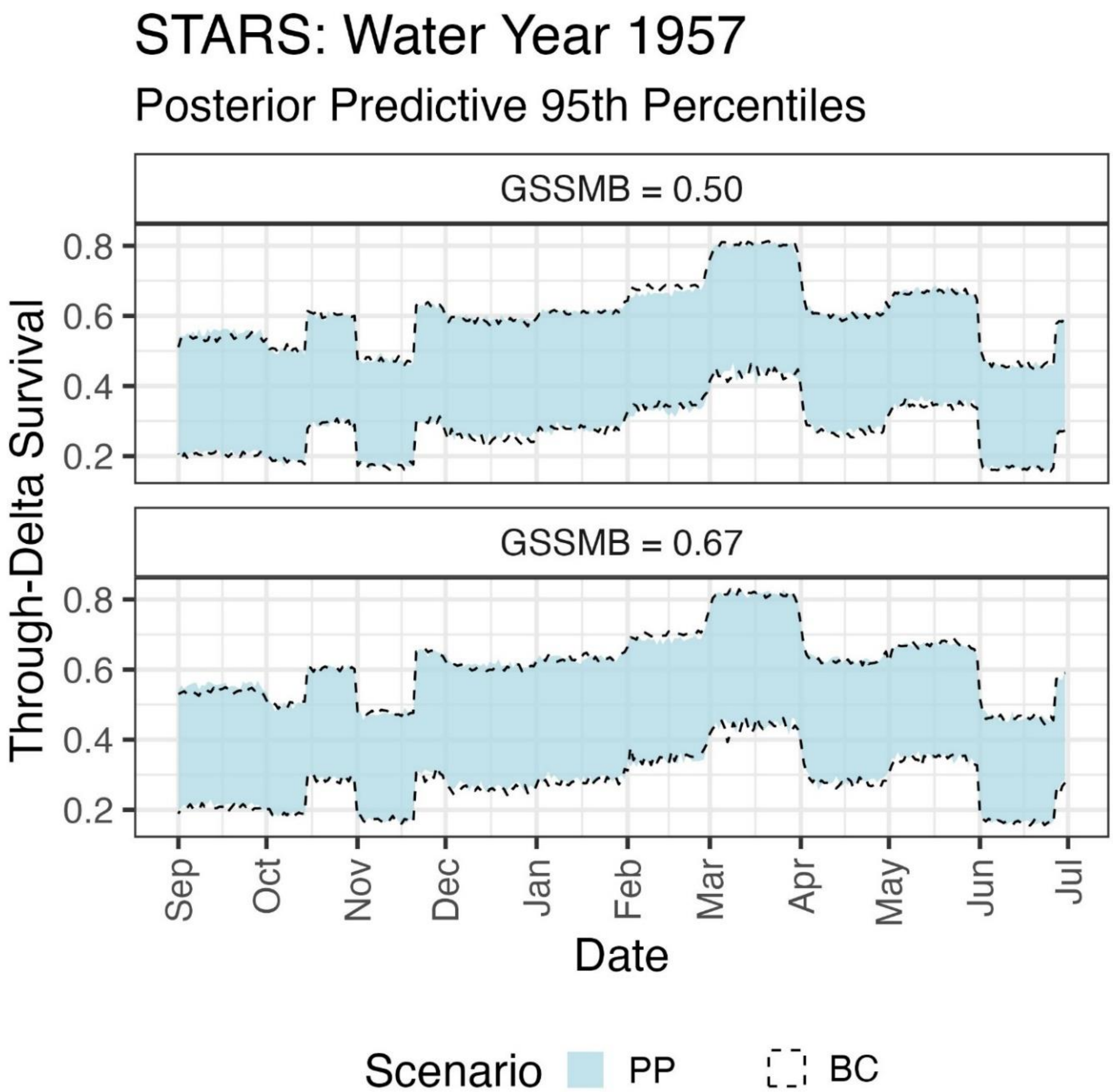
Note: September is included in following water year.

Figure 6B-328. STARS: 95% Posterior Predictive Intervals for Water Year 1955.



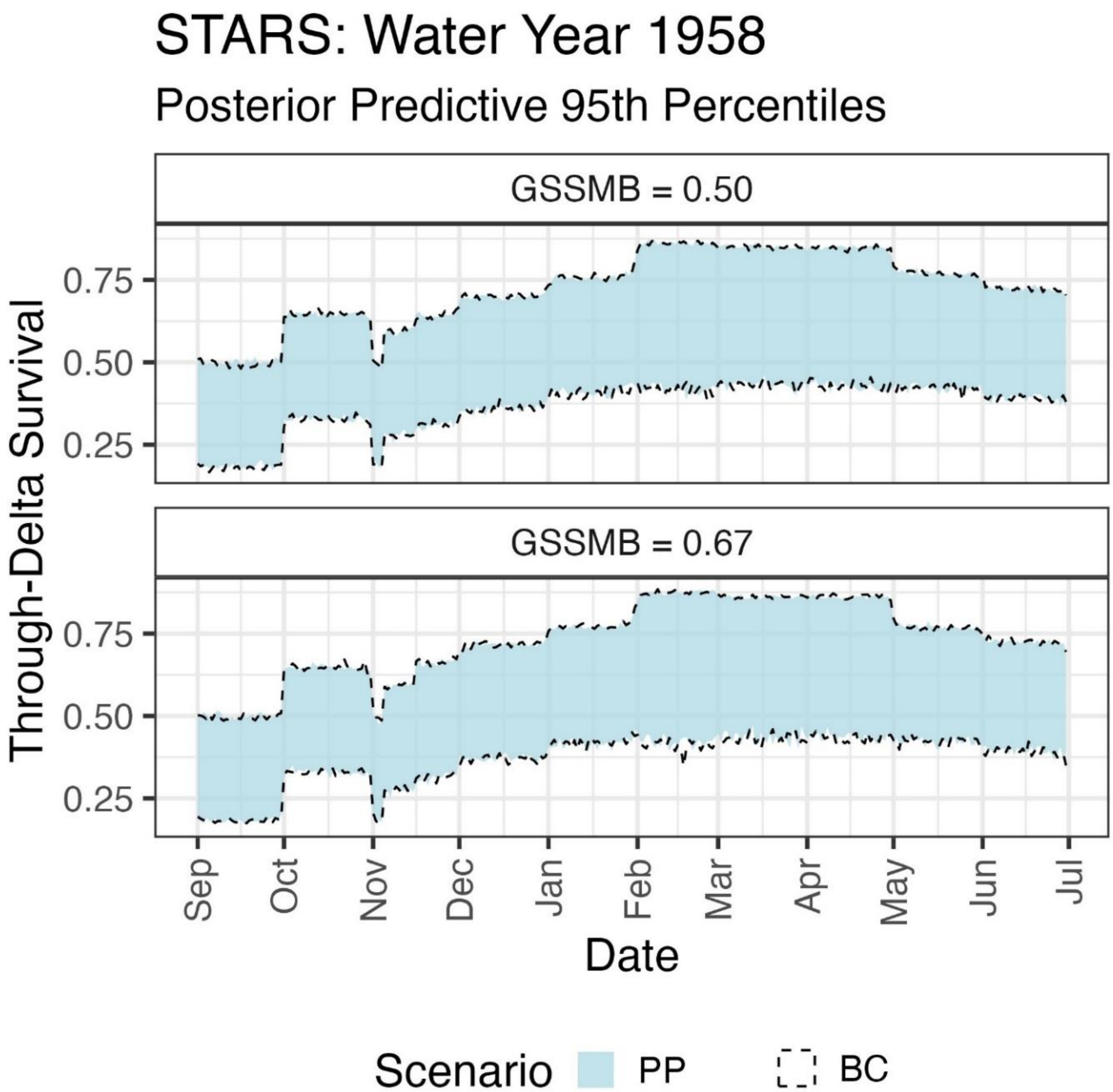
Note: September is included in following water year.

Figure 6B-329. STARS: 95% Posterior Predictive Intervals for Water Year 1956.



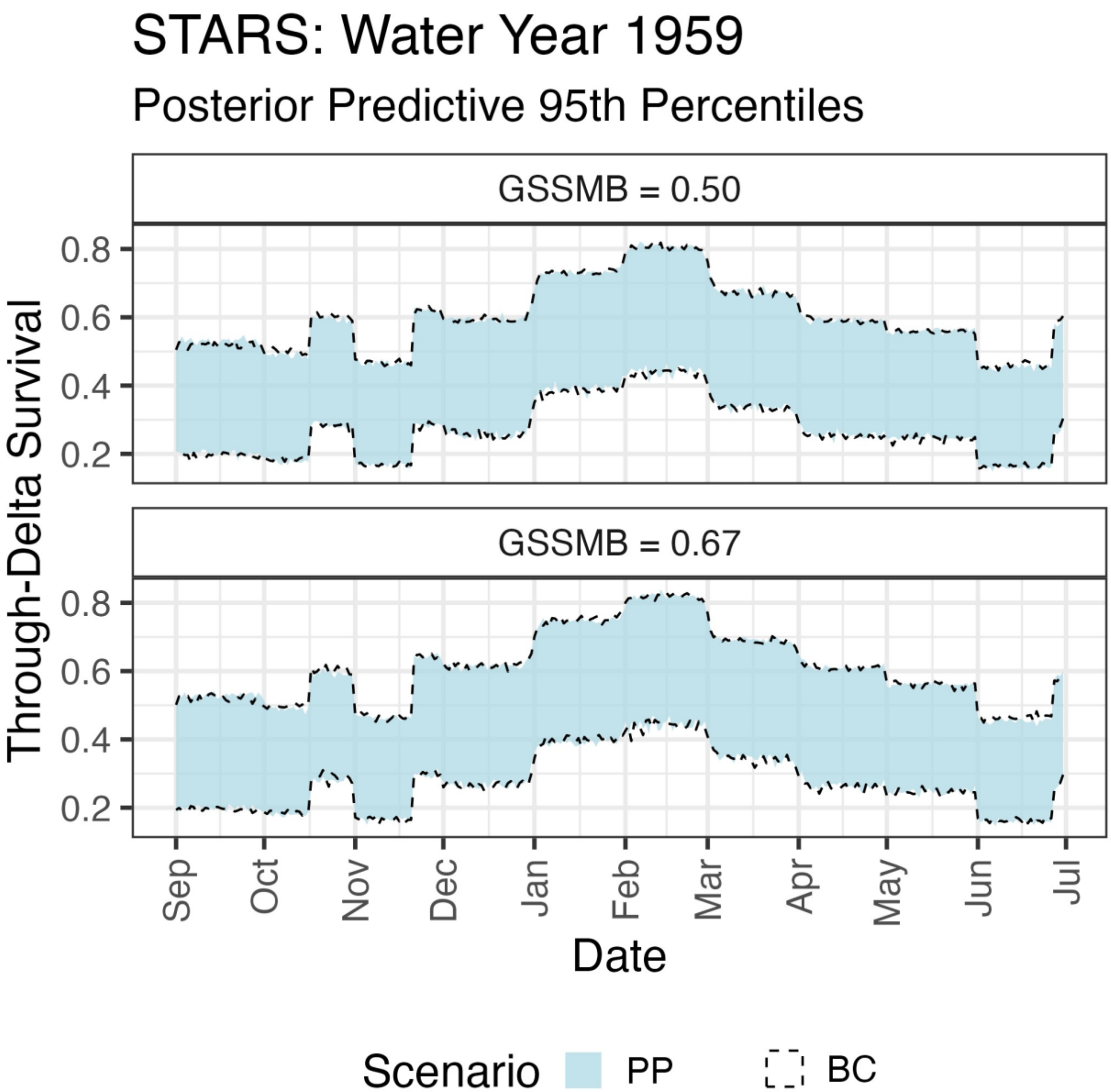
Note: September is included in following water year.

Figure 6B-330. STARS: 95% Posterior Predictive Intervals for Water Year 1957.



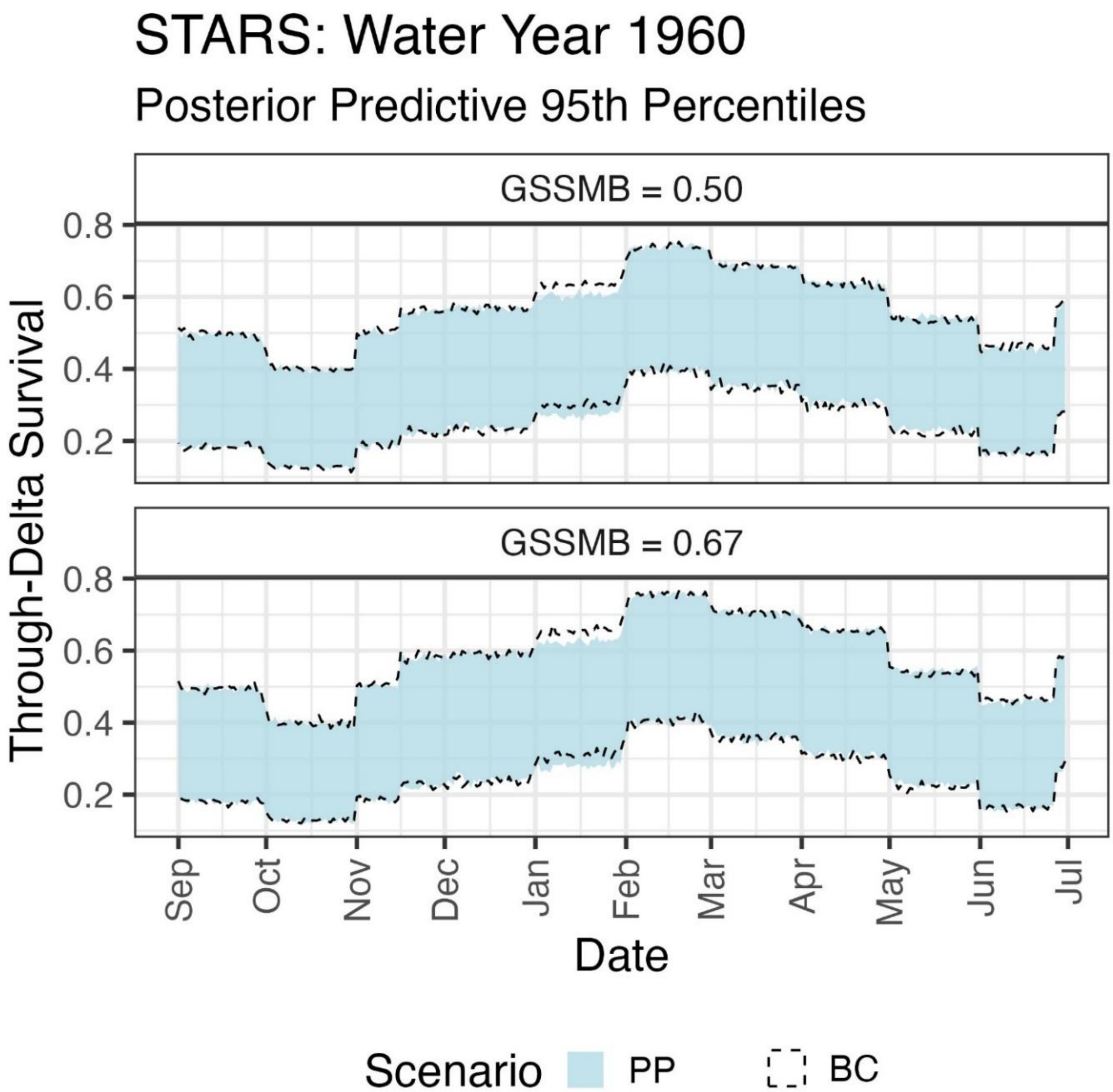
Note: September is included in following water year.

Figure 6B-331. STARS: 95% Posterior Predictive Intervals for Water Year 1958.



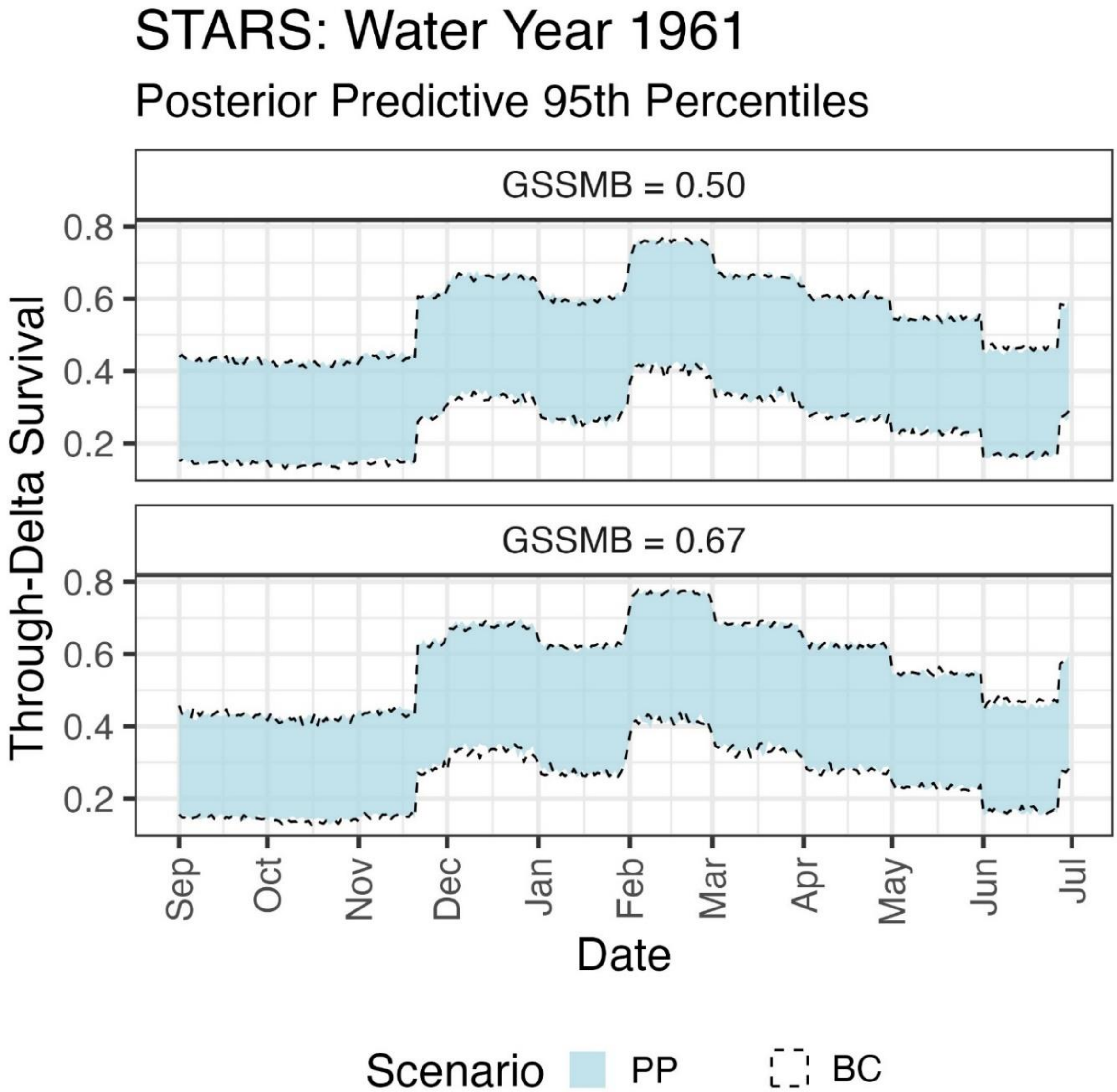
Note: September is included in following water year.

Figure 6B-332. STARS: 95% Posterior Predictive Intervals for Water Year 1959.



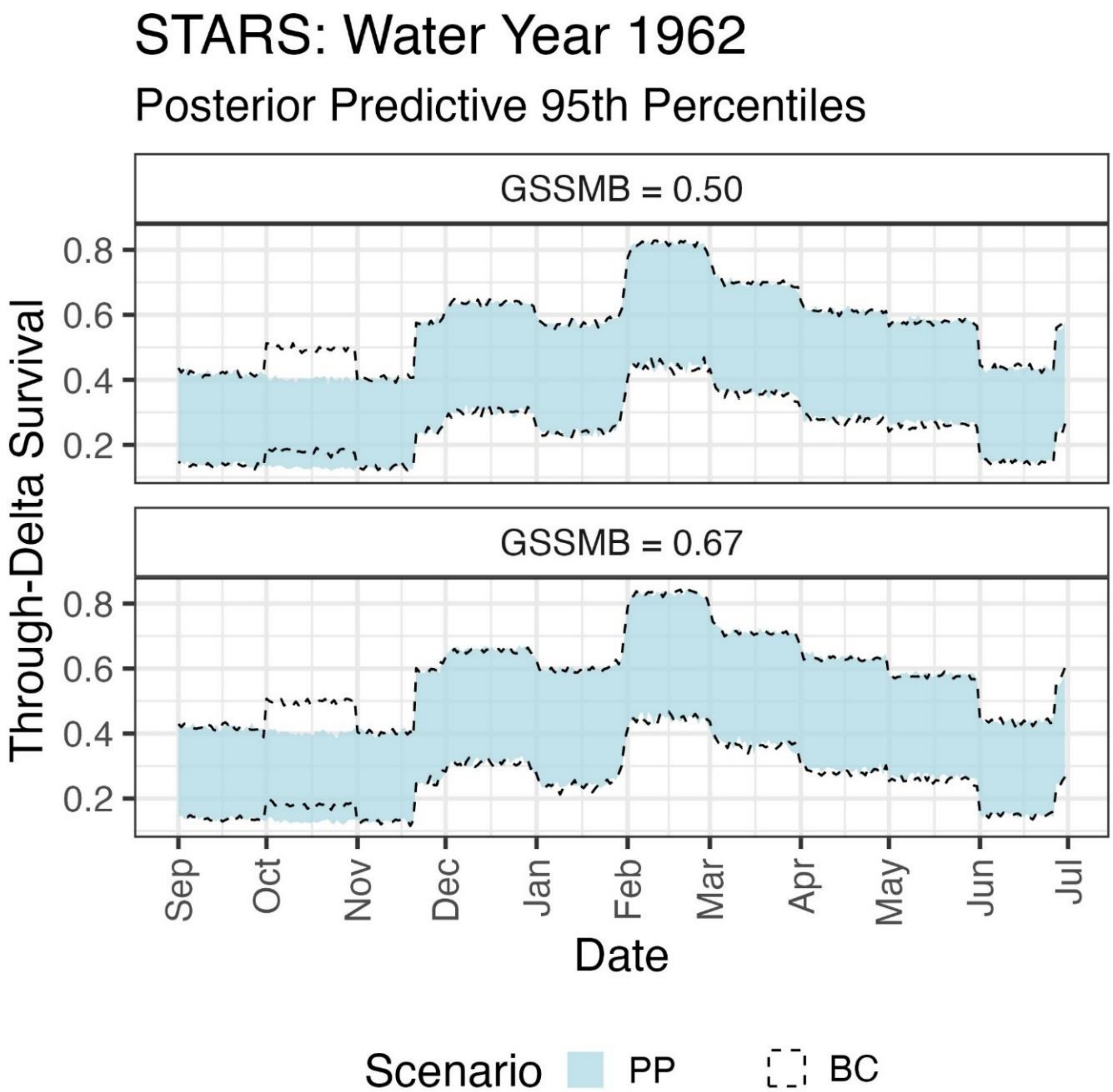
Note: September is included in following water year.

Figure 6B-333. STARS: 95% Posterior Predictive Intervals for Water Year 1960.



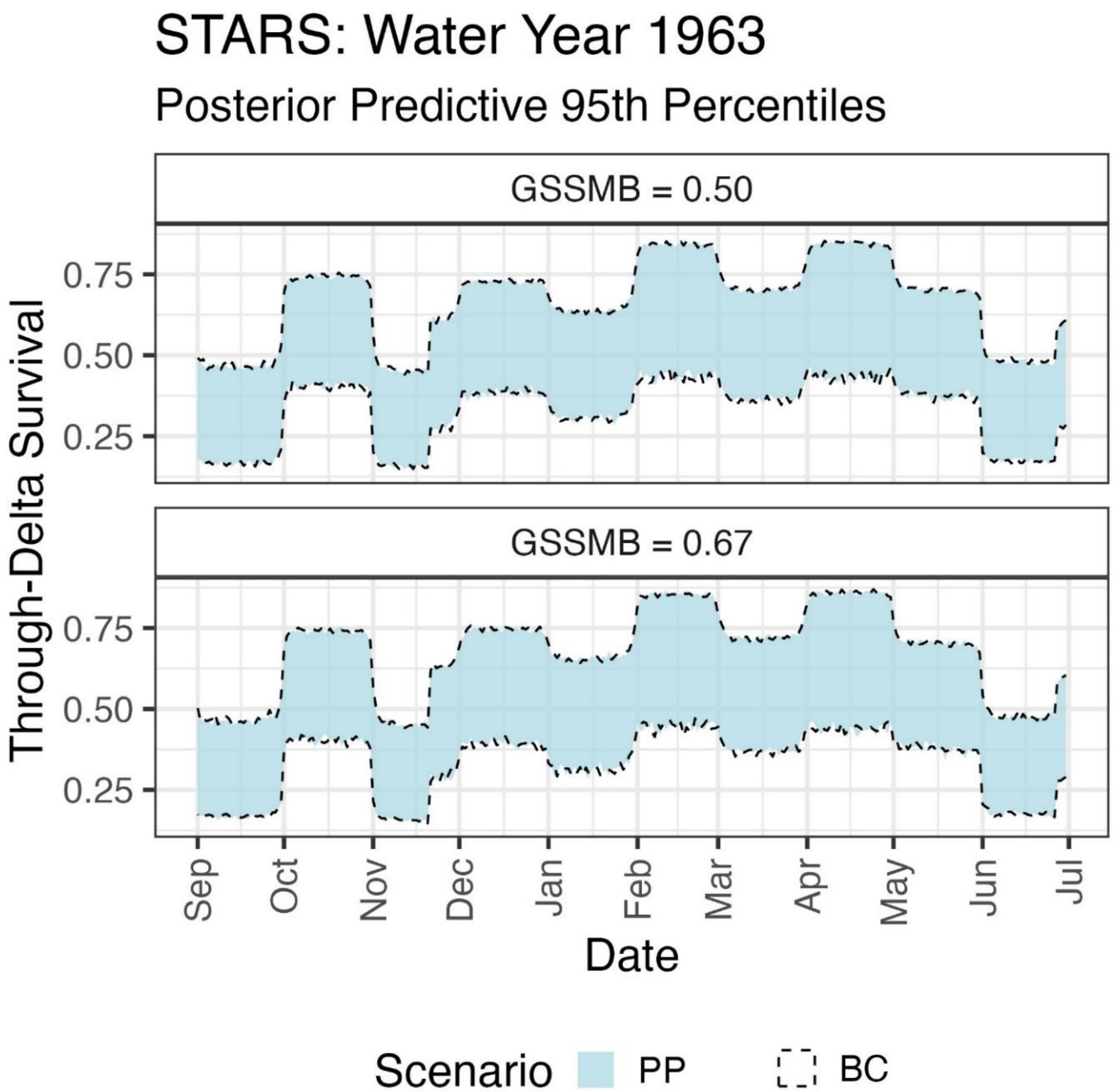
Note: September is included in following water year.

Figure 6B-334. STARS: 95% Posterior Predictive Intervals for Water Year 1961.



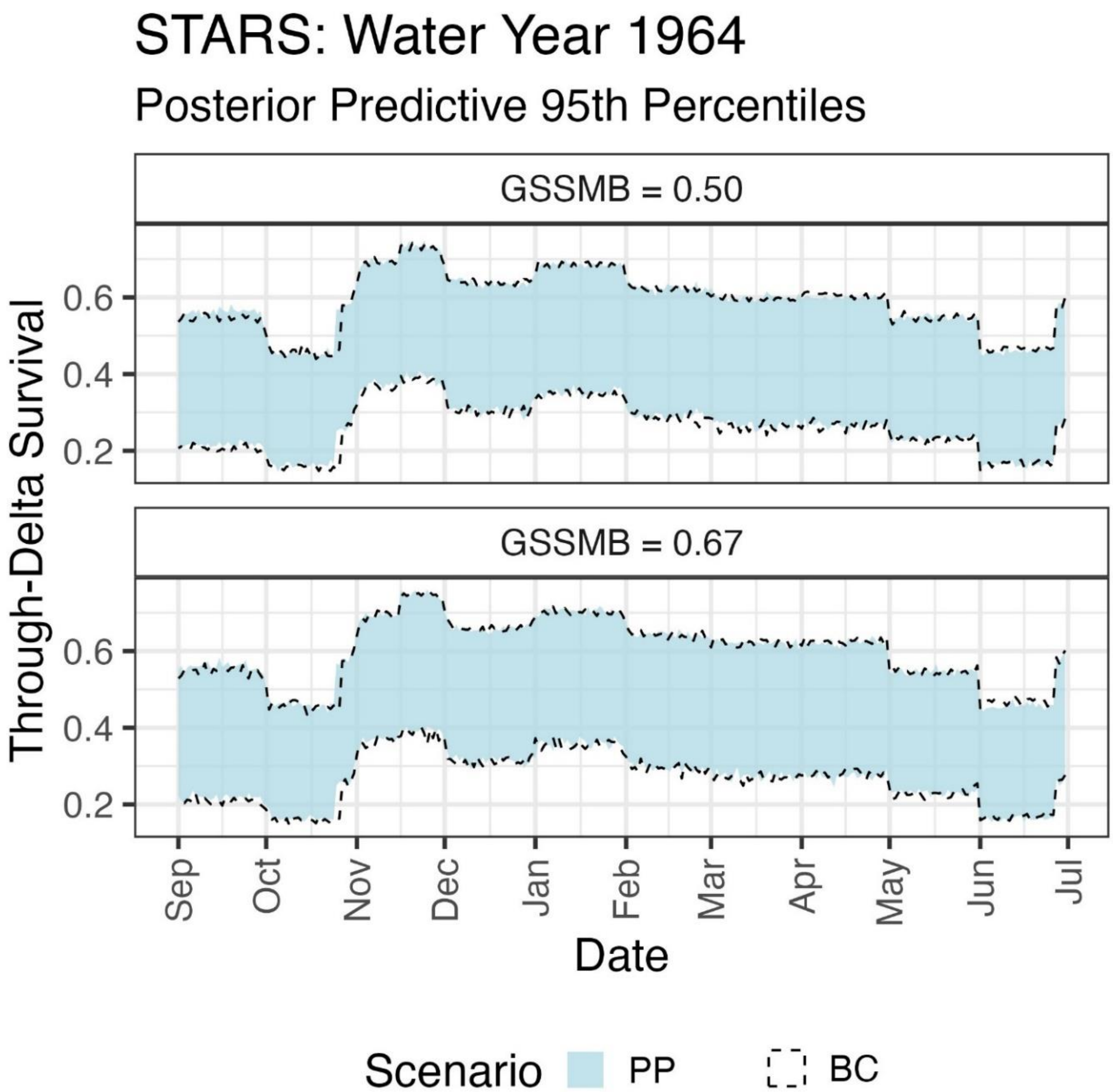
Note: September is included in following water year.

Figure 6B-335. STARS: 95% Posterior Predictive Intervals for Water Year 1962.



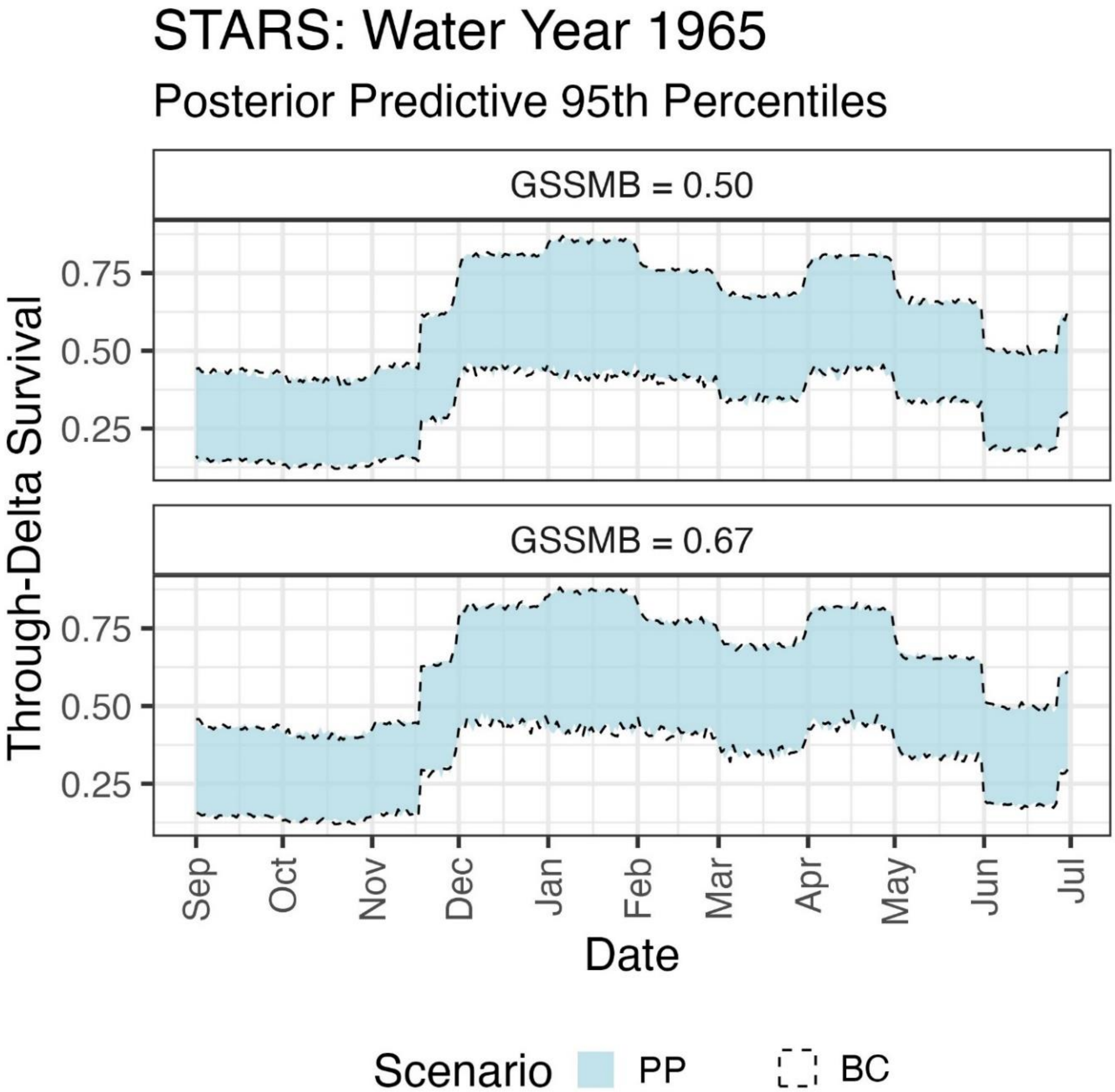
Note: September is included in following water year.

Figure 6B-336. STARS: 95% Posterior Predictive Intervals for Water Year 1963.



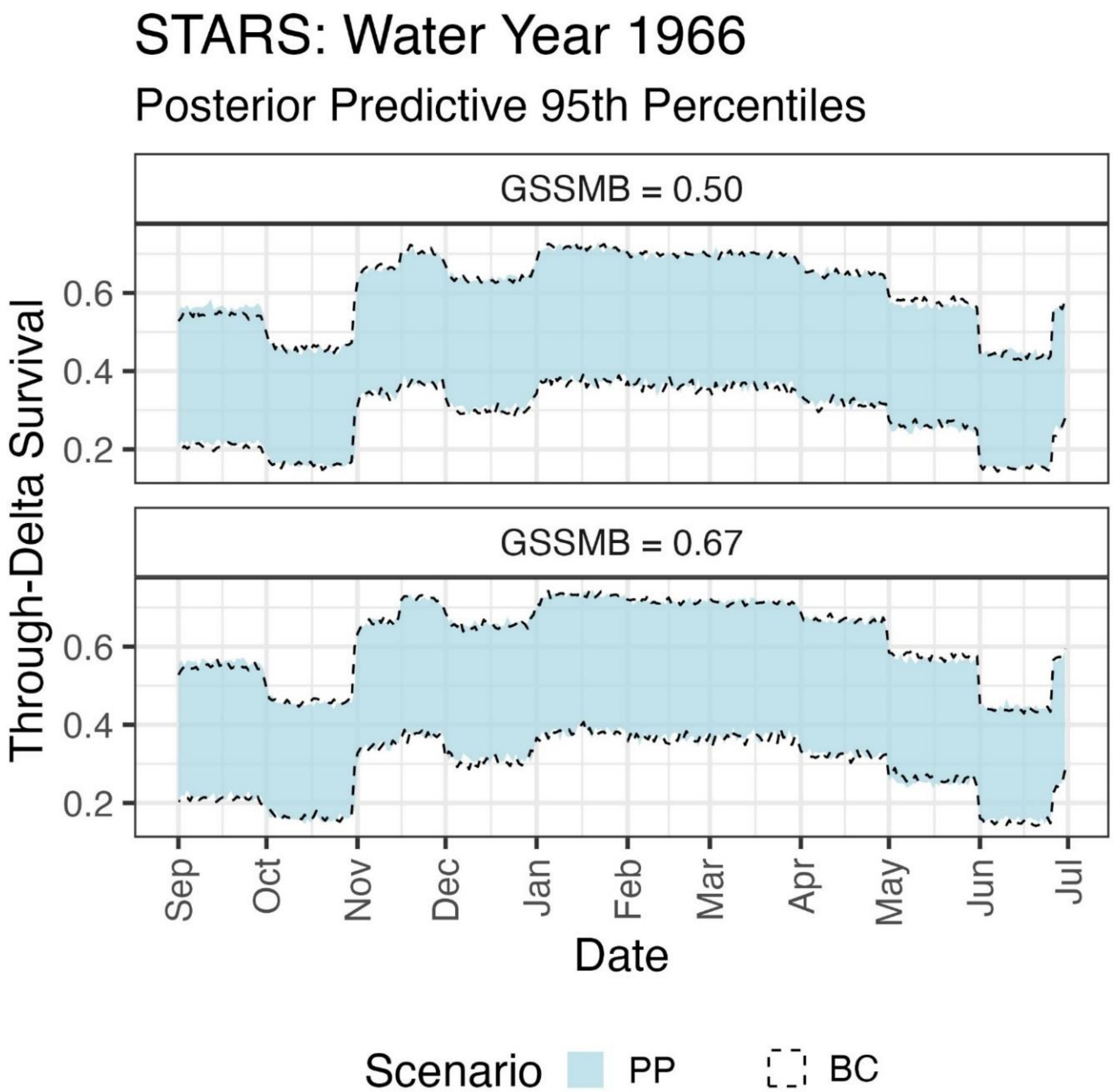
Note: September is included in following water year.

Figure 6B-337. STARS: 95% Posterior Predictive Intervals for Water Year 1964.



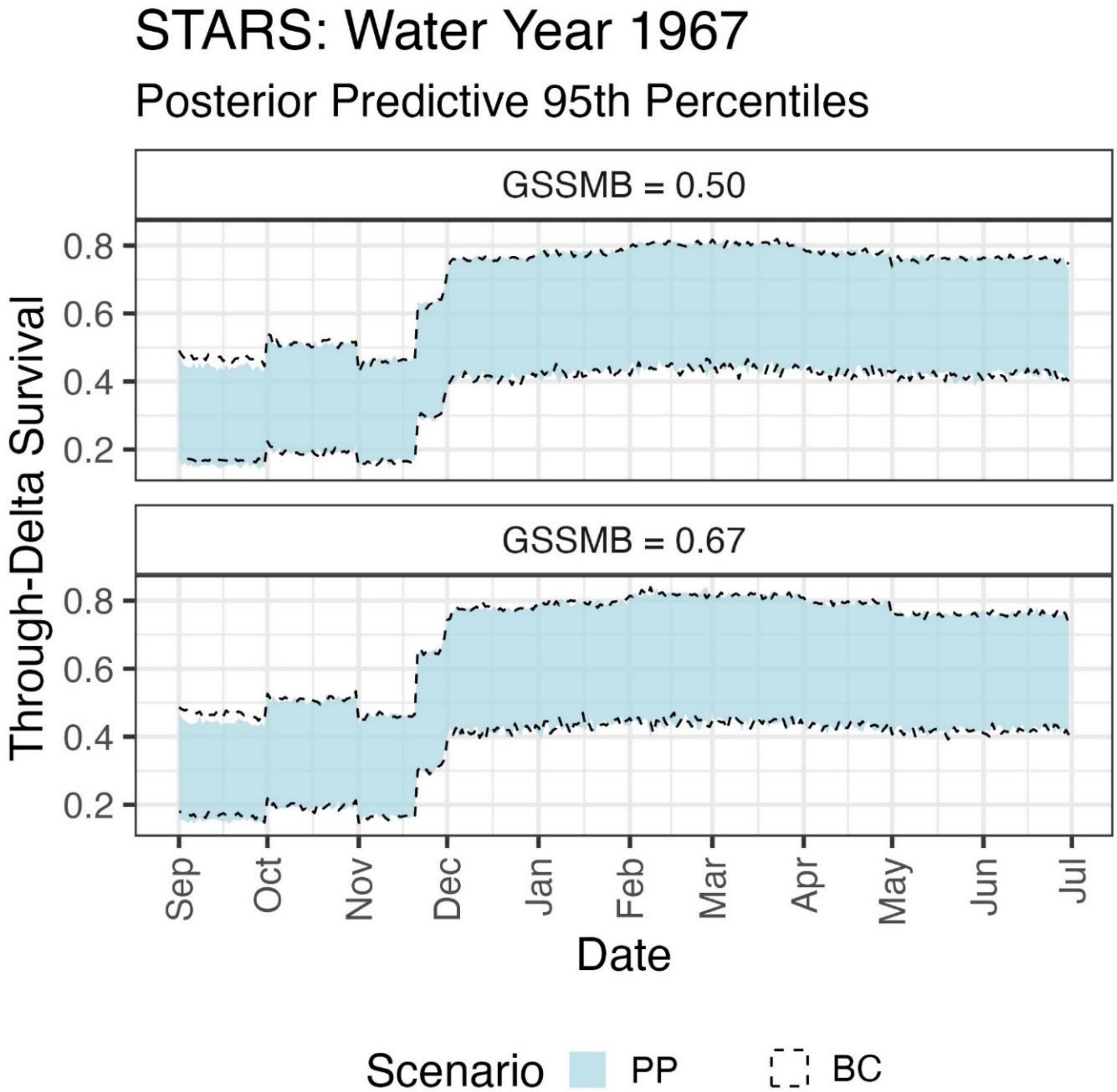
Note: September is included in following water year.

Figure 6B-338. STARS: 95% Posterior Predictive Intervals for Water Year 1965.



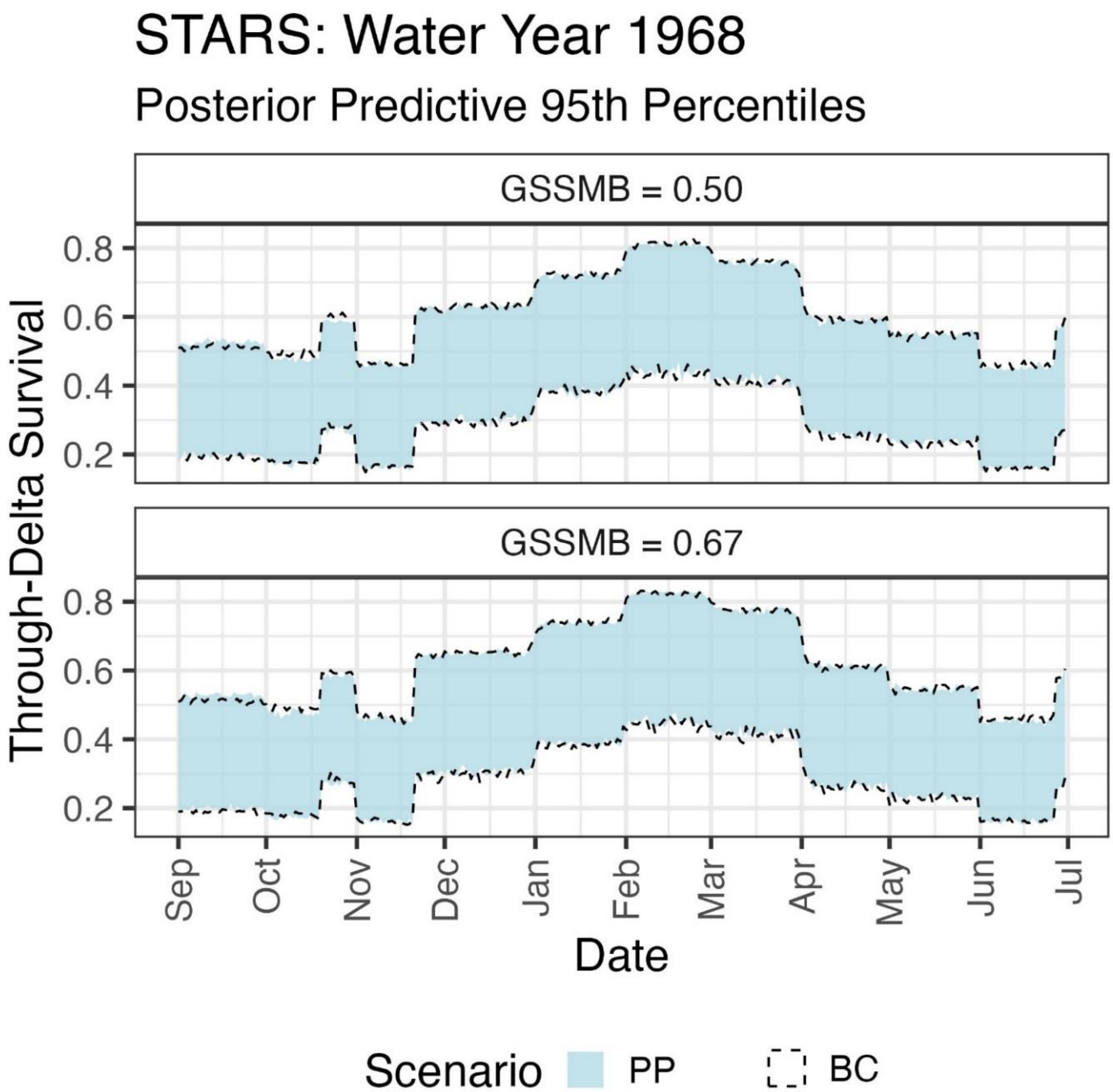
Note: September is included in following water year.

Figure 6B-339. STARS: 95% Posterior Predictive Intervals for Water Year 1966.



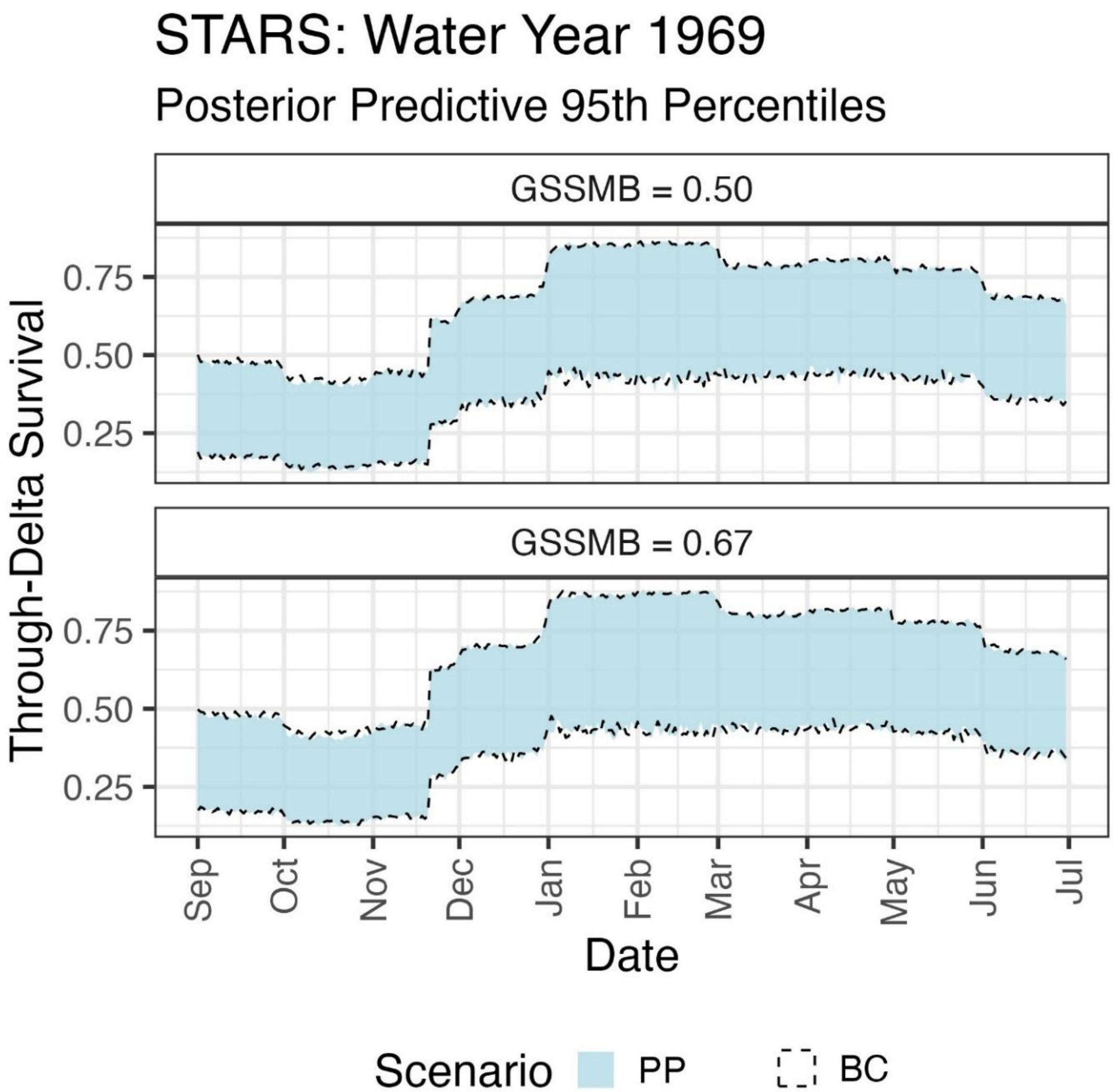
Note: September is included in following water year.

Figure 6B-340. STARS: 95% Posterior Predictive Intervals for Water Year 1967.



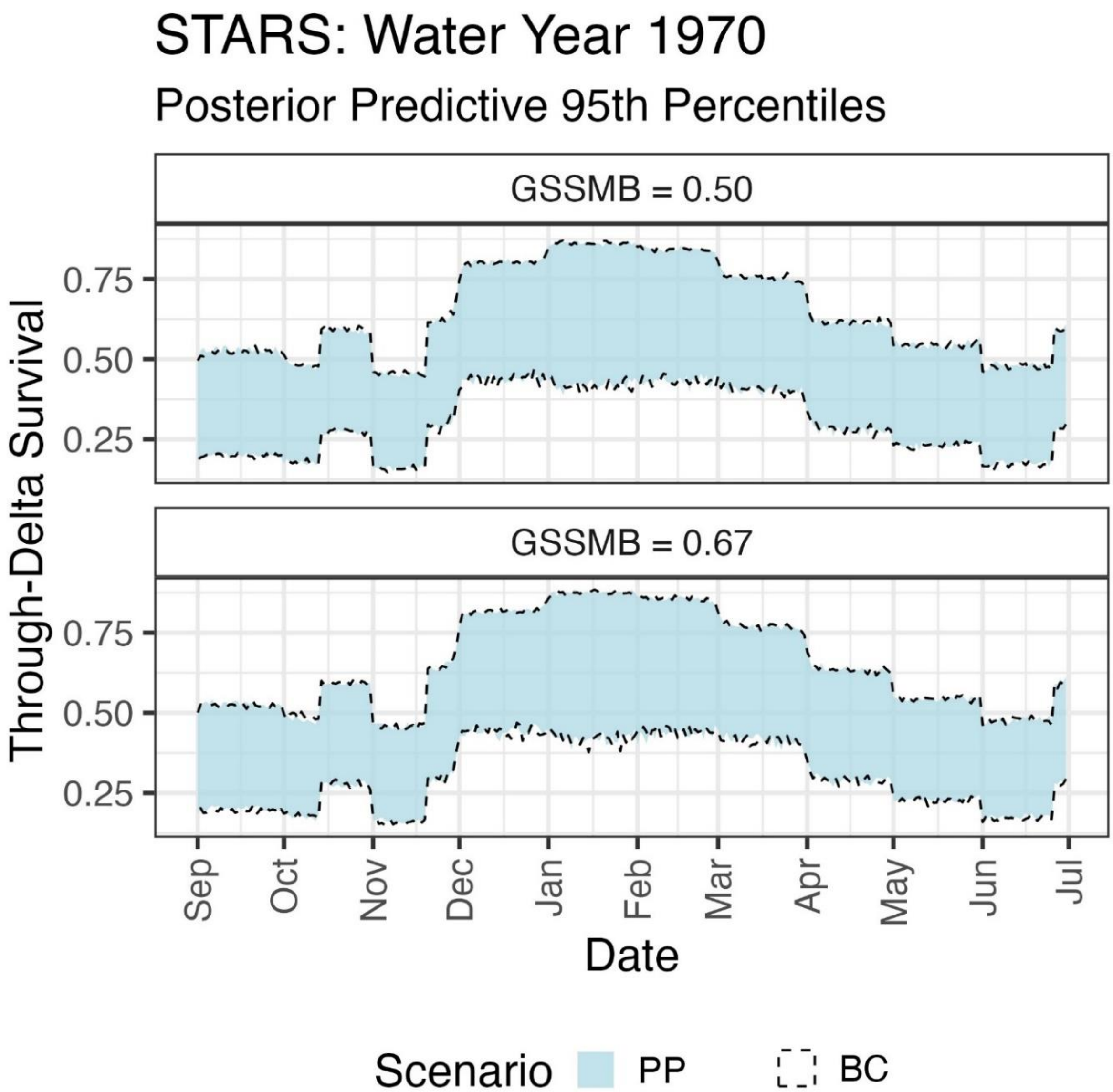
Note: September is included in following water year.

Figure 6B-341. STARS: 95% Posterior Predictive Intervals for Water Year 1968.



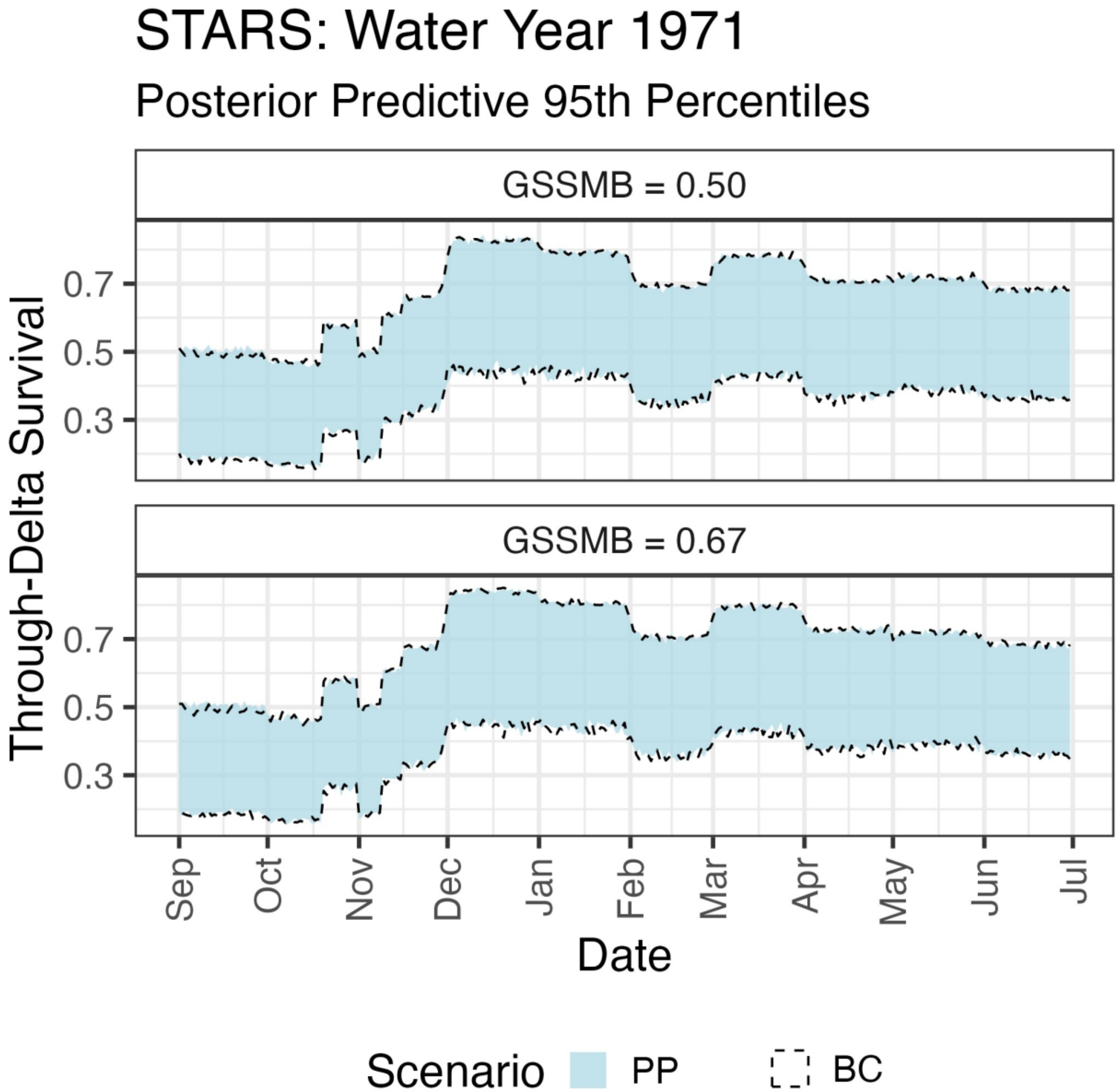
Note: September is included in following water year.

Figure 6B-342. STARS: 95% Posterior Predictive Intervals for Water Year 1969.



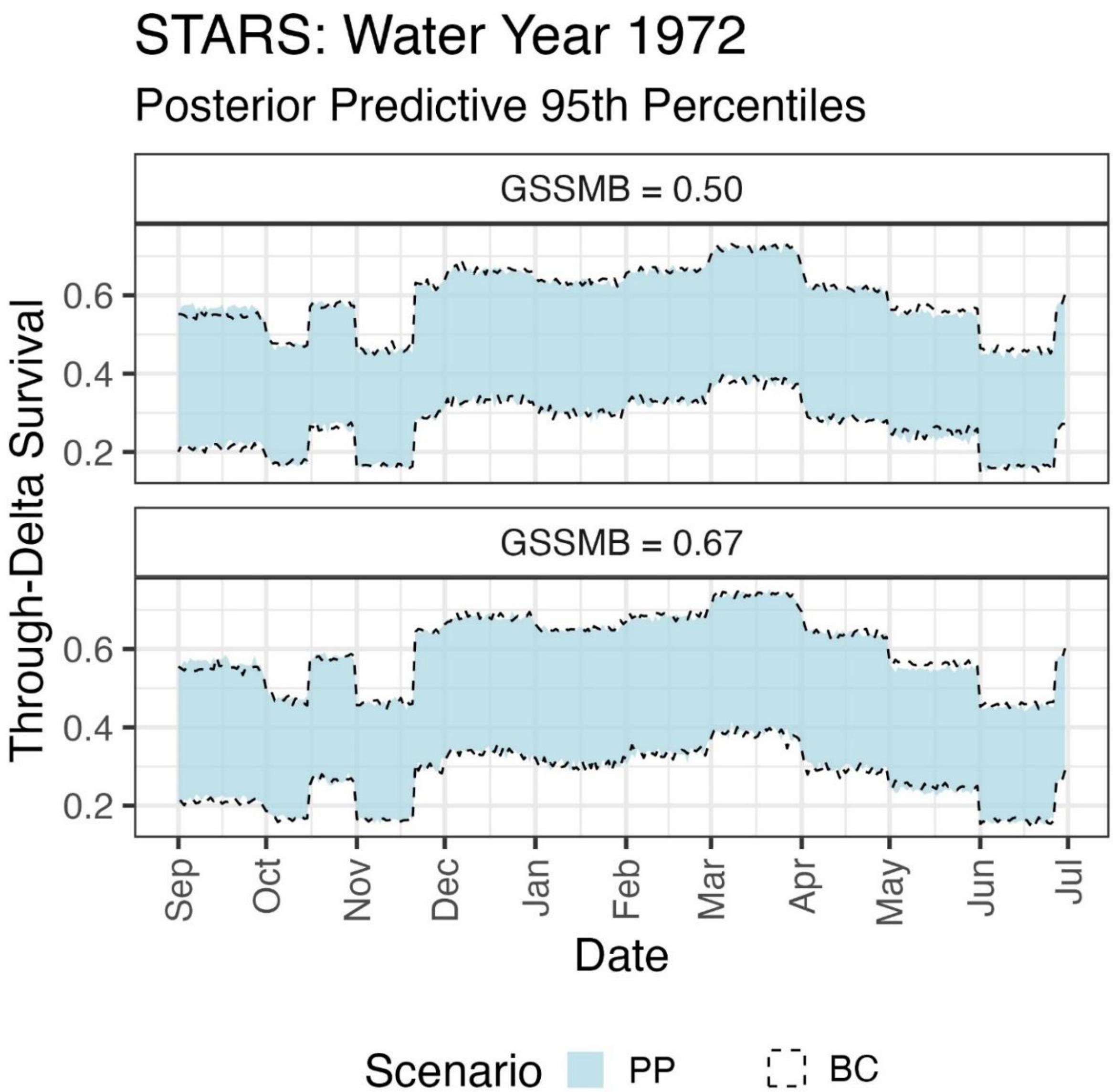
Note: September is included in following water year.

Figure 6B-343. STARS: 95% Posterior Predictive Intervals for Water Year 1970.



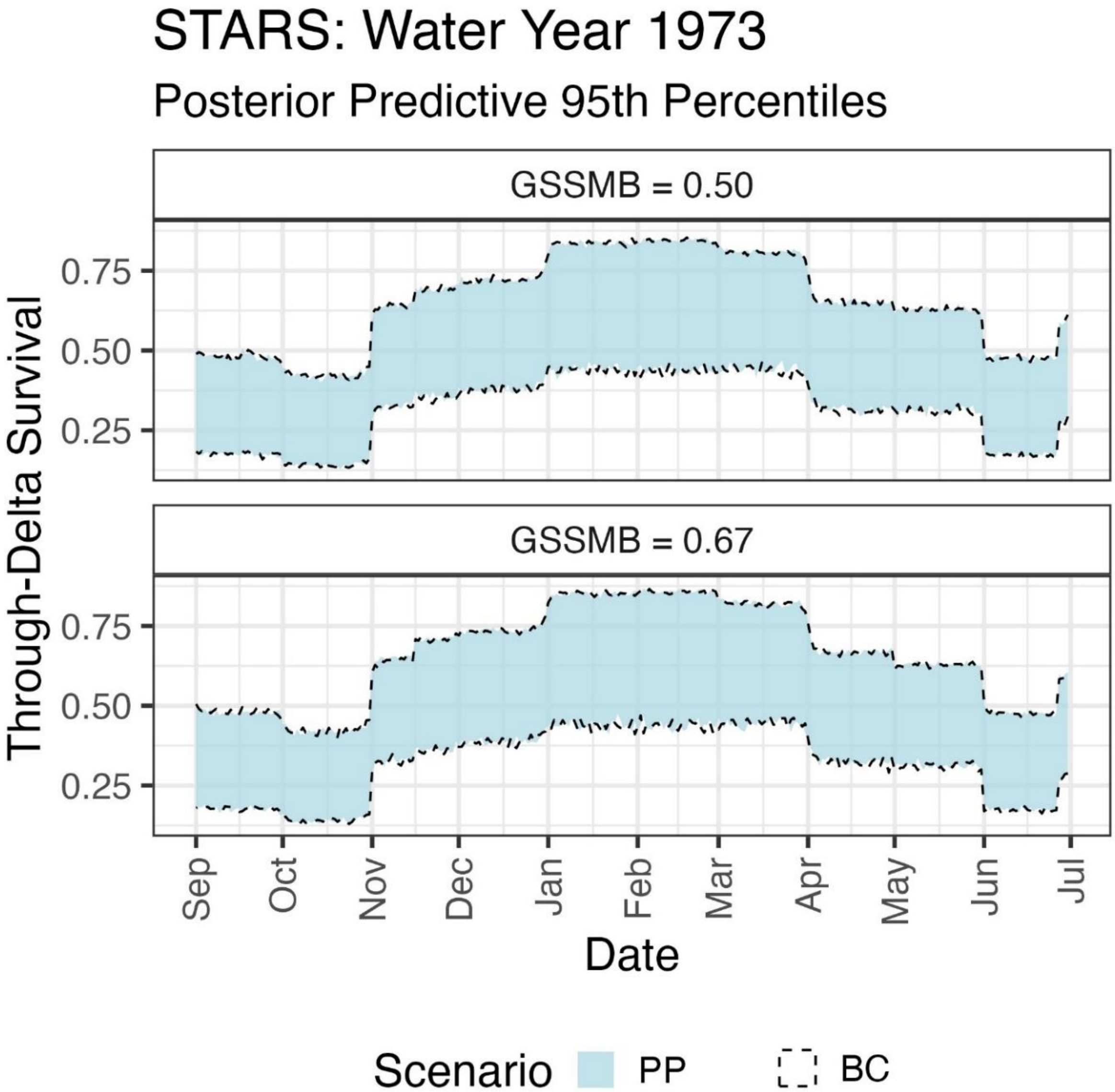
Note: September is included in following water year.

Figure 6B-344. STARS: 95% Posterior Predictive Intervals for Water Year 1971.



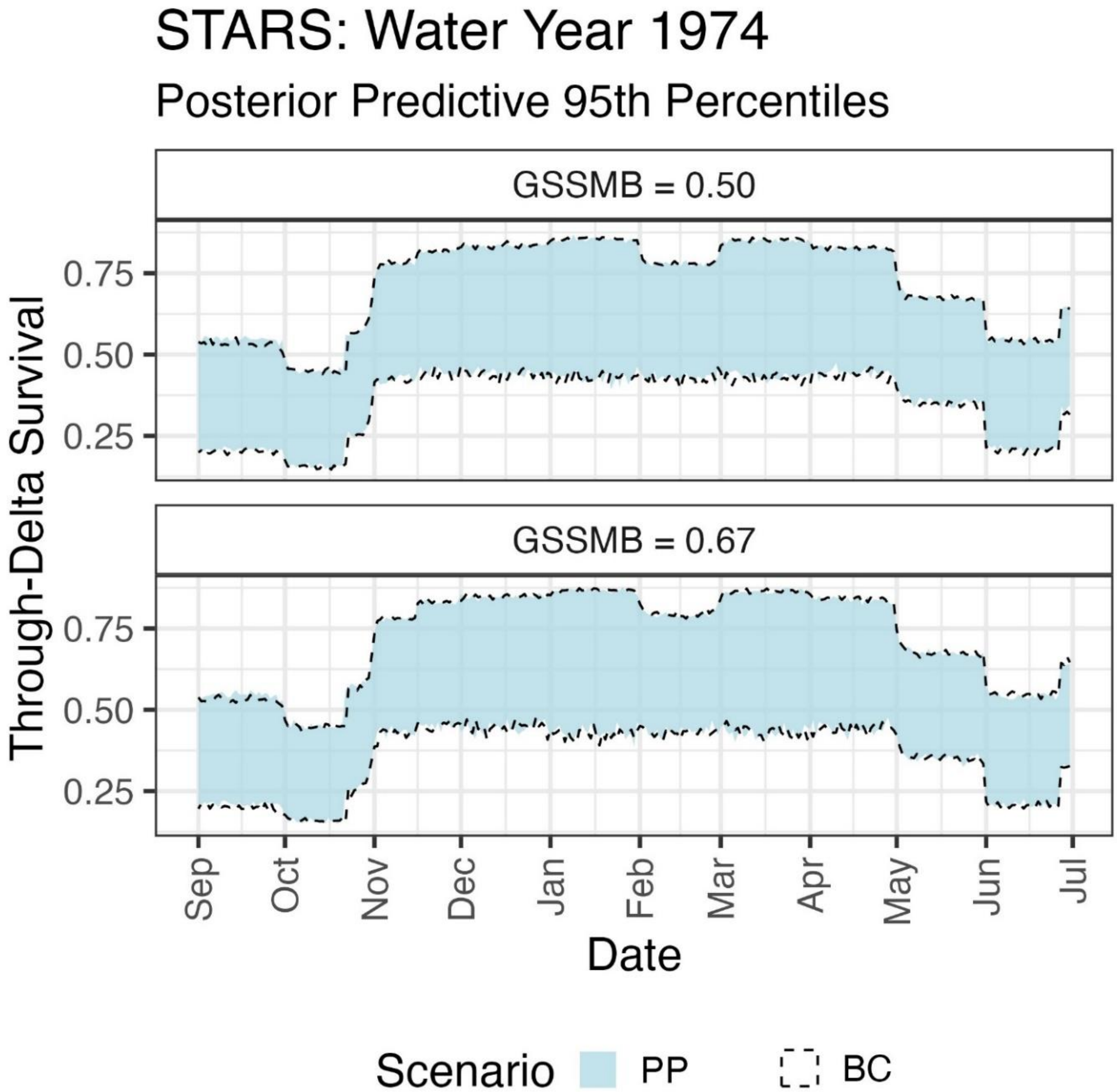
Note: September is included in following water year.

Figure 6B-345. STARS: 95% Posterior Predictive Intervals for Water Year 1972.



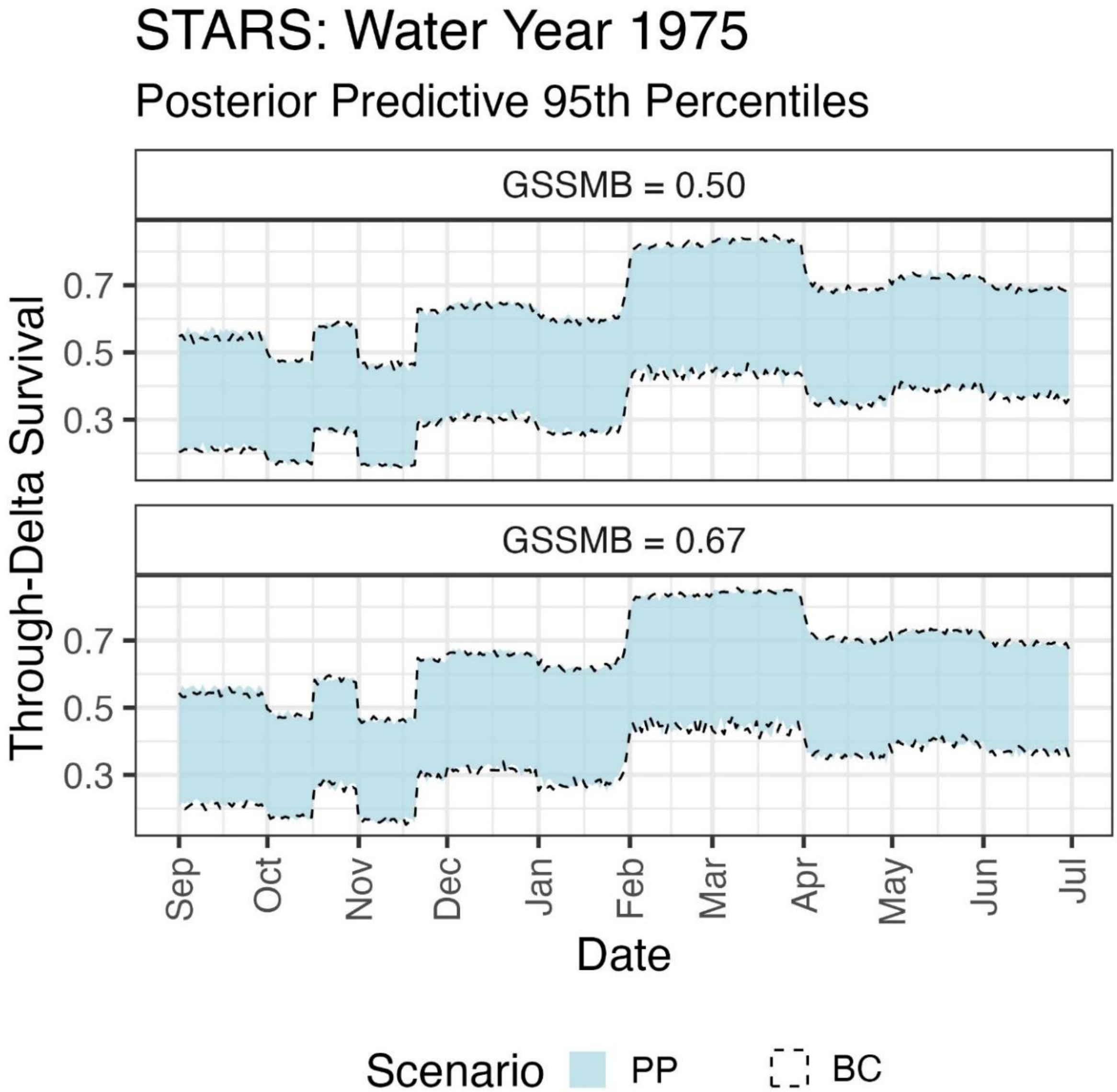
Note: September is included in following water year.

Figure 6B-346. STARS: 95% Posterior Predictive Intervals for Water Year 1973.



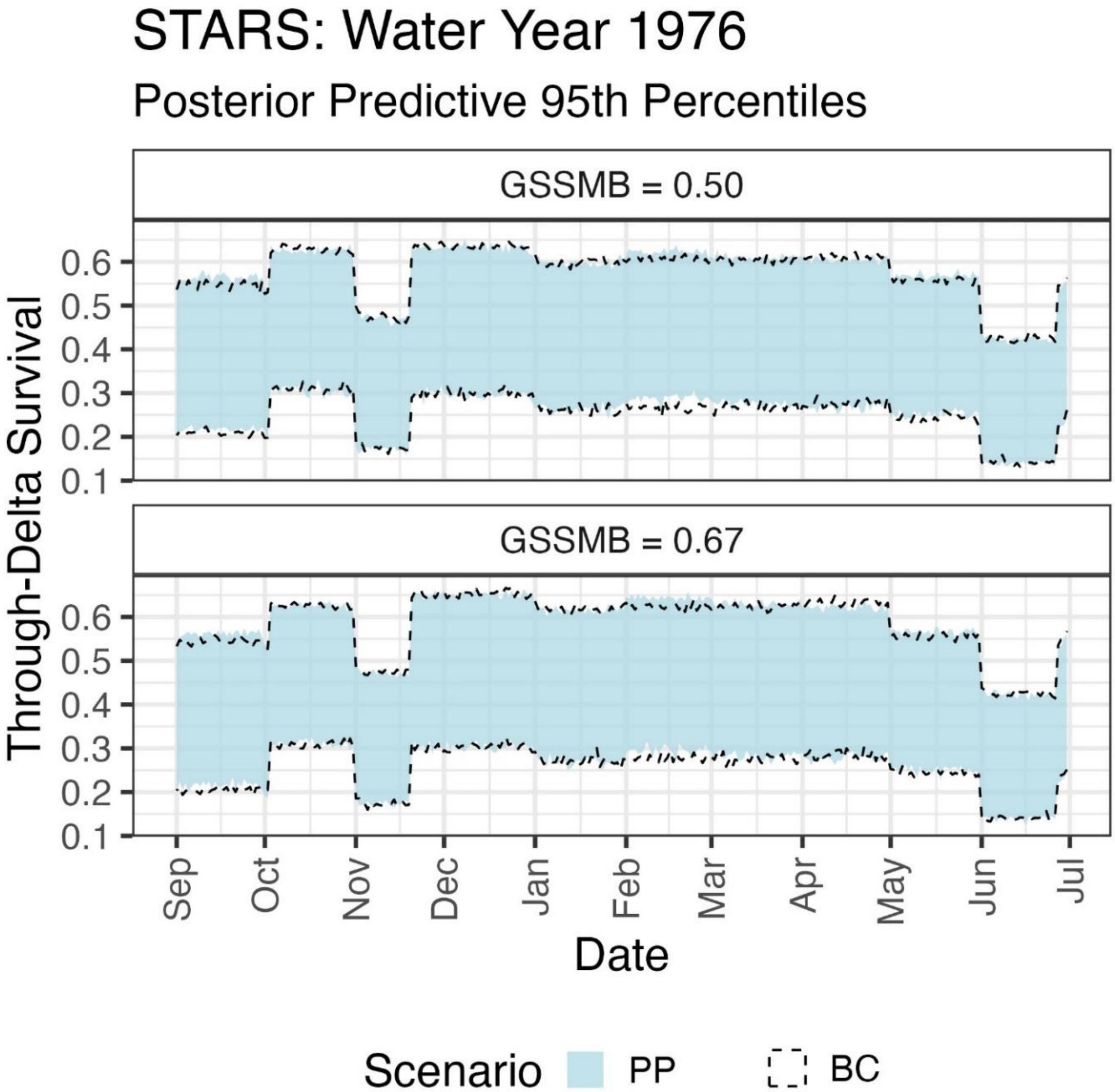
Note: September is included in following water year.

Figure 6B-347. STARS: 95% Posterior Predictive Intervals for Water Year 1974.



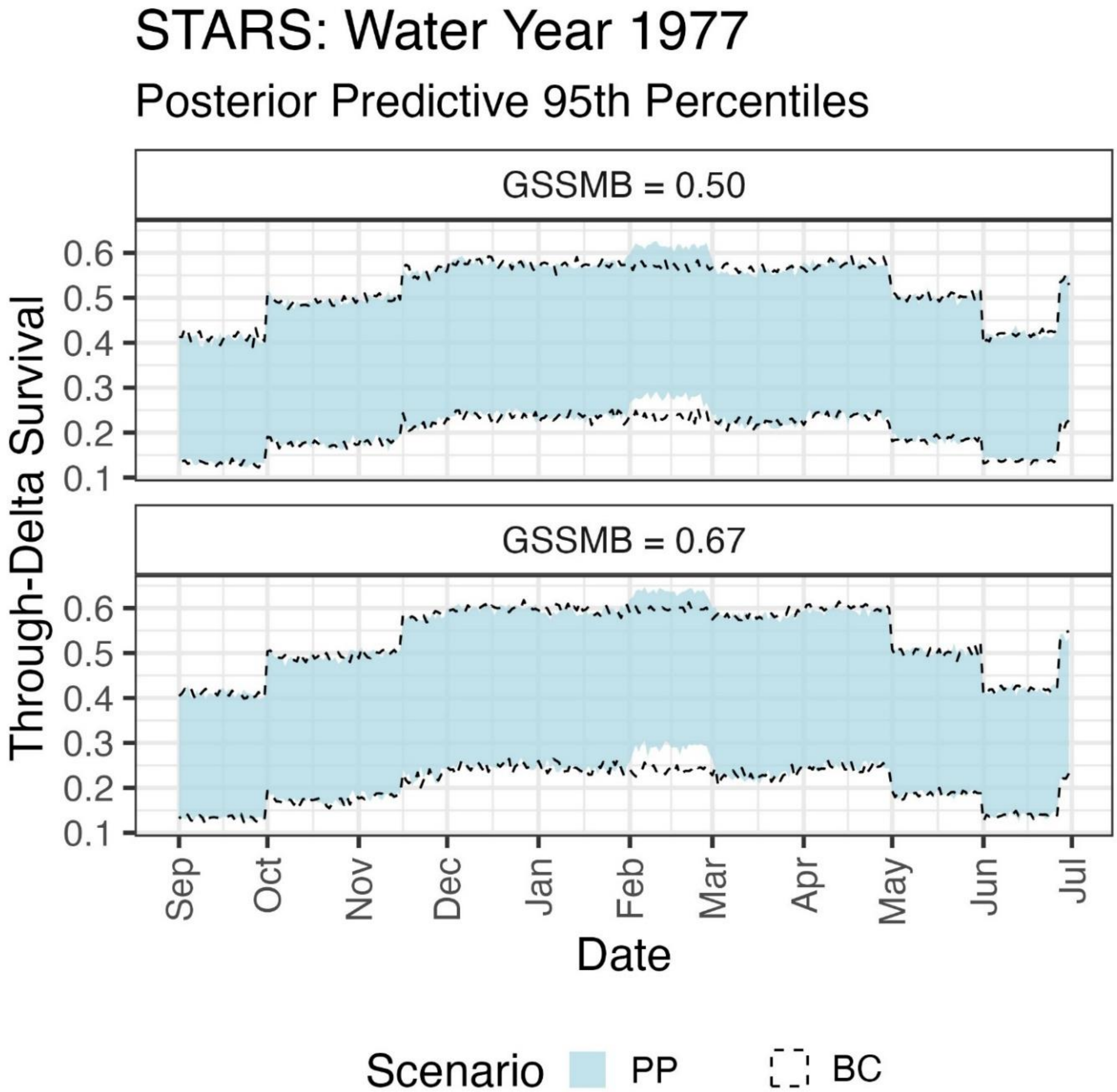
Note: September is included in following water year.

Figure 6B-348. STARS: 95% Posterior Predictive Intervals for Water Year 1975.



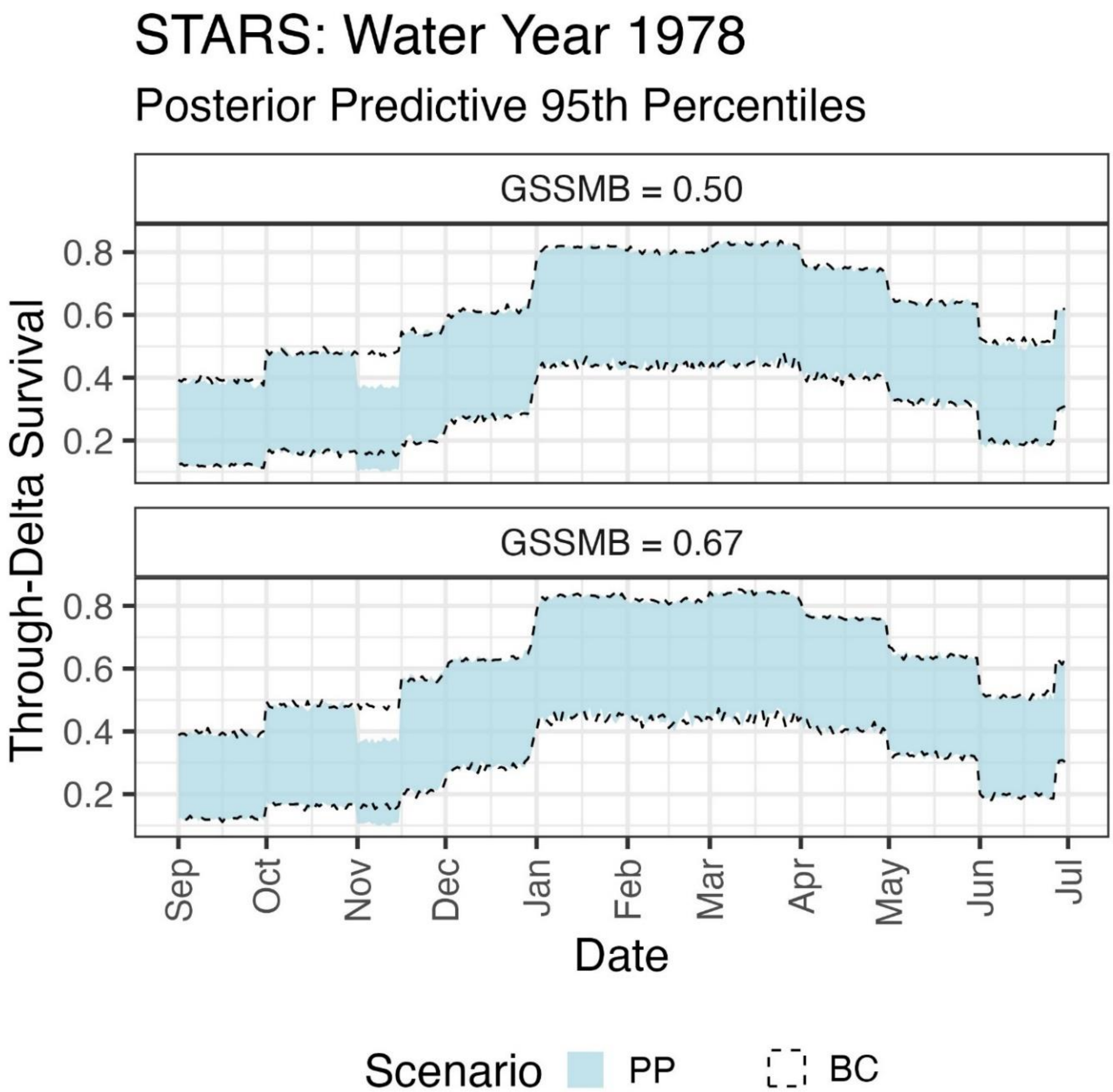
Note: September is included in following water year.

Figure 6B-349. STARS: 95% Posterior Predictive Intervals for Water Year 1976.



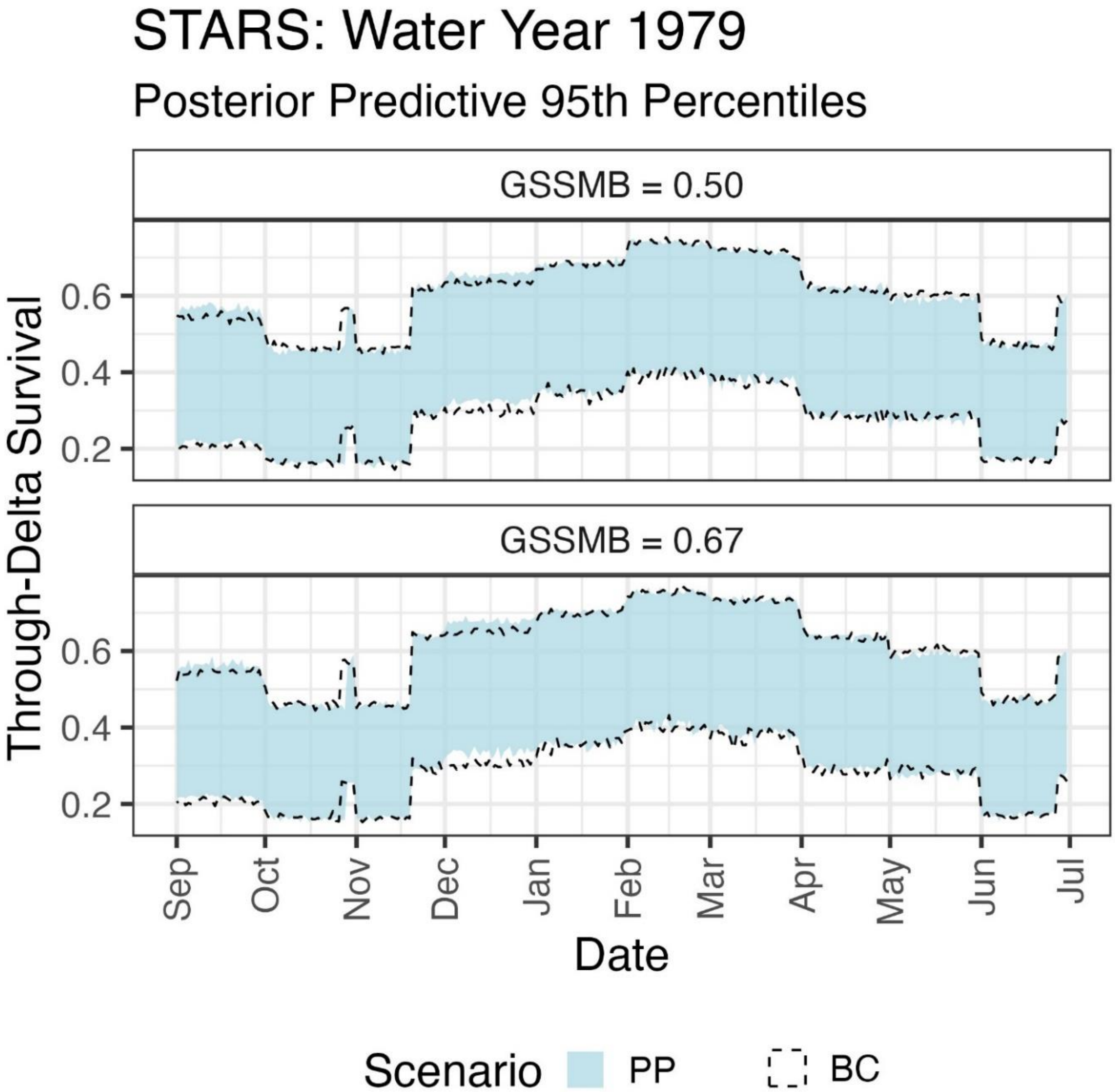
Note: September is included in following water year.

Figure 6B-350. STARS: 95% Posterior Predictive Intervals for Water Year 1977.



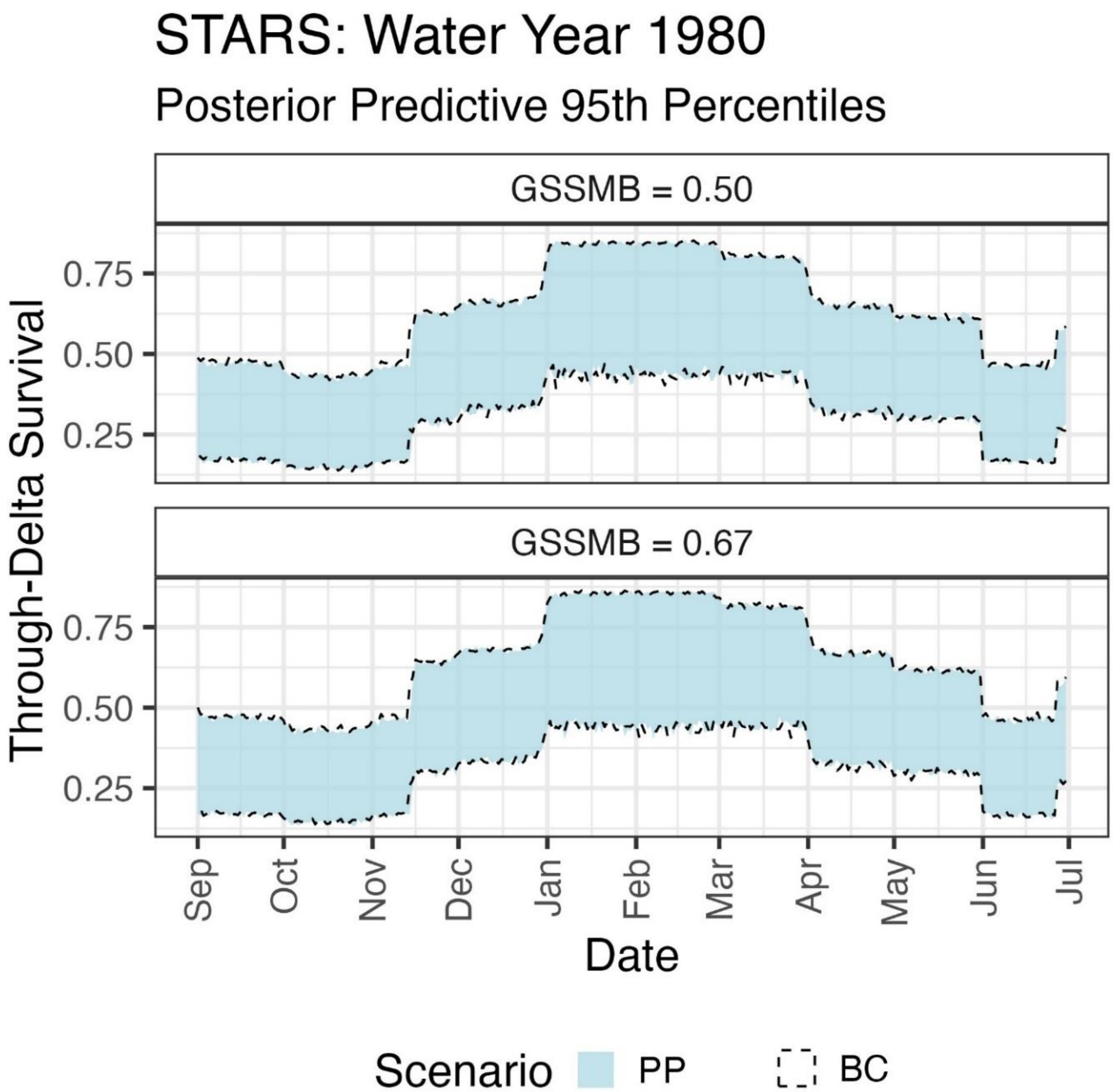
Note: September is included in following water year.

Figure 6B-351. STARS: 95% Posterior Predictive Intervals for Water Year 1978.



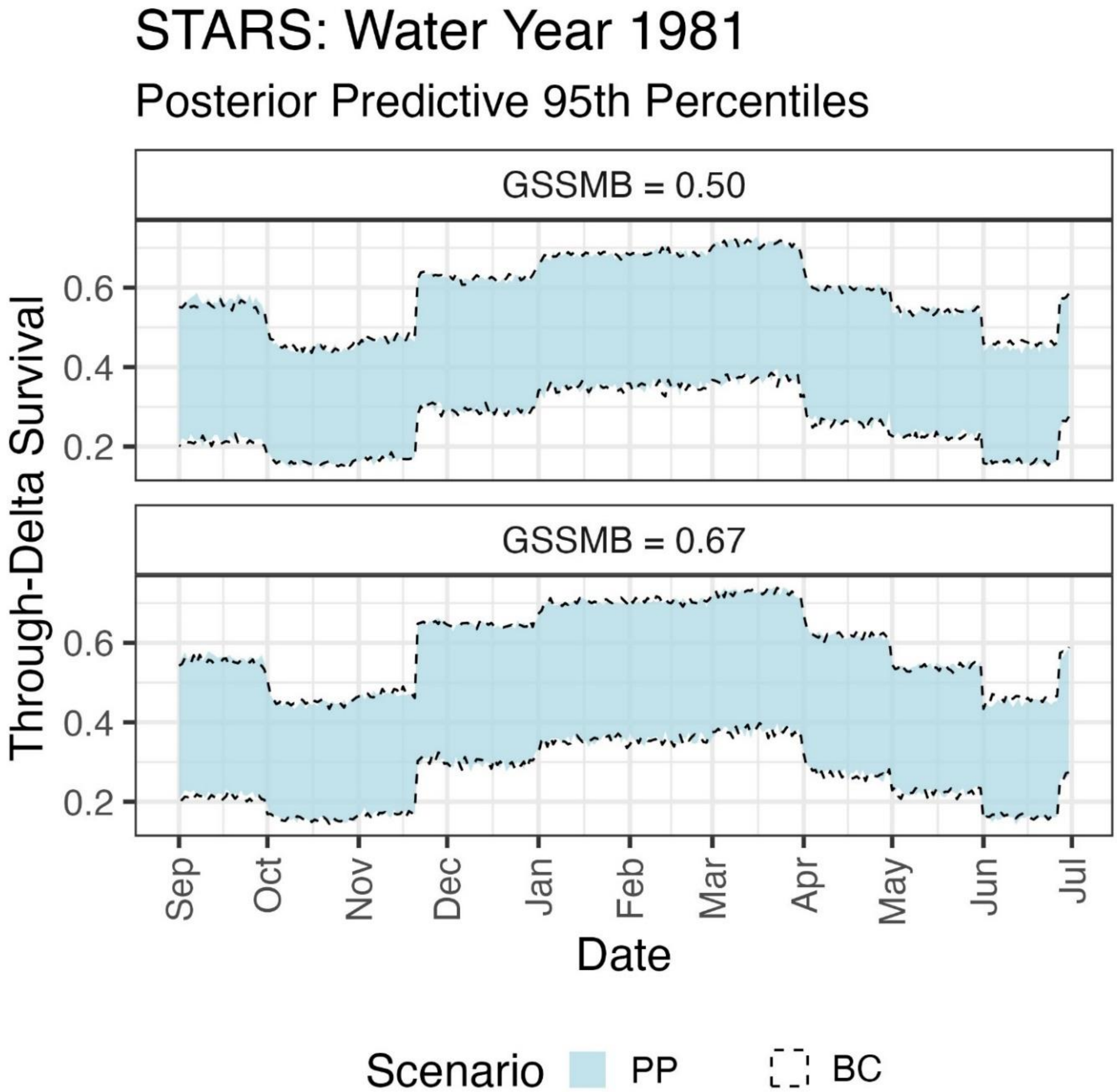
Note: September is included in following water year.

Figure 6B-352. STARS: 95% Posterior Predictive Intervals for Water Year 1979.



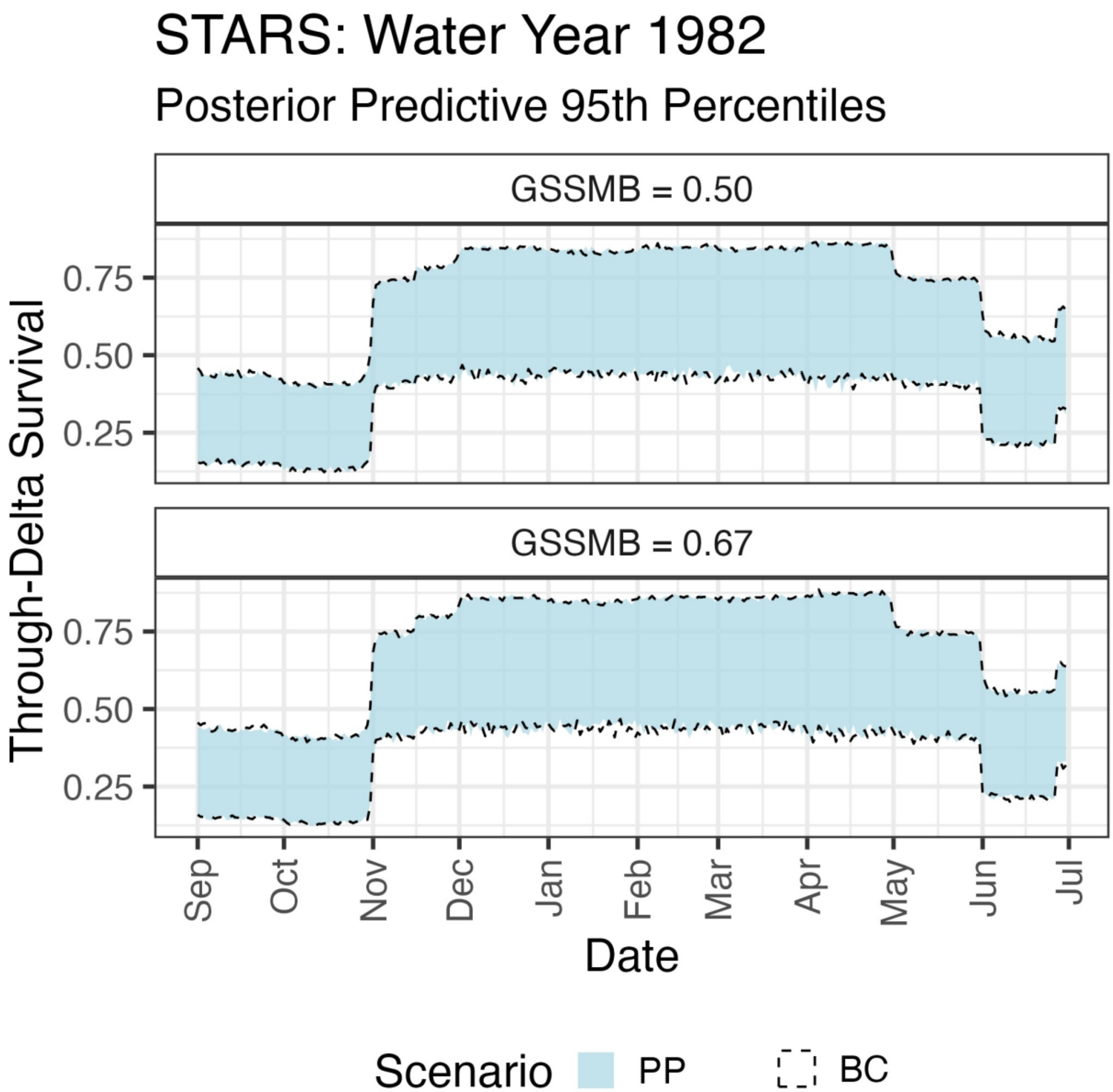
Note: September is included in following water year.

Figure 6B-353. STARS: 95% Posterior Predictive Intervals for Water Year 1980.



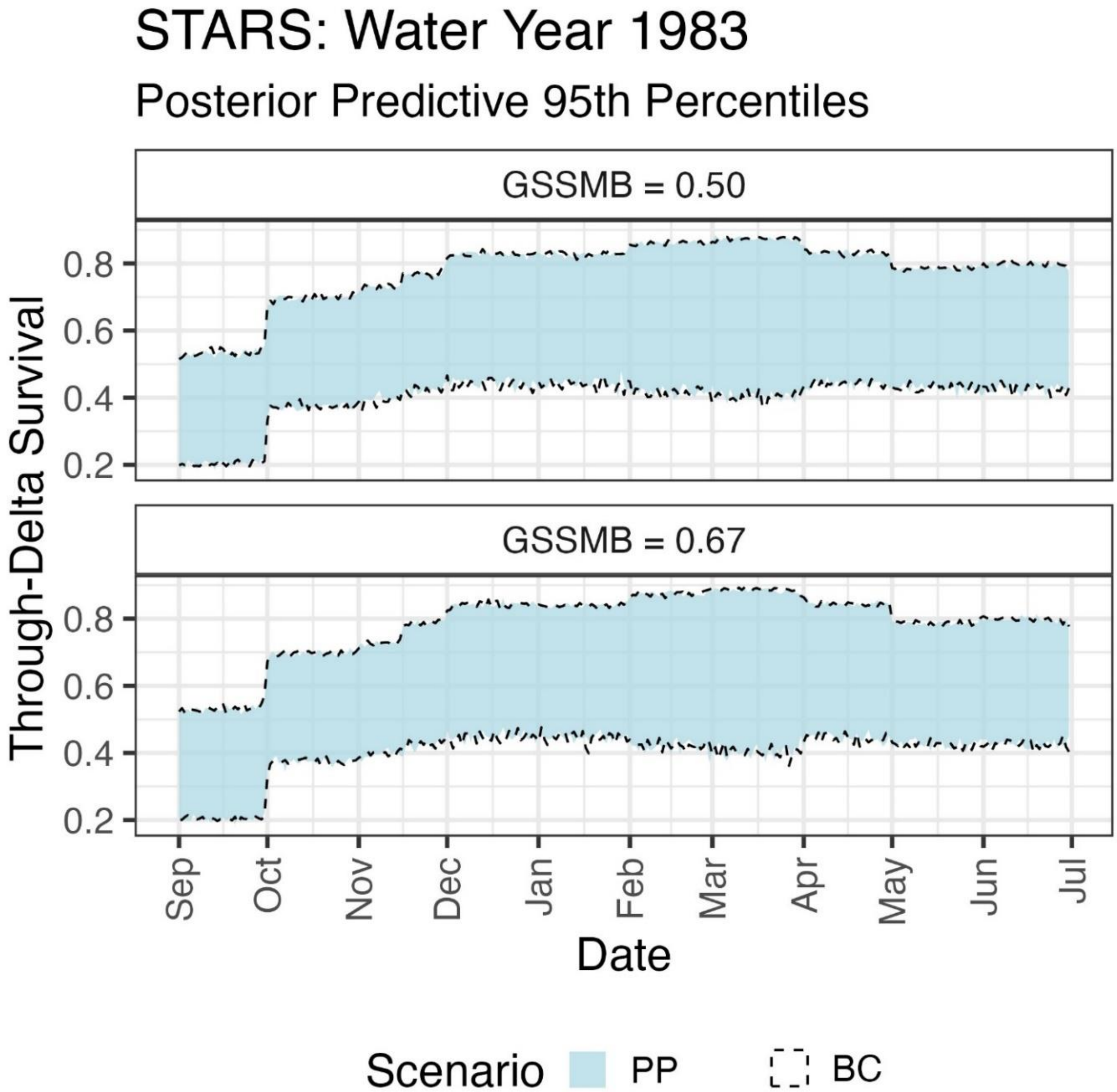
Note: September is included in following water year.

Figure 6B-354. STARS: 95% Posterior Predictive Intervals for Water Year 1981.



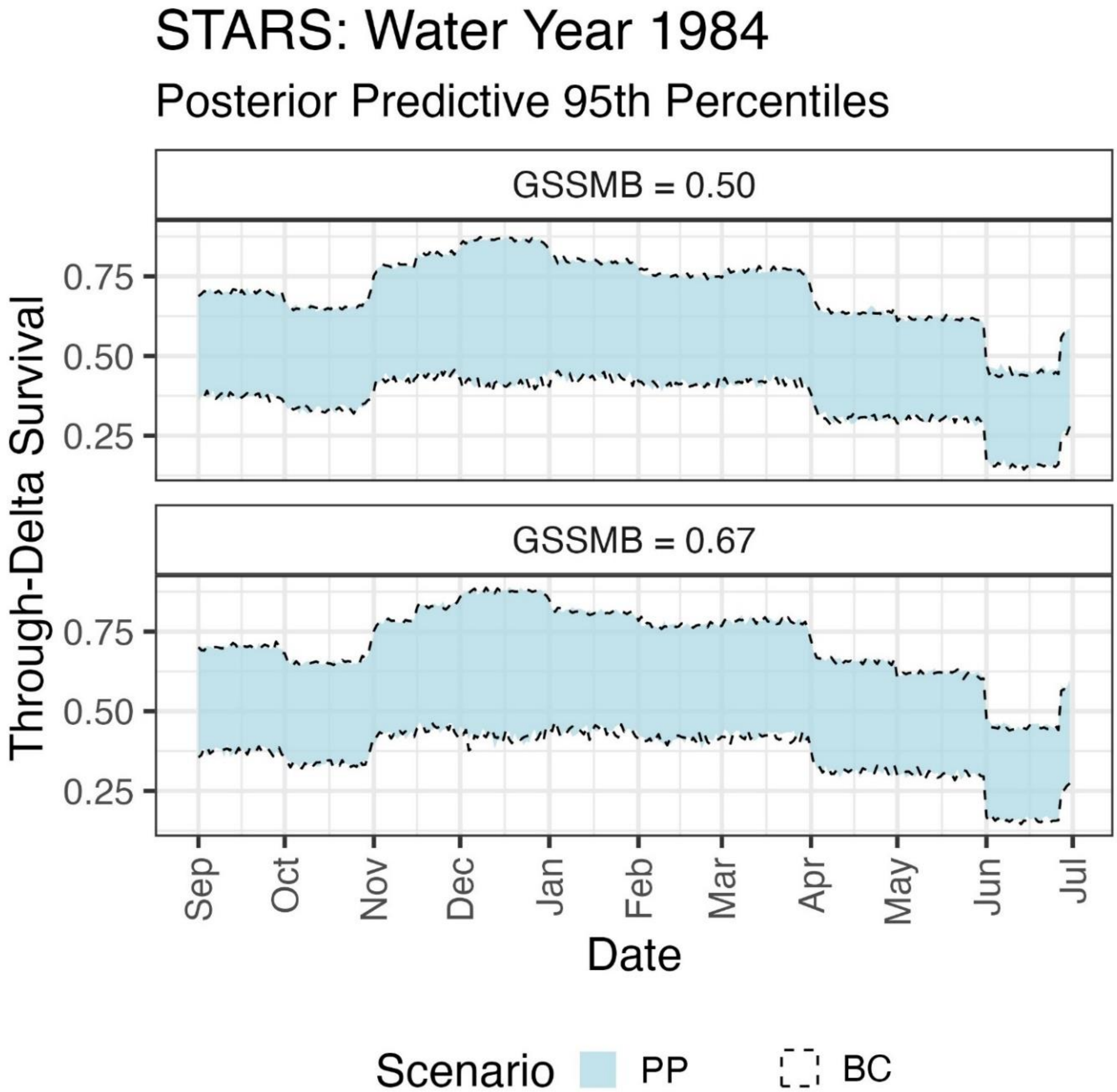
Note: September is included in following water year.

Figure 6B-355. STARS: 95% Posterior Predictive Intervals for Water Year 1982.



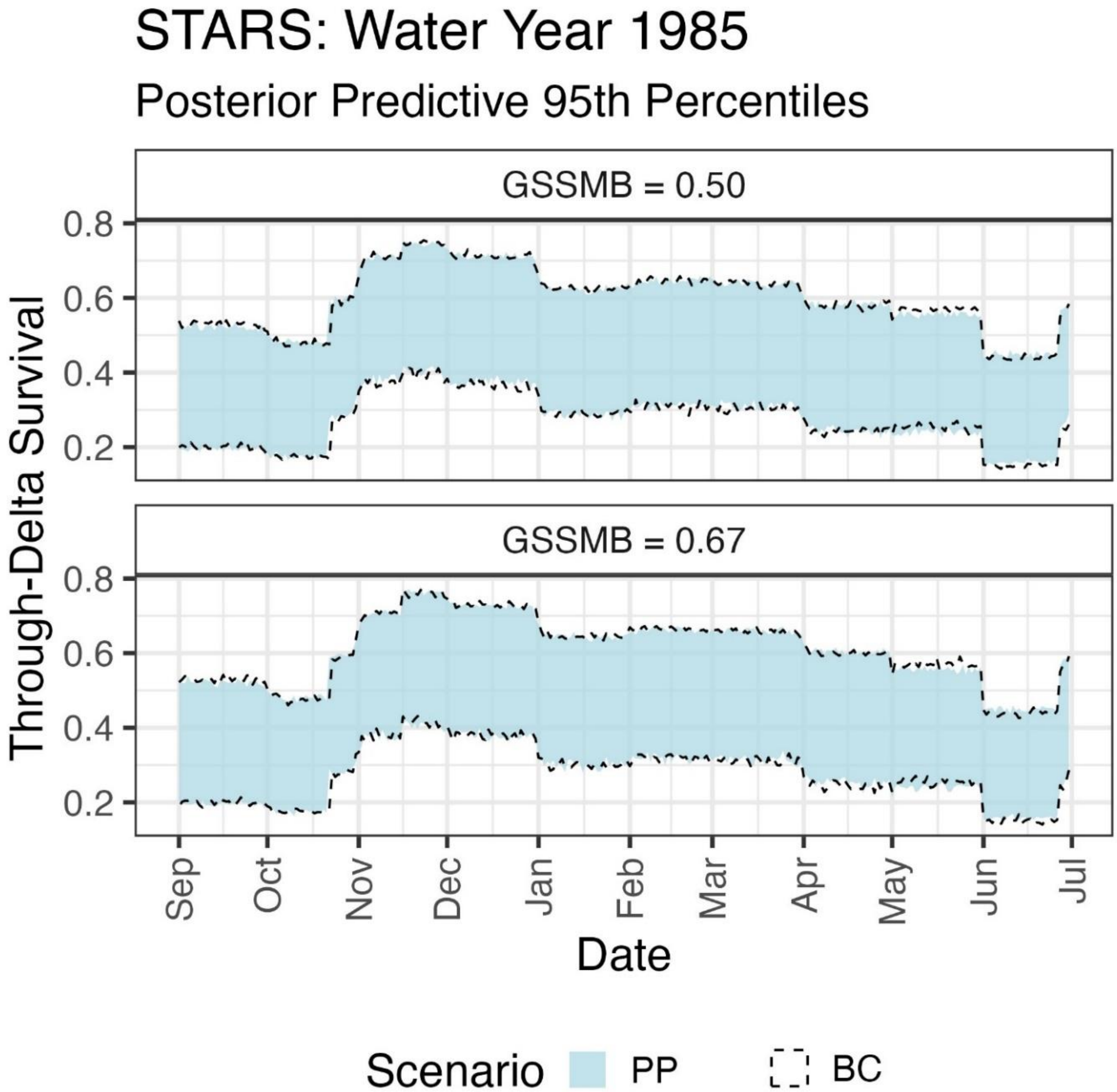
Note: September is included in following water year.

Figure 6B-356. STARS: 95% Posterior Predictive Intervals for Water Year 1983.



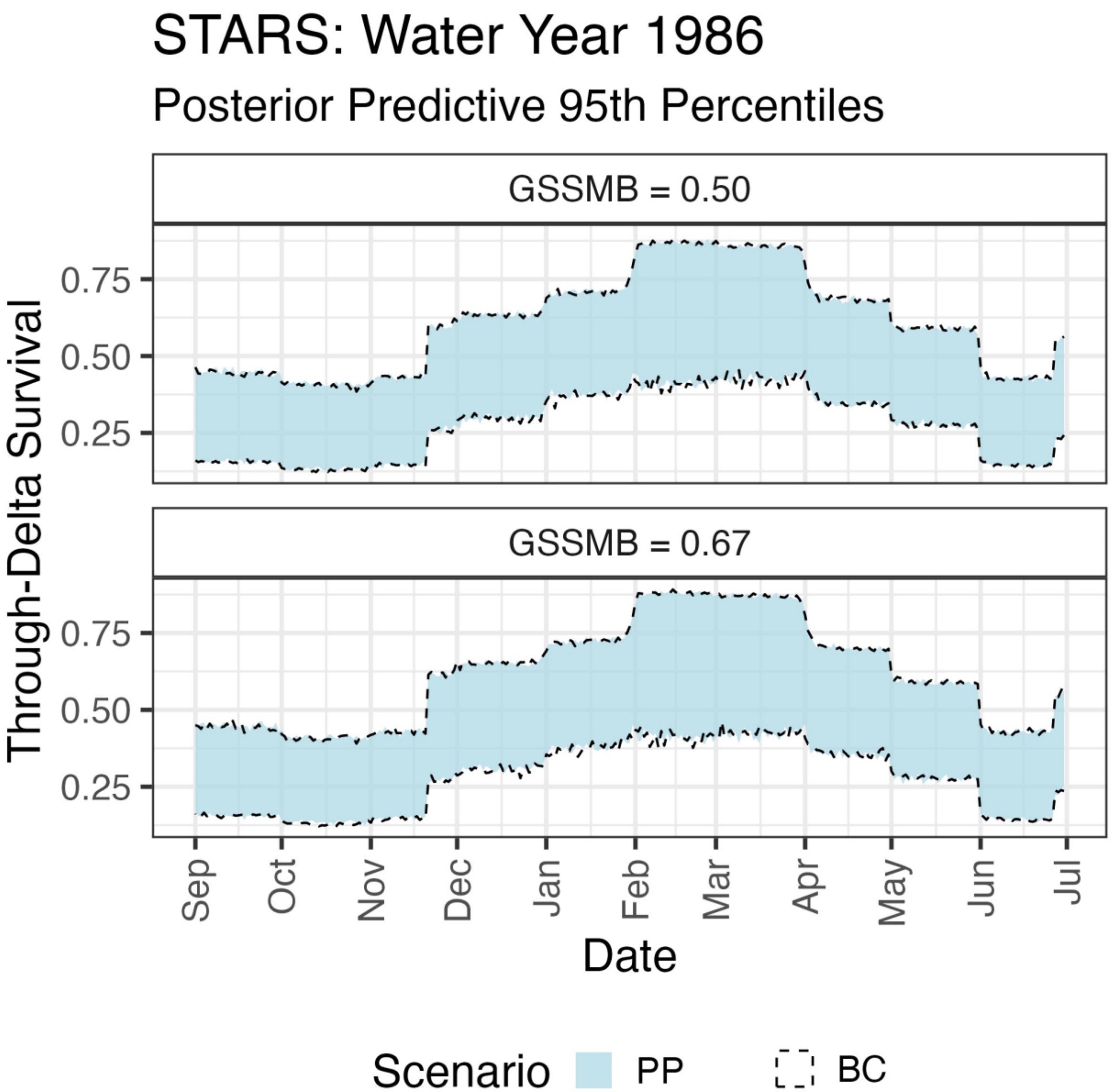
Note: September is included in following water year.

Figure 6B-357. STARS: 95% Posterior Predictive Intervals for Water Year 1984.



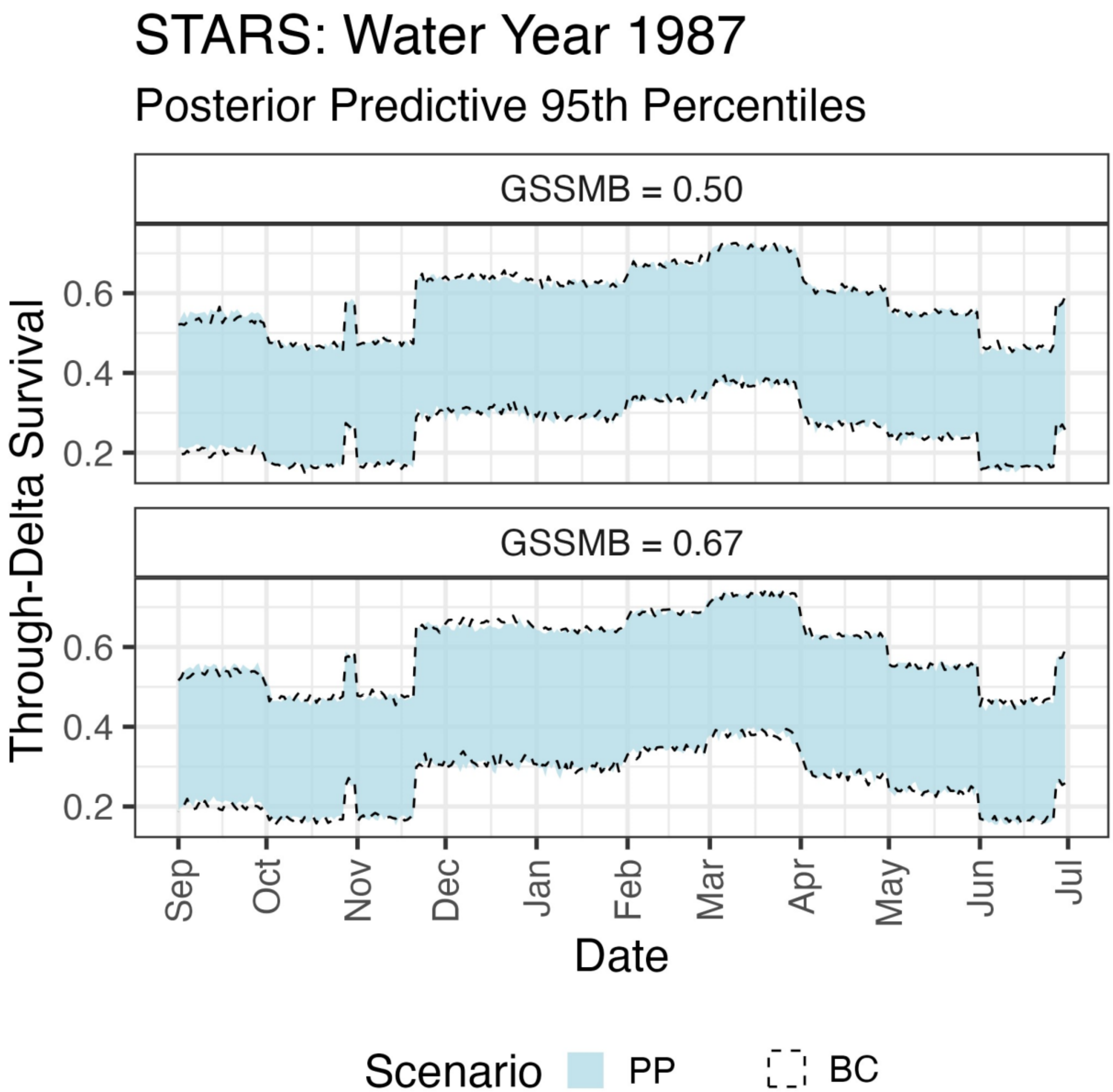
Note: September is included in following water year.

Figure 6B-358. STARS: 95% Posterior Predictive Intervals for Water Year 1985.



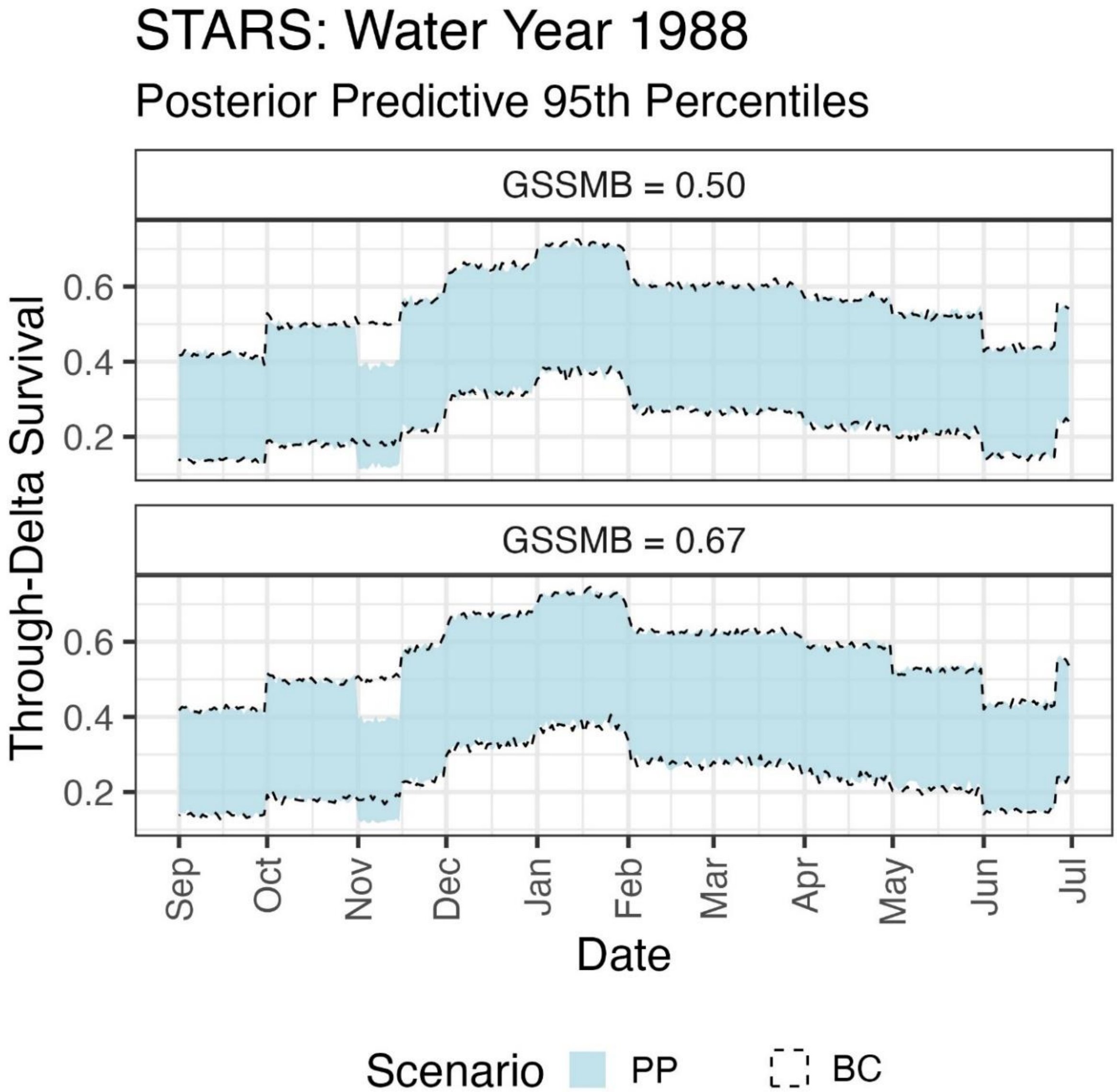
Note: September is included in following water year.

Figure 6B-359. STARS: 95% Posterior Predictive Intervals for Water Year 1986.



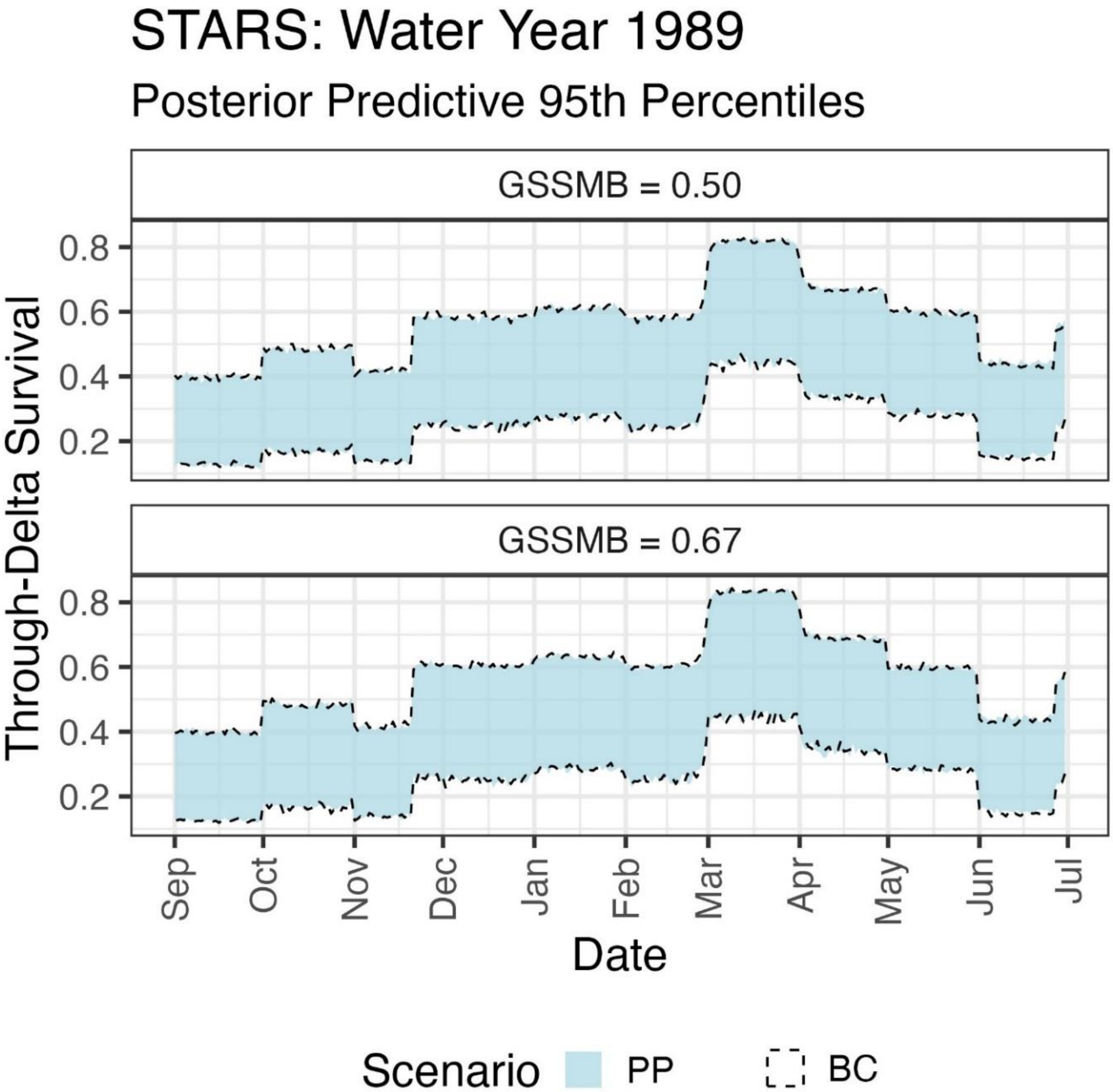
Note: September is included in following water year.

Figure 6B-360. STARS: 95% Posterior Predictive Intervals for Water Year 1987.



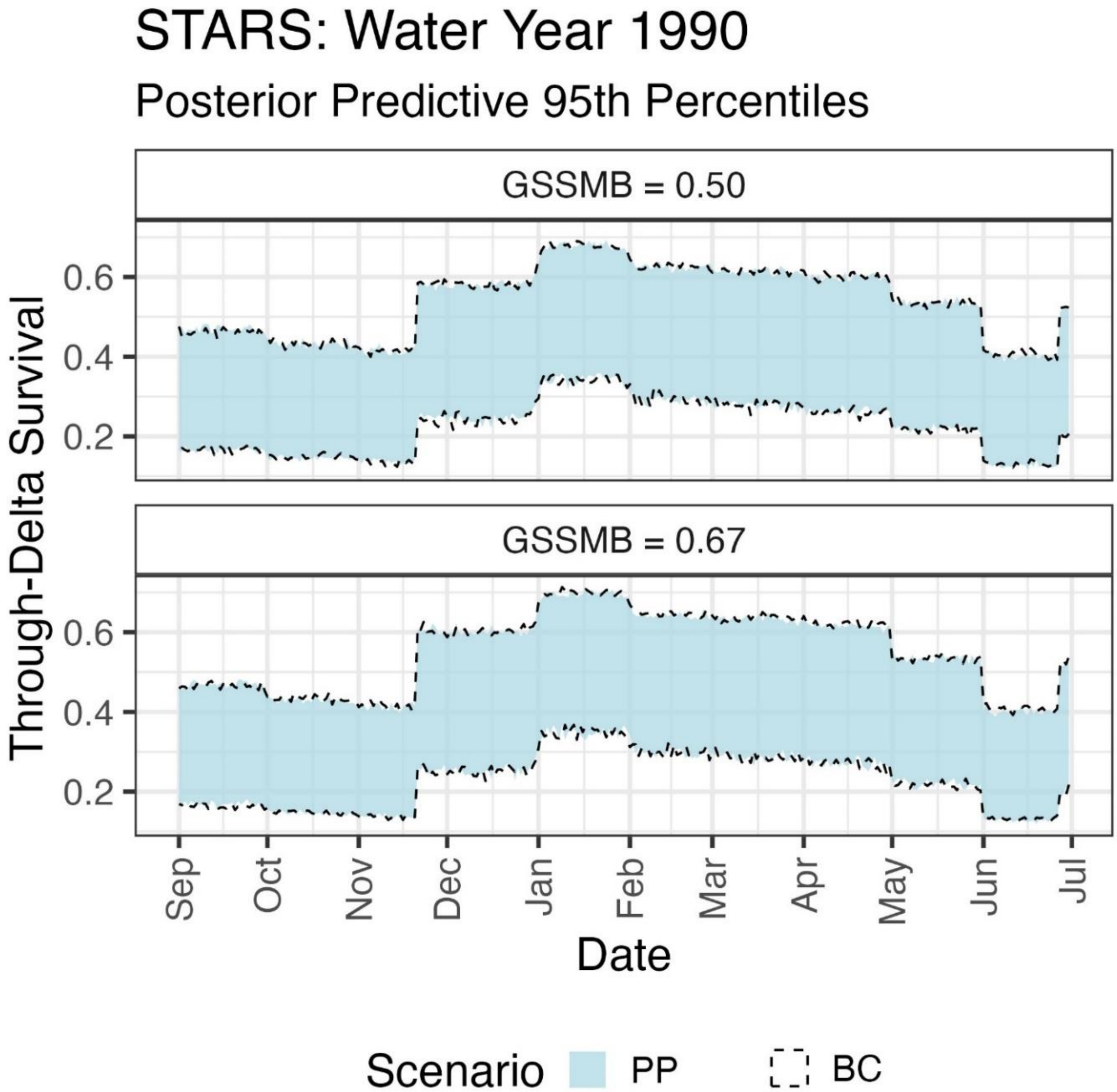
Note: September is included in following water year.

Figure 6B-361. STARS: 95% Posterior Predictive Intervals for Water Year 1988.



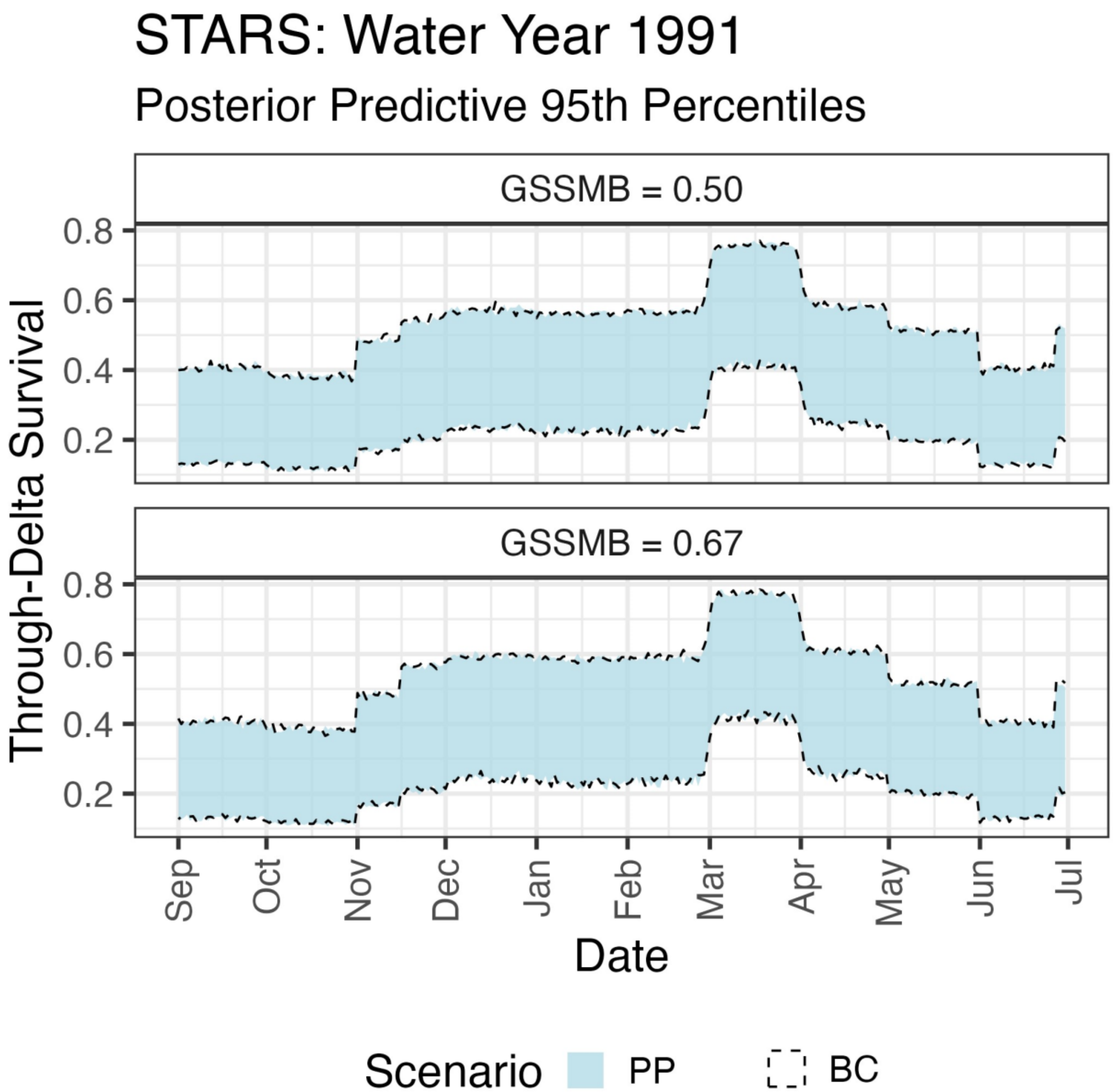
Note: September is included in following water year.

Figure 6B-362. STARS: 95% Posterior Predictive Intervals for Water Year 1989.



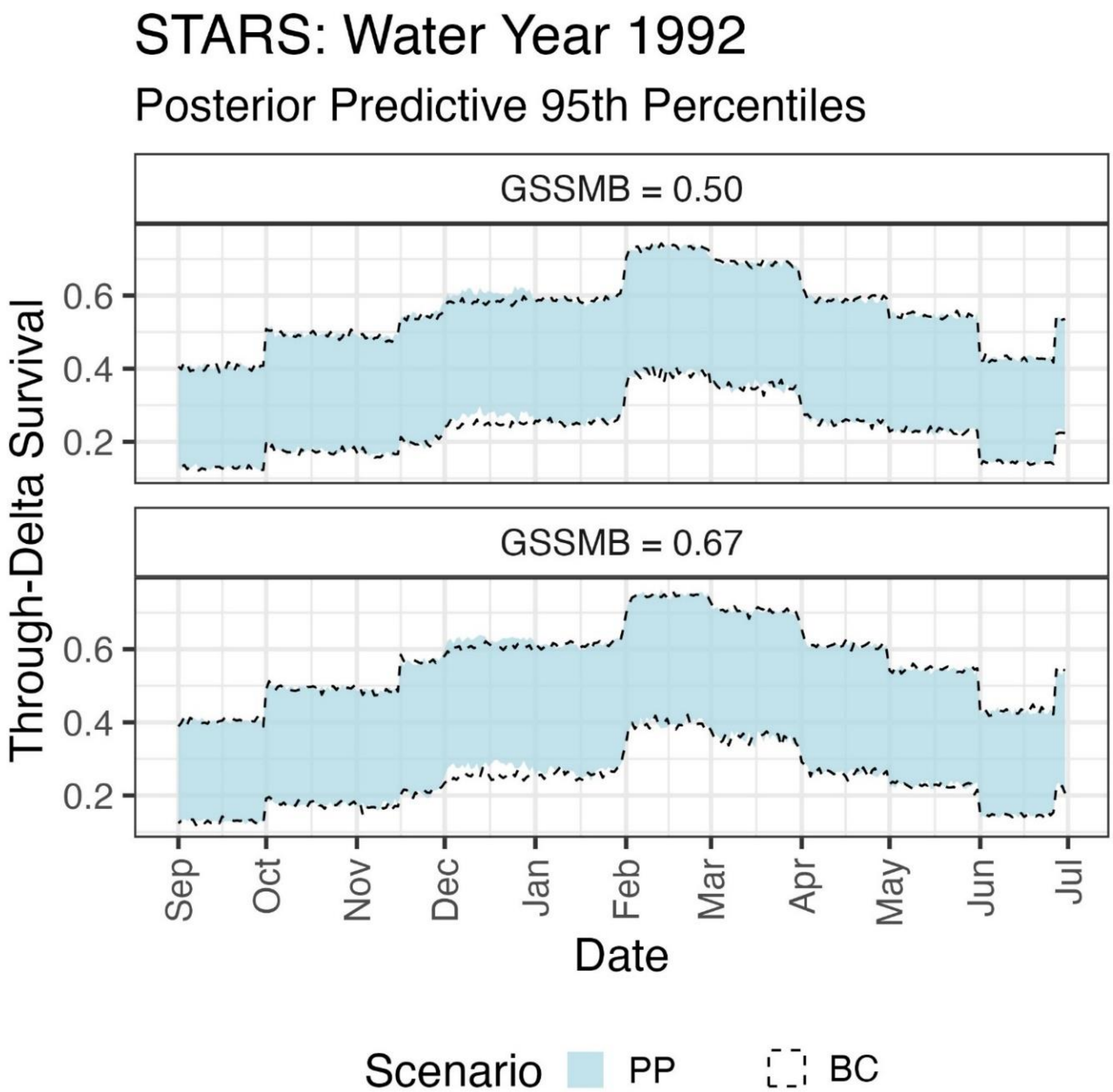
Note: September is included in following water year.

Figure 6B-363. STARS: 95% Posterior Predictive Intervals for Water Year 1990.



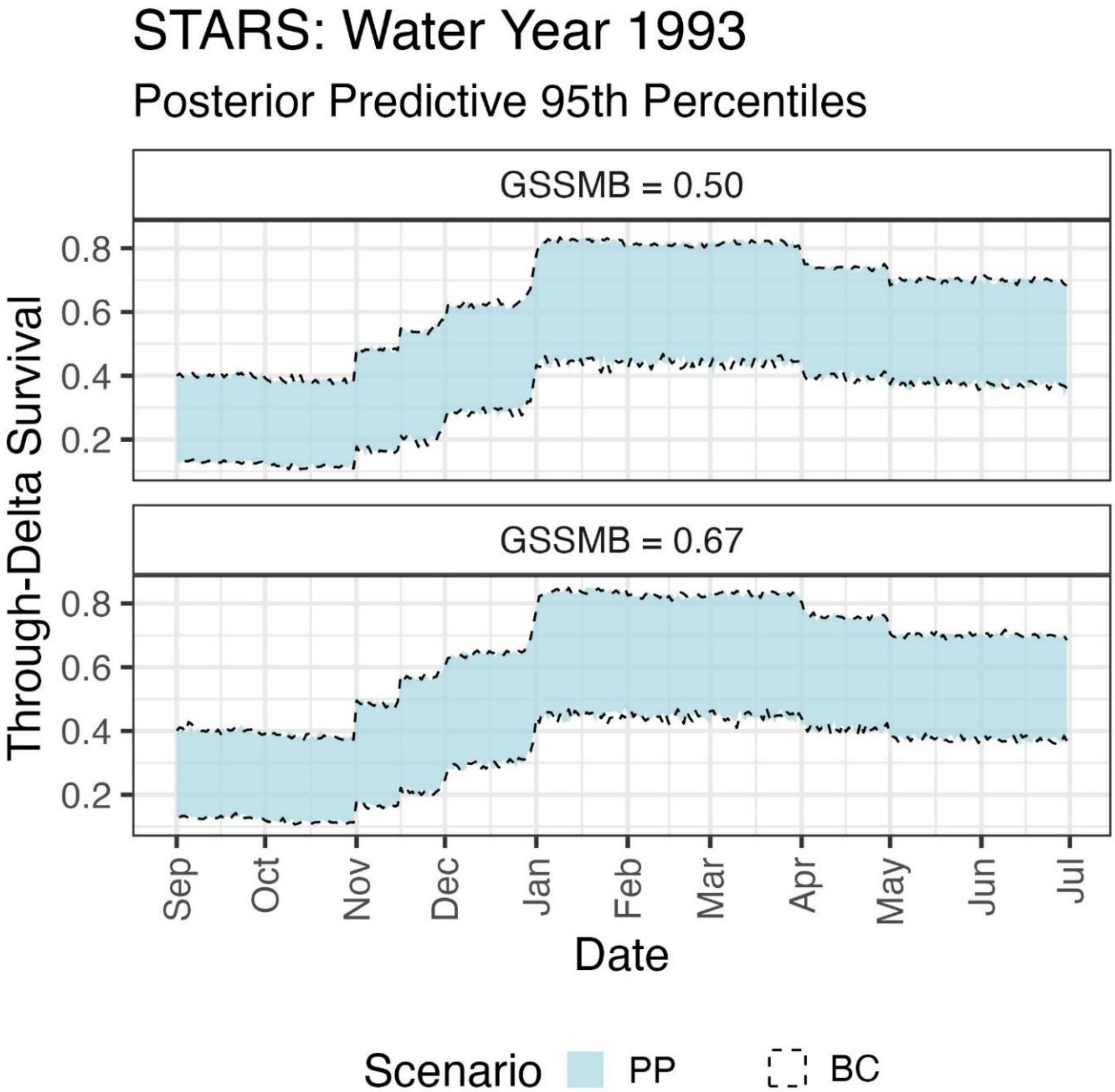
Note: September is included in following water year.

Figure 6B-364. STARS: 95% Posterior Predictive Intervals for Water Year 1991.



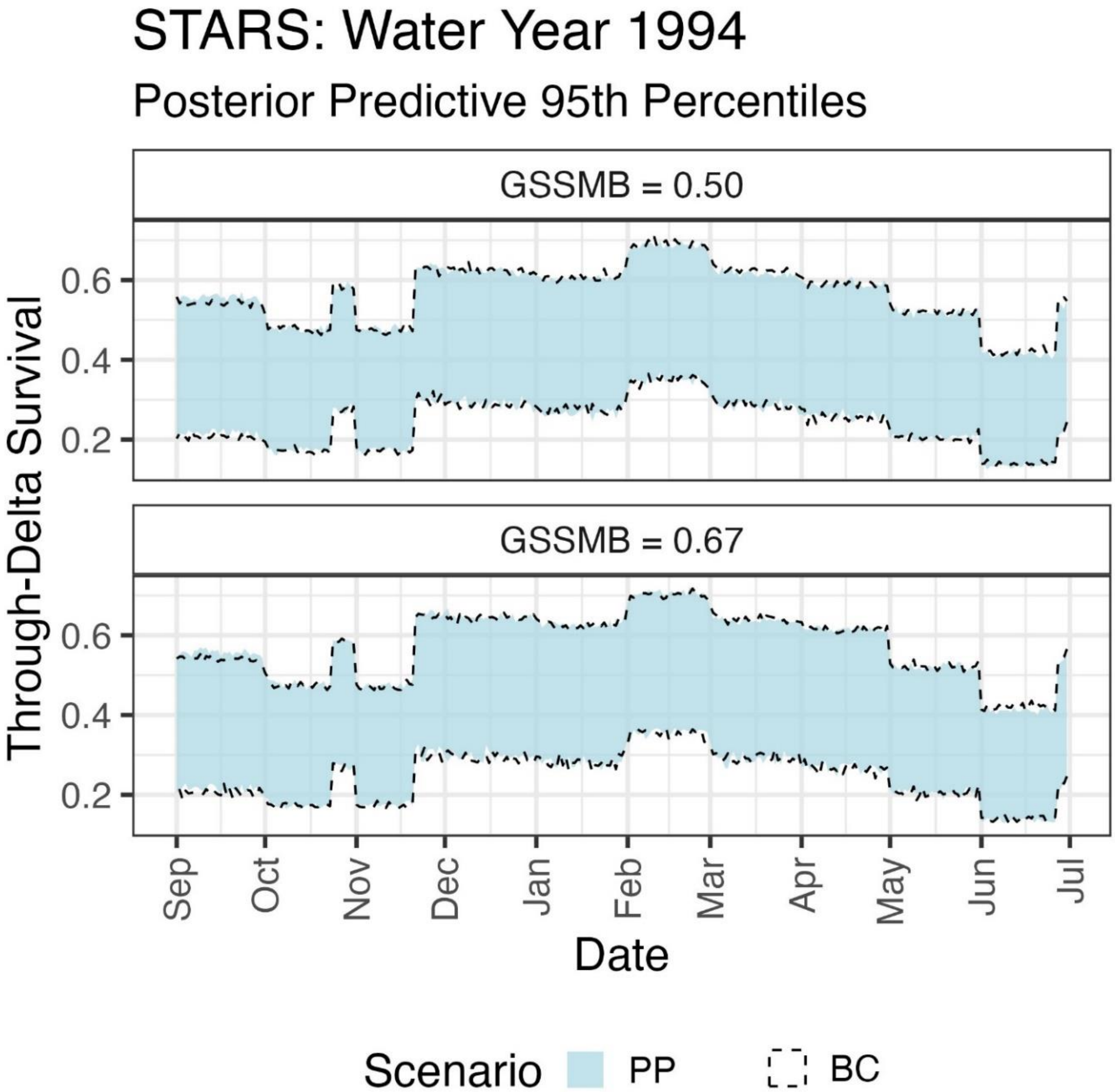
Note: September is included in following water year.

Figure 6B-365. STARS: 95% Posterior Predictive Intervals for Water Year 1992.



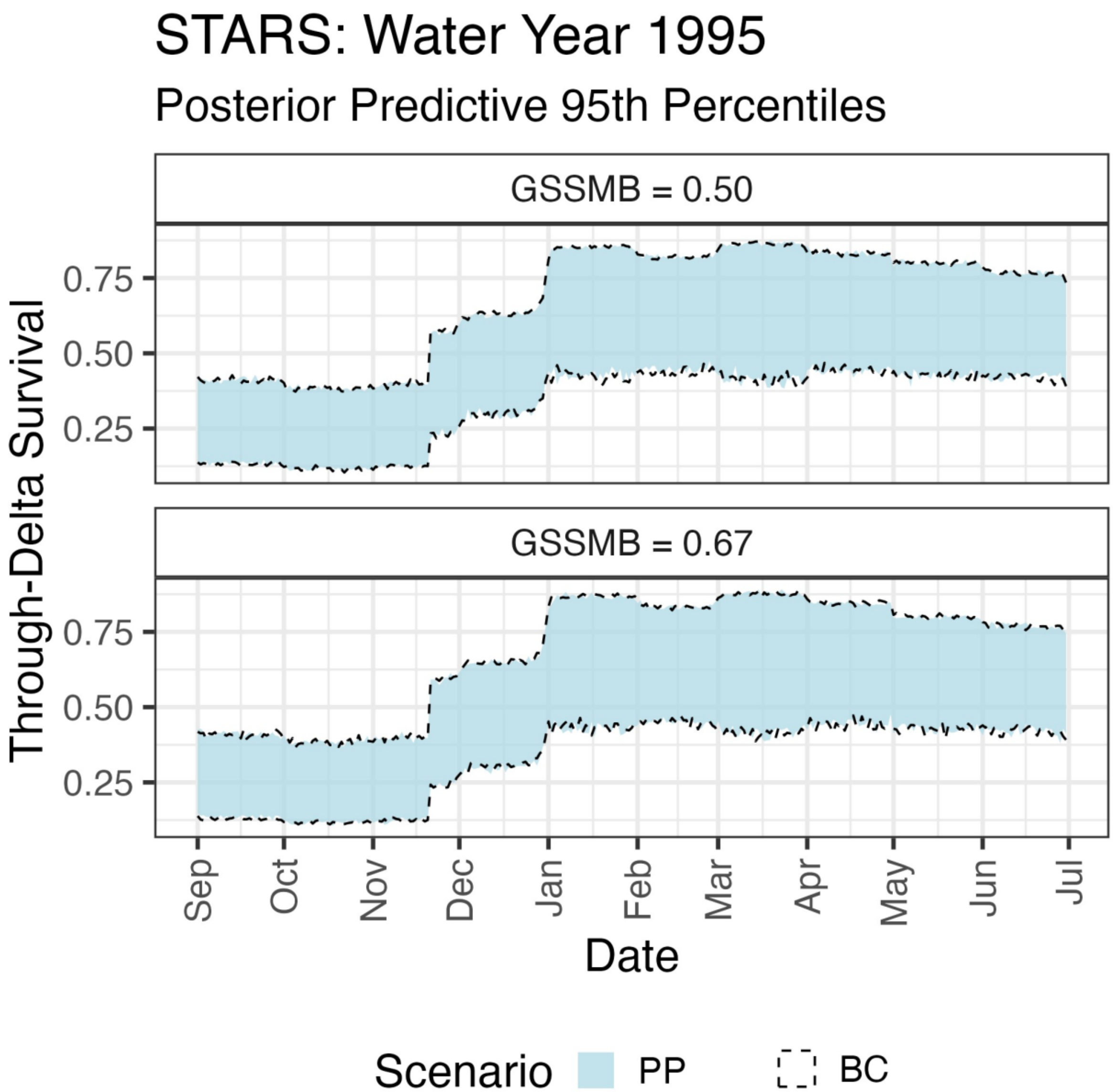
Note: September is included in following water year.

Figure 6B-366. STARS: 95% Posterior Predictive Intervals for Water Year 1993.



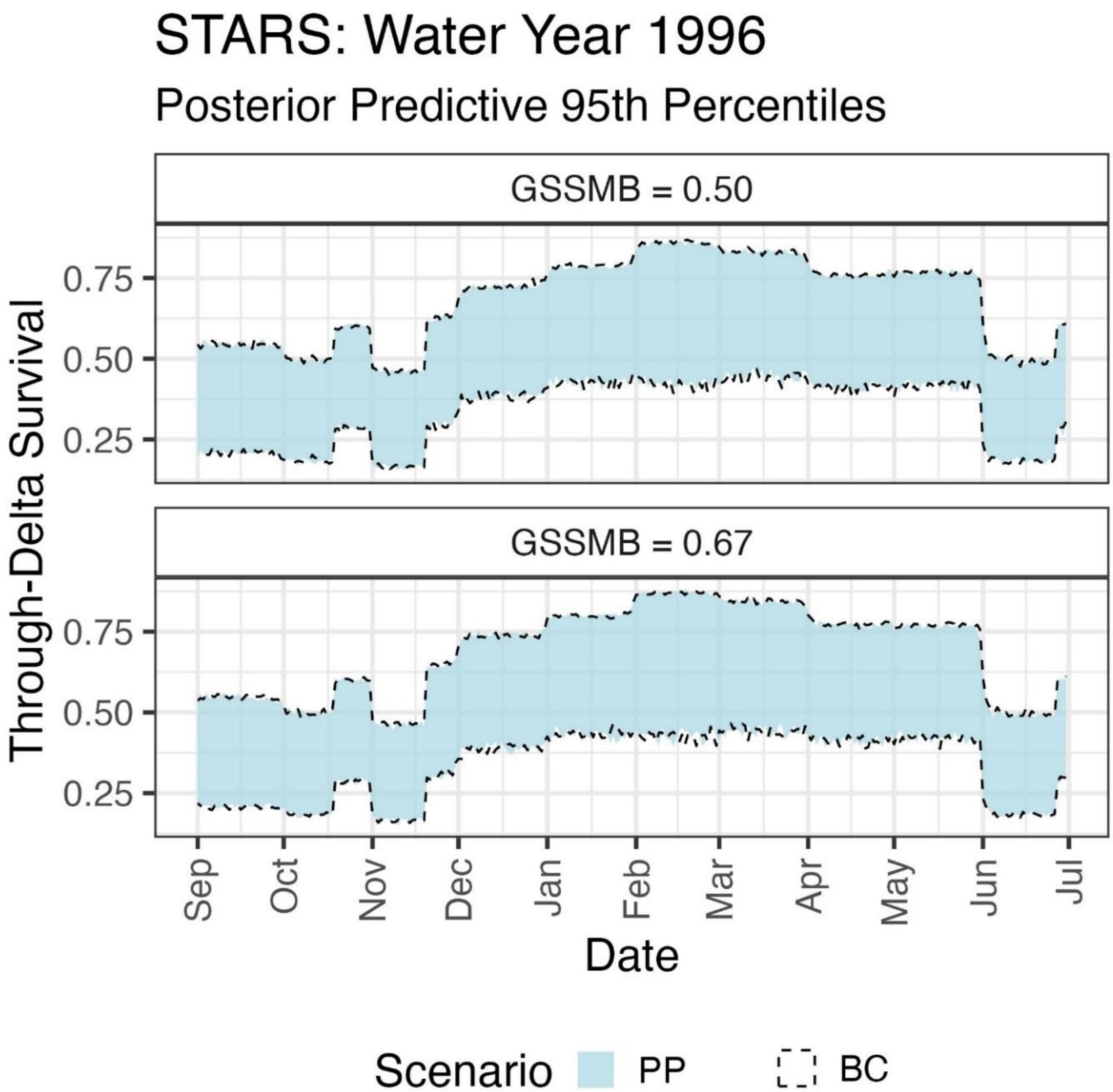
Note: September is included in following water year.

Figure 6B-367. STARS: 95% Posterior Predictive Intervals for Water Year 1994.



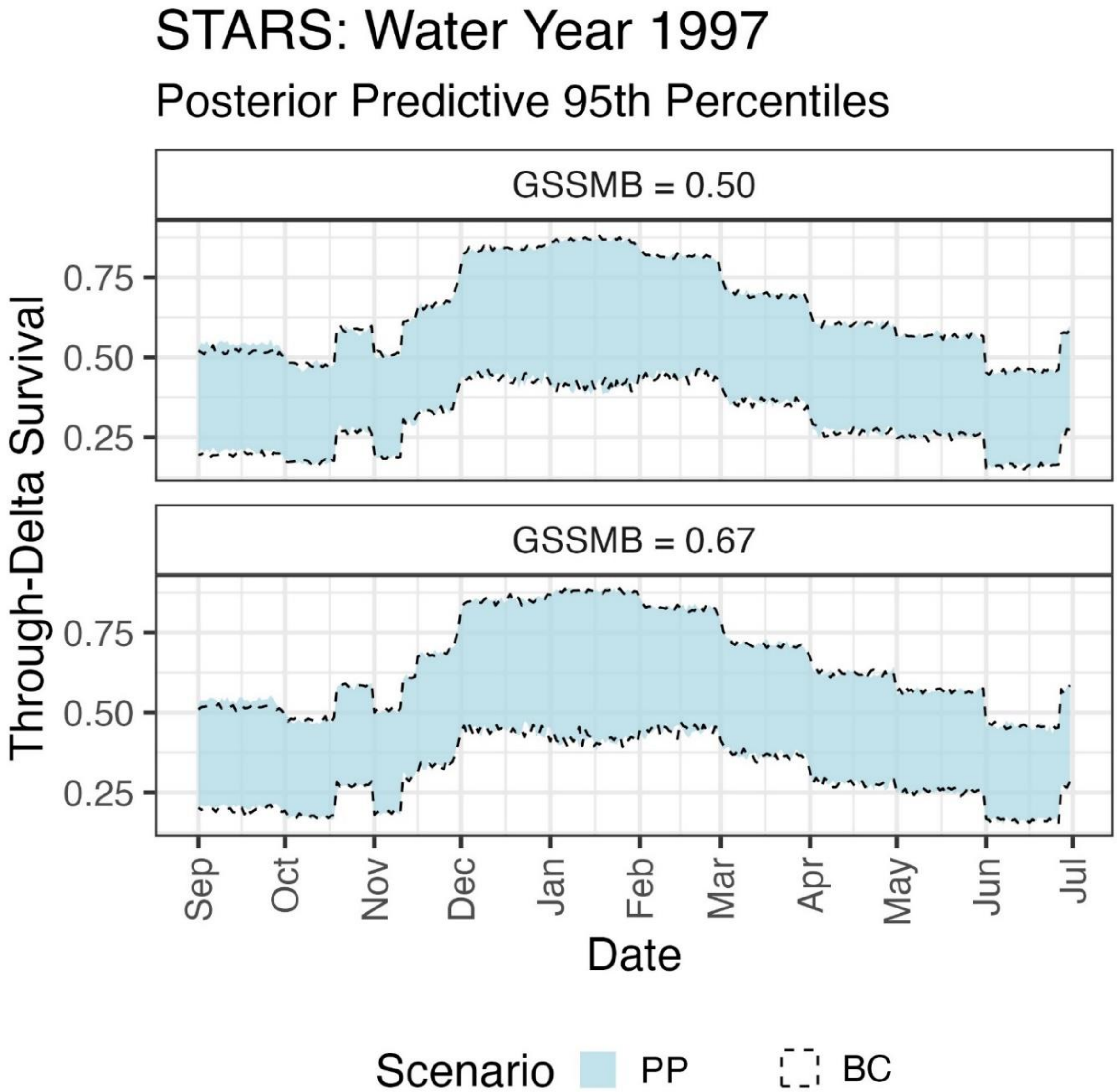
Note: September is included in following water year.

Figure 6B-368. STARS: 95% Posterior Predictive Intervals for Water Year 1995.



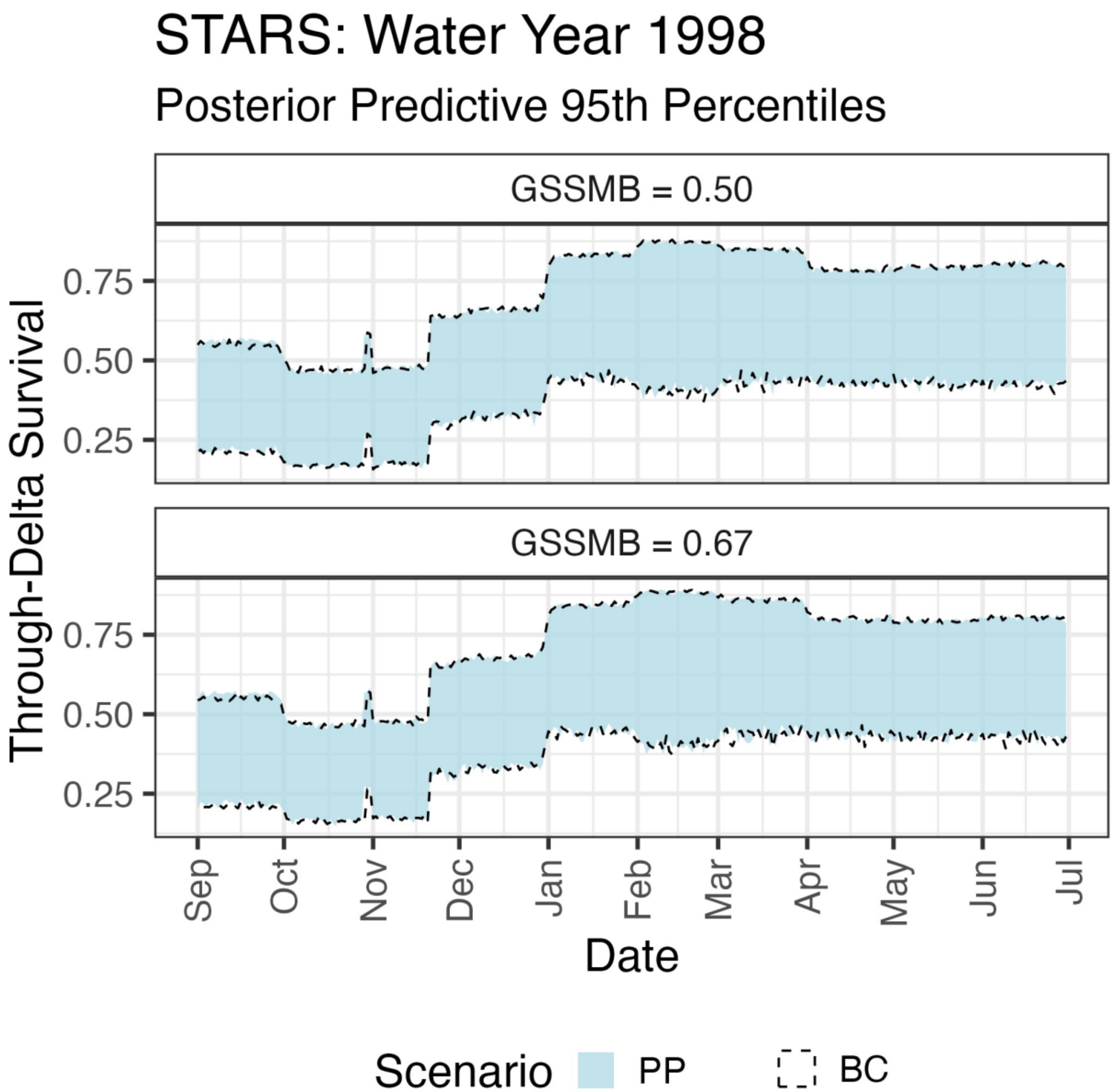
Note: September is included in following water year.

Figure 6B-369. STARS: 95% Posterior Predictive Intervals for Water Year 1996.



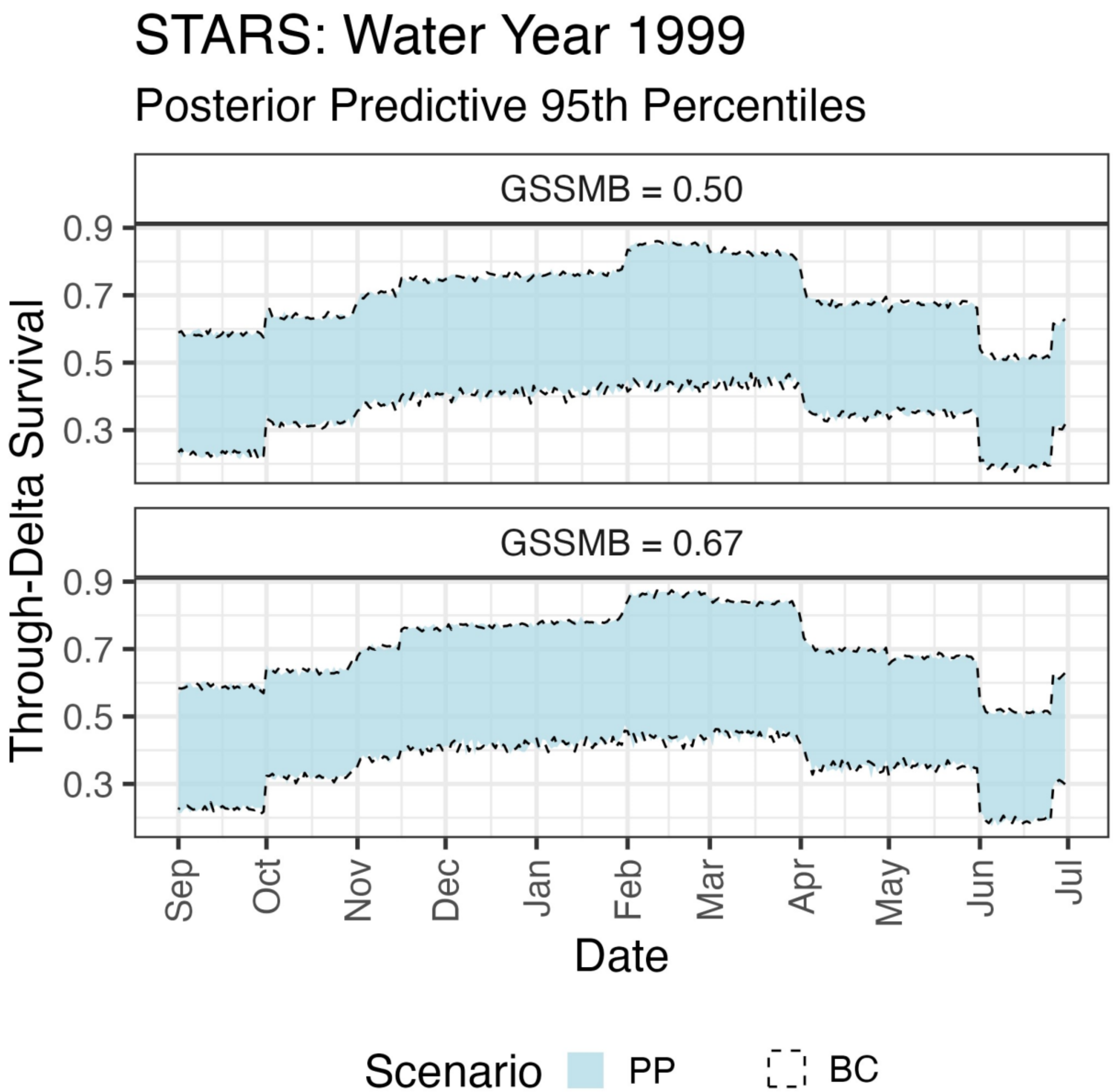
Note: September is included in following water year.

Figure 6B-370. STARS: 95% Posterior Predictive Intervals for Water Year 1997.



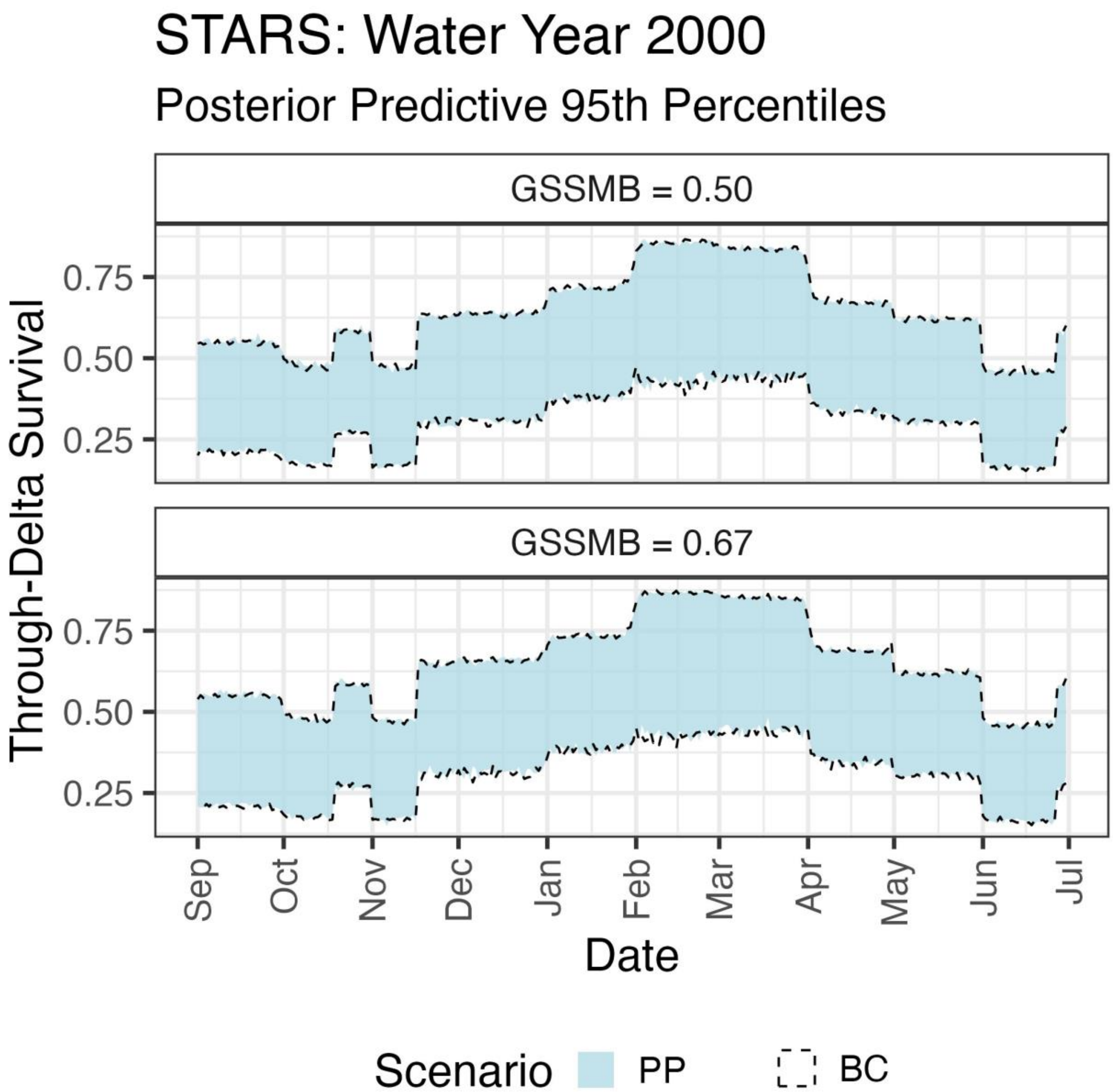
Note: September is included in following water year.

Figure 6B-371. STARS: 95% Posterior Predictive Intervals for Water Year 1998.



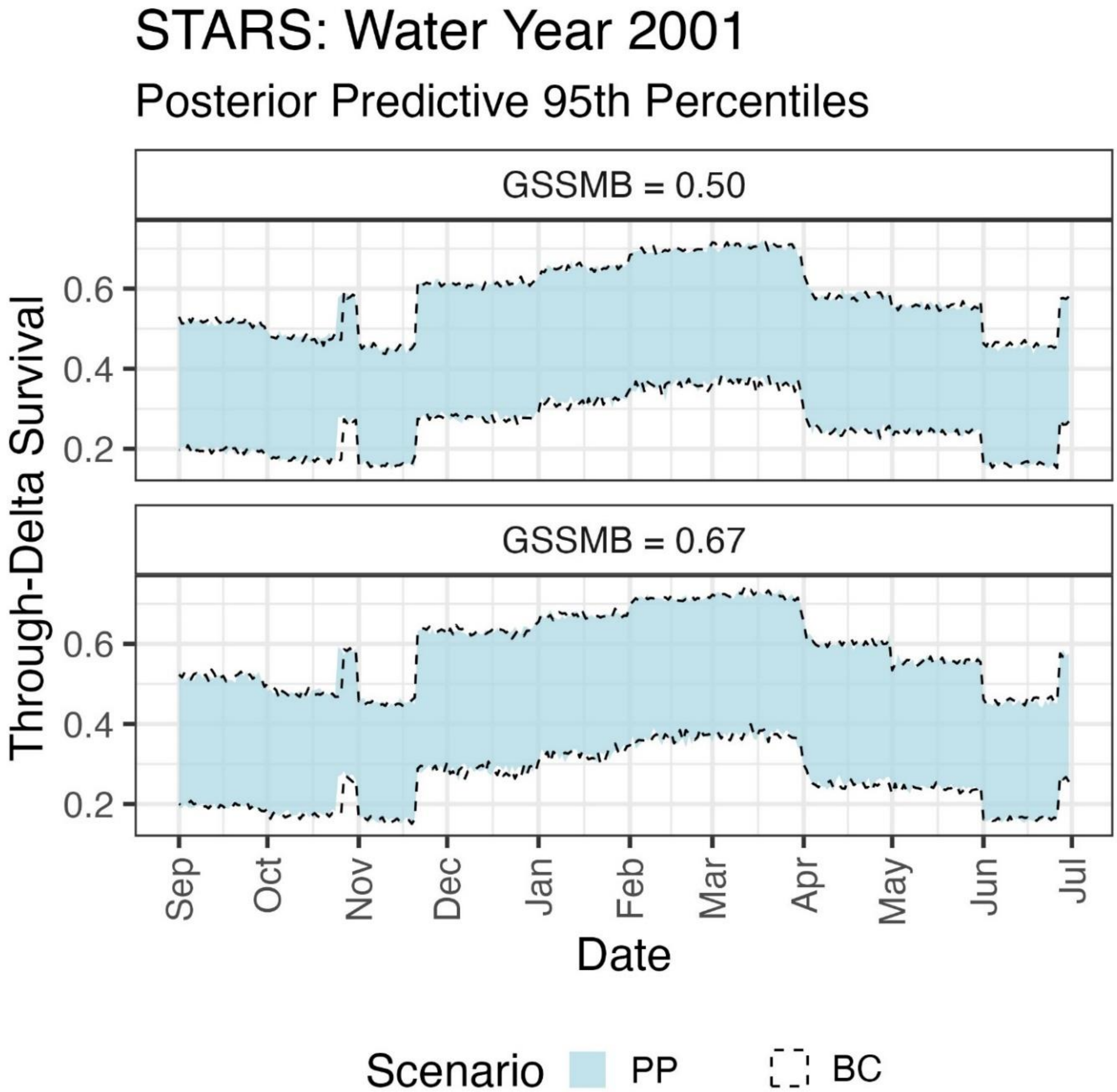
Note: September is included in following water year.

Figure 6B-372. STARS: 95% Posterior Predictive Intervals for Water Year 1999.



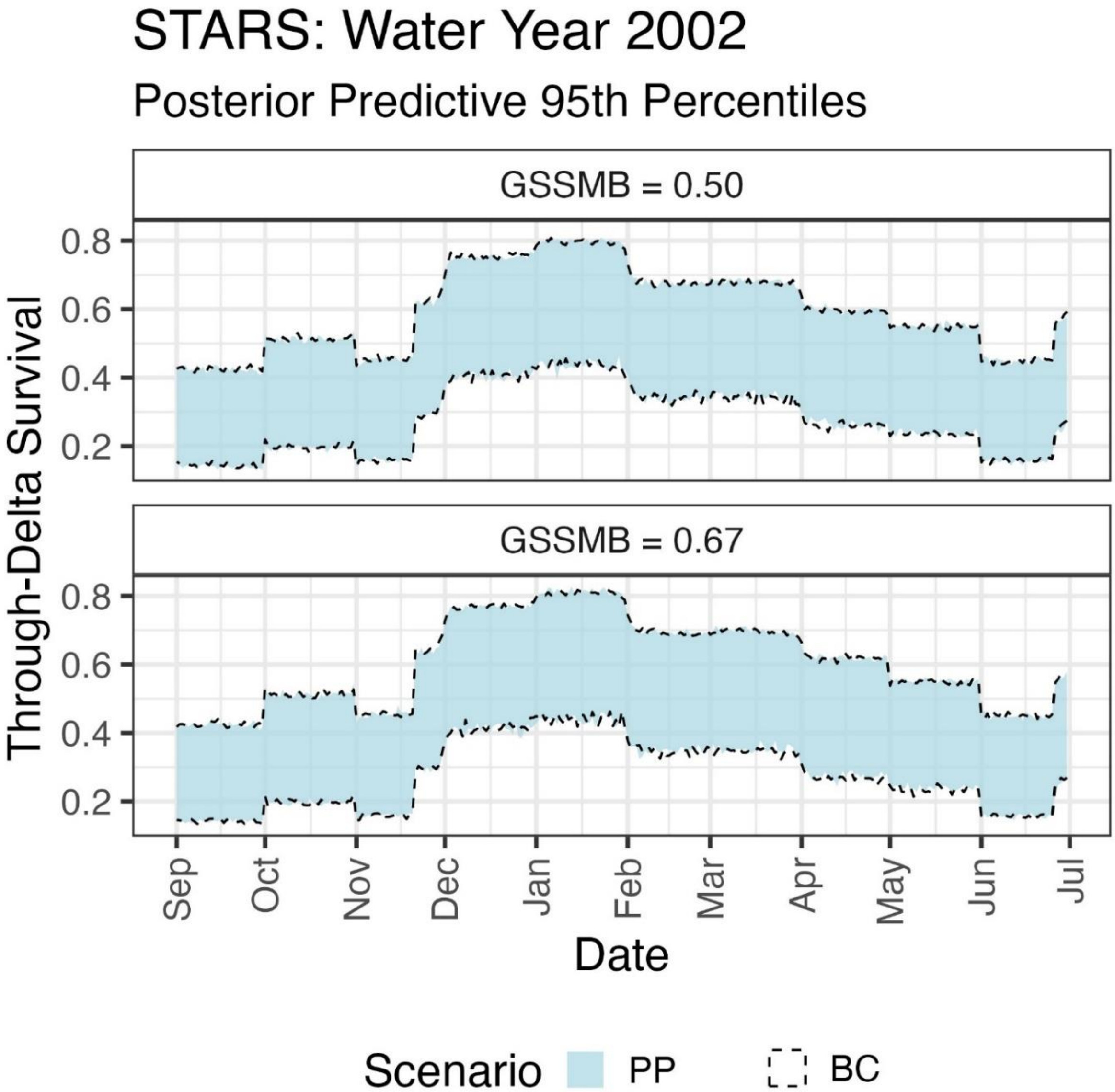
Note: September is included in following water year.

Figure 6B-373. STARS: 95% Posterior Predictive Intervals for Water Year 2000.



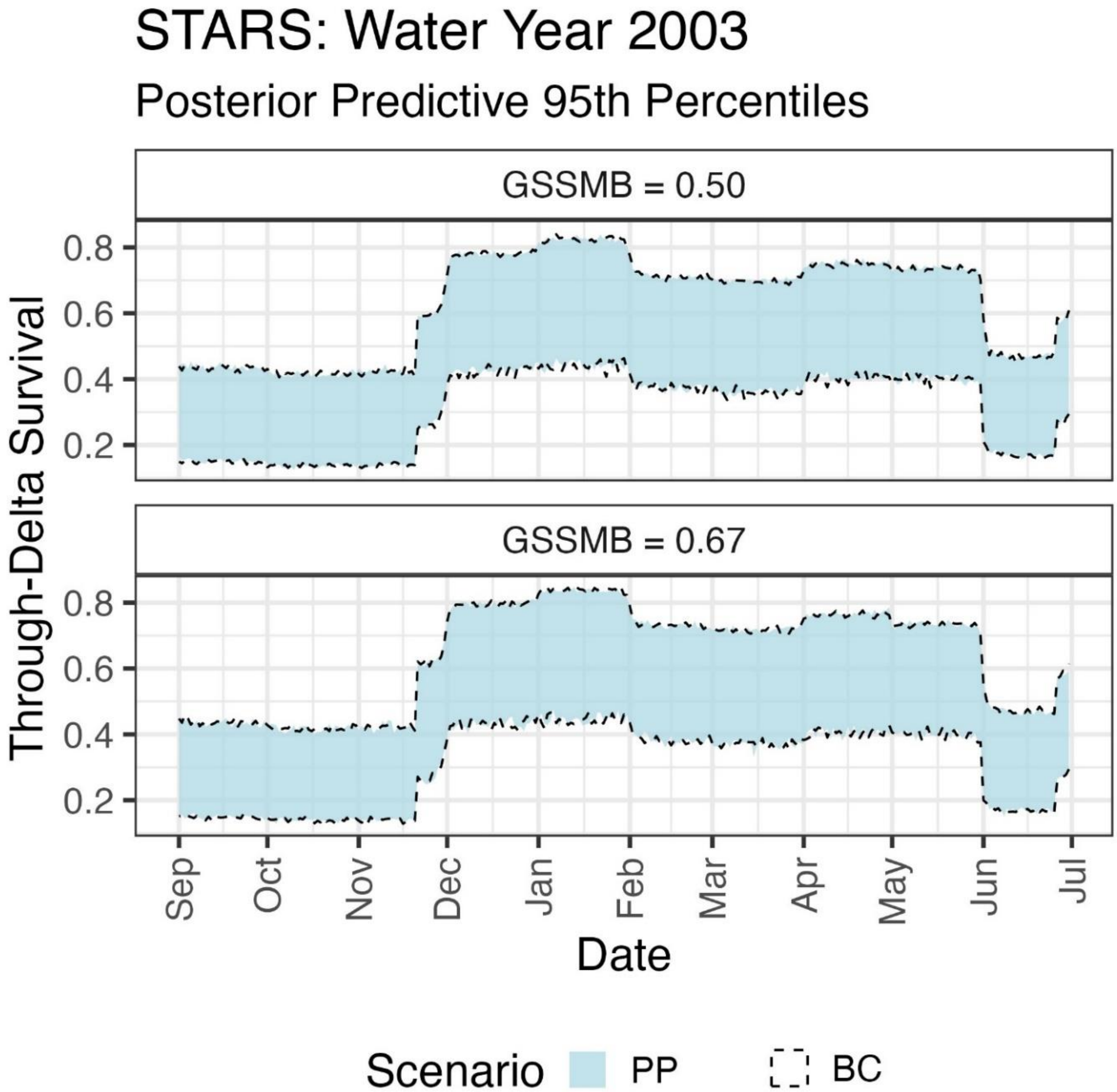
Note: September is included in following water year.

Figure 6B-374. STARS: 95% Posterior Predictive Intervals for Water Year 2001.



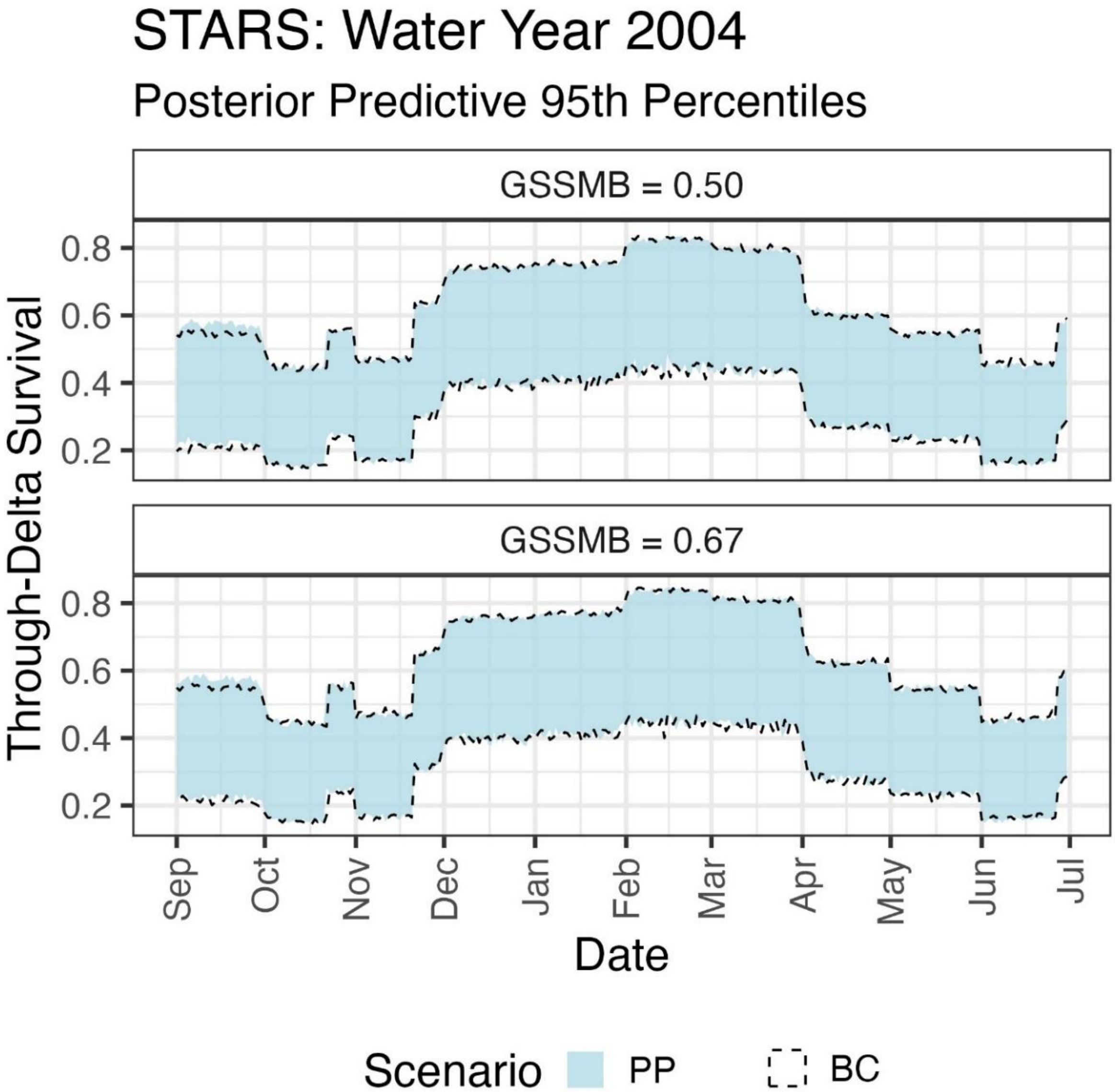
Note: September is included in following water year.

Figure 6B-375. STARS: 95% Posterior Predictive Intervals for Water Year 2002.



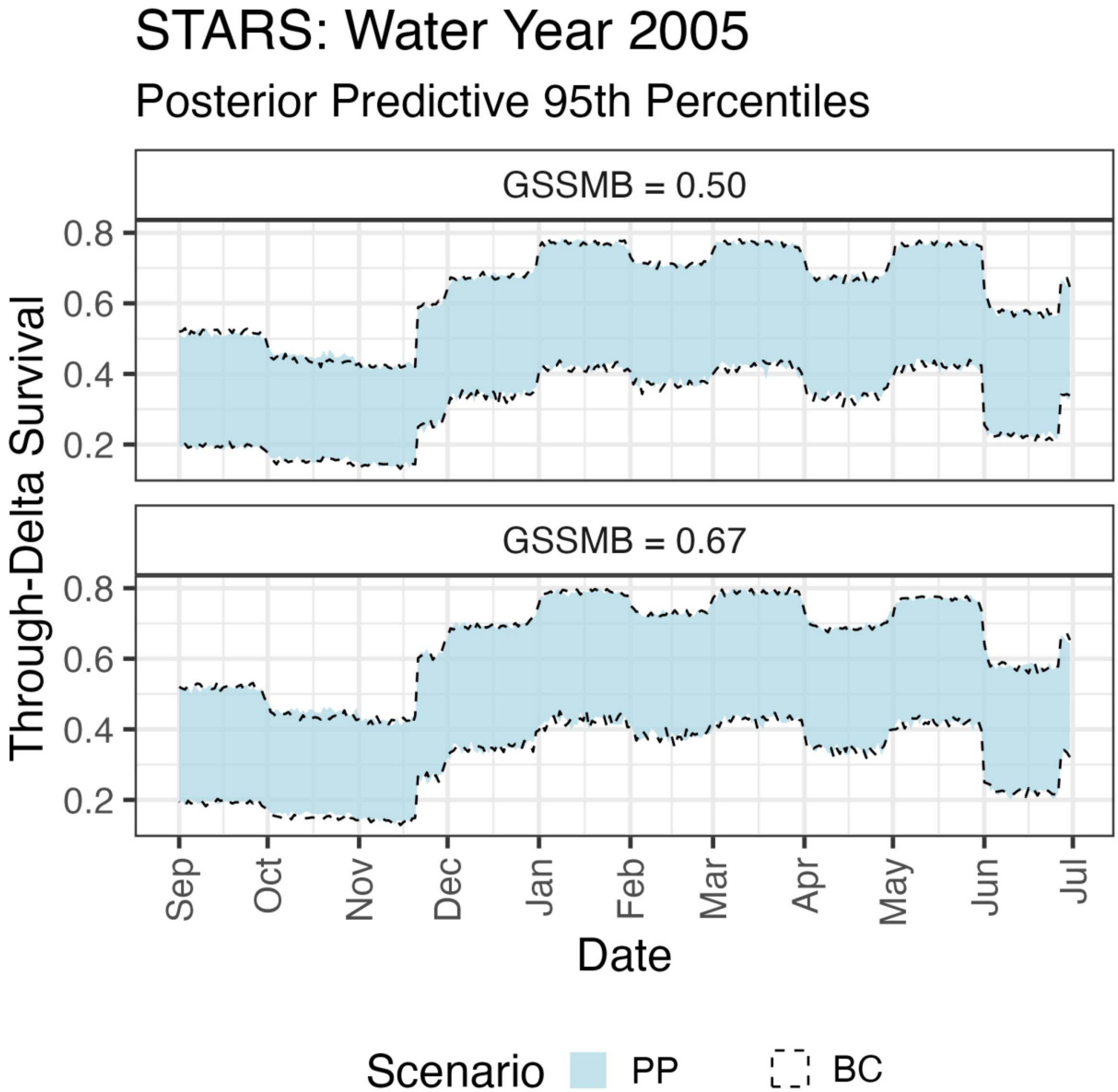
Note: September is included in following water year.

Figure 6B-376. STARS: 95% Posterior Predictive Intervals for Water Year 2003.



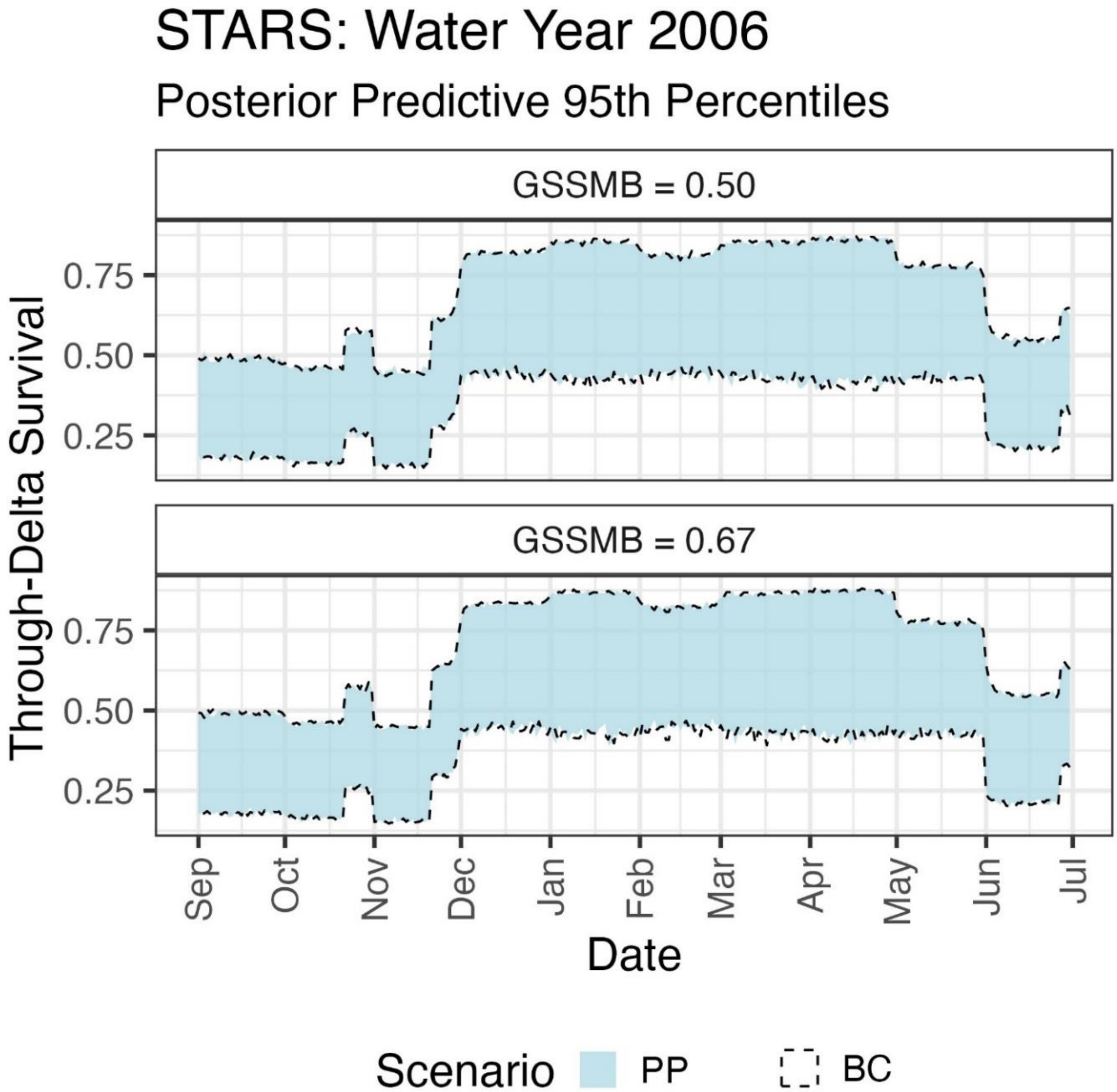
Note: September is included in following water year.

Figure 6B-377. STARS: 95% Posterior Predictive Intervals for Water Year 2004.



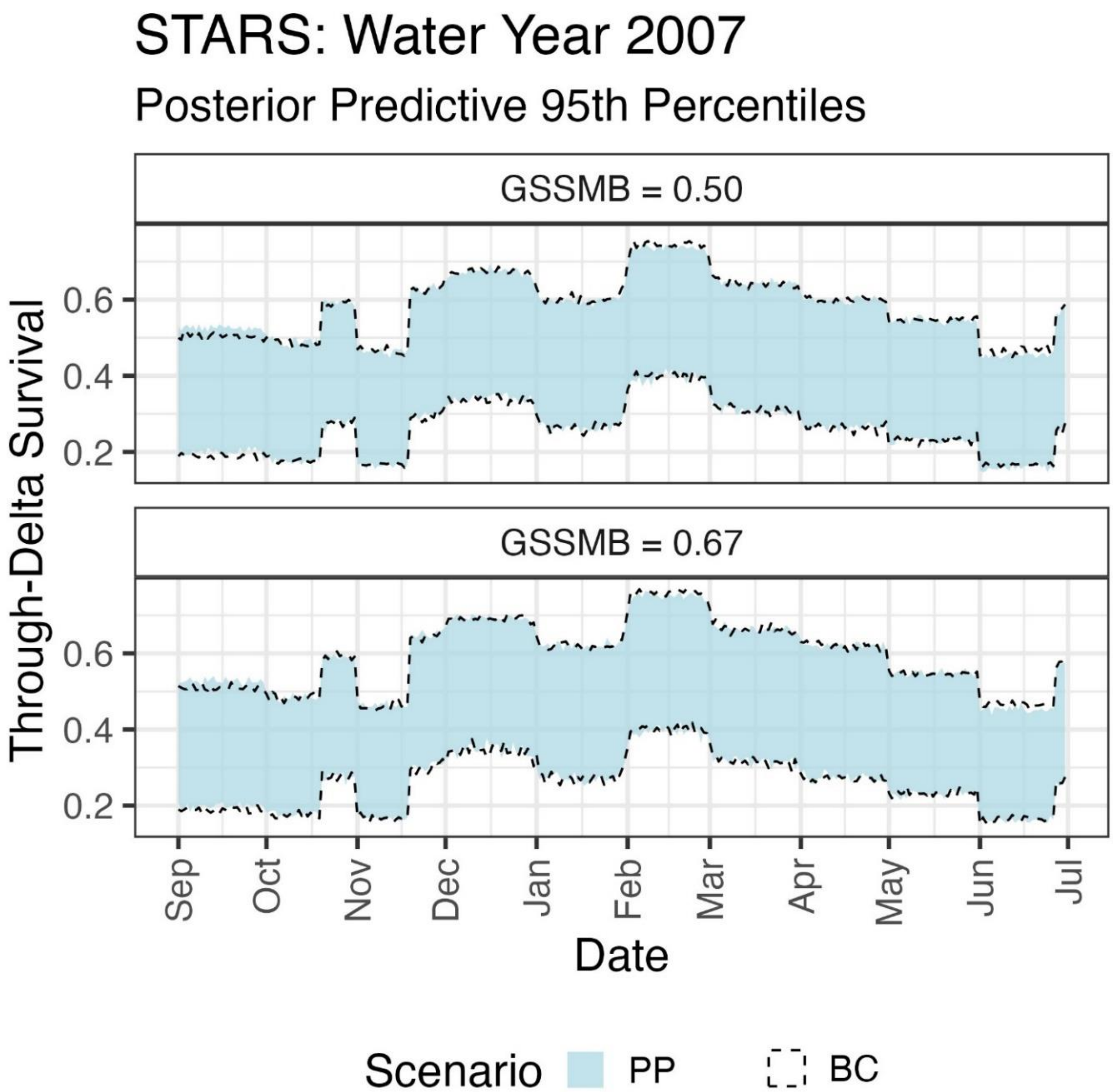
Note: September is included in following water year.

Figure 6B-378. STARS: 95% Posterior Predictive Intervals for Water Year 2005.



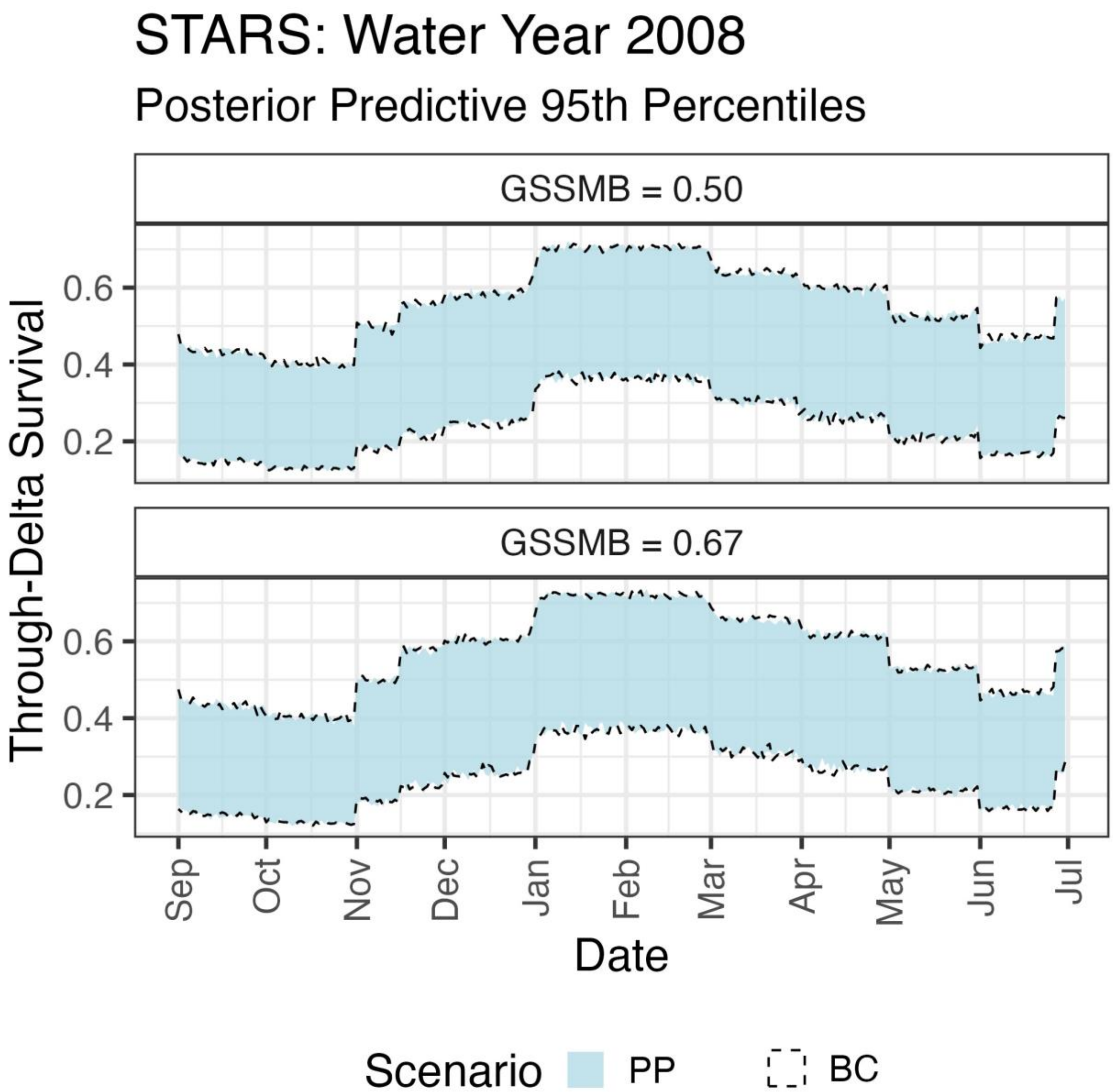
Note: September is included in following water year.

Figure 6B-379. STARS: 95% Posterior Predictive Intervals for Water Year 2006.



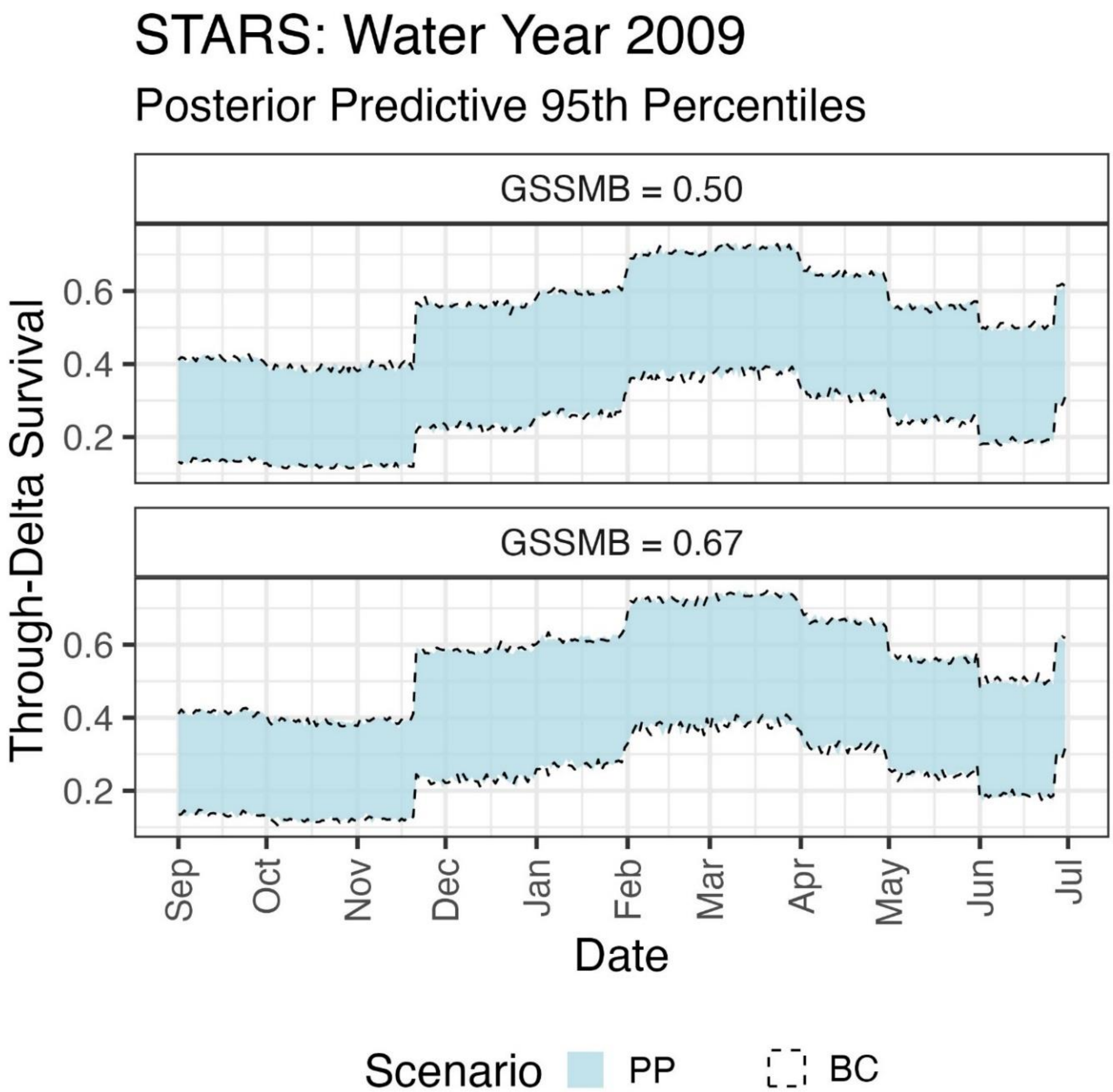
Note: September is included in following water year.

Figure 6B-380. STARS: 95% Posterior Predictive Intervals for Water Year 2007.



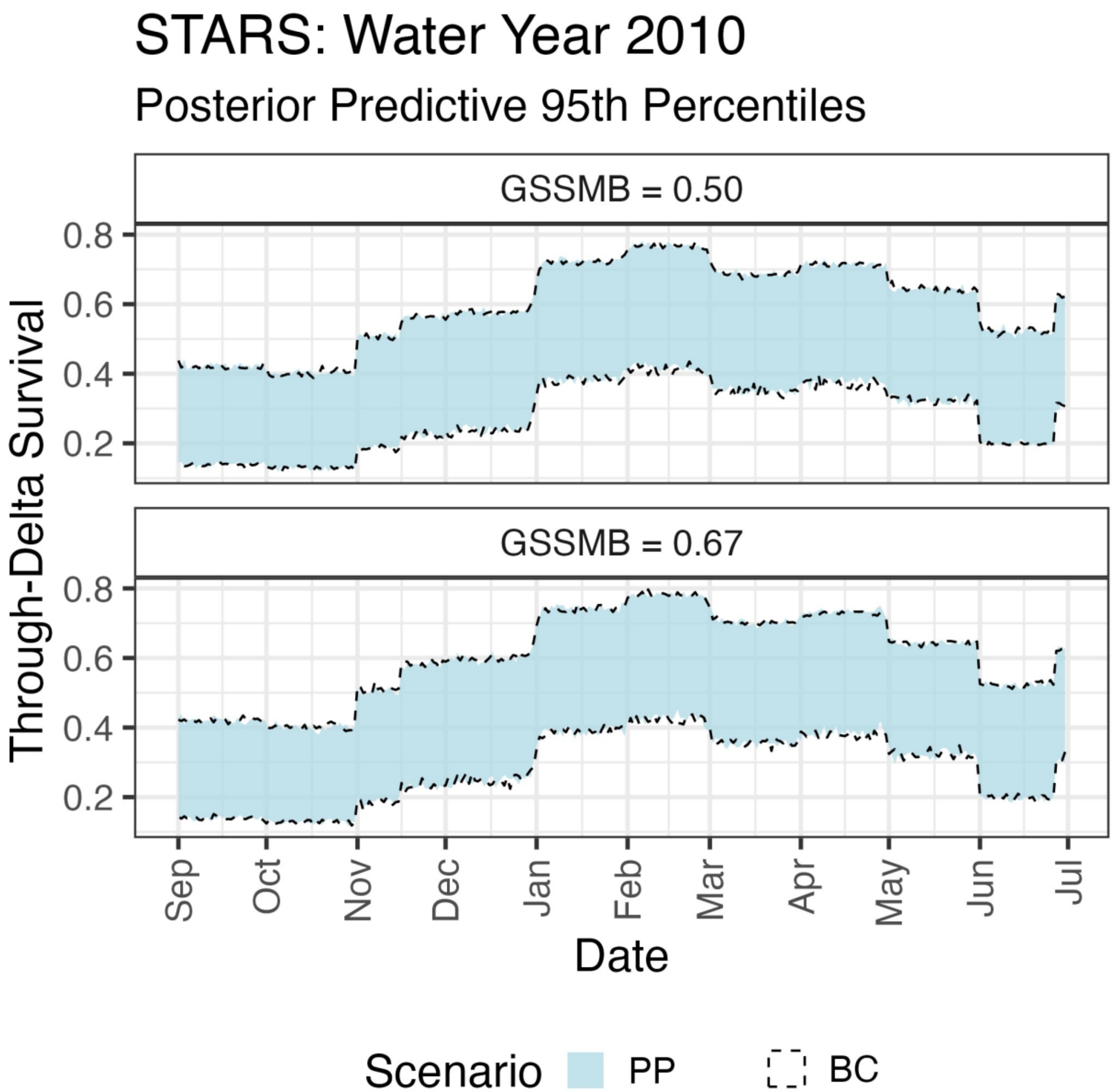
Note: September is included in following water year.

Figure 6B-381. STARS: 95% Posterior Predictive Intervals for Water Year 2008.



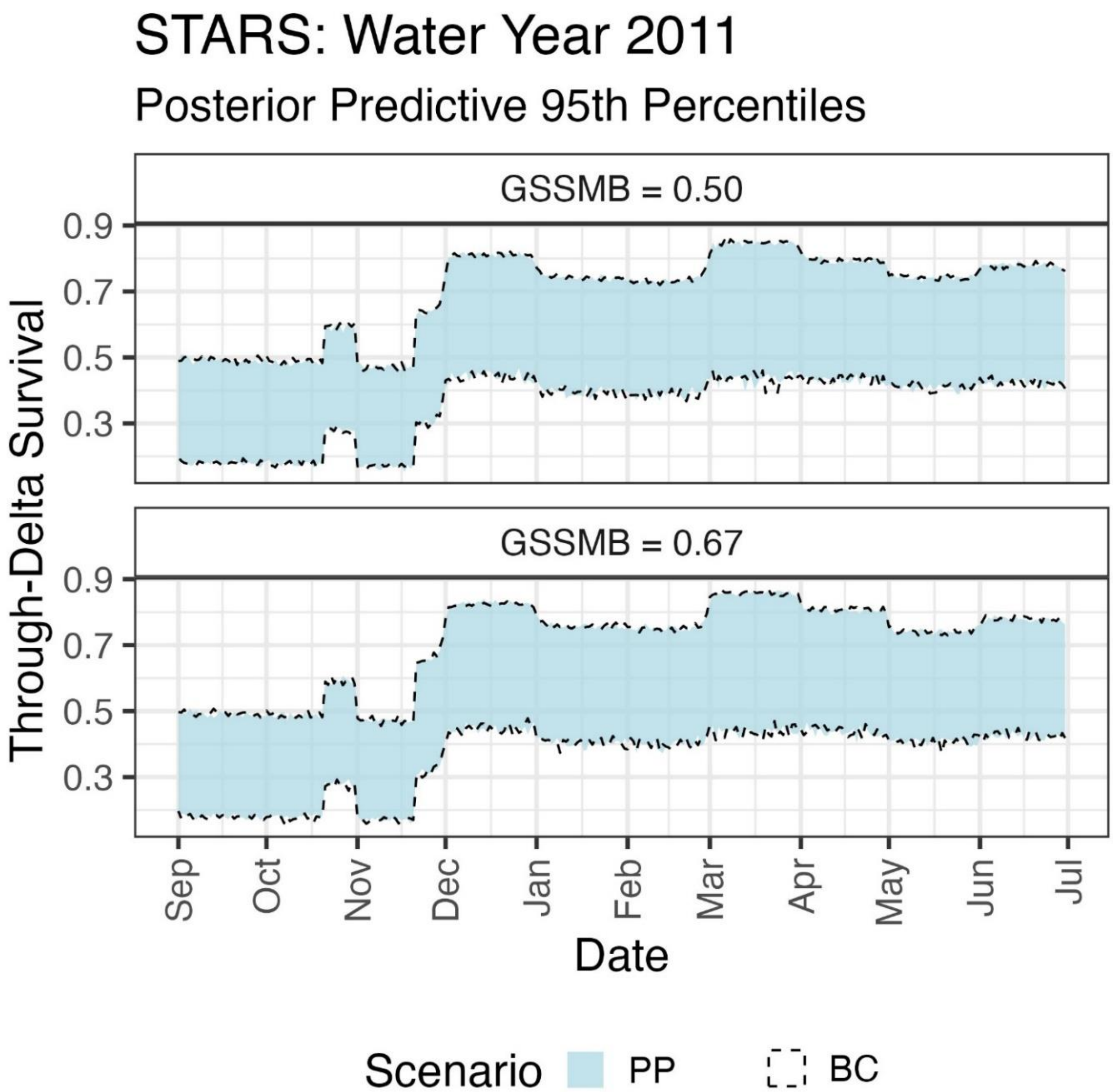
Note: September is included in following water year.

Figure 6B-382. STARS: 95% Posterior Predictive Intervals for Water Year 2009.



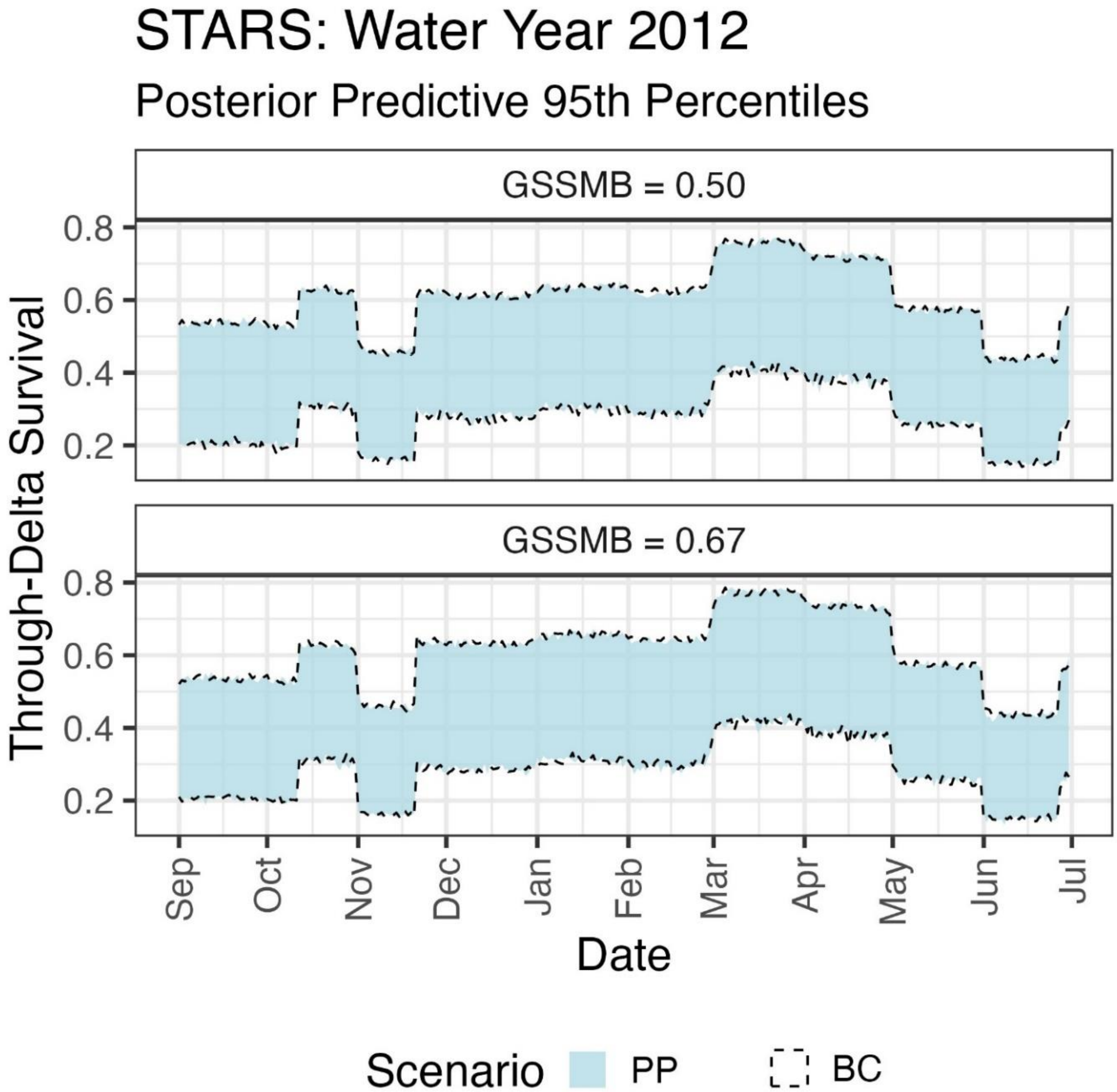
Note: September is included in following water year.

Figure 6B-383. STARS: 95% Posterior Predictive Intervals for Water Year 2010.



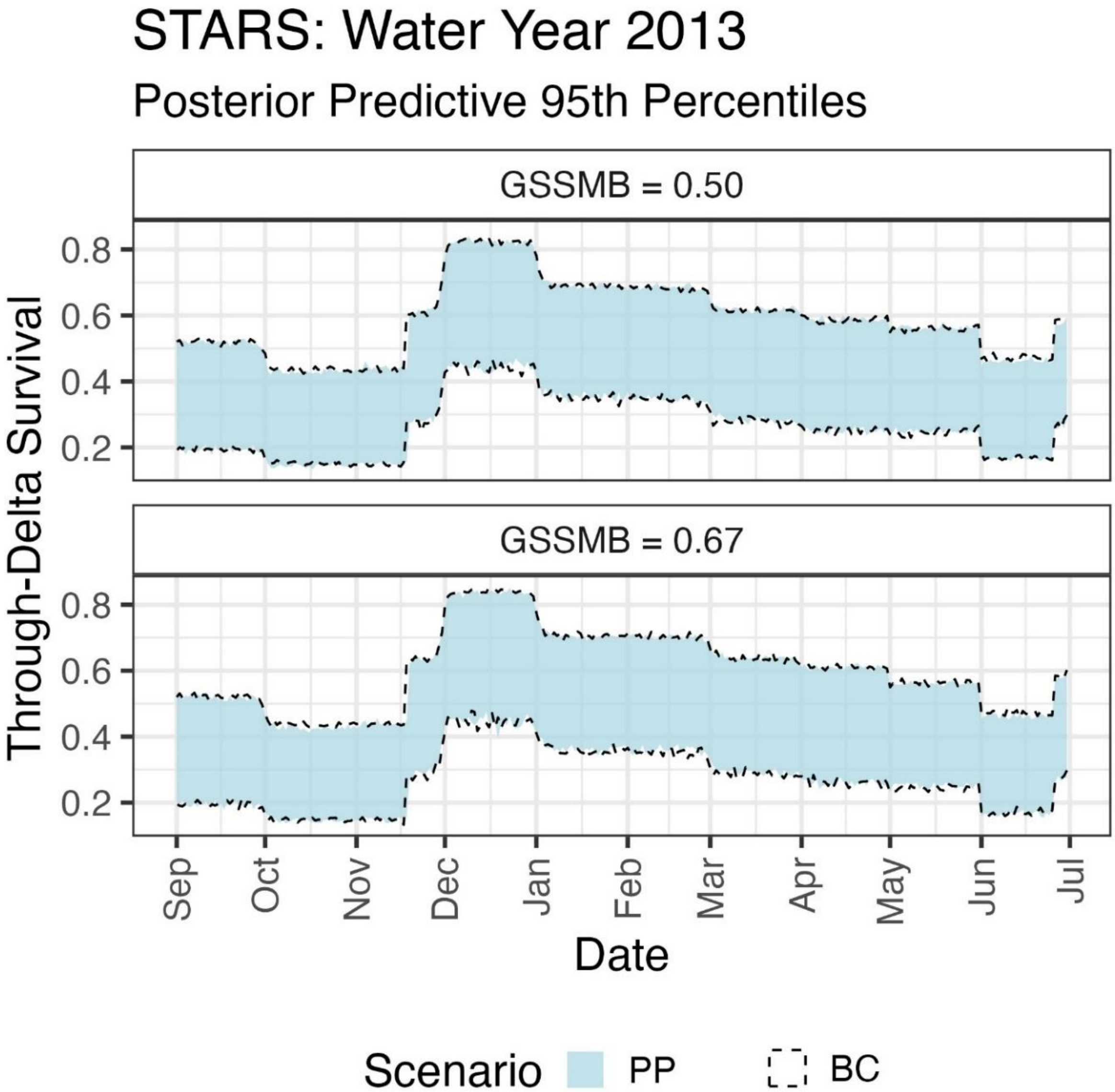
Note: September is included in following water year.

Figure 6B-384. STARS: 95% Posterior Predictive Intervals for Water Year 2011.



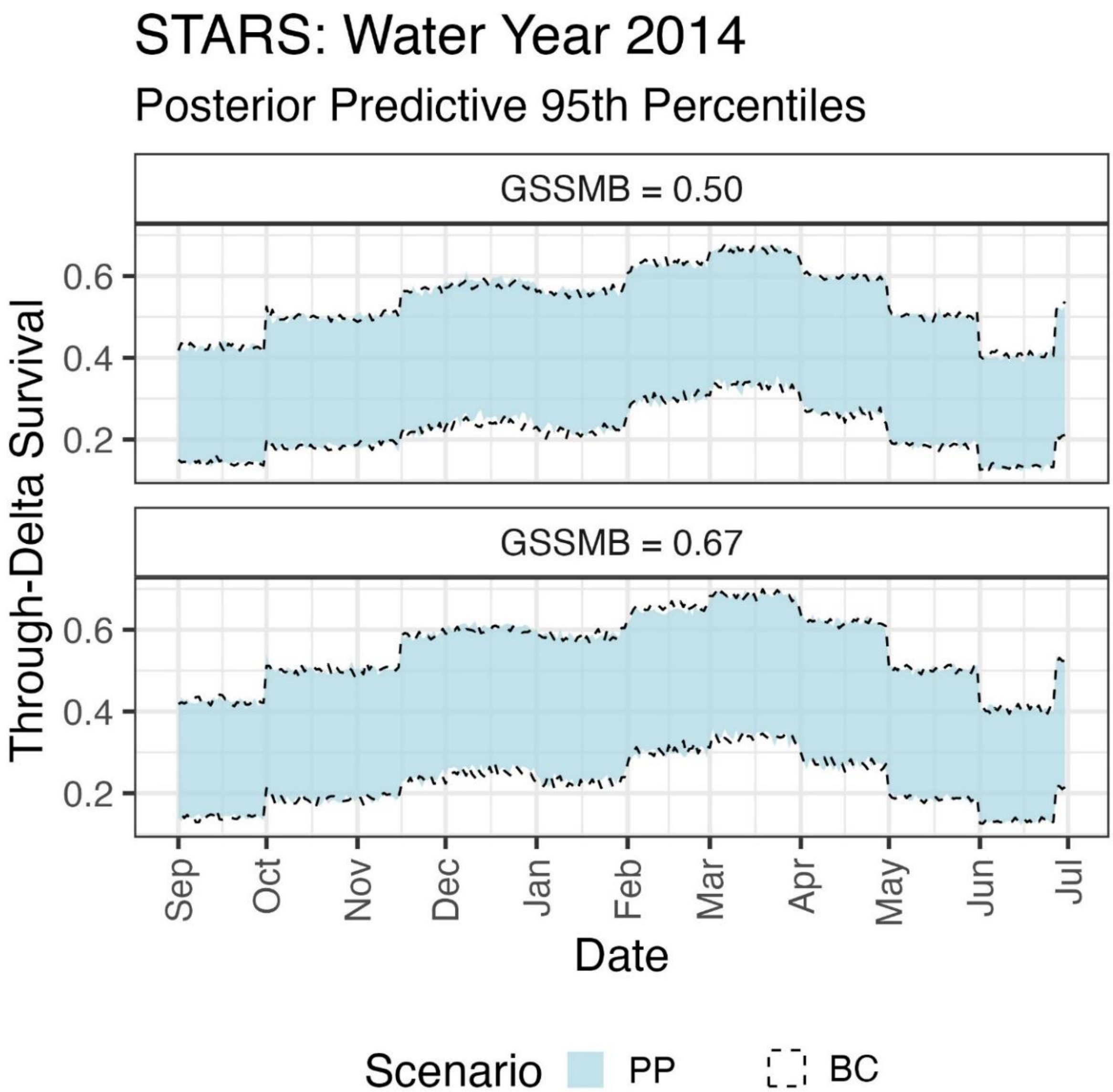
Note: September is included in following water year.

Figure 6B-385. STARS: 95% Posterior Predictive Intervals for Water Year 2012.



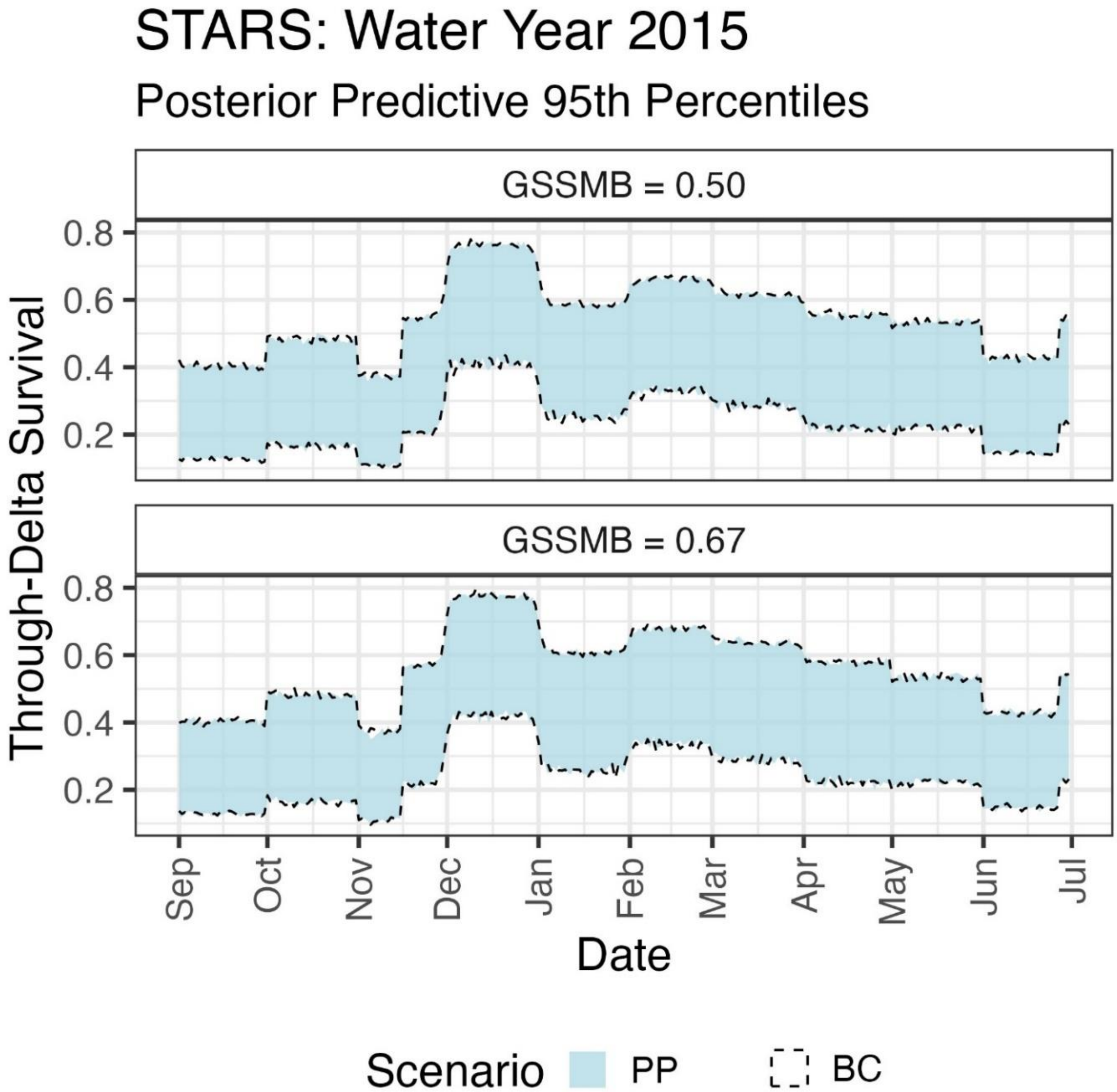
Note: September is included in following water year.

Figure 6B-386. STARS: 95% Posterior Predictive Intervals for Water Year 2013.



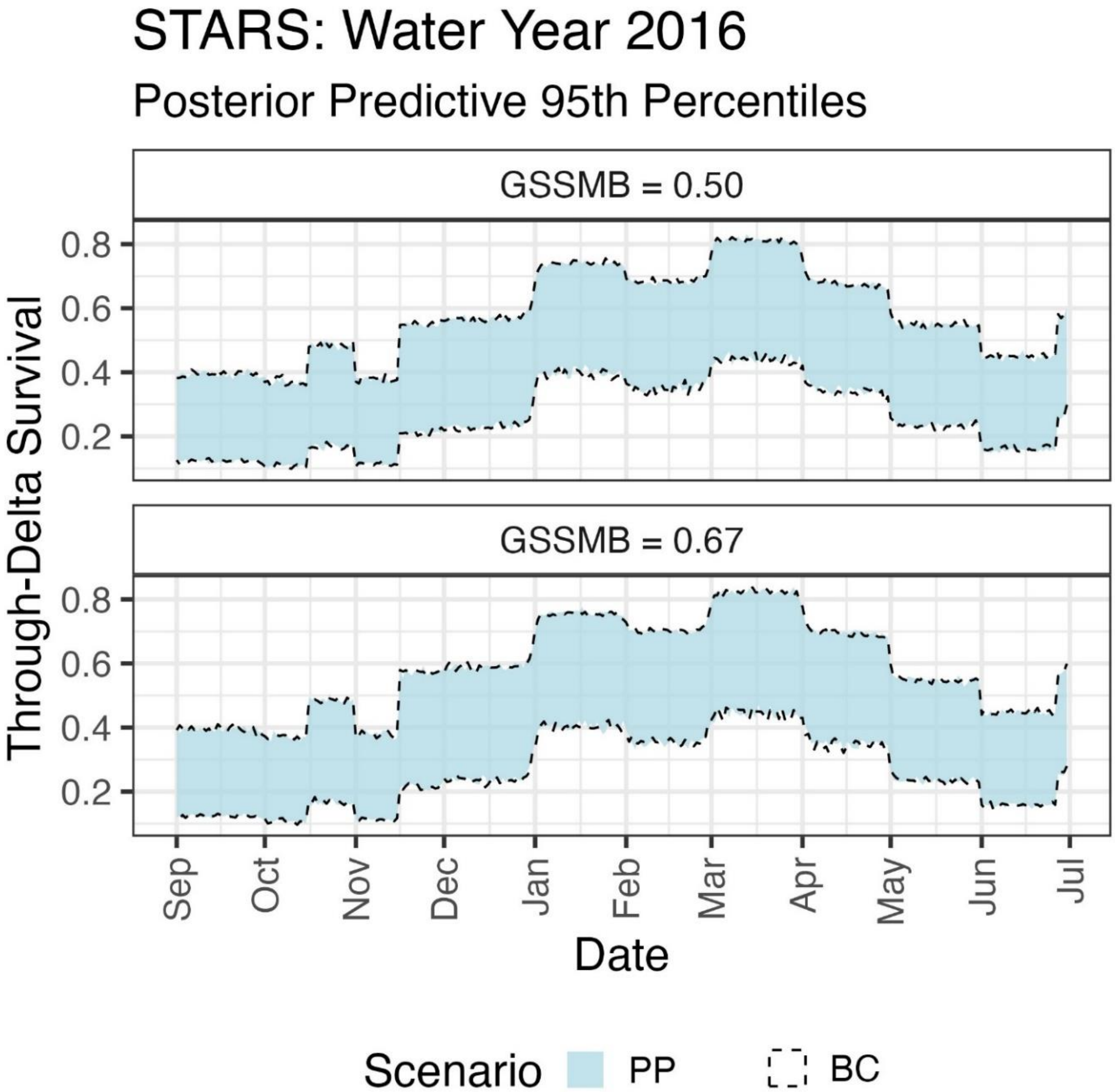
Note: September is included in following water year.

Figure 6B-387. STARS: 95% Posterior Predictive Intervals for Water Year 2014.



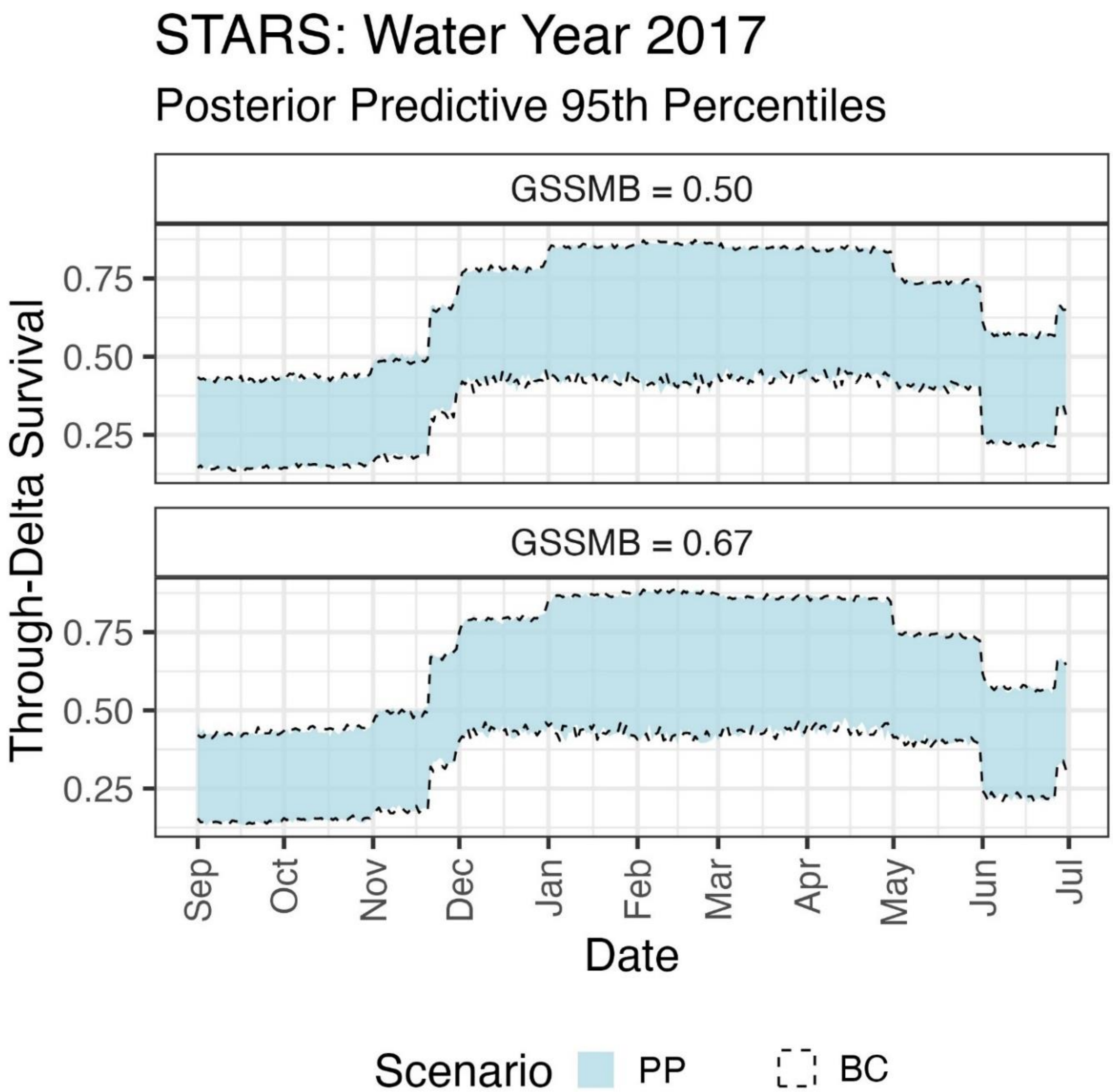
Note: September is included in following water year.

Figure 6B-388. STARS: 95% Posterior Predictive Intervals for Water Year 2015.



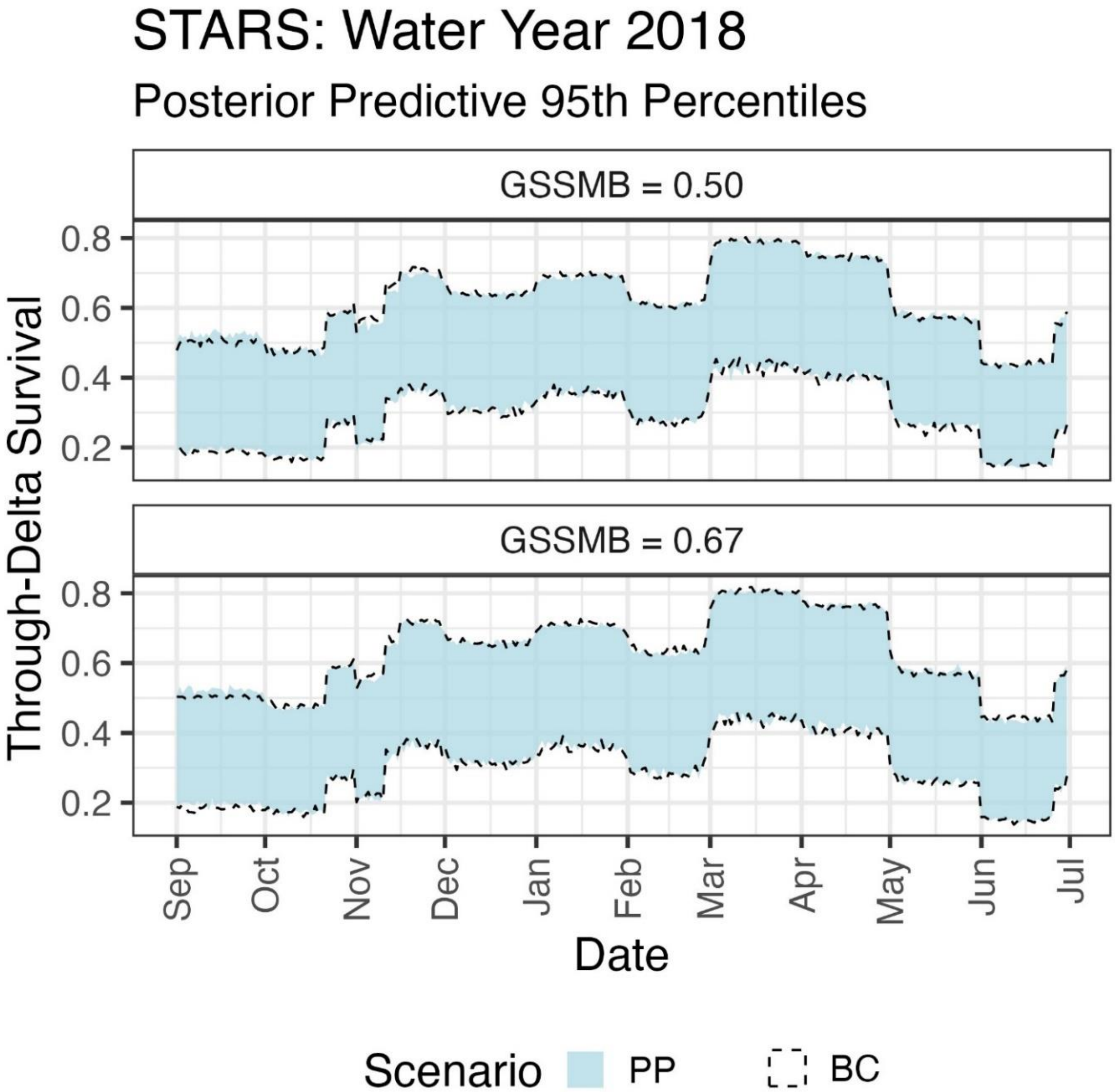
Note: September is included in following water year.

Figure 6B-389. STARS: 95% Posterior Predictive Intervals for Water Year 2016.



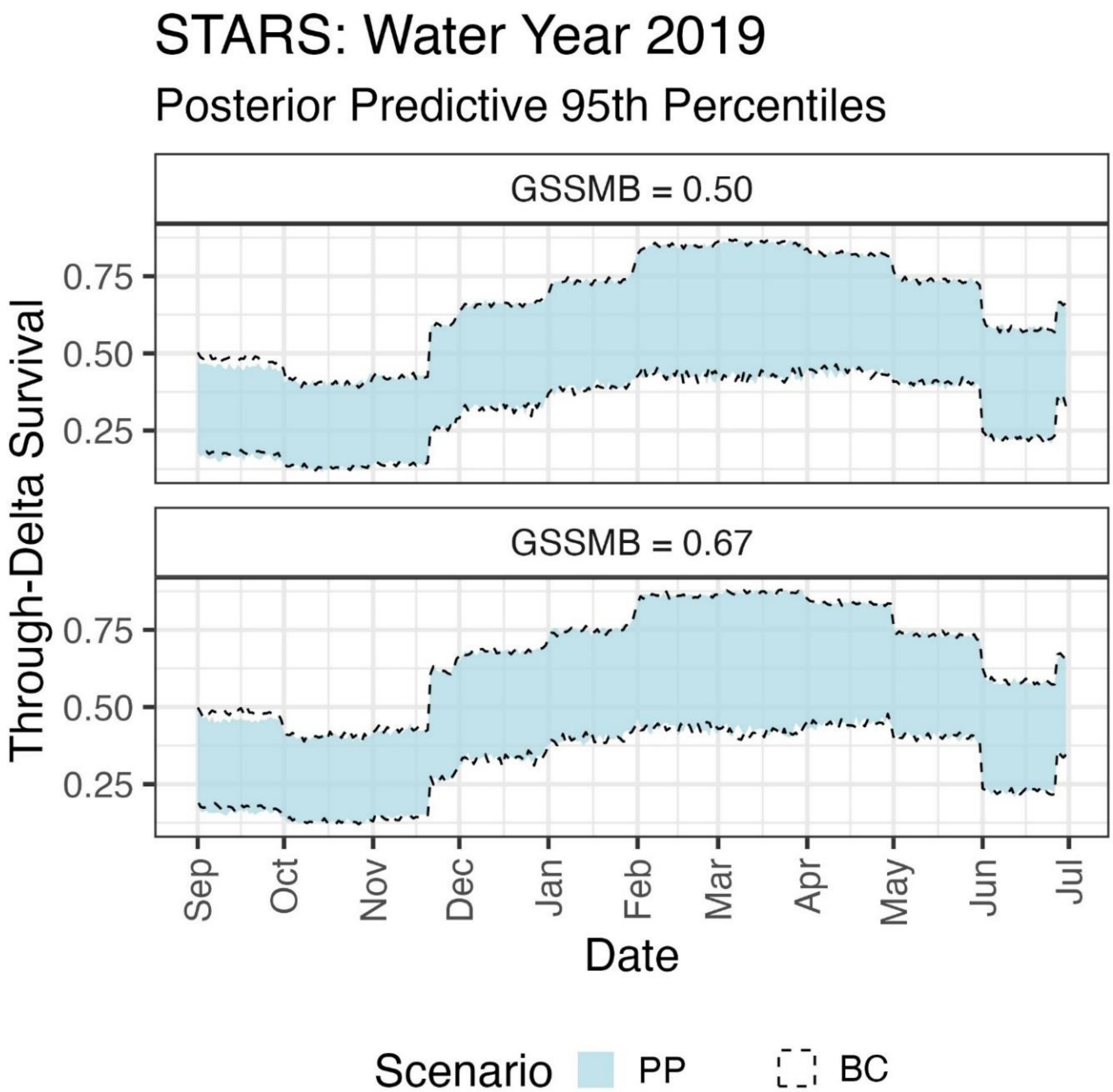
Note: September is included in following water year.

Figure 6B-390. STARS: 95% Posterior Predictive Intervals for Water Year 2017.



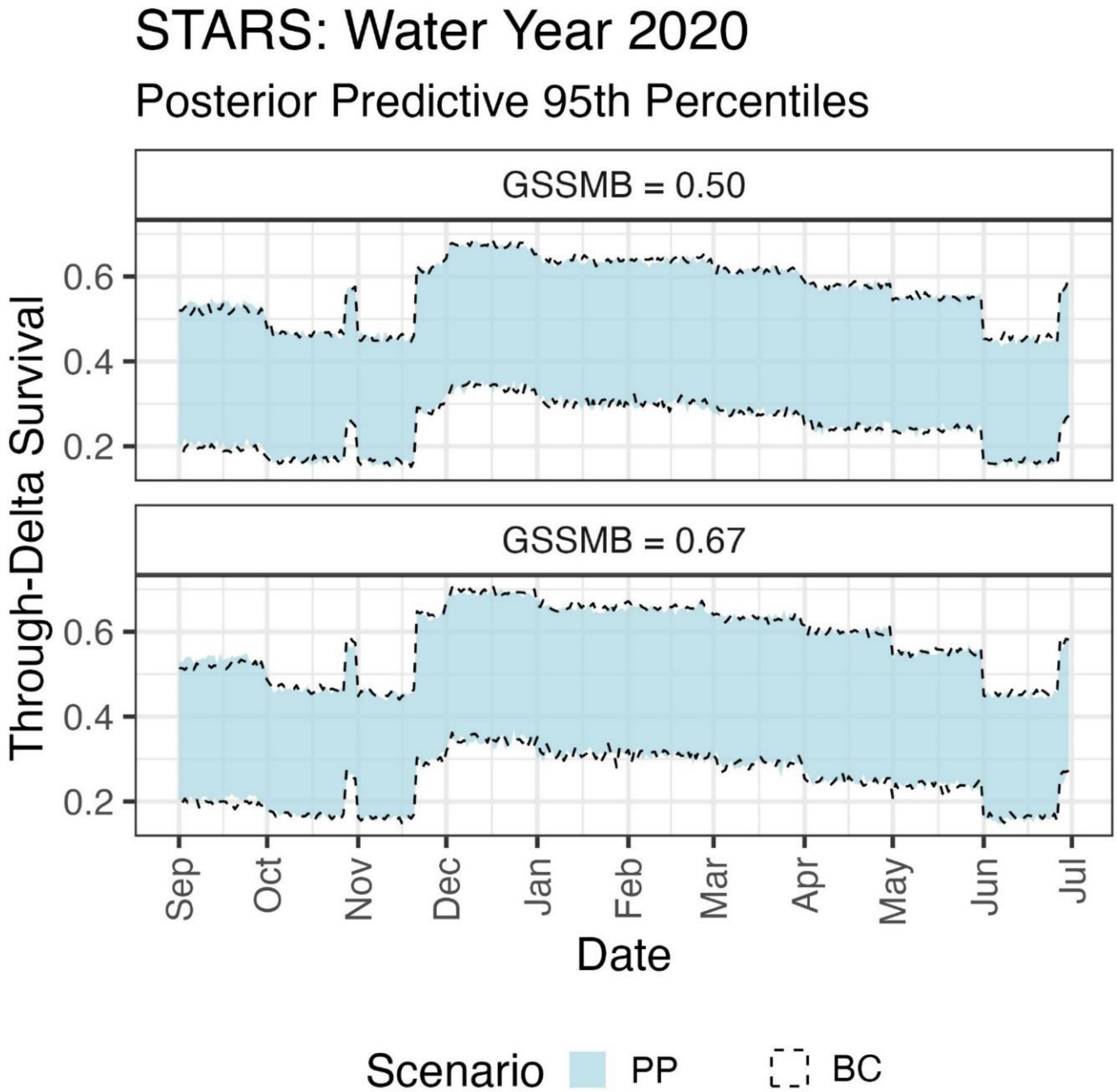
Note: September is included in following water year.

Figure 6B-391. STARS: 95% Posterior Predictive Intervals for Water Year 2018.



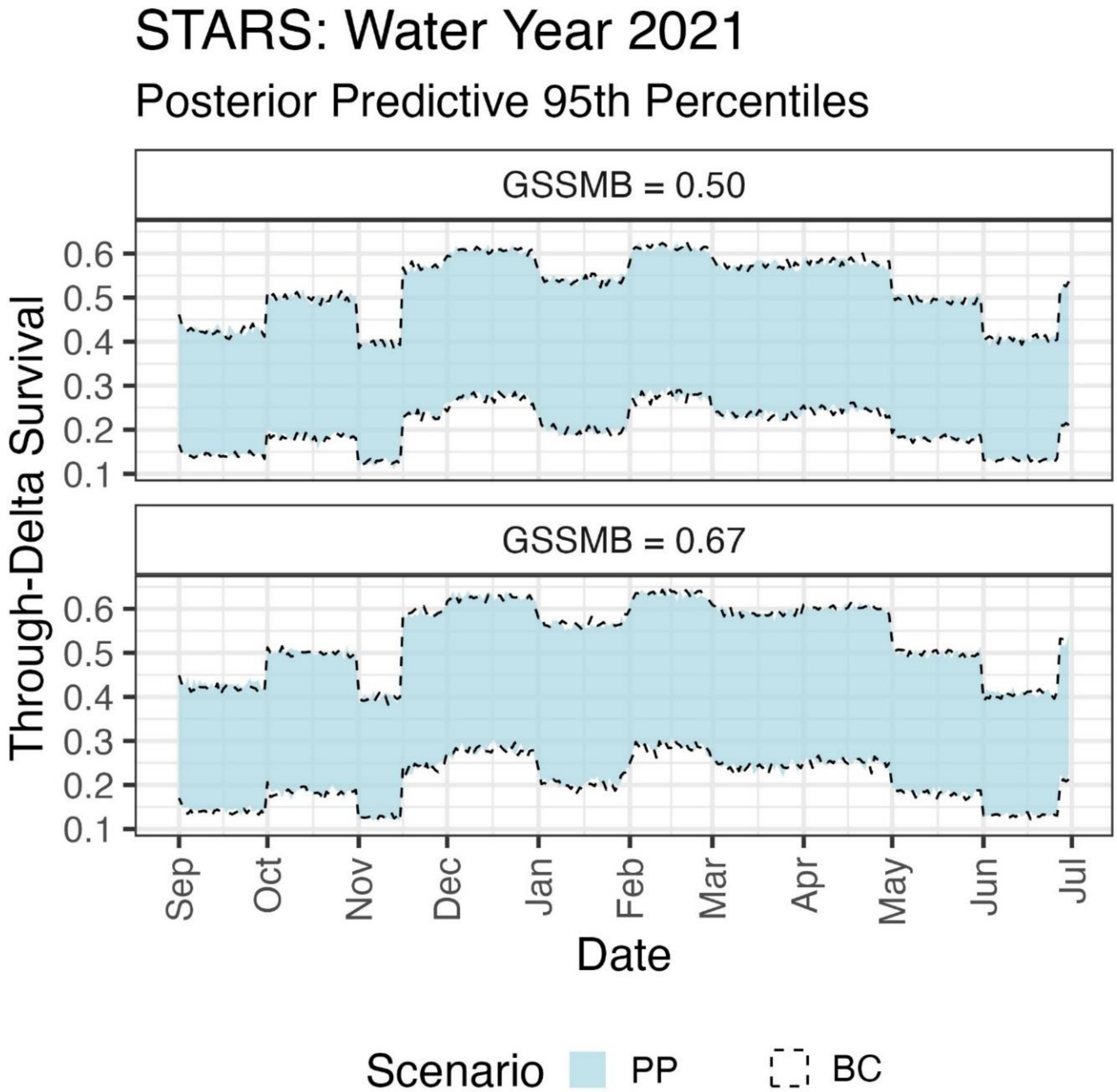
Note: September is included in following water year.

Figure 6B-392. STARS: 95% Posterior Predictive Intervals for Water Year 2019.



Note: September is included in following water year.

Figure 6B-393. STARS: 95% Posterior Predictive Intervals for Water Year 2020.



Note: September is included in following water year.

Figure 6B-394. STARS: 95% Posterior Predictive Intervals for Water Year 2021.

6B.6 ECO-PTM

6B.6.1 Methods

ECO-PTM is an individual-based juvenile salmon migration model based on a random-walk particle-tracking method with fish-like behaviors attached to the particles. The behavioral parameters are estimated from acoustic telemetry tag data of juvenile late-fall-run Chinook Salmon (Tag Data) from various field studies (Perry et al. 2018). A stochastic optimization tool, Particle Swarm Optimization, is used to calibrate the swimming behavior parameters. ECO-PTM can simulate juvenile salmonid migration timing, routing, and survival. Further detail is provided by Wang (2019).

The details for the ECO-PTM modeling were:

- Modeling period: 10/1/1921–6/30/2021
- Particle release location: Freeport
- Particle release months: September–June
- Particle release frequency: Daily, every 15 minutes (100 particles per 15 minutes = 9,600 particles per day)
- Simulation (particle tracking) period: 90 days
- No entrainment into Delta Channel Depletion diversions (i.e., small, non-project diversions)
- Georgiana Slough Salmonid Migratory Barrier[6]: assumed to reduce flow-related entry of juvenile salmon into Georgiana Slough by (1) 50 percent (based on California Department of Water Resources 2015) and (2) 67 percent (based on California Department of Water Resources 2012)[7]

6B.6.2 Results

The results of the analysis are presented and discussed in Chapter 6.

[6] Model code revisions are being undertaken to allow dynamic representation of barrier operations to be assumed, consistent with the final Georgiana Slough Salmonid Migratory Barrier Operations Plan (California Department of Water Resources 2022), i.e., turning the barrier on and off during November 16–December 31 in association with DCC gate operations and turning the barrier on during January 1–April 30. An additional scenario with no Georgiana Slough Salmonid Migratory Barrier assumption was also run.

[7] For example, if flow-related entry (i.e., the expected juvenile salmon entry into Georgiana Slough based on the proportion of Sacramento River mainstem flow entering Georgiana Slough) is 30 percent, operation of the barrier would reduce entry to 15 percent under the 50 percent barrier scenario and would reduce entry to 10 percent under the 67 percent barrier scenario.

6B.7 San Joaquin River Juvenile Chinook Salmon Through-Delta Survival (Structured Decision Model Routing Application)

The Delta Structured Decision Model Chinook Salmon Routing Application was developed by the Central Valley Project Improvement Act Science Integration Team to evaluate the effect of different management decisions on the survival and routing of juvenile fall-run Chinook Salmon. The model relies on survival-environment relationships and routing-environment relationships from acoustic studies conducted in the Sacramento and San Joaquin rivers and at the state and federal south Delta export facilities. Here only the results from the San Joaquin River submodel were reported, with analysis conducted for spring-run Chinook Salmon. The model and documentation have not been finalized, and the code for the most recent model version used here was accessed at https://github.com/FlowWest/chinookRoutingApp. Total South Delta Survival probability was unmodified from the Routing Application's original "SouFish" equation, which defines survival to Chipps Island for South Delta-routed fish as:

SouFish =

(S_prea * psi_sjr1 * S_a * psi_sjr2 * S_bc) + (S_prea * psi_sjr1 * S_a * psi_TC * S_efc) +

(S_prea * psi_OR * S_d * psi_ORN * S_efc) + (S_prea * psi_OR * S_d * psi_CVP * S_CVP) +

(S_prea * psi_OR * S_d * psi_SWP * S_SWP).

Model functions, parameters, and inputs used for this analysis are described in Table 6B-34. Where inputs were not available, they were assumed to be the mean values for the studies used to establish the model parameters. For the effects analysis, the model was run using DPM Delta entry weightings for spring-run Chinook Salmon from the Sacramento River Basin, which were assumed to be representative of daily weightings of spring-run Chinook Salmon from the San Joaquin River Basin.

Table 6B-34. Functions, Parameter Calculations, and Inputs Used in the Structured Decision Model Chinook Salmon Routing Application San Joaquin Submodel

Function	Parameters	Inputs
S_prea = survival through the tributaries to the Head of Old River (HOR)	inv.logit(5.77500 + 0.00706 * Q_vern - 0.32810 * Temp_vern + 0.152 *(FL- 155.1) / 21.6)	Q_vern (Flow at Vernalis): DSM2 Temp_vern (Temperature at Vernalis): 16.7C FL (Fork length): 120mm
psi_sjr1 = probability of remaining in SJR at HOR	inv.logit(-0.75908 + 1.72020 * hor_barr + 0.00361 * Q_vern + 0.02718 * hor_barr * Q_vern)	hor_barr (Head of Old River barrier): DSM2 Q_vern: DSM2
S_a = survival from the HOR to Turner Cut	inv.logit(-2.90330 + 0.01059 * Q_vern + 0.152 * (FL - 155.1) / 21.6)	Q_vern: DSM2 FL: 120mm
psi_sjr2 = the probability of remaining in SJR at Turner Cut	inv.logit(5.83131 - 0.037708993 * Q_stck)	Q_stck (Flow at Stockton): DSM2

Function	Parameters	Inputs
S_bc = survival from SJR Turner Cut to Chipps	inv.logit(13.41840 - 0.90070 * Temp_pp + 0.152 * (FL - 155.1) / 21.6)	Temp_pp: 17.8C FL: 120mm
psi_TC = probability of taking Turner Cut	psi_TC <- 1 - psi_sjr2	See psi_sjr2 above
psi_OR = probability of entering Old River	1 - psi_sjr1	See psi_sjr1 above
S_d = Survival down OR to HOR to CVP	inv.logit(2.16030 - 0.20500 * Temp_vern + 0.152 * (FL - 155.1)/21.6)	Temp_vern: 16.7C FL: 120mm
psi_ORN = probability of remaining in Old River North	1 - psi_CVP - psi_SWP	See psi_CVP and psi_SWP, below
S_efc = Survival from Old River North to Chipps Island (San Joaquin River Group Authority)	0.01	0.01
psi_CVP = probability of entrainment at CVP	inv.logit(-3.9435 + 2.9025 * no.pump - 0.3771 * no.pump ^ 2)	no.pump (Number of CVP pumps in operation): DSM2*
psi_SWP = probability of entrainment at SWP	(1 - psi_CVP) * inv.logit(-1.48969 + 0.016459209 * SWP_exp)	SWP_exp (SWP exports): DSM2
S_CVP = survival through CVP (Karp et al. 2017)	inv.logit(-3.0771 + 1.8561 * no.pump - 0.2284 * no.pump ^ 2)	no.pump: DSM2*
S_SWP = survival through SWP (Gingras 1997)	0.1325	0.1325

* The model calculates the number of pumps based on DSM2 export inputs (cubic feet per second).

6B.8 Delta Smelt Larval Entrainment (DSM2 Particle Tracking Model)

The most recent version of the DSM2 Particle Tracking Model (DSM2-PTM) was used in the effects analysis to estimate the proportional entrainment of Delta Smelt larvae by various water diversions (i.e., the south Delta export facilities and the North Bay Aqueduct [NBA] Barker Slough Pumping Plant). This approach assumed the susceptibility of Delta Smelt larvae can be represented by entrainment of passive particles, based on existing literature (Kimmerer 2008, 2011). Results of the PTM simulations do not represent the actual entrainment of larval Delta Smelt that may have occurred in the past or would occur in the future, but rather should be viewed as a comparative indicator of the relative risk of larval entrainment under different operational scenarios. For the purposes of this effects analysis, particles were characterized as entrained when estimated to have entered the various water diversion locations included in the PTM outputs (e.g., south Delta export facilities and NBA). The latest version of DSM2-PTM allows agricultural diversions to be excluded as sources of entrainment (while still being included as water diversion sources): For this effects analysis, these agricultural diversions were excluded, given the relative coarseness of the assumptions related to specific locations of the agricultural diversions, the timing of water withdrawals by individual irrigators, and field observations that the density of young Delta Smelt entrained by these diversions is relatively low (Nobriga et al. 2004; Kimmerer 2008).

Delta Smelt starting distributions used in the PTM larval entrainment analysis were based on the California Department of Fish and Wildlife (CDFW) 20-mm Survey and were developed in association with M. Nobriga (USFWS Bay-Delta Office). This method paired Delta Smelt larval distributions from survey data with modeled hydraulic conditions from DSM2-PTM. Each pair was made by matching the observed Delta outflows of the first 20-mm Survey that captured larval smelt (16 years of 20-mm surveys, 1995–2011) with the closest modeled mean monthly Delta outflow for the months of March to June in the nearly 100 years of PTM simulations.

The 20-mm Survey samples 47 stations throughout the Delta on alternate weeks, March–July. The average length of Delta Smelt caught during each survey was averaged across all stations (8–10 surveys per year) (Table 6B-35 through Table 6B-42). The survey with mean fish length closest to 13 mm was chosen to represent the starting distribution of larval smelt in the Delta for that particular year (Table 6B-35 through Table 6B-42). A length of 13 mm was chosen to represent a consistent period across years with respect to size and age of Delta Smelt larvae, as larvae approached the target size of the gear (i.e., 20 mm). Catch efficiency changes rapidly for Delta Smelt larvae as they grow (see Kimmerer 2008:Figure 8); the choice of 13 mm represents a compromise between early juveniles (i.e., ≥20 mm), which have likely dispersed beyond their starting distribution and are unlikely to behave as passive particles, and early larvae (e.g., <10 mm) too small to be effectively sampled by the 20-mm Survey for a reliable starting distribution. During the period included in the analysis (1995–2011), the fourth survey was selected most frequently (range between the first and fifth surveys).

Once a survey was chosen for a given year, actual Delta Smelt catch was examined for each station. Stations downstream of the Sacramento River-San Joaquin River confluence, in Suisun Bay and Suisun Marsh, were eliminated, as particles originating in these areas would not be subject to entrainment in the Delta. The PTM is better suited to Delta channels than the open-estuary environment. Several stations introduced in 2008 in the Cache Slough area were also excluded. Table 6B-35 through Table 6B-42 provide a list of stations and counts of Delta Smelt, along with the proportion of Delta Smelt catch excluded from calculation of the starting distribution. Note the percentage of larvae collected downstream of the Sacramento–San Joaquin confluence varies from zero to almost 100 percent, depending on water year. For example, during survey 4 in 2002, outflow was relatively low outflow at approximately 13,500 cfs, and only 2.5 percent of larval catch occurred downstream of the confluence. In contrast, over 70 percent of larvae were caught downstream of the confluence during survey 4 in 1998, when outflow was nearly 70,000 cfs (Figure 6B-395). These percentages were used to adjust the percentage of particles (particles representing larvae) considered susceptible to entrainment.

To remove spatial disparities, Delta smelt counts per station were divided by the contributing area of a given station in acres (Table 6B-43). Percentages of the total number of Delta Smelt caught were calculated for each of the main areas included in the analysis. The final annual starting distributions were then established by evenly distributing assigned percentages to each DSM2-PTM node (i.e., model particle insertion points) in a given area.

Table 6B-35. Distribution of Larval Delta Smelt (Number of Smelt) in Selected Survey Period (Survey Number) at West Delta/Lower Sacramento River Sampling Stations

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Survey Number	1	3	4	4	2	4	5	4	4	4	4	5	4	4	4	4	4
Average Monthly Outflow (cfs)	90,837	46,021	12,257	67,612	35,509	22,057	9,612	13,483	41,877	12,354	29,876	82,004	11,235	9,482	11,944	25,102	84,981
508	–	51	–	1	3	1	–	–	1	–	2	–	–	–	–	–	–
513	–	110	3	–	1	18	1	–	1	7	7	–	–	–	–	2	–
520	4	65	26	1	–	9	–	–	1	–	2	–	–	–	–	1	1
801	–	41	2	–	8	18	–	–	2	13	1	–	–	1	–	1	–

Note: "–" indicates the cell is blank.
cfs = cubic feet per second.

Table 6B-36. Distribution of Larval Delta Smelt (Number of Smelt) in Selected Survey Period (Survey Number) at West Delta/ Sacramento–San Joaquin Confluence Sampling Stations

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Survey Number	1	3	4	4	2	4	5	4	4	4	4	5	4	4	4	4	4
Average Monthly Outflow (cfs)	90,837	46,021	12,257	67,612	35,509	22,057	9,612	13,483	41,877	12,354	29,876	82,004	11,235	9,482	11,944	25,102	84,981
704	–	11	8	–	4	–	3	–	–	1	–	–	–	1	–	–	–
705	–	4	12	–	–	1	14	5	1	8	–	1	–	–	1	–	–
706	–	4	14	2	–	1	5	1	–	3	1	–	1	–	–	1	–
707	–	–	–	–	–	–	11	–	–	2	–	–	–	–	–	–	–

Note: "–" indicates the cell is blank.
cfs = cubic feet per second.

Table 6B-37. Distribution of Larval Delta Smelt (Number of Smelt) in Selected Survey Period (Survey Number) at Cache Slough and North Delta Sampling Stations

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Survey Number	1	3	4	4	2	4	5	4	4	4	4	5	4	4	4	4	4
Average Monthly Outflow (cfs)	90,837	46,021	12,257	67,612	35,509	22,057	9,612	13,483	41,877	12,354	29,876	82,004	11,235	9,482	11,944	25,102	84,981
711	–	–	7	–	–	1	1	1	–	–	–	1	1	–	–	–	–
716	–	–	6	–	–	3	5	1	2	2	1	3	–	–	1	2	1
719	–	–	–	–	–	–	–	–	–	–	–	–	–	2	12	38	39

Note: "–" indicates the cell is blank.
cfs = cubic feet per second.

Table 6B-38. Distribution of Larval Delta Smelt (Number of Smelt) in Selected Survey Period (Survey Number) at West Delta/Lower San Joaquin River Sampling Stations

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Survey Number	1	3	4	4	2	4	5	4	4	4	4	5	4	4	4	4	4
Average Monthly Outflow (cfs)	90,837	46,021	12,257	67,612	35,509	22,057	9,612	13,483	41,877	12,354	29,876	82,004	11,235	9,482	11,944	25,102	84,981
804	–	8	32	12	15	8	–	4	4	5	–	1	–	1	–	1	–
809	–	20	13	–	–	–	28	1	1	87	–	–	–	–	–	–	–
812	–	8	6	–	–	1	49	3	–	6	–	–	–	1	–	–	–
815	–	3	5	–	18	1	13	5	–	26	1	1	–	2	1	1	–
901	–	5	5	–	7	–	13	2	1	4	–	–	–	–	–	–	–

Note: "–" indicates the cell is blank.
cfs = cubic feet per second.

Table 6B-39. Distribution of Larval Delta Smelt (Number of Smelt) in Selected Survey Period (Survey Number) at South Delta Sampling Stations

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Survey Number	1	3	4	4	2	4	5	4	4	4	4	5	4	4	4	4	4
Average Monthly Outflow (cfs)	90,837	46,021	12,257	67,612	35,509	22,057	9,612	13,483	41,877	12,354	29,876	82,004	11,235	9,482	11,944	25,102	84,981
902–915	–	0	4	–	45	18	11	14	8	3	2	–	–	3	2	1	–
918	–	1	–	–	–	21	1	1	–	2	1	–	–	–	–	–	–

Note: "–" indicates the cell is blank.
cfs = cubic feet per second.

Table 6B-40. Distribution of Larval Delta Smelt (Number of Smelt) in Selected Survey Period (Survey Number) at East Delta Sampling Stations

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Survey Number	1	3	4	4	2	4	5	4	4	4	4	5	4	4	4	4	4
Average Monthly Outflow (cfs)	90,837	46,021	12,257	67,612	35,509	22,057	9,612	13,483	41,877	12,354	29,876	82,004	11,235	9,482	11,944	25,102	84,981
919	–	1	5	–	–	1	10	1	–	–	–	–	–	–	–	–	–

Note: "–" indicates the cell is blank.
cfs = cubic feet per second.

Table 6B-41. Distribution of Larval Delta Smelt (Number of Smelt) in Selected Survey Period (Survey Number) at Other Sampling Stations

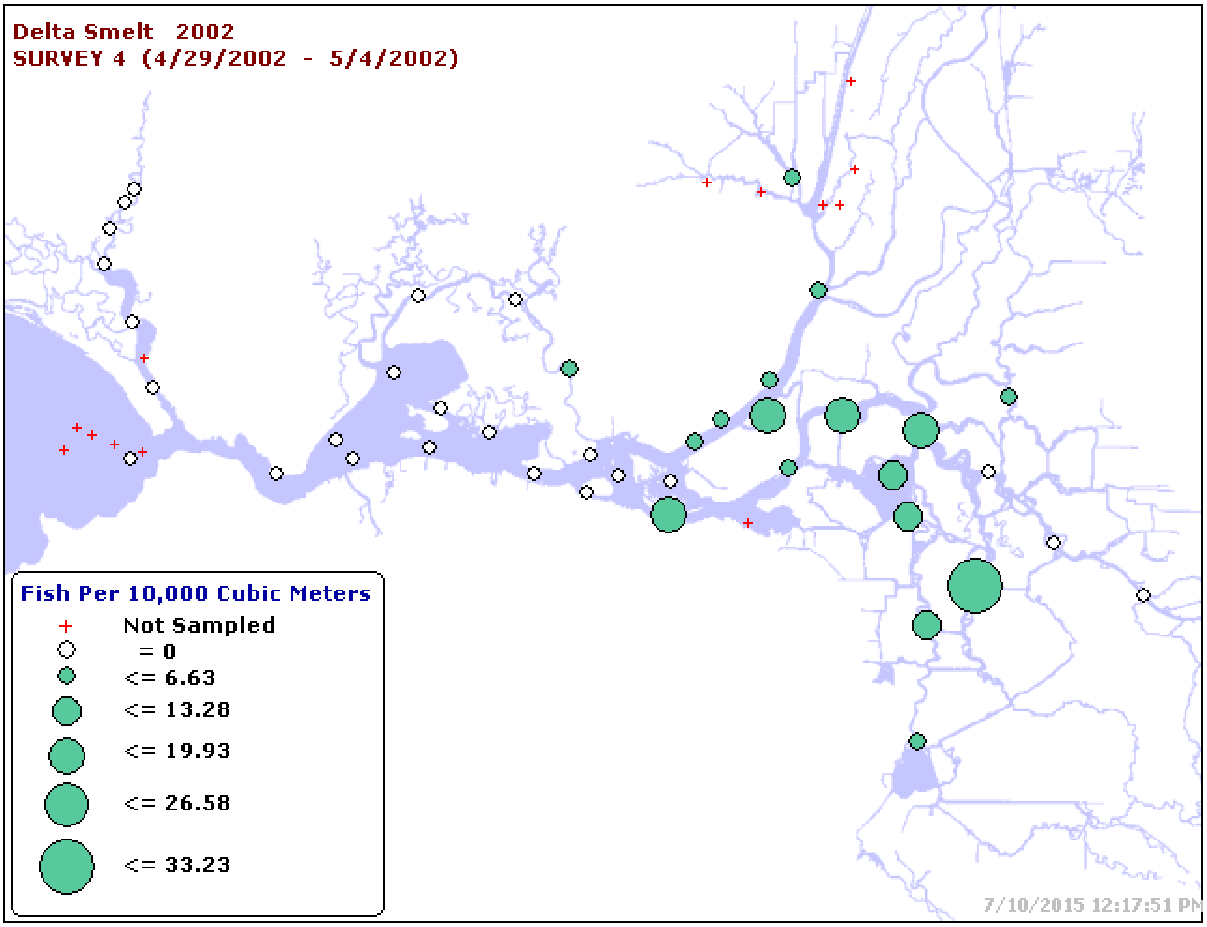
Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Survey Number	1	3	4	4	2	4	5	4	4	4	4	5	4	4	4	4	4
Average Monthly Outflow (cfs)	90,837	46,021	12,257	67,612	35,509	22,057	9,612	13,483	41,877	12,354	29,876	82,004	11,235	9,482	11,944	25,102	84,981
Cache Slough Stations	0	0	0	0	0	0	0	0	0	0	0	0	0	10	4	16	4
Downstream of Confluence	7	567	66	43	127	46	8	1	7	20	50	242	1	0	1	4	120

Note: "–" indicates the cell is blank.
cfs = cubic feet per second.

Table 6B-42. Percentage of Total Larval Delta Smelt Count in Selected Survey Period (Survey Number) Not Considered for Starting Distribution

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Survey Number	1	3	4	4	2	4	5	4	4	4	4	5	4	4	4	4	4
Average Monthly Outflow (cfs)	90,837	46,021	12,257	67,612	35,509	22,057	9,612	13,483	41,877	12,354	29,876	82,004	11,235	9,482	11,944	25,102	84,981
Cache Slough Stations	0	0	0	0	0	0	0	0	0	0	0	0	0	47.6	18.2	23.5	2.4
Downstream of Confluence	63.6	63.1	30.8	72.9	55.7	31.1	4.6	2.5	24.1	10.6	73.5	97.2	33.3	0	4.5	5.9	72.7

Note: "–" indicates the cell is blank.
cfs = cubic feet per second.



Source: California Department of Fish and Wildlife 2015.

Figure 6B-395. Density of Delta Smelt from 20-mm Survey 4, 2002

Table 6B-43. Area of Water Represented by Each 20-mm Survey Station

Station	Area (acres)
508	2,296
513	1,703
520	438
801	2,226
704	605
705	277
706	931
707	1,859
711	1,994
716	3,110 [a]
719	3,110 [a]
804	1,195
809	1,392
812	1,767
815	4,023
901	3,822
902	1,744
906	1,780
910	1,925
912	1,225
914	1,554
915	1,146
918	1,601
919	2,043

Source: Saha 2008.

[a] Acreage for Station 716 was split between Stations 716 and 719.

Each of the months included in the PTM (i.e., March–June in the 1923–2021 simulation period) was matched to the closest starting distribution based on the average monthly Delta outflow. Average monthly Delta outflow for the months modeled by PTM hydroperiods were based on CalSim (Baseline Conditions scenario). Average monthly Delta outflow during the selected 20-mm Survey period was calculated from Dayflow. If the selected survey period spanned two months (usually April–May), the applied outflow was for the month when most of the sampling occurred. The correspondence was reasonable between the modeled Delta outflow and the applied starting distribution outflow from the 20-mm Survey: the mean difference was 4 percent (median = 2 percent), and ranged from -192 percent (modeled Delta outflow of nearly 270,000 cfs in March 1983 matched with historical outflow of 90,837 cfs during survey 1 of 1995) to +58 percent (several years with modeled Delta outflow of 4,000 cfs matched with historical outflow of 9,482 cfs from survey 4 of 2008). Analysis of the PTM outputs was then done by multiplying the percentage of particles entrained from each release location by the applicable starting distribution percentage summarized in Table 6B-44 through Table 6B-49.

Table 6B-44. Percentage of Particles at PTM Insertion Locations in Sacramento–San Joaquin Confluence Area Used as Starting Distributions in the Delta Smelt Particle Tracking Analysis

Average Monthly Outflow in cfs	9,482	9,612	11,235	11,944	12,257	12,354	13,483	22,057	25,102	29,876	35,509	46,021	67,612	82,004	84,891	90,837
Sacramento River at Sherman Lake	16.52	7.72	1.65	0	8.21	0	0.11	2.65	0	6.55	2.65	19.9	3.65	0	2.92	25.00
Sacramento River at Port Chicago	16.52	7.72	1.65	0	8.21	0	0.11	2.65	0	6.55	2.65	19.9	3.65	0	2.92	25.00
San Joaquin River downstream of Dutch Slough	16.52	7.72	1.65	0	8.21	0	0.11	2.65	0	6.55	2.65	19.9	3.65	0	2.92	25.00
Sacramento River at Pittsburg	16.52	7.72	1.65	0	8.21	0	0.11	2.65	0	6.55	2.65	19.9	3.65	0	2.92	25.00

cfs = cubic feet per second; PTM = Particle Tracking Model.

Table 6B-45. Percentage of Particles at PTM Insertion Locations in Lower Sacramento River Area Used as Starting Distributions in the Delta Smelt Particle Tracking Analysis

Average Monthly Outflow in cfs	9,482	9,612	11,235	11,944	12,257	12,354	13,483	22,057	25,102	29,876	35,509	46,021	67,612	82,004	84,891	90,837
Threemile Slough	1.30	0.67	4.24	8.76	6.96	10.64	9.10	2.35	6.00	4.13	2.35	2.13	2.12	8.76	0	0
Sacramento River at Rio Vista	1.30	0.67	4.24	8.76	6.96	10.64	9.10	2.35	6.00	4.13	2.35	2.13	2.12	8.76	0	0
Sacramento River downstream of Decker Island	1.30	0.67	4.24	8.76	6.96	10.64	9.10	2.35	6.00	4.13	2.35	2.13	2.12	8.76	0	0

cfs = cubic feet per second; PTM = Particle Tracking Model.

Table 6B-46. Percentage of Particles at PTM Insertion Locations in Cache Slough and North Delta Area Used as Starting Distributions in the Delta Smelt Particle Tracking Analysis

Average Monthly Outflow in cfs	9,482	9,612	11,235	11,944	12,257	12,354	13,483	22,057	25,102	29,876	35,509	46,021	67,612	82,004	84,891	90,837
Miner Slough	0.32	0.35	0.06	5.86	1.26	1.05	0.40	0	9.11	0.60	0	0	0	5.86	9.82	0
Sacramento Deep Water Ship Channel	0.32	0.35	0.06	5.86	1.26	1.05	0.40	0	9.11	0.60	0	0	0	5.86	9.82	0
Cache Slough at Shag Slough	0.32	0.35	0.06	5.86	1.26	1.05	0.40	0	9.11	0.60	0	0	0	5.86	9.82	0
Cache Slough at Liberty Island	0.32	0.35	0.06	5.86	1.26	1.05	0.40	0	9.11	0.60	0	0	0	5.86	9.82	0
Lindsey Slough at Barker Slough	0.32	0.35	0.06	5.86	1.26	1.05	0.40	0	9.11	0.60	0	0	0	5.86	9.82	0
Sacramento River at Sacramento	0.32	0.35	0.06	5.86	1.26	1.05	0.40	0	9.11	0.60	0	0	0	5.86	9.82	0
Sacramento River at Sutter Slough	0.32	0.35	0.06	5.86	1.26	1.05	0.40	0	9.11	0.60	0	0	0	5.86	9.82	0
Sacramento River at Ryde	0.32	0.35	0.06	5.86	1.26	1.05	0.40	0	9.11	0.60	0	0	0	5.86	9.82	0
Sacramento River near Cache Slough confluence	0.32	0.35	0.06	5.86	1.26	1.05	0.40	0	9.11	0.60	0	0	0	5.86	9.82	0

cfs = cubic feet per second; PTM = Particle Tracking Model.

Table 6B-47. Percentage of Particles at PTM Insertion Locations in West Delta/San Joaquin River Area Used as Starting Distributions in the Delta Smelt Particle Tracking Analysis

Average Monthly Outflow in cfs	9,482	9,612	11,235	11,944	12,257	12,354	13,483	22,057	25,102	29,876	35,509	46,021	67,612	82,004	84,891	90,837
San Joaquin River at Potato Slough	0.80	2.86	25.12	7.00	10.87	11.13	19.73	17.80	0	13.16	17.80	4.24	26.34	7.00	0	0
San Joaquin River at Twitchell Island	0.80	2.86	25.12	7.00	10.87	11.13	19.73	17.80	0	13.16	17.80	4.24	26.34	7.00	0	0
San Joaquin River near Jersey Point	0.80	2.86	25.12	7.00	10.87	11.13	19.73	17.80	0	13.16	17.80	4.24	26.34	7.00	0	0

cfs = cubic feet per second; PTM = Particle Tracking Model.

Table 6B-48. Percentage of Particles at PTM Insertion Locations in Central/South Delta Area Used as Starting Distributions in the Delta Smelt Particle Tracking Analysis

Average Monthly Outflow in cfs	9,482	9,612	11,235	11,944	12,257	12,354	13,483	22,057	25,102	29,876	35,509	46,021	67,612	82,004	84,891	90,837
San Joaquin River downstream of Rough and Ready Island	2.47	5.50	0.47	0	0.07	2.34	0.50	2.89	0	1.66	2.89	0.10	0	0	0	0
San Joaquin River at Buckley Cove	2.47	5.50	0.47	0	0.07	2.34	0.50	2.89	0	1.66	2.89	0.10	0	0	0	0
San Joaquin River near Medford Island	2.47	5.50	0.47	0	0.07	2.34	0.50	2.89	0	1.66	2.89	0.10	0	0	0	0
Old River near Victoria Canal	2.47	5.50	0.47	0	0.07	2.34	0.50	2.89	0	1.66	2.89	0.10	0	0	0	0
Old River at Railroad Cut	2.47	5.50	0.47	0	0.07	2.34	0.50	2.89	0	1.66	2.89	0.10	0	0	0	0
Old River near Quimby Island	2.47	5.50	0.47	0	0.07	2.34	0.50	2.89	0	1.66	2.89	0.10	0	0	0	0
Middle River at Victoria Canal	2.47	5.50	0.47	0	0.07	2.34	0.50	2.89	0	1.66	2.89	0.10	0	0	0	0
Middle River u/s of Mildred Island	2.47	5.50	0.47	0	0.07	2.34	0.50	2.89	0	1.66	2.89	0.10	0	0	0	0
Grant Line Canal	2.47	5.50	0.47	0	0.07	2.34	0.50	2.89	0	1.66	2.89	0.10	0	0	0	0
Frank's Tract East	2.47	5.50	0.47	0	0.07	2.34	0.50	2.89	0	1.66	2.89	0.10	0	0	0	0

cfs = cubic feet per second; PTM = Particle Tracking Model.

Table 6B-49. Percentage of Particles at PTM Insertion Locations in East Delta Area Used as Starting Distributions in the Delta Smelt Particle Tracking Analysis

Average Monthly Outflow in cfs	9,482	9,612	11,235	11,944	12,257	12,354	13,483	22,057	25,102	29,876	35,509	46,021	67,612	82,004	84,891	90,837
Little Potato Slough	0	0.08	0	0	0.26	0.30	0.74	0.00	0	0	0	0.03	0	0	0	0
Mokelumne River downstream of Cosumnes confluence	0	0.08	0	0	0.26	0.30	0.74	0.00	0	0	0	0.03	0	0	0	0
South Fork Mokelumne	0	0.08	0	0	0.26	0.30	0.74	0.00	0	0	0	0.03	0	0	0	0
Mokelumne River downstream of Georgiana confluence	0	0.08	0	0	0.26	0.30	0.74	0.00	0	0	0	0.03	0	0	0	0
North Fork Mokelumne	0	0.08	0	0	0.26	0.30	0.74	0	0	0	0	0.03	0	0	0	0
Georgiana Slough	0	0.08	0	0	0.26	0.30	0.74	0	0	0	0	0.03	0	0	0	0

cfs = cubic feet per second; PTM = Particle Tracking Model.

Results were summarized for 30-day particle tracking periods as the percentage of particles being entrained at the south Delta exports or NBA. The total number of particles released at each location was 4,000. Note that a 30-day particle tracking period may result in relatively low fate resolution at low flows (Kimmerer and Nobriga 2008), but the relative differences between scenarios would be expected to be consistent, based on previous model comparisons of 30-day and 60-day fates. Results for south Delta exports are discussed in Chapter 6. Results for NBA are shown in Table 6B-50.

Table 6B-50. Entrainment of Particles at the North Bay Aqueduct from DSM2 Particle Tracking Modeling, Weighted by Delta Smelt Larval/Early Juvenile Distribution

Water Year Type	Baseline Conditions	Proposed Project
March		
Wet	0.04	0.04 (-1%)
Above Normal	0.01	0.01 (-16%)
Below Normal	0.09	0.09 (0%)
Dry	0.09	0.08 (-5%)
Critically Dry	0.01	0.01 (-2%)
April		
Wet	0.03	0.03 (3%)
Above Normal	0.02	0.02 (3%)
Below Normal	0.20	0.20 (0%)
Dry	0.10	0.11 (6%)
Critically Dry	0.08	0.07 (-4%)
May		
Wet	0.08	0.09 (2%)
Above Normal	0.08	0.08 (-3%)
Below Normal	0.17	0.17 (1%)
Dry	0.25	0.24 (-5%)
Critically Dry	0.12	0.12 (-2%)
June		
Wet	0.16	0.17 (2%)
Above Normal	0.23	0.25 (9%)
Below Normal	0.27	0.28 (2%)
Dry	0.21	0.21 (1%)
Critically Dry	0.14	0.14 (0%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

6B.9 Zooplankton-Delta Outflow Analysis

6B.9.1 Methods

This analysis followed the general scheme of other prior similar analyses (Kimmerer 2002; Hennessy and Burris 2017; Greenwood 2018; California Department of Water Resources and U.S. Bureau of Reclamation 2023:2-10) to examine the relationship between Delta Smelt and Longfin Smelt zooplankton prey density (catch per cubic meter) in the low-salinity zone (i.e., 0.5–6 parts per thousand salinity) and spring (March–May), summer (June–August), and fall (September–November) Delta outflow for the period from 2000 to 2021 (this period generally represents the onset of the Pelagic Organism Decline [POD] ecological regime; Thomson et al. 2010). Zooplankton examined in the analyses were based on taxa (species or species groupings, split by life stage where appropriate) included in recent studies (Smith 2021:45; Barros et al. 2022; Smith and Nobriga 2023).

The main steps in preparing the data for analysis were as follows.

1. Historical zooplankton data were synthesized using the R (R Core Team 2023) statistical software package zooper (Bashevkin et al. 2022, 2023a, 2023b).
    a. Data were subset as appropriate.
        1) For mysids, surveys included 'EMP' (Environmental Monitoring Program) data, whereas for other taxa surveys included 'EMP' as well as '20mm' (20-mm Survey in spring), 'STN' (Summer Townet) and 'FMWT' (Fall Midwater Trawl).
        2) The data type chosen was 'Community', with size class of 'Macro' for mysids and 'Micro', 'Meso', and 'Macro' for other taxa.
    b. Only samples within the low salinity zone (salinity = 0.5–6 parts per thousand) were selected.
    c. The mean catch per unit effort (number per cubic meter) was calculated by year.
2. Historical Delta outflow data by year for each seasonal period were obtained from Dayflow via the DroughtData R package's[8] dataset raw_hydro_1975_2022.

For each taxon, mean annual $\log_e$-transformed catch per unit effort + 1 for each taxon was regressed against mean annual $\log_e$-transformed Delta outflow for each seasonal period. Statistically significant regressions (Table 6B-51, Table 6B-52, and Table 6B-53) were then applied to the modeled Baseline Conditions and Proposed Project scenarios 1922–2021 CalSim 3-modeled data, with predictions back-transformed to the original measurement scale (catch per unit effort, number per cubic meter) for summary of results.

[8] https://github.com/mountaindboz/DroughtData/releases, accessed June 22, 2023.

Table 6B-51. Zooplankton Spring (March–May) Regression Summary, With Bold Indicating Statistically Significant (P<0.05) Regressions Subsequently Applied to CalSim 3-Modeled Data

Taxon	Intercept	Slope	R^2	P
Acartiella sinensis (copepod) adults	8.134	-0.506	0.125	0.107
Cladocerans except *Daphnia*	**-3.746**	**0.730**	**0.365**	**0.003**
Copepod nauplii	10.145	0.140	0.079	0.205
Cyclopoid copepods except *Limnoithona* adults	7.441	0.042	0.005	0.764
Daphnia adults	-0.639	0.318	0.169	0.057
***Eurytemora affinis* (copepod) adults**	**0.234**	**0.528**	**0.255**	**0.016**
Harpacticoid copepods	**1.072**	**0.501**	**0.309**	**0.007**
Limnoithona (cladoceran) adults	7.973	0.135	0.030	0.439
Mysids	1.563	0.114	0.015	0.593
Other calanoid copepod adults	**-1.593**	**0.669**	**0.210**	**0.032**
Other calanoid copepod copepodites	**2.296**	**0.469**	**0.357**	**0.003**
Pseudodiaptomus (copepod) adults	4.496	0.053	0.001	0.874
Pseudodiaptomus (copepod) copepodites	0.882	0.476	0.149	0.076

Note: Regressions were $\log_e$(mean annual catch per cubic meter+1) = $\log_e$(mean annual Delta outflow).

Table 6B-52. Zooplankton Summer (June–August) Regression Summary

Taxon	Intercept	Slope	R^2	P
Acartiella sinensis (copepod) adults	3.779	0.196	0.006	0.732
Cladocerans except *Daphnia*	11.625	-0.836	0.034	0.410
Copepod nauplii	10.883	0.163	0.038	0.385
Cyclopoid copepods except *Limnoithona* adults	9.204	-0.021	0.000	0.922
Daphnia adults	13.713	-1.316	0.104	0.143
Eurytemora affinis (copepod) adults	-2.567	0.445	0.055	0.294
Harpacticoid copepods	-2.539	0.788	0.119	0.117
Limnoithona (cladoceran) adults	9.811	0.077	0.012	0.621
Mysids	0.065	0.364	0.031	0.211
Other calanoid copepod adults	8.603	-0.444	0.076	0.215
Other calanoid copepod copepodites	4.051	0.188	0.024	0.487
Pseudodiaptomus (copepod) adults	4.822	0.211	0.058	0.282
Pseudodiaptomus (copepod) copepodites	2.674	0.435	0.072	0.228

Note: Regressions were $\log_e$(mean annual catch per cubic meter+1) = $\log_e$(mean annual Delta outflow). None of the regressions were statistically significant (P<0.05).

Table 6B-53. Zooplankton Fall (September–November) Regression Summary, With Bold Indicating Statistically Significant (P<0.05) Regressions Subsequently Applied to CalSim 3-Modeled Data

Taxon	Intercept	Slope	R^2	P
Acartiella sinensis (copepod) adults	7.658	-0.119	0.005	0.752
Cladocerans except *Daphnia*	14.953	-1.375	0.053	0.300
Copepod nauplii	8.321	0.427	0.095	0.164
Cyclopoid copepods except *Limnoithona* adults	9.852	-0.069	0.002	0.862
Daphnia adults	6.854	-0.729	0.038	0.382
***Eurytemora affinis* (copepod) adults**	**-6.972**	**0.908**	**0.234**	**0.023**
Harpacticoid copepods	4.114	0.054	0.000	0.960
Limnoithona (cladoceran) adults	5.613	0.542	0.173	0.054
Mysids	**-7.945**	**1.153**	**0.213**	**0.018**
Other calanoid copepod adults	6.321	-0.436	0.012	0.621
Other calanoid copepod copepodites	2.286	0.359	0.032	0.426
Pseudodiaptomus (copepod) adults	11.444	-0.581	0.146	0.080
Pseudodiaptomus (copepod) copepodites	10.184	-0.484	0.047	0.334

Note: Regressions were $\log_e$(mean annual catch per cubic meter+1) = $\log_e$(mean annual Delta outflow).

6B.9.2 Results

The results of the analysis are presented and discussed in Chapter 6.

6B.10 Delta Smelt Life Cycle Model with Entrainment (LCME)

6B.10.1 Methods

The Delta Smelt Life Cycle Model with Entrainment (LCME) model estimates annual population replacement rate (lambda) as a function of various covariates acting on six different life stages. R statistical software (R Core Team 2023) model code was provided by the lead author (Smith pers. comm. Feb. 13, 2023). Coordination was undertaken with the model authors to establish the appropriate application of the model for the comparison of modeling scenarios. Although the LCME model includes numerous covariates (see Smith et al. 2021:Table 1), the appropriate use of the model indicated by the authors was to focus on CalSim 3-modeled inputs for several OMR flow covariates (Table 6B-54 and Table 6B-55) and June–August Delta outflow (Table 6B-56), leaving other covariates at historical values for the 1995–2015 modeling period.

Table 6B-54. Old and Middle River Flow Inputs (Cubic Feet per Second) for Delta Smelt LCME Modeling, Baseline Conditions

Cohort Year	Early postlarval (PL1); April–May	Late postlarval (PL2); June	Early subadult (SA1); December–January	Late subadult (SA2); February	Early adult (A1); March
1995	-2,406	-4,301	-5,537	-4,464	-3,365
1996	-2,344	-4,930	-4,903	-4,036	-3,426
1997	-1,361	-4,109	6,706	1,617	-3,365
1998	-423	-3,527	-6,606	910	-2,669
1999	-1,743	-5,000	-4,903	-4,021	-3,426
2000	-1,508	-4,729	-6,160	-4,036	-3,425
2001	-768	-5,000	-5,564	-4,316	-3,997
2002	-255	-5,000	-4,903	-4,144	-3,429
2003	-1,168	-5,000	-4,903	-4,021	-3,434
2004	-941	-5,000	-4,903	-4,160	-3,428
2005	-428	-4,322	-4,903	-4,144	-3,424
2006	1,905	-4,301	-4,903	-3,906	-447
2007	-1,488	-5,000	-7,329	-4,144	-3,429
2008	-1,141	-5,000	-3,569	-4,160	-3,998
2009	-232	-5,000	-1,658	-4,415	-3,999
2010	930	-5,000	-3,467	-4,144	-3,997
2011	-1,863	-4,301	-4,903	-2,851	1,632
2012	-883	-4,822	-5,898	-4,761	-3,998
2013	-1,335	-5,000	-5,145	-3,615	-3,435
2014	-1,083	-2,720	-1,852	-2,780	-4,565
2015	-983	-1,437	---	---	---

Table 6B-55. Old and Middle River Flow (Cubic Feet per Second) Inputs for Delta Smelt LCME Modeling, Proposed Project

Cohort Year	Early postlarval (PL1); April–May	Late postlarval (PL2); June	Early subadult (SA1); December–January	Late subadult (SA2); February	Early adult (A1); March
1995	-2,901	-4,301	-5,474	-4,464	-2,745
1996	-2,403	-4,435	-4,903	-4,065	-4,476
1997	-2,541	-3,827	6,675	1,512	-4,356
1998	-465	-3,530	-6,607	904	-2,255
1999	-3,324	-4,505	-4,903	-4,625	-3,576
2000	-2,682	-4,490	-6,204	-4,625	-3,950
2001	-966	-4,400	-5,397	-3,580	-3,772
2002	-624	-4,400	-4,583	-4,030	-2,688
2003	-1,639	-4,490	-4,583	-3,741	-2,693
2004	-1,109	-4,475	-4,817	-4,188	-2,762

Cohort Year	Early postlarval (PL1); April–May	Late postlarval (PL2); June	Early subadult (SA1); December–January	Late subadult (SA2); February	Early adult (A1); March
2005	-1,897	-4,172	-4,827	-4,030	-2,683
2006	2,200	-4,301	-4,748	-3,734	-446
2007	-1,414	-4,400	-7,329	-3,626	-2,688
2008	-1,342	-4,850	-3,251	-4,041	-3,773
2009	-537	-4,400	-1,655	-3,808	-3,774
2010	267	-4,475	-3,210	-4,030	-3,772
2011	-3,255	-4,301	-4,827	-2,741	2,390
2012	-924	-4,475	-5,980	-4,250	-3,774
2013	-1,389	-4,400	-5,033	-3,875	-2,694
2014	-1,247	-2,342	-2,107	-4,625	-4,265
2015	-1,023	-1,438	---	---	---

Table 6B-56. June–August Delta Outflow (1,000 Cubic Meters) Inputs for Delta Smelt LCME Modeling

Cohort Year	Baseline Conditions	Proposed Project
1995	5,722,944	5,720,965
1996	1,922,569	1,937,644
1997	1,746,037	1,757,242
1998	7,847,041	7,844,825
1999	2,023,644	2,038,721
2000	1,913,327	1,854,705
2001	1,236,487	1,137,809
2002	1,169,188	1,168,975
2003	1,766,171	1,693,570
2004	1,479,900	1,448,275
2005	2,543,155	2,553,789
2006	2,908,368	2,882,769
2007	1,334,834	1,366,016
2008	1,062,546	1,062,546
2009	1,372,771	1,372,771
2010	1,767,233	1,809,071
2011	5,802,363	5,801,365
2012	1,313,096	1,286,744
2013	1,165,792	1,165,792
2014	824,495	824,495
2015	1,052,026	1,052,026

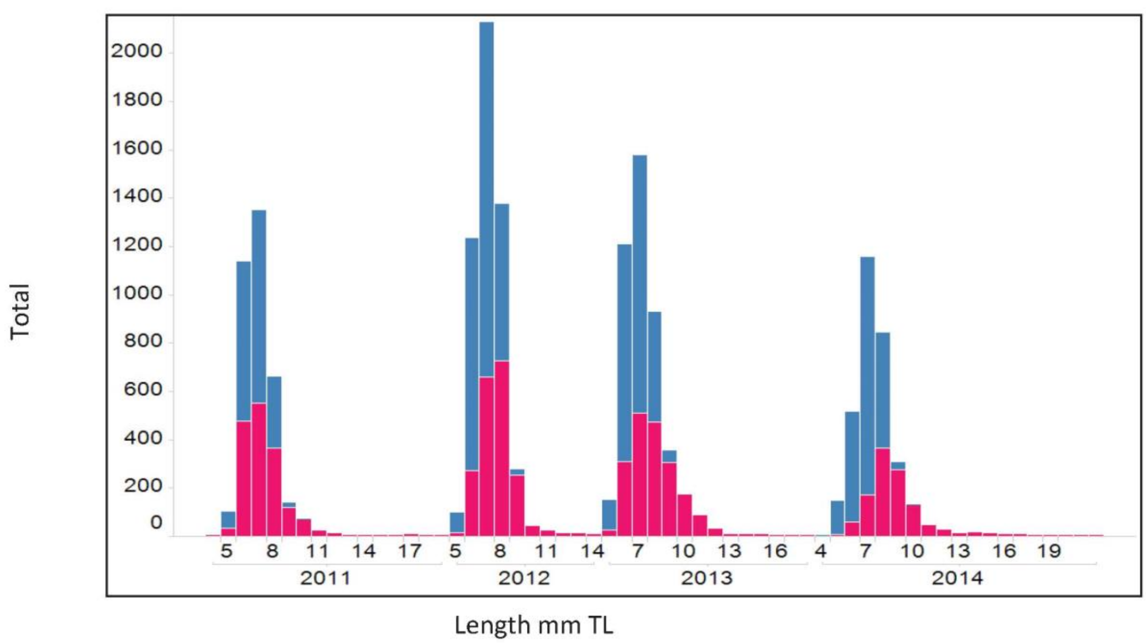
6B.10.2 Results

The results of the analysis are presented and discussed in Chapter 6.

6B.11 Longfin Smelt Larval Entrainment (DSM2 Particle Tracking Model)

6B.11.1 Derivation of Larval Longfin Smelt Hatching Locations

The potential effect of the Proposed Project on entrainment in the Delta and Suisun Marsh was evaluated through a PTM of neutrally buoyant and surface-oriented particles representing newly hatched larvae inserted at various locations in the Delta. The first step in the analysis was to determine appropriate weights for particle insertion points, to reflect the hatching locations of larval Longfin Smelt. Injection points for scenario comparisons were determined via the spatial distributions of larvae observed in the Smelt Larval Survey (SLS), from 2009 through 2014. This is consistent with CDFW's approach in its effects and Incidental Take Permit analysis for SWP and CVP data (California Department of Fish and Game 2009a). Data were obtained from the CDFW website (California Department of Fish and Wildlife 2021). From 2009 to 2013, the SLS conducted five to six surveys at 35 stations in the Delta from January through March; stations 323 to 343 in the Napa River were added in 2014 and are excluded from this analysis. Data were filtered to include Longfin Smelt larvae ≥ 6-mm total length. Larvae at this size are mostly newly hatched, but could include individuals up to eight days old, assuming conservative hatch lengths as low as 4-mm standard length and growth rate up to ~0.25 mm/day (California Department of Fish and Game 2009b:9). Most newly hatched Longfin Smelt larvae are about 6-mm total length (Figure 6B-396), based on size distribution and yolk sac presence in Longfin Smelt SLS catch data. This is consistent with the presumed range of 4- to 8-mm standard length (Wang 2007:34; California Department of Fish and Game 2009b).



Note: Larvae with yolk-sacs are represented by blue bars. The California Department of Fish and Game did not distinguish yolk sac larvae in 2009 and 2010.

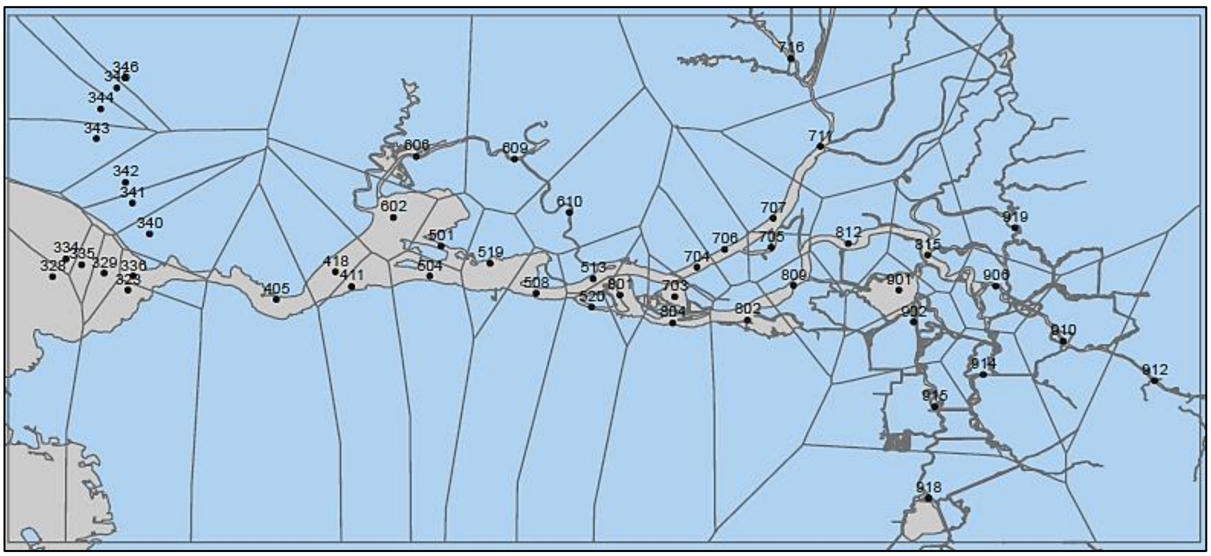
Figure 6B-396. Length-Frequency Histogram of Longfin Smelt Larvae Collected in the Smelt Larvae Survey

The density of larvae (≤6-mm total length) per cubic meter sampled at each station was calculated as:

Density = Number of larvae/(0.37*(26873+99999)*Net meter reading),

where the conversion factor derives from calibration of the net flow meter used during SLS sampling.

The SLS includes a subset of the stations that are used for the March through June 20-mm Survey for larval/juvenile Delta Smelt. Saha (2008) estimated the areas and volumes that each of the 20-mm Survey stations represents within the Delta and Suisun Marsh and Bay using a Voronoi diagram (Figure 6B-397). There is a station (723) that was not part of the 20-mm Survey when Saha (2008) made the area and volume calculations; this station is close to station 716, so the area and volume represented by station 716 were halved for the present analysis, with the other half being considered to be the area and volume represented by station 723 (Table 6B-57).



Source: Saha 2008.

Figure 6B-397. Division of the Delta and Suisun Marsh and Bay Around 20-mm Survey Stations with a Voronoi Diagram

Table 6B-57. Area and Volume Represented by Smelt Larvae Survey Stations

Station	Area (acre)	Volume (acre-feet)	Area (square meters)	Volume (cubic meters)
405	3,547	139,804	14,354,198	172,445,718
411	2,119	37,344	8,575,288	46,063,152
418	2,756	63,186	11,153,135	77,938,794
501	3,692	36,856	14,940,992	45,461,213
504	2,403	44,046	9,724,595	54,329,948
508	2,296	53,344	9,291,581	65,798,864
513	1,703	41,921	6,891,796	51,708,799
519	4,101	67,942	16,596,156	83,805,234
520	438	12,130	1,772,523	14,962,137
602	7,361	72,852	29,788,907	89,861,631
606	1,332	17,685	5,390,412	21,814,129
609	727	8,114	2,942,064	10,008,473
610	259	3,156	1,048,136	3,892,869
703	2,091	25,853	8,461,976	31,889,210
704	605	15,952	2,448,348	19,676,505
705	277	3,741	1,120,979	4,614,456
706	931	24,539	3,767,623	30,268,415
707	1,859	37,076	7,523,105	45,732,579
711	1,994	39,391	8,069,431	48,588,089
716*	3,110	51,796	12,583,699	63,889,434
723*	3,110	51,796	12,583,699	63,889,434
801	2,226	45,662	9,008,301	56,323,255
802	3,546	45,094	14,350,151	55,622,637
804	1,195	32,119	4,835,993	39,618,208
809	1,392	33,562	5,633,224	41,398,123
812	1,767	43,810	7,150,795	54,038,846
815	4023	72053	16,280,502	88,876,079
901	3,822	33,855	15,467,084	41,759,533
902	1,744	22,095	7,057,717	27,253,785
906	1,780	32,694	7,203,404	40,327,461
910	1,925	25,760	7,790,198	31,774,496
912	1,225	13,747	4,957,399	16,956,677
914	1,554	23,552	6,288,814	29,050,968
915	1,146	13,302	4,637,697	16,407,778
918	1601	14,685	6,479,016	18,113,683
919	2,043	20,702	8,267,727	25,535,544

The total number of Longfin Smelt larvae ≤6 mm in the volume of water represented by each station (Table 6B-57) was calculated by multiplying the density of larvae by the volume of each station.[9] The proportion of larvae in the volume of water represented by each SLS station was calculated for each survey as the number of larvae per station divided by the total sum of larvae across all stations (Table 6B-58).

The annual distribution of Longfin Smelt larvae from the SLS did not appear to vary with hydrological conditions, at least for the groups of stations examined herein (Table 6B-59).[10] Therefore, an overall mean distribution was used to weigh the results of the DSM2-PTM analysis, based on the mean proportion by station from all surveys from 2009 through 2014.

6B.11.2 DSM2-Particle Tracking Modeling Runs

Scenarios were modeled as 90-day DSM2-PTM runs at 39 particle injection locations in the Delta, Suisun Marsh, and Suisun Bay (Table 6B-60) beginning at the start of January, February, and March, 1922–2021. The particle injection locations were chosen to represent SLS stations, with particular emphasis on Delta stations. For each run, 4,000 neutrally buoyant passive particles were injected evenly every hour (i.e., about 160 particles per hour) over a 24.75-hour period at the beginning of the month. The fate of the particles was output at ninety days. For consistency with the analysis conducted by CDFG (2009a), in addition to neutrally buoyant particles, a second set of runs included particles simulated as oriented towards the surface (top 10 percent of water column).

[9] For reference, the overall estimated number of larvae across all stations ranged from around 600,000 (survey 6 in 2014) to around 160,000,000 (survey 4 in 2009). Dividing these estimates by fecundity of 7,500 (California Department of Fish and Game 2009b:Figure 3) for a 2-year-old female and multiplying by 2 (under the assumption of a 1:1 sex ratio) gives an estimate of adult Longfin Smelt abundance, assuming 100 percent survival from eggs to larvae. Applying 10 percent, 50 percent, and 90 percent survival from eggs to larvae gives estimates of adult population size of around 500–2,300 (survey 6 in 2014) to 130,000–650,000 (survey 4 in 2009). These estimates bracket the "tens of thousands" of adults suggested by Newman (pers. comm. to California Department of Fish and Game 2009b), perhaps providing some indication that the numbers are of a reasonable order of magnitude for the purposes of the present analysis. However, the analysis is not dependent on absolute numbers of larvae to be accurately represented, as gear efficiency for smaller stages would need to be refined.

[10] This does not preclude the possibility of a considerable proportion of the population occurring downstream of the SLS sampling area during wet years, for example.

Table 6B-58. Volume-Weighted Proportion of Longfin Smelt Larvae ≤6 mm By Station, 2009–2014

Year	Survey	405	411	418	501	504	508	513	519	520	602	606	609	610	703	704	705	706	707	711	716	723	801	804	809	812	815	901	902	906	910	912	914	915	918	919
2009	1	0.0466	0.0000	0.0000	0.0118	0.0000	0.0151	0.2600	0.0217	0.0079	0.0000	0.0164	0.0000	0.0000	0.0164	0.0173	0.0104	0.2071	0.0365	0.0504	0.0161	0.0470	0.1693	0.0089	0.0193	0.0000	0.0000	0.0110	0.0000	0.0106	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2009	2	0.0000	0.0000	0.0000	0.0034	0.0000	0.1338	0.0993	0.0057	0.0227	0.0142	0.0015	0.0014	0.0033	0.0144	0.0771	0.0221	0.0779	0.2020	0.0296	0.0254	0.0045	0.0437	0.0848	0.0651	0.0150	0.0179	0.0324	0.0000	0.0000	0.0000	0.0000	0.0000	0.0027	0.0000	0.0000
2009	3	0.0000	0.0000	0.0000	0.0035	0.0021	0.0479	0.0019	0.0099	0.0099	0.0029	0.0083	0.0037	0.0009	0.0774	0.0369	0.0125	0.1055	0.1392	0.0355	0.1416	0.1250	0.0784	0.0316	0.0437	0.0632	0.0124	0.0056	0.0000	0.0000	0.0000	0.0000	0.0000	0.0006	0.0000	0.0000
2009	4	0.1055	0.0222	0.0320	0.0052	0.0016	0.0773	0.2536	0.0267	0.0164	0.0827	0.0007	0.0013	0.0005	0.0126	0.0231	0.0027	0.0101	0.0309	0.0000	0.0305	0.0302	0.1554	0.0467	0.0209	0.0016	0.0028	0.0050	0.0008	0.0000	0.0000	0.0000	0.0008	0.0005	0.0000	0.0000
2009	5	0.0152	0.0190	0.0447	0.1238	0.0582	0.2174	0.1067	0.0734	0.0199	0.0931	0.0095	0.0012	0.0002	0.0129	0.0052	0.0015	0.0062	0.0139	0.0000	0.0178	0.0185	0.0587	0.0543	0.0047	0.0084	0.0064	0.0090	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2010	1	0.0130	0.0118	0.0218	0.0429	0.0161	0.1210	0.0807	0.0456	0.0451	0.0300	0.0000	0.0014	0.0006	0.0048	0.0105	0.0078	0.0526	0.1396	0.0035	0.0639	0.0745	0.0257	0.0383	0.0734	0.0421	0.0000	0.0272	0.0038	0.0000	0.0000	0.0000	0.0021	0.0000	0.0000	0.0000
2010	4	0.0506	0.0167	0.0480	0.0663	0.1274	0.0574	0.0304	0.0226	0.0283	0.0371	0.0000	0.0019	0.0033	0.0086	0.0753	0.0031	0.0841	0.1396	0.0038	0.0225	0.0094	0.0457	0.0631	0.0208	0.0095	0.0133	0.0097	0.0019	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2010	5	0.0670	0.1457	0.0848	0.1239	0.0744	0.0428	0.0147	0.0515	0.0162	0.0436	0.0000	0.0011	0.0000	0.0280	0.0164	0.0038	0.0361	0.0436	0.0106	0.0197	0.0534	0.0400	0.0274	0.0283	0.0175	0.0000	0.0071	0.0016	0.0000	0.0000	0.0000	0.0000	0.0000	0.0011	0.0000
2010	6	0.0171	0.0000	0.0000	0.0000	0.0106	0.1488	0.3585	0.0163	0.0095	0.0103	0.0095	0.0000	0.0005	0.0143	0.0479	0.0000	0.1063	0.0431	0.0167	0.0220	0.1016	0.0112	0.0161	0.0120	0.0138	0.0000	0.0088	0.0000	0.0000	0.0000	0.0000	0.0000	0.0022	0.0000	0.0029
2011	1	0.0130	0.0110	0.0187	0.0146	0.0212	0.1665	0.0837	0.2172	0.0349	0.0542	0.0204	0.0008	0.0006	0.0159	0.0576	0.0030	0.0682	0.1289	0.0000	0.0096	0.0102	0.0034	0.0278	0.0186	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2011	2	0.0336	0.0024	0.0307	0.0287	0.0181	0.0758	0.0363	0.0819	0.0251	0.0191	0.0053	0.0005	0.0044	0.0029	0.0314	0.0042	0.0487	0.0846	0.0193	0.0785	0.1454	0.0624	0.0531	0.0296	0.0137	0.0134	0.0490	0.0013	0.0000	0.0000	0.0008	0.0000	0.0000	0.0000	0.0000
2011	3	0.0000	0.0079	0.0062	0.0150	0.0301	0.0522	0.0043	0.0143	0.0067	0.0000	0.0000	0.0009	0.0010	0.0725	0.0207	0.0069	0.0611	0.1476	0.0775	0.2083	0.1842	0.0000	0.0228	0.0259	0.0190	0.0075	0.0075	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2011	4	0.0000	0.0038	0.0000	0.0916	0.1170	0.2984	0.0612	0.0802	0.0198	0.0184	0.0000	0.0000	0.0005	0.0113	0.0252	0.0030	0.0097	0.1250	0.0144	0.0057	0.0846	0.0128	0.0044	0.0000	0.0050	0.0000	0.0049	0.0031	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2011	5	0.2285	0.0972	0.0192	0.0641	0.1032	0.0171	0.0000	0.0814	0.0078	0.2402	0.0000	0.0000	0.0009	0.0236	0.0183	0.0012	0.0000	0.0000	0.0124	0.0000	0.0289	0.0000	0.0100	0.0096	0.0259	0.0000	0.0106	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2012	1	0.0000	0.0000	0.0127	0.0206	0.0000	0.1460	0.1212	0.0000	0.0075	0.0282	0.0017	0.0022	0.0000	0.0224	0.0130	0.0028	0.0766	0.1361	0.0000	0.1099	0.1076	0.0275	0.0437	0.0819	0.0196	0.0189	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2012	2	0.2521	0.0066	0.0415	0.0310	0.0193	0.0884	0.0153	0.0077	0.0072	0.0519	0.0029	0.0010	0.0009	0.0301	0.0301	0.0011	0.0460	0.0765	0.0000	0.0543	0.0935	0.0384	0.0047	0.0355	0.0373	0.0000	0.0203	0.0035	0.0019	0.0000	0.0000	0.0000	0.0000	0.0000	0.0012
2012	3	0.0000	0.0000	0.0143	0.0081	0.0000	0.1628	0.0815	0.0082	0.0225	0.0258	0.0000	0.0009	0.0024	0.0026	0.0182	0.0024	0.0551	0.1591	0.0164	0.1159	0.1445	0.0047	0.0522	0.0050	0.0373	0.0508	0.0095	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2012	4	0.0593	0.0053	0.0236	0.0390	0.0248	0.0813	0.0322	0.1418	0.0230	0.0000	0.0000	0.0011	0.0000	0.0099	0.0250	0.0015	0.0829	0.1637	0.0168	0.0388	0.1124	0.0754	0.0192	0.0043	0.0000	0.0000	0.0102	0.0063	0.0000	0.0000	0.0000	0.0000	0.0000	0.0019	0.0000
2012	6	0.0894	0.0469	0.0522	0.0211	0.2308	0.1499	0.0583	0.0204	0.0683	0.1683	0.0000	0.0000	0.0048	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0151	0.0000	0.0392	0.0082	0.0000	0.0274	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2013	1	0.1422	0.0980	0.0000	0.0635	0.1968	0.0000	0.2731	0.0000	0.0000	0.1031	0.0000	0.0000	0.0000	0.0000	0.0078	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0208	0.0000	0.0141	0.0192	0.0000	0.0614	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2013	2	0.0124	0.0147	0.1148	0.0597	0.0858	0.0918	0.0308	0.1344	0.0087	0.1266	0.0000	0.0000	0.0000	0.0330	0.0013	0.0009	0.0704	0.0787	0.0034	0.0423	0.0280	0.0224	0.0202	0.0117	0.0000	0.0000	0.0079	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2013	3	0.0440	0.0000	0.0713	0.0527	0.0554	0.0301	0.0232	0.0568	0.0187	0.0499	0.0000	0.0000	0.0000	0.0514	0.0289	0.0037	0.0223	0.0807	0.0462	0.0927	0.1084	0.0435	0.0099	0.0472	0.0098	0.0164	0.0348	0.0000	0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2013	4	0.0000	0.0548	0.0103	0.0188	0.0253	0.0369	0.0194	0.0912	0.0116	0.0510	0.0000	0.0000	0.0000	0.0045	0.0296	0.0035	0.0585	0.1107	0.0934	0.1044	0.1985	0.0276	0.0201	0.0110	0.0036	0.0000	0.0134	0.0017	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2013	5	0.0689	0.0000	0.0506	0.0253	0.0280	0.1278	0.0172	0.0957	0.0245	0.0084	0.0000	0.0000	0.0000	0.0083	0.0134	0.0029	0.0422	0.1206	0.0498	0.0531	0.1243	0.0666	0.0384	0.0192	0.0115	0.0000	0.0034	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2013	6	0.0000	0.0680	0.0000	0.0000	0.0000	0.0000	0.1270	0.0000	0.0550	0.0000	0.0000	0.0000	0.0000	0.0411	0.0000	0.0000	0.3130	0.0000	0.0000	0.0000	0.0000	0.0000	0.3286	0.0000	0.0000	0.0000	0.0673	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2014	1	0.0000	0.0000	0.0190	0.0094	0.0000	0.2113	0.2272	0.0000	0.0332	0.0382	0.0053	0.0022	0.0100	0.0320	0.0287	0.0008	0.0131	0.0197	0.0276	0.0126	0.0259	0.0814	0.0425	0.0773	0.0467	0.0175	0.0183	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2014	2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0494	0.0598	0.0291	0.0171	0.0373	0.0020	0.0009	0.0007	0.0137	0.0079	0.0021	0.0095	0.0501	0.0446	0.2024	0.2176	0.0570	0.0096	0.0156	0.1374	0.0143	0.0162	0.0057	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2014	3	0.0000	0.0168	0.0415	0.0223	0.0137	0.0434	0.0381	0.0462	0.0159	0.0413	0.0000	0.0042	0.0000	0.0148	0.0024	0.0046	0.0042	0.0230	0.0367	0.2676	0.1165	0.1119	0.0160	0.0664	0.0324	0.0000	0.0201	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2014	4	0.0000	0.0000	0.0000	0.0000	0.0098	0.0124	0.0606	0.1058	0.0194	0.0000	0.0000	0.0018	0.0014	0.0208	0.0358	0.0000	0.0762	0.1184	0.0000	0.0980	0.2803	0.1038	0.0000	0.0280	0.0207	0.0000	0.0070	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2014	5	0.0000	0.0000	0.2679	0.0000	0.1638	0.0460	0.0423	0.0652	0.0338	0.0000	0.0000	0.0000	0.0105	0.0000	0.0000	0.0000	0.0221	0.0000	0.0000	0.0000	0.0000	0.0900	0.1203	0.0316	0.0391	0.0000	0.0673	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2014	6	0.0000	0.0000	0.0000	0.0000	0.3797	0.0000	0.0000	0.0000	0.1078	0.0000	0.0000	0.0000	0.0338	0.0000	0.0000	0.0000	0.4788	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note: Surveys 2 and 3 in 2010 and 5 in 2012 had missing data and were excluded from the analysis.

Table 6B-59. Mean Proportion of Longfin Smelt Larvae in Each Group of Smelt Larvae Survey Stations

Year	Mean Dec–March Delta Outflow (cfs)	400s	500s	600s	700s	800s	900s
2009	13,808	0.06	0.33	0.05	0.35	0.20	0.02
2010	19,863	0.12	0.39	0.03	0.32	0.12	0.02
2011	55,663	0.09	0.37	0.07	0.37	0.07	0.02
2012	11,946	0.12	0.33	0.06	0.36	0.13	0.01
2013	23,600	0.13	0.31	0.06	0.35	0.13	0.03
2014	8,331	0.06	0.31	0.03	0.38	0.19	0.02
Mean	–	0.09	0.34	0.05	0.36	0.14	0.02

Note: "–" indicates the cell is blank.
cfs = cubic feet per second.

Each particle injection location was assigned to one or more SLS stations, and some SLS stations had multiple particle injection locations assigned to them, reflecting the distribution of injection locations relative to their nearest SLS station (e.g., station 919 was assigned five injection locations, and station 901 was only assigned one injection location; Table 6B-60). The weight assigned to particles injected at each PTM injection location reflected the mean proportion of larvae captured at the associated SLS station (Table 6B-58), divided by the number of injection locations at a given station. For example, station 707 was assigned two particle injection locations: Threemile Slough (location no. 15) and Sacramento River at Rio Vista (location no. 31) (Table 6B-60). The overall mean proportion of larval Longfin Smelt at station 707 across all surveys, 2009–2014 was 0.078 (mean of values in the 707 column of Table 6B-58). This 0.078 (i.e., 7.8 percent of larvae) was then divided equally among the two particle injection locations assigned to SLS station 707, giving a weight of 0.039 (i.e., 3.9 percent of larvae) for the particles injected at each location (Table 6B-60). Professional judgement was used to assign representative weights when a broad area contained relatively few stations in the geographic vicinity (i.e., Cache Slough Complex injection locations 22–26 represented by SLS stations 716 and 713).

Table 6B-60. Particle Injection Locations, Associated Smelt Larvae Survey Stations, and Location Weight for the DSM2-PTM Analysis of Potential Larval Longfin Smelt Entrainment

PTM Injection Location Number	PTM Injection Location Name	SLS Station	Weight
1	San Joaquin River at Vernalis	912	0.000014
2	San Joaquin River at Mossdale	912	0.000014
3	San Joaquin River d/s of Rough and Ready Island	910	0.000000
4	San Joaquin River at Buckley Cove	910	0.000000
5	San Joaquin River near Medford Island	906	0.000463
6	San Joaquin River at Potato Slough	815	0.003088
7	San Joaquin River at Twitchell Island	812	0.021832
8	Old River near Victoria Canal	918	0.000032
9	Old River at Railroad Cut	915	0.000191
10	Old River near Quimby Island	902	0.000957

PTM Injection Location Number	PTM Injection Location Name	SLS Station	Weight
11	Middle River at Victoria Canal	918	0.000032
12	Middle River u/s of Mildred Island	914	0.000094
13	Grant Line Canal	918	0.000032
14	Frank's Tract East	901	0.017578
15	Threemile Slough	707	0.038899
16	Little Potato Slough	919	0.000026
17	Mokelumne River d/s of Cosumnes confluence	919	0.000026
18	South Fork Mokelumne	919	0.000026
19	Mokelumne River d/s of Georgiana confluence	815	0.003088
20	North Fork Mokelumne	919	0.000026
21	Georgiana Slough	919	0.000026
22	Miner Slough	716+723	0.028025
23	Sacramento Deep Water Ship Channel	716+723	0.028025
24	Cache Slough at Shag Slough	716+723	0.028025
25	Cache Slough at Liberty Island	716+723	0.028025
26	Cache Slough near Lindsey Slough	716+723	0.028025
27	Sacramento River at Sacramento	upstream	0.000000
28	Sacramento River at Sutter Slough	upstream	0.000000
29	Sacramento River at Ryde	711	0.009815
30	Sacramento River near Cache Slough confluence	711	0.009815
31	Sacramento River at Rio Vista	707	0.038899
32	Sacramento River d/s of Decker Island	705+706	0.075899
33	Sacramento River at Sherman Lake	704	0.022743
34	Sacramento River at Port Chicago	downstream	0.000000
35	Montezuma Slough near National Steel	downstream	0.000000
36	Montezuma Slough at Suisun Slough	downstream	0.000000
37	San Joaquin River d/s of Dutch Slough	703+804	0.058814
38	Sacramento River at Pittsburg	801	0.048938
39	San Joaquin River near Jersey Point	809	0.026464

Note: See https://data.cnra.ca.gov/dataset/dsm2-georeferenced-model-grid for locations of DSM2 model nodes.
PTM = Particle Tracking Modeling; SLS = Smelt Larvae Survey; d/s = downstream; u/s = upstream.

SLS stations downstream of the Sacramento–San Joaquin River confluence (i.e., stations numbered 400s to 600s) were considered as downstream of the influence of the SWP/CVP export facilities, and so were excluded from the PTM analysis (but were used in the calculation of proportions; see Table 6B-58). Similarly, PTM injection locations downstream of the confluence were assigned zero weight,[11] because these particles would not be susceptible to entrainment at the locations of interest. In addition, particles injected in the Sacramento River at Sacramento and Sutter Slough

[11] PTM results for injection locations assigned zero weight are available upon request.

were assigned zero weight because they are upstream of the range of the SLS (suggesting that this portion of the river is of minor concern for Longfin Smelt management). The summed weight of all the PTM injection locations in the analysis was 0.52, meaning 0.48 of the larval population was assumed to be downstream of the confluence and therefore not susceptible to entrainment in the Delta (see sum of the 400s, 500s, and 600s stations in Table 6B-59). As discussed further in Section 6B.11.3, “Note on Proportion of Larval Population outside the Delta and Suisun Marsh and Bay,” the spatial extent of the SLS data used in the present analysis includes only the Delta and Suisun Marsh and Suisun Bay, but the full extent of the distribution of larval Longfin Smelt may be considerably greater in wet years.

For each injection location for each run (i.e., representing particles injecting at the start of each of January, February, and March in each of the 100 years [1922–2021] included in the analysis), the DSM2-PTM output the percentage of particles subject to each of three possible fates: entrainment at the SWP’s Clifton Court Forebay, entrainment at the NBA Barker Slough Pumping Plant, and passing Chipps Island. Percentages were multiplied by the weight of their respective particle injection location (Table 6B-60), and summed across all injection locations, to give a relative comparison between the modeled scenarios of the overall percentage of larvae that would have been entrained. These percentages should only be interpreted as simulations of operational scenarios and are not intended to represent an absolute estimate of the actual percentage of larvae that would be entrained. The latest version of DSM2-PTM allows the user to prevent particles from being entrained into small agricultural diversions. This option was used in the present analysis, as losses to agricultural diversions were outside the focus of this analysis and are likely insubstantial for Longfin Smelt (Nobriga et al. 2004).

6B.11.3 Note on Proportion of Larval Population outside the Delta and Suisun Marsh and Bay

The actual spatial distribution of newly hatched larvae is likely much broader than observed during wet years. Grimaldo et al. (2017) showed larval Longfin Smelt hatch in shallow water and tidal marsh habitats in salinities up to 8 parts per thousand. Previously thought to concentrate their spawning in fresh water (Rosenfield and Baxter 2007; California Department of Fish and Game 2009a, 2009b; Kimmerer et al. 2009), the analysis presented here and work by Grimaldo et al. (2017) show Longfin Smelt hatching is broadly distributed throughout Suisun Bay in most years (Table 6B-58). The proportion of newly hatched larvae from Delta stations was consistently lower than densities observed in Suisun Bay. In wet years, hatching and spawning likely occur outside the area sampled by SLS, as larval Longfin Smelt abundance in the SLS is lowest in wet years, when San Pablo Bay and adjacent tributaries (e.g., Napa River, Petaluma River) become suitable for spawning. Ultimately, this does not affect interpretation of results presented here because relative comparisons of the operational scenarios were made using data for observations of larvae.

6B.11.4 Results

Results for SWP south Delta exports and the NBA are discussed in Chapter 6. (Results for SWP south Delta exports are presented in Chapter 6, whereas results for the NBA are presented in Section 6B.11.4.1, “North Bay Aqueduct”). Section 6B.11.4.2, “Detailed Results for California Department of Fish and Game (2009a) Stations of Interest,” provides detailed results for California Department of Fish and Game (2009a) stations of interest.

6B.11.4.1 North Bay Aqueduct

Table 6B-61. Percentage of Neutrally Buoyant Particles That Were Entrained over 90 Days into North Bay Aqueduct, Weighted by Longfin Smelt Larval Distribution

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	0.38	0.38 (0%)
January	Above Normal	0.28	0.27 (-2%)
January	Below Normal	0.41	0.40 (-2%)
January	Dry	0.46	0.46 (1%)
January	Critically Dry	0.20	0.21 (3%)
February	Wet	0.37	0.37 (0%)
February	Above Normal	0.27	0.27 (-1%)
February	Below Normal	0.35	0.36 (2%)
February	Dry	0.28	0.28 (-1%)
February	Critically Dry	0.14	0.15 (4%)
March	Wet	0.19	0.19 (-2%)
March	Above Normal	0.17	0.17 (1%)
March	Below Normal	0.27	0.26 (-2%)
March	Dry	0.22	0.22 (0%)
March	Critically Dry	0.16	0.16 (1%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

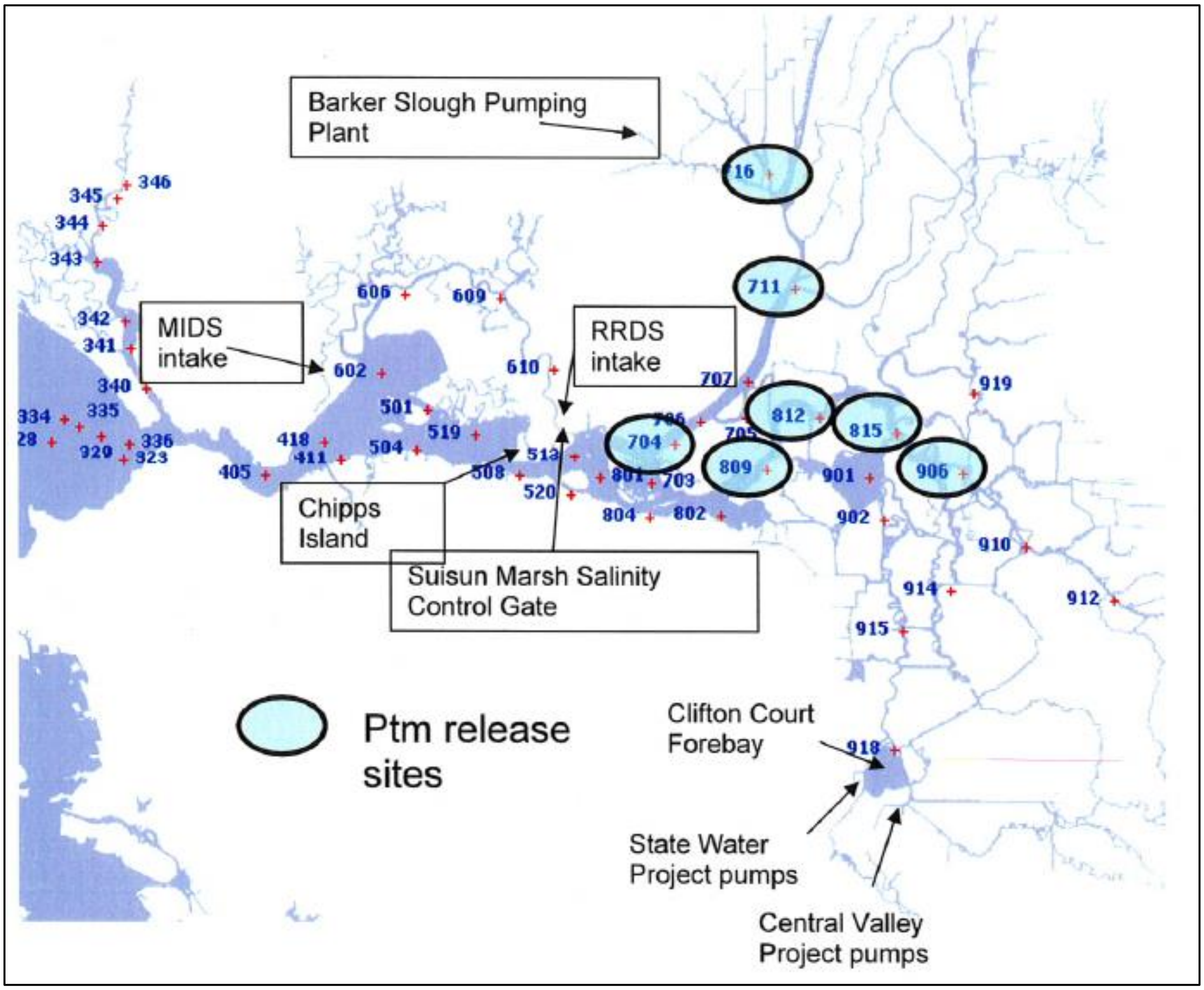
Table 6B-62. Percentage of Surface-Oriented Particles That Were Entrained over 90 Days into North Bay Aqueduct, Weighted by Longfin Smelt Larval Distribution

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	0.39	0.39 (1%)
January	Above Normal	0.23	0.23 (1%)
January	Below Normal	0.36	0.36 (0%)
January	Dry	0.45	0.45 (0%)
January	Critically Dry	0.24	0.25 (3%)
February	Wet	0.36	0.35 (-1%)
February	Above Normal	0.31	0.30 (-2%)
February	Below Normal	0.29	0.30 (2%)
February	Dry	0.32	0.31 (-3%)
February	Critically Dry	0.20	0.21 (4%)
March	Wet	0.19	0.19 (-1%)
March	Above Normal	0.16	0.16 (1%)
March	Below Normal	0.22	0.22 (-4%)
March	Dry	0.19	0.19 (-2%)
March	Critically Dry	0.21	0.21 (0%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

6B.11.4.2 Detailed Results for California Department of Fish and Game (2009a) Stations of Interest

To supplement the above analysis and provide some comparability with the CDFG (2009a) effects analysis, PTM results were summarized for the seven particle injection stations analyzed by CDFG (2009a; Figure 6B-398). The results are presented below in Table 6B-63 through Table 6B-83 for neutrally buoyant particles and Table 6B-84 through Table 6B-104 for surface-oriented particles. Note that these are “raw” results, with no weighting as undertaken by CDFG (2009a).



Source: California Department of Fish and Game 2009a.

Figure 6B-398. Particle Tracking Injection (Release) Locations Used by CDFG (2009a)

Table 6B-63. Percentage of Neutrally Buoyant Particles Injected at Station 716 (Cache Slough at Liberty Island) That Were Entrained over 90 Days into Clifton Court Forebay

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	0.66	0.71 (8%)
January	Above Normal	0.90	0.79 (-13%)
January	Below Normal	3.36	2.97 (-12%)
January	Dry	5.32	4.95 (-7%)
January	Critically Dry	7.43	6.32 (-15%)
February	Wet	0.09	0.09 (-5%)
February	Above Normal	0.27	0.28 (5%)
February	Below Normal	1.40	1.12 (-20%)
February	Dry	2.18	1.62 (-26%)
February	Critically Dry	2.93	3.00 (2%)
March	Wet	0.11	0.10 (-5%)
March	Above Normal	0.22	0.19 (-12%)
March	Below Normal	0.46	0.33 (-28%)
March	Dry	1.24	1.06 (-14%)
March	Critically Dry	1.66	1.93 (16%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-64. Percentage of Neutrally Buoyant Particles Injected at Station 716 (Cache Slough at Liberty Island) That Were Entrained over 90 Days into North Bay Aqueduct

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	2.60	2.66 (2%)
January	Above Normal	1.82	1.83 (0%)
January	Below Normal	2.92	2.87 (-2%)
January	Dry	3.47	3.57 (3%)
January	Critically Dry	1.52	1.55 (2%)
February	Wet	2.75	2.72 (-1%)
February	Above Normal	1.79	1.78 (-1%)
February	Below Normal	2.52	2.54 (1%)
February	Dry	2.08	2.11 (1%)
February	Critically Dry	0.90	0.96 (7%)
March	Wet	1.18	1.17 (-1%)
March	Above Normal	1.02	1.00 (-3%)
March	Below Normal	1.77	1.76 (-1%)
March	Dry	1.47	1.50 (2%)
March	Critically Dry	1.05	1.17 (11%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-65. Percentage of Neutrally Buoyant Particles Injected at Station 716 (Cache Slough at Liberty Island) That Passed Chipps Island over 90 Days

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	93.70	93.73 (0%)
January	Above Normal	93.54	93.81 (0%)
January	Below Normal	83.11	83.92 (1%)
January	Dry	74.41	76.14 (2%)
January	Critically Dry	70.16	73.45 (5%)
February	Wet	95.33	95.37 (0%)
February	Above Normal	96.02	96.03 (0%)
February	Below Normal	90.91	91.95 (1%)
February	Dry	85.50	86.62 (1%)
February	Critically Dry	80.07	81.26 (1%)
March	Wet	96.69	96.74 (0%)
March	Above Normal	96.41	96.61 (0%)
March	Below Normal	94.75	95.08 (0%)
March	Dry	90.91	91.61 (1%)
March	Critically Dry	84.53	82.87 (-2%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-66. Percentage of Neutrally Buoyant Particles Injected at Station 711 (Sacramento River near Cache Slough confluence) That Were Entrained over 90 Days into Clifton Court Forebay

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	0.81	0.85 (5%)
January	Above Normal	0.96	0.81 (-16%)
January	Below Normal	4.27	3.83 (-10%)
January	Dry	6.00	5.59 (-7%)
January	Critically Dry	8.13	6.99 (-14%)
February	Wet	0.06	0.07 (10%)
February	Above Normal	0.26	0.27 (3%)
February	Below Normal	1.50	1.23 (-18%)
February	Dry	2.36	1.77 (-25%)
February	Critically Dry	3.40	3.07 (-10%)
March	Wet	0.09	0.09 (7%)
March	Above Normal	0.17	0.10 (-38%)
March	Below Normal	0.55	0.40 (-27%)
March	Dry	1.41	1.20 (-15%)
March	Critically Dry	1.67	1.77 (6%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-67. Percentage of Neutrally Buoyant Particles Injected at Station 711 (Sacramento River near Cache Slough confluence) That Were Entrained over 90 Days into North Bay Aqueduct

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	0.08	0.08 (1%)
January	Above Normal	0.13	0.07 (-48%)
January	Below Normal	0.28	0.30 (10%)
January	Dry	0.41	0.43 (3%)
January	Critically Dry	0.21	0.21 (-1%)
February	Wet	0.02	0.02 (4%)
February	Above Normal	0.05	0.06 (30%)
February	Below Normal	0.20	0.24 (24%)
February	Dry	0.22	0.21 (-5%)
February	Critically Dry	0.13	0.12 (-2%)
March	Wet	0.02	0.02 (28%)
March	Above Normal	0.04	0.03 (-33%)
March	Below Normal	0.12	0.12 (1%)
March	Dry	0.14	0.13 (-8%)
March	Critically Dry	0.13	0.13 (2%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-68. Percentage of Neutrally Buoyant Particles Injected at Station 711 (Sacramento River near Cache Slough confluence) That Passed Chipps Island over 90 Days

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	95.95	95.99 (0%)
January	Above Normal	95.25	95.55 (0%)
January	Below Normal	84.09	84.94 (1%)
January	Dry	75.98	77.91 (3%)
January	Critically Dry	71.14	74.72 (5%)
February	Wet	98.33	98.35 (0%)
February	Above Normal	98.08	98.04 (0%)
February	Below Normal	93.41	94.25 (1%)
February	Dry	87.43	88.56 (1%)
February	Critically Dry	81.19	83.14 (2%)
March	Wet	98.44	98.45 (0%)
March	Above Normal	98.25	98.47 (0%)
March	Below Normal	97.53	97.81 (0%)
March	Dry	93.50	94.55 (1%)
March	Critically Dry	88.74	87.59 (-1%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-69. Percentage of Neutrally Buoyant Particles Injected at Station 704 (Sacramento River at Sherman Lake) That Were Entrained over 90 Days into Clifton Court Forebay

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	0.09	0.09 (3%)
January	Above Normal	0.03	0.03 (-13%)
January	Below Normal	0.63	0.44 (-29%)
January	Dry	0.93	0.82 (-12%)
January	Critically Dry	1.54	1.18 (-23%)
February	Wet	0.00	0.00 (0%)
February	Above Normal	0.01	0.00 (-67%)
February	Below Normal	0.07	0.05 (-16%)
February	Dry	0.12	0.10 (-16%)
February	Critically Dry	0.25	0.22 (-10%)
March	Wet	0.00	0.00 (50%)
March	Above Normal	0.00	0.00 (-100%)
March	Below Normal	0.01	0.01 (-36%)
March	Dry	0.06	0.05 (-22%)
March	Critically Dry	0.09	0.10 (9%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-70. Percentage of Neutrally Buoyant Particles Injected at Station 704 (Sacramento River at Sherman Lake) That Were Entrained over 90 Days into North Bay Aqueduct

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	0.00	0.00 (0%)
January	Above Normal	0.00	0.00 (0%)
January	Below Normal	0.00	0.00 (0%)
January	Dry	0.00	0.00 (0%)
January	Critically Dry	0.00	0.00 (0%)
February	Wet	0.00	0.00 (0%)
February	Above Normal	0.00	0.00 (0%)
February	Below Normal	0.00	0.00 (0%)
February	Dry	0.00	0.00 (0%)
February	Critically Dry	0.00	0.00 (0%)
March	Wet	0.00	0.00 (0%)
March	Above Normal	0.00	0.00 (0%)
March	Below Normal	0.00	0.00 (0%)
March	Dry	0.00	0.00 (0%)
March	Critically Dry	0.00	0.00 (0%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-71. Percentage of Neutrally Buoyant Particles Injected at Station 704 (Sacramento River at Sherman Lake) That Passed Chipps Island over 90 Days

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	96.84	96.93 (0%)
January	Above Normal	97.32	97.35 (0%)
January	Below Normal	89.59	90.11 (1%)
January	Dry	84.13	85.47 (2%)
January	Critically Dry	82.66	85.86 (4%)
February	Wet	98.39	98.39 (0%)
February	Above Normal	98.51	98.51 (0%)
February	Below Normal	95.95	96.99 (1%)
February	Dry	91.52	91.87 (0%)
February	Critically Dry	86.41	88.49 (2%)
March	Wet	98.45	98.44 (0%)
March	Above Normal	98.46	98.45 (0%)
March	Below Normal	98.73	98.78 (0%)
March	Dry	96.48	97.36 (1%)
March	Critically Dry	92.62	91.88 (-1%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-72. Percentage of Neutrally Buoyant Particles Injected at Station 809 (San Joaquin River near Jersey Point) That Were Entrained over 90 Days into Clifton Court Forebay

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	1.82	1.80 (-1%)
January	Above Normal	2.18	2.10 (-4%)
January	Below Normal	8.33	7.37 (-11%)
January	Dry	11.33	10.52 (-7%)
January	Critically Dry	13.57	11.50 (-15%)
February	Wet	0.23	0.24 (3%)
February	Above Normal	0.95	0.79 (-16%)
February	Below Normal	3.17	2.68 (-15%)
February	Dry	4.89	3.79 (-23%)
February	Critically Dry	6.82	6.17 (-9%)
March	Wet	0.23	0.24 (4%)
March	Above Normal	0.42	0.33 (-21%)
March	Below Normal	1.26	0.95 (-25%)
March	Dry	2.95	2.50 (-15%)
March	Critically Dry	3.04	3.18 (5%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-73. Percentage of Neutrally Buoyant Particles Injected at Station 809 (San Joaquin River near Jersey Point) That Were Entrained over 90 Days into North Bay Aqueduct

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	0.00	0.00 (0%)
January	Above Normal	0.00	0.00 (0%)
January	Below Normal	0.00	0.00 (0%)
January	Dry	0.00	0.00 (-100%)
January	Critically Dry	0.00	0.00 (0-100%)
February	Wet	0.00	0.00 (0%)
February	Above Normal	0.00	0.00 (0%)
February	Below Normal	0.00	0.00 (0%)
February	Dry	0.00	0.00 (0%)
February	Critically Dry	0.00	0.00 (0%)
March	Wet	0.00	0.00 (0%)
March	Above Normal	0.00	0.00 (0%)
March	Below Normal	0.00	0.00 (0%)
March	Dry	0.00	0.00 (0%)
March	Critically Dry	0.00	0.00 (0%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-74. Percentage of Neutrally Buoyant Particles Injected at Station 809 (San Joaquin River near Jersey Point) That Passed Chipps Island over 90 Days

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	94.55	94.82 (0%)
January	Above Normal	93.36	93.24 (0%)
January	Below Normal	78.77	80.45 (2%)
January	Dry	68.65	71.01 (3%)
January	Critically Dry	63.02	68.04 (8%)
February	Wet	98.28	98.36 (0%)
February	Above Normal	97.03	97.19 (0%)
February	Below Normal	90.58	92.01 (2%)
February	Dry	83.34	85.21 (2%)
February	Critically Dry	75.70	77.70 (3%)
March	Wet	98.45	98.43 (0%)
March	Above Normal	97.90	98.10 (0%)
March	Below Normal	96.47	96.93 (0%)
March	Dry	90.84	92.33 (2%)
March	Critically Dry	86.06	85.36 (-1%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-75. Percentage of Neutrally Buoyant Particles Injected at Station 812 (San Joaquin River at Twitchell Island) That Were Entrained over 90 Days into Clifton Court Forebay

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	8.77	8.69 (-1%)
January	Above Normal	11.98	11.37 (-5%)
January	Below Normal	24.66	23.26 (-6%)
January	Dry	29.82	28.40 (-5%)
January	Critically Dry	32.71	29.68 (-9%)
February	Wet	3.71	3.74 (1%)
February	Above Normal	7.97	7.29 (-9%)
February	Below Normal	14.22	12.39 (-13%)
February	Dry	20.07	16.34 (-19%)
February	Critically Dry	23.47	22.70 (-3%)
March	Wet	3.00	3.25 (8%)
March	Above Normal	5.04	4.05 (-20%)
March	Below Normal	8.80	6.55 (-26%)
March	Dry	14.74	13.45 (-9%)
March	Critically Dry	13.70	14.34 (5%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-76. Percentage of Neutrally Buoyant Particles Injected at Station 812 (San Joaquin River at Twitchell Island) That Were Entrained over 90 Days into North Bay Aqueduct

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	0.00	0.00 (0%)
January	Above Normal	0.00	0.00 (0%)
January	Below Normal	0.00	0.00 (0%)
January	Dry	0.00	0.00 (-100%)
January	Critically Dry	0.00	0.00 (-100%)
February	Wet	0.00	0.00 (0%)
February	Above Normal	0.00	0.00 (0%)
February	Below Normal	0.00	0.00 (0%)
February	Dry	0.00	0.00 (-100%)
February	Critically Dry	0.00	0.00 (0%)
March	Wet	0.00	0.00 (0%)
March	Above Normal	0.00	0.00 (0%)
March	Below Normal	0.00	0.00 (0%)
March	Dry	0.00	0.00 (-100%)
March	Critically Dry	0.00	0.00 (-100%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-77. Percentage of Neutrally Buoyant Particles Injected at Station 812 (San Joaquin River at Twitchell Island) That Passed Chipps Island over 90 Days

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	82.90	83.62 (1%)
January	Above Normal	75.78	76.75 (1%)
January	Below Normal	53.76	56.02 (4%)
January	Dry	39.44	42.74 (8%)
January	Critically Dry	33.27	38.21 (15%)
February	Wet	92.89	92.91 (0%)
February	Above Normal	84.69	85.55 (1%)
February	Below Normal	71.92	74.81 (4%)
February	Dry	56.40	62.12 (10%)
February	Critically Dry	45.87	48.33 (5%)
March	Wet	94.21	93.92 (0%)
March	Above Normal	90.42	91.90 (2%)
March	Below Normal	82.39	86.14 (5%)
March	Dry	67.14	70.31 (5%)
March	Critically Dry	61.73	61.27 (-1%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-78. Percentage of Neutrally Buoyant Particles Injected at Station 815 (San Joaquin River at Potato Slough) That Were Entrained over 90 Days into Clifton Court Forebay

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	13.92	13.63 (-2%)
January	Above Normal	17.31	16.89 (-2%)
January	Below Normal	29.46	28.05 (-5%)
January	Dry	33.21	32.24 (-3%)
January	Critically Dry	36.19	33.25 (-8%)
February	Wet	8.30	8.27 (0%)
February	Above Normal	13.08	12.28 (-6%)
February	Below Normal	19.47	17.52 (-10%)
February	Dry	24.60	20.81 (-15%)
February	Critically Dry	27.55	26.62 (-3%)
March	Wet	6.53	6.93 (6%)
March	Above Normal	9.70	7.93 (-18%)
March	Below Normal	14.37	10.72 (-25%)
March	Dry	20.01	18.01 (-10%)
March	Critically Dry	17.20	18.15 (6%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-79. Percentage of Neutrally Buoyant Particles Injected at Station 815 (San Joaquin River at Potato Slough) That Were Entrained over 90 Days into North Bay Aqueduct

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	0.00	0.00 (0%)
January	Above Normal	0.00	0.00 (0%)
January	Below Normal	0.00	0.00 (0%)
January	Dry	0.00	0.00 (0%)
January	Critically Dry	0.00	0.00 (-50%)
February	Wet	0.00	0.00 (0%)
February	Above Normal	0.00	0.00 (0%)
February	Below Normal	0.00	0.00 (0%)
February	Dry	0.00	0.00 (0%)
February	Critically Dry	0.00	0.00 (0%)
March	Wet	0.00	0.00 (0%)
March	Above Normal	0.00	0.00 (0%)
March	Below Normal	0.00	0.00 (0%)
March	Dry	0.00	0.00 (0%)
March	Critically Dry	0.00	0.00 (-100%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-80. Percentage of Neutrally Buoyant Particles Injected at Station 815 (San Joaquin River at Potato Slough) That Passed Chipps Island over 90 Days

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	74.29	75.38 (1%)
January	Above Normal	66.27	67.57 (2%)
January	Below Normal	45.97	48.07 (5%)
January	Dry	33.75	36.52 (8%)
January	Critically Dry	28.52	32.98 (16%)
February	Wet	86.26	86.24 (0%)
February	Above Normal	76.42	77.70 (2%)
February	Below Normal	62.94	65.90 (5%)
February	Dry	47.75	54.47 (14%)
February	Critically Dry	39.37	42.02 (7%)
March	Wet	89.40	88.89 (-1%)
March	Above Normal	82.99	85.56 (3%)
March	Below Normal	73.46	78.78 (7%)
March	Dry	57.64	61.57 (7%)
March	Critically Dry	55.13	55.12 (0%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-81. Percentage of Neutrally Buoyant Particles Injected at Station 906 (San Joaquin River near Medford Island) That Were Entrained over 90 Days into Clifton Court Forebay

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	30.26	29.82 (-1%)
January	Above Normal	36.08	35.40 (-2%)
January	Below Normal	48.12	47.16 (-2%)
January	Dry	47.62	47.68 (0%)
January	Critically Dry	49.31	47.25 (-4%)
February	Wet	22.28	22.60 (1%)
February	Above Normal	29.88	28.97 (-3%)
February	Below Normal	37.19	34.92 (-6%)
February	Dry	41.87	37.65 (-10%)
February	Critically Dry	43.15	42.57 (-1%)
March	Wet	16.86	18.10 (7%)
March	Above Normal	24.37	20.89 (-14%)
March	Below Normal	31.07	24.54 (-21%)
March	Dry	37.77	34.95 (-7%)
March	Critically Dry	31.04	32.43 (4%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-82. Percentage of Neutrally Buoyant Particles Injected at Station 906 (San Joaquin River near Medford Island) That Were Entrained over 90 Days into North Bay Aqueduct

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	0.00	0.00 (0%)
January	Above Normal	0.00	0.00 (0%)
January	Below Normal	0.00	0.00 (0%)
January	Dry	0.00	0.00 (0%)
January	Critically Dry	0.00	0.00 (-100%)
February	Wet	0.00	0.00 (0%)
February	Above Normal	0.00	0.00 (0%)
February	Below Normal	0.00	0.00 (0%)
February	Dry	0.00	0.00 (0%)
February	Critically Dry	0.00	0.00 (0%)
March	Wet	0.00	0.00 (0%)
March	Above Normal	0.00	0.00 (0%)
March	Below Normal	0.00	0.00 (0%)
March	Dry	0.00	0.00 (0%)
March	Critically Dry	0.00	0.00 (0%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-83. Percentage of Neutrally Buoyant Particles Injected at Station 906 (San Joaquin River near Medford Island) That Passed Chipps Island over 90 Days

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	48.66	50.23 (3%)
January	Above Normal	33.18	34.72 (5%)
January	Below Normal	17.06	18.80 (10%)
January	Dry	11.28	12.49 (11%)
January	Critically Dry	9.20	11.22 (22%)
February	Wet	66.23	65.94 (0%)
February	Above Normal	48.54	49.77 (3%)
February	Below Normal	33.37	36.26 (9%)
February	Dry	16.86	23.82 (41%)
February	Critically Dry	13.63	16.06 (18%)
March	Wet	74.75	73.34 (-2%)
March	Above Normal	60.46	64.57 (7%)
March	Below Normal	45.67	53.14 (16%)
March	Dry	24.33	28.74 (18%)
March	Critically Dry	29.99	29.28 (-2%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-84. Percentage of Surface-Oriented Particles Injected at Station 716 (Cache Slough at Liberty Island) That Were Entrained over 90 Days into Clifton Court Forebay

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	2.65	2.66 (0%)
January	Above Normal	1.10	1.05 (-5%)
January	Below Normal	3.03	2.92 (-4%)
January	Dry	3.91	3.13 (-20%)
January	Critically Dry	5.85	5.13 (-12%)
February	Wet	1.21	1.07 (-11%)
February	Above Normal	0.48	0.44 (-9%)
February	Below Normal	1.49	1.38 (-7%)
February	Dry	2.07	1.32 (-36%)
February	Critically Dry	1.83	1.91 (4%)
March	Wet	0.72	0.68 (-5%)
March	Above Normal	0.38	0.30 (-20%)
March	Below Normal	0.81	0.73 (-10%)
March	Dry	1.06	0.94 (-11%)
March	Critically Dry	1.22	1.38 (13%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-85. Percentage of Surface-Oriented Particles Injected at Station 716 (Cache Slough at Liberty Island) That Were Entrained over 90 Days into North Bay Aqueduct

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	2.61	2.70 (3%)
January	Above Normal	1.39	1.35 (-3%)
January	Below Normal	2.58	2.52 (-3%)
January	Dry	3.20	3.18 (-1%)
January	Critically Dry	1.60	1.63 (2%)
February	Wet	2.60	2.52 (-3%)
February	Above Normal	2.14	2.05 (-4%)
February	Below Normal	1.98	2.03 (3%)
February	Dry	2.26	2.25 (-1%)
February	Critically Dry	1.18	1.22 (4%)
March	Wet	1.13	1.15 (2%)
March	Above Normal	0.95	0.87 (-9%)
March	Below Normal	1.36	1.32 (-3%)
March	Dry	1.20	1.17 (-3%)
March	Critically Dry	1.46	1.48 (1%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-86. Percentage of Surface-Oriented Particles Injected at Station 716 (Cache Slough at Liberty Island) That Passed Chipps Island over 90 Days

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	87.61	87.64 (0%)
January	Above Normal	91.99	92.12 (0%)
January	Below Normal	84.13	84.97 (1%)
January	Dry	81.19	83.22 (3%)
January	Critically Dry	74.01	76.23 (3%)
February	Wet	92.51	92.60 (0%)
February	Above Normal	95.27	95.44 (0%)
February	Below Normal	91.13	91.49 (0%)
February	Dry	86.93	89.33 (3%)
February	Critically Dry	84.10	85.08 (1%)
March	Wet	95.08	95.23 (0%)
March	Above Normal	96.17	96.16 (0%)
March	Below Normal	94.44	94.01 (0%)
March	Dry	92.15	93.63 (2%)
March	Critically Dry	87.80	87.37 (0%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-87. Percentage of Surface-Oriented Particles Injected at Station 711 (Sacramento River near Cache Slough confluence) That Were Entrained over 90 Days into Clifton Court Forebay

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	3.04	3.10 (2%)
January	Above Normal	1.06	0.99 (-7%)
January	Below Normal	3.47	3.24 (-7%)
January	Dry	4.13	3.60 (-13%)
January	Critically Dry	6.60	5.89 (-11%)
February	Wet	1.40	1.14 (-18%)
February	Above Normal	0.46	0.44 (-4%)
February	Below Normal	1.49	1.49 (0%)
February	Dry	2.23	1.38 (-38%)
February	Critically Dry	2.15	2.05 (-5%)
March	Wet	0.81	0.69 (-15%)
March	Above Normal	0.27	0.33 (23%)
March	Below Normal	0.74	0.68 (-8%)
March	Dry	1.10	0.94 (-14%)
March	Critically Dry	1.25	1.25 (0%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-88. Percentage of Surface-Oriented Particles Injected at Station 711 (Sacramento River near Cache Slough confluence) That Were Entrained over 90 Days into North Bay Aqueduct

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	0.21	0.21 (-3%)
January	Above Normal	0.04	0.05 (38%)
January	Below Normal	0.22	0.26 (17%)
January	Dry	0.34	0.37 (9%)
January	Critically Dry	0.20	0.19 (-6%)
February	Wet	0.12	0.11 (-9%)
February	Above Normal	0.02	0.02 (0%)
February	Below Normal	0.15	0.19 (25%)
February	Dry	0.19	0.18 (-8%)
February	Critically Dry	0.13	0.13 (-1%)
March	Wet	0.06	0.04 (-25%)
March	Above Normal	0.02	0.02 (11%)
March	Below Normal	0.12	0.11 (-14%)
March	Dry	0.11	0.10 (-8%)
March	Critically Dry	0.13	0.12 (-9%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-89. Percentage of Surface-Oriented Particles Injected at Station 711 (Sacramento River near Cache Slough confluence) That Passed Chipps Island over 90 Days

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	89.12	89.23 (0%)
January	Above Normal	93.20	93.29 (0%)
January	Below Normal	85.52	86.58 (1%)
January	Dry	83.60	85.10 (2%)
January	Critically Dry	74.34	76.95 (4%)
February	Wet	95.16	95.29 (0%)
February	Above Normal	97.63	97.72 (0%)
February	Below Normal	92.79	93.38 (1%)
February	Dry	88.97	91.50 (3%)
February	Critically Dry	85.08	86.30 (1%)
March	Wet	96.95	97.16 (0%)
March	Above Normal	97.95	98.05 (0%)
March	Below Normal	96.88	96.49 (0%)
March	Dry	93.85	96.01 (2%)
March	Critically Dry	91.45	91.59 (0%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-90. Percentage of Surface-Oriented Particles Injected at Station 704 (Sacramento River at Sherman Lake) That Were Entrained over 90 Days into Clifton Court Forebay

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	0.57	0.49 (-13%)
January	Above Normal	0.04	0.04 (-11%)
January	Below Normal	0.67	0.55 (-18%)
January	Dry	0.60	0.47 (-22%)
January	Critically Dry	1.32	1.04 (-21%)
February	Wet	0.13	0.11 (-22%)
February	Above Normal	0.02	0.01 (-29%)
February	Below Normal	0.08	0.08 (0%)
February	Dry	0.15	0.07 (-53%)
February	Critically Dry	0.15	0.15 (-1%)
March	Wet	0.05	0.04 (-4%)
March	Above Normal	0.01	0.01 (0%)
March	Below Normal	0.03	0.02 (-36%)
March	Dry	0.05	0.04 (-24%)
March	Critically Dry	0.06	0.07 (12%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-91. Percentage of Surface-Oriented Particles Injected at Station 704 (Sacramento River at Sherman Lake) That Were Entrained over 90 Days into North Bay Aqueduct

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	0.00	0.00 (0%)
January	Above Normal	0.00	0.00 (0%)
January	Below Normal	0.00	0.00 (0%)
January	Dry	0.00	0.00 (0%)
January	Critically Dry	0.00	0.00 (0%)
February	Wet	0.00	0.00 (0%)
February	Above Normal	0.00	0.00 (0%)
February	Below Normal	0.00	0.00 (0%)
February	Dry	0.00	0.00 (0%)
February	Critically Dry	0.00	0.00 (0%)
March	Wet	0.00	0.00 (0%)
March	Above Normal	0.00	0.00 (0%)
March	Below Normal	0.00	0.00 (0%)
March	Dry	0.00	0.00 (0%)
March	Critically Dry	0.00	0.00 (0%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-92. Percentage of Surface-Oriented Particles Injected at Station 704 (Sacramento River at Sherman Lake) That Passed Chipps Island over 90 Days

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	92.83	92.82 (0%)
January	Above Normal	95.65	95.77 (0%)
January	Below Normal	90.16	92.04 (2%)
January	Dry	89.67	90.30 (1%)
January	Critically Dry	83.95	86.56 (3%)
February	Wet	97.69	97.50 (0%)
February	Above Normal	98.53	98.51 (0%)
February	Below Normal	95.62	96.53 (1%)
February	Dry	92.76	94.22 (2%)
February	Critically Dry	88.16	89.16 (1%)
March	Wet	98.50	98.56 (0%)
March	Above Normal	98.51	98.55 (0%)
March	Below Normal	98.67	98.10 (-1%)
March	Dry	96.16	98.44 (2%)
March	Critically Dry	94.47	95.36 (1%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-93. Percentage of Surface-Oriented Particles Injected at Station 809 (San Joaquin River near Jersey Point) That Were Entrained over 90 Days into Clifton Court Forebay

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	6.02	5.88 (-2%)
January	Above Normal	2.35	2.19 (-7%)
January	Below Normal	6.66	6.15 (-8%)
January	Dry	8.17	7.08 (-13%)
January	Critically Dry	10.86	9.59 (-12%)
February	Wet	2.78	2.31 (-17%)
February	Above Normal	1.14	0.99 (-13%)
February	Below Normal	3.32	3.23 (-3%)
February	Dry	4.52	2.94 (-35%)
February	Critically Dry	4.19	3.93 (-6%)
March	Wet	1.47	1.33 (-10%)
March	Above Normal	0.63	0.61 (-3%)
March	Below Normal	1.65	1.43 (-14%)
March	Dry	2.17	1.81 (-16%)
March	Critically Dry	2.23	2.28 (2%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-94. Percentage of Surface-Oriented Particles Injected at Station 809 (San Joaquin River near Jersey Point) That Were Entrained over 90 Days into North Bay Aqueduct

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	0.00	0.00 (0%)
January	Above Normal	0.00	0.00 (0%)
January	Below Normal	0.00	0.00 (0%)
January	Dry	0.00	0.00 (-100%)
January	Critically Dry	0.00	0.00 (0%)
February	Wet	0.00	0.00 (-100%)
February	Above Normal	0.00	0.00 (0%)
February	Below Normal	0.00	0.00 (0%)
February	Dry	0.00	0.00 (0%)
February	Critically Dry	0.00	0.00 (0%)
March	Wet	0.00	0.00 (-100%)
March	Above Normal	0.00	0.00 (0%)
March	Below Normal	0.00	0.00 (-100%)
March	Dry	0.00	0.00 (0%)
March	Critically Dry	0.00	0.00 (0%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-95. Percentage of Surface-Oriented Particles Injected at Station 809 (San Joaquin River near Jersey Point) That Passed Chipps Island over 90 Days

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	84.97	85.54 (1%)
January	Above Normal	91.21	91.68 (1%)
January	Below Normal	80.69	82.55 (2%)
January	Dry	77.47	79.63 (3%)
January	Critically Dry	68.04	71.53 (5%)
February	Wet	92.77	93.41 (1%)
February	Above Normal	96.60	96.85 (0%)
February	Below Normal	89.90	90.48 (1%)
February	Dry	85.57	88.70 (4%)
February	Critically Dry	81.79	83.23 (2%)
March	Wet	95.90	96.15 (0%)
March	Above Normal	97.50	97.51 (0%)
March	Below Normal	95.41	95.30 (0%)
March	Dry	92.25	94.58 (3%)
March	Critically Dry	89.08	89.59 (1%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-96. Percentage of Surface-Oriented Particles Injected at Station 812 (San Joaquin River at Twitchell Island) That Were Entrained over 90 Days into Clifton Court Forebay

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	16.74	17.14 (2%)
January	Above Normal	12.13	11.65 (-4%)
January	Below Normal	19.99	18.67 (-7%)
January	Dry	23.23	21.40 (-8%)
January	Critically Dry	26.35	24.24 (-8%)
February	Wet	10.33	9.70 (-6%)
February	Above Normal	7.48	7.03 (-6%)
February	Below Normal	14.68	13.77 (-6%)
February	Dry	16.87	12.40 (-26%)
February	Critically Dry	16.41	15.87 (-3%)
March	Wet	7.08	6.55 (-7%)
March	Above Normal	5.37	4.76 (-11%)
March	Below Normal	9.97	8.65 (-13%)
March	Dry	10.68	9.31 (-13%)
March	Critically Dry	12.24	12.09 (-1%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-97. Percentage of Surface-Oriented Particles Injected at Station 812 (San Joaquin River at Twitchell Island) That Were Entrained over 90 Days into North Bay Aqueduct

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	0.00	0.00 (0%)
January	Above Normal	0.00	0.00 (0%)
January	Below Normal	0.00	0.00 (0%)
January	Dry	0.00	0.00 (-100%)
January	Critically Dry	0.00	0.00 (-100%)
February	Wet	0.00	0.00 (0%)
February	Above Normal	0.00	0.00 (0%)
February	Below Normal	0.00	0.00 (0%)
February	Dry	0.00	0.00 (0%)
February	Critically Dry	0.00	0.00 (0%)
March	Wet	0.00	0.00 (0%)
March	Above Normal	0.00	0.00 (0%)
March	Below Normal	0.00	0.00 (-100%)
March	Dry	0.00	0.00 (0%)
March	Critically Dry	0.00	0.00 (-100%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-98. Percentage of Surface-Oriented Particles Injected at Station 812 (San Joaquin River at Twitchell Island) That Passed Chipps Island over 90 Days

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	67.98	68.42 (1%)
January	Above Normal	74.46	75.42 (1%)
January	Below Normal	60.03	62.06 (3%)
January	Dry	52.99	56.49 (7%)
January	Critically Dry	43.57	47.07 (8%)
February	Wet	79.29	80.49 (2%)
February	Above Normal	85.35	86.15 (1%)
February	Below Normal	70.36	71.46 (2%)
February	Dry	63.66	70.60 (11%)
February	Critically Dry	59.61	62.07 (4%)
March	Wet	85.65	86.59 (1%)
March	Above Normal	89.49	90.63 (1%)
March	Below Normal	79.66	82.08 (3%)
March	Dry	75.74	78.79 (4%)
March	Critically Dry	66.53	67.56 (2%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-99. Percentage of Surface-Oriented Particles Injected at Station 815 (San Joaquin River at Potato Slough) That Were Entrained over 90 Days into Clifton Court Forebay

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	21.22	21.57 (2%)
January	Above Normal	17.32	16.81 (-3%)
January	Below Normal	24.44	22.82 (-7%)
January	Dry	26.97	25.33 (-6%)
January	Critically Dry	30.02	28.06 (-7%)
February	Wet	14.06	13.36 (-5%)
February	Above Normal	11.80	11.03 (-7%)
February	Below Normal	19.63	18.75 (-4%)
February	Dry	20.88	16.49 (-21%)
February	Critically Dry	20.86	20.01 (-4%)
March	Wet	10.35	10.07 (-3%)
March	Above Normal	9.14	8.04 (-12%)
March	Below Normal	15.19	13.27 (-13%)
March	Dry	15.14	13.11 (-13%)
March	Critically Dry	15.81	15.55 (-2%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-100. Percentage of Surface-Oriented Particles Injected at Station 815 (San Joaquin River at Potato Slough) That Were Entrained over 90 Days into North Bay Aqueduct

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	0.00	0.00 (0%)
January	Above Normal	0.00	0.00 (0%)
January	Below Normal	0.00	0.00 (0%)
January	Dry	0.00	0.00 (-100%)
January	Critically Dry	0.00	0.00 (0%)
February	Wet	0.00	0.00 (0%)
February	Above Normal	0.00	0.00 (0%)
February	Below Normal	0.00	0.00 (0%)
February	Dry	0.00	0.00 (0%)
February	Critically Dry	0.00	0.00 (0%)
March	Wet	0.00	0.00 (0%)
March	Above Normal	0.00	0.00 (0%)
March	Below Normal	0.00	0.00 (0%)
March	Dry	0.00	0.00 (0%)
March	Critically Dry	0.00	0.00 (-100%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-101. Percentage of Surface-Oriented Particles Injected at Station 815 (San Joaquin River at Potato Slough) That Passed Chipps Island over 90 Days

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	60.75	61.36 (1%)
January	Above Normal	65.66	67.10 (2%)
January	Below Normal	53.17	54.95 (3%)
January	Dry	46.71	49.80 (7%)
January	Critically Dry	37.88	41.07 (8%)
February	Wet	73.43	74.65 (2%)
February	Above Normal	78.72	79.73 (1%)
February	Below Normal	61.40	62.71 (2%)
February	Dry	56.71	64.06 (13%)
February	Critically Dry	52.69	55.21 (5%)
March	Wet	80.69	81.30 (1%)
March	Above Normal	84.00	85.65 (2%)
March	Below Normal	71.51	74.27 (4%)
March	Dry	68.14	71.80 (5%)
March	Critically Dry	59.26	60.87 (3%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-102. Percentage of Surface-Oriented Particles Injected at Station 906 (San Joaquin River near Medford Island) That Were Entrained over 90 Days into Clifton Court Forebay

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	36.88	37.47 (2%)
January	Above Normal	35.23	34.82 (-1%)
January	Below Normal	42.35	40.25 (-5%)
January	Dry	42.01	41.43 (-1%)
January	Critically Dry	43.85	42.37 (-3%)
February	Wet	27.69	27.45 (-1%)
February	Above Normal	26.16	25.69 (-2%)
February	Below Normal	36.62	35.26 (-4%)
February	Dry	35.30	30.72 (-13%)
February	Critically Dry	36.80	35.26 (-4%)
March	Wet	21.50	21.16 (-2%)
March	Above Normal	21.64	19.24 (-11%)
March	Below Normal	30.02	27.67 (-8%)
March	Dry	29.21	25.68 (-12%)
March	Critically Dry	28.98	27.92 (-4%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-103. Percentage of Surface-Oriented Particles Injected at Station 906 (San Joaquin River near Medford Island) That Were Entrained over 90 Days into North Bay Aqueduct

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	0.00	0.00 (0%)
January	Above Normal	0.00	0.00 (0%)
January	Below Normal	0.00	0.00 (0%)
January	Dry	0.00	0.00 (0%)
January	Critically Dry	0.00	0.00 (-100%)
February	Wet	0.00	0.00 (0%)
February	Above Normal	0.00	0.00 (0%)
February	Below Normal	0.00	0.00 (0%)
February	Dry	0.00	0.00 (0%)
February	Critically Dry	0.00	0.00 (0%)
March	Wet	0.00	0.00 (0%)
March	Above Normal	0.00	0.00 (0%)
March	Below Normal	0.00	0.00 (0%)
March	Dry	0.00	0.00 (0%)
March	Critically Dry	0.00	0.00 (0%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

Table 6B-104. Percentage of Surface-Oriented Particles Injected at Station 906 (San Joaquin River near Medford Island) That Passed Chipps Island over 90 Days

Month	Water Year Type	Baseline Conditions	Proposed Project
January	Wet	36.11	36.63 (1%)
January	Above Normal	35.24	36.76 (4%)
January	Below Normal	25.82	27.93 (8%)
January	Dry	22.75	24.44 (7%)
January	Critically Dry	15.78	17.84 (13%)
February	Wet	51.59	52.59 (2%)
February	Above Normal	56.34	57.04 (1%)
February	Below Normal	32.18	34.00 (6%)
February	Dry	32.04	39.67 (24%)
February	Critically Dry	26.88	30.12 (12%)
March	Wet	63.32	63.77 (1%)
March	Above Normal	65.70	68.56 (4%)
March	Below Normal	46.58	49.78 (7%)
March	Dry	42.84	47.32 (10%)
March	Critically Dry	33.51	35.43 (6%)

Note: Percentage values in parentheses indicate differences of Proposed Project compared to Baseline Conditions.

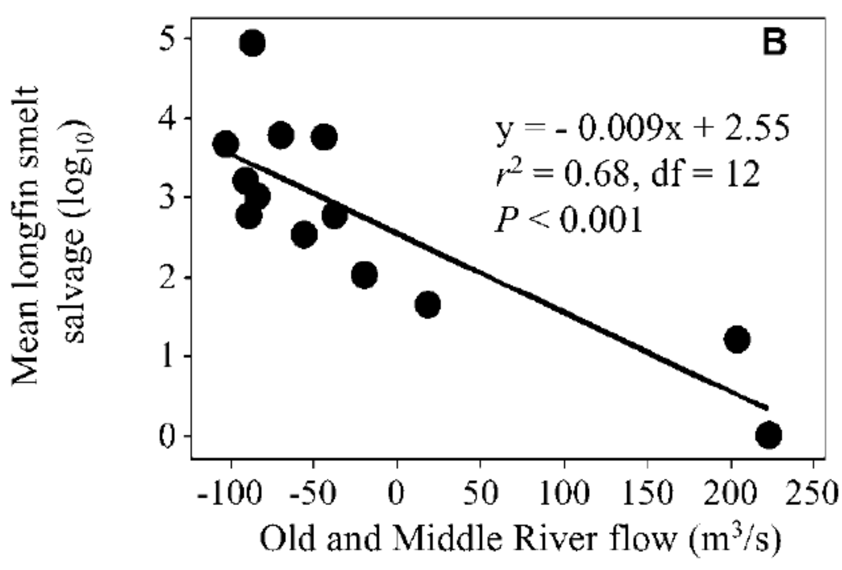
6B.12 Longfin Smelt Salvage–Old and Middle River Flow Analysis Based on Grimaldo et al. (2009)

6B.12.1 Methods

Grimaldo et al. (2009:Figure 7B) found a significant relationship between juvenile Longfin Smelt salvage in April and May as a function of mean April–May OMR flows. In order to assess potential differences in salvage between the modeled scenarios, the regression of Grimaldo et al. (2009) was recreated in order to be able to fully account for sources of error in the predictions; this allowed calculation of prediction intervals from CalSim 3-derived estimates of OMR flows for the modeled scenarios, as recommended by Simenstad et al. (2016:49).

Longfin Smelt salvage data for April and May 1993–2005 were obtained from the CDFW salvage monitoring website.[12] Consistent with Grimaldo et al. (2009), a record of 616 Longfin Smelt salvaged on April 7, 1998, was assumed to be in error, and was converted to zero for the analysis. OMR flow data were provided by Smith (pers. comm. 2012). Following Grimaldo et al. (2009), $\log_{10}$(total salvage) was regressed against mean April–May OMR flow (converted to cubic meters/second). The resulting regression equation was very similar to that obtained by Grimaldo et al. (2009; Figure 6B-399):

$$\text{Log}_{10}(\text{April–May total Longfin Smelt salvage}) = 2.5454\ (\pm\ 0.2072\ \text{SE}) - 0.0100\ (\pm\ 0.0020\ \text{SE})^{*}\ (\text{Mean April–May Old and Middle River flow});\ r^2 = 0.70,\ 12\ \text{degrees of freedom.}$$



Source: Grimaldo et al. 2009.

Figure 6B-399. Regression of April–May Longfin Smelt Salvage as a Function of Old and Middle River Flow

[12] http://www.dfg.ca.gov/delta/apps/salvage/SalvageExportChart.aspx?Species=1&SampleDate=1%2f22%2f2016&Facility=1, accessed January 1, 2016, and August 17, 2016 (salvage for Longfin Smelt at both facilities was selected).

For the comparison of the modeled scenarios, CalSim 3 data outputs were used to calculate mean April–May OMR flows for each year of the 1922–2021 simulation. The salvage-OMR flow regression calculated as above was used to estimate salvage for the modeled scenarios. The log-transformed salvage estimates were back-transformed to a linear scale for comparison of the modeled scenarios. In order to illustrate the variability in predictions from the salvage-OMR flow regression, annual estimates were made for the mean and upper and lower 95 percent prediction limits of the salvage estimates, as recommended by Simenstad et al. (2016). Means and prediction limits giving negative estimates of salvage were converted to zero before statistical summary. Statistical analyses were conducted with R statistical software (R Core Team 2023).

6B.12.2 Results

The results of the analysis are presented and discussed in Chapter 6.

6B.13 Longfin Smelt Delta Outflow–Abundance Index Analysis (Bayesian Method)

6B.13.1 Methods

6B.13.1.1 Development of Statistical Relationships

Fall Midwater Trawl Abundance Index

The potential effect of the Proposed Project on Longfin Smelt was investigated through development of a statistical model relating the Longfin Smelt Fall Midwater Trawl (FMWT) abundance index to Delta outflow, the FMWT abundance index two years earlier (as a representation of parental stock size), and ecological regime (i.e., 1967–1987, pre-*Potamocorbula amurensis* invasion; 1988–2002, post-*P. amurensis* invasion; and 2003–2022, POD; to represent major ecological changepoints in the Delta, e.g., Nobriga and Rosenfield 2016).[13] Total Delta outflow (thousand acre-feet) was summed and examined for March through May and December through May, similar time periods to previous work by Mount et al. (2013:66–69) and Nobriga and Rosenfield (2016).

Twelve log-linear regression models were considered in the analysis. The models were fit using a Bayesian approach implemented in the R statistical computing language (R Core Team 2023) via the *brms* package (Bürkner 2017) with model weights for averaging posterior predictive distributions calculated using the *loo* package (Vehtari et al. 2020): three Markov Chain Monte Carlo chains were run; flat priors were assumed; there was a 2,000-sample warm-up; 10,000 samples were retained from each chain (30,000 samples total from the posterior); and the $\hat{R} < 1.01$ on estimated parameters indicated sampling converged on the posterior probability distributions for all models.

[13] A linear regression method was also investigated for Delta outflow effects on Longfin Smelt based on FMWT Index data for 2003 through 2022; the relationship was not statistically significant and therefore was not considered further: $\log_e$(Fall midwater trawl index) = -3.837 + 0.831*$\log_e$(December–May Delta outflow, cfs), r^2 = 0.18, P = 0.06.

Preliminary model comparison was performed using leave-one-out cross validation (LOO; Vehtari et al. 2017). Measures of model predictive accuracy using LOO are asymptotically equal to the widely applicable information criteria (WAIC; Watanabe 2010), but in the case of finite data LOO has been shown to be more robust to influential observations like outliers (Vehtari et al. 2017). The extent of model overlap in predictive accuracy was measured by the differences (and the standard errors of the differences) in expected log pointwise predictive densities, i.e., the differences in out-of-sample predictive accuracy between models. The preliminary model comparisons indicated there was a relatively high degree of similarity in terms of predictive ability between the top scoring individual models.

Therefore, rather than selecting a single model for inference, the posterior predictive probability distributions were combined as a weighted average across models. This process involved taking draws from the posterior of each single model in proportion to its model weight. For example, if a single model's weight was 25 percent of the total model set, then 2,500 draws from its posterior were added to the averaged posterior predictive distribution, which again included 10,000 total draws across all models. The statistical approach used to calculate the model weights for averaging the posterior predictive distributions across models is known as "stacking" (Yao et al. 2018).

Compared to more traditional model averaging approaches, stacking differs in terms of how model weights are assigned. Instead of calculating model weights based on the relative predictive ability for each individual model—where the best model for prediction would be given the highest weight—the model weights estimated through stacking minimize the LOO mean squared error of the resulting averaged posterior predictive distribution across models. In other words, stacking was used to estimate the optimal linear combination of model weights (Yao et al. 2018).

Hence, the model with the largest stacking weight does not necessarily have the highest predictive score compared to other models in the set. For example, the models in this case can be divided into two subsets: one subset includes a covariate for Delta outflow during December–May and the other model subset includes a covariate for March–May Delta outflow (Table 6B-105). Comparing the predictive ability of each individual model using LOO resulted in a model with December–May outflow (the model with the third highest stacking weight in Table 6B-105) having the highest individual predictive accuracy of any single model considered. In contrast, when the optimal linear combination of weighted model predictions was calculated, stacking resulted in a model with March–May Delta outflow having the highest single model weight (37 percent of the total stacking weight across the model set). Nevertheless, because stacking optimizes the linear combination of model weights for predictive accuracy, the next four models (~63 percent of the stacking weight) all include December–May Delta outflow instead of March–May Delta outflow. Therefore, in this case, even though the model with highest stacking weight included March–May Delta outflow, the averaged posterior predictive distribution was ultimately weighted more heavily with models that include December–May Delta outflow compared to models with March–May Delta outflow. Of the twelve models considered, the top five models by stacking weight accounted for >99.9 percent of the averaged posterior predictive distribution (Table 6B-105).

Several additional models were also examined, in addition to those in Table 6B-105, but they were ultimately not included in this analysis due to poor model fits and what would have been additional computational cost without an expected difference in results. The additional models included a squared term on Delta outflow and their examination was motivated by the modeling results of Nobriga and Rosenfield (2016). Those authors assessed the relationship between Delta outflow and the ratio of age-0 to age-2 Longfin Smelt abundance in the two-life-stage versions of the models included in their analyses. They found support for non-linearity in this relationship (i.e., there was a peak in productivity at more intermediate outflow values), which led to the inclusion of a second-order polynomial regression (i.e., a squared term) on Delta outflow (Nobriga and Rosenfield 2016:50). Given the approach taken here, which differs from the Nobriga and Rosenfield analysis in terms of: (1) the survey data used for Longfin Smelt abundance; (2) how Delta outflow values were included as covariates, and; (3) the overall time periods for available data included in the regression models, there was little to no support found for a second-order polynomial regression on Delta outflow. The aforementioned factors that differed between the two analyses are briefly described in the next paragraph for completeness; however, given the poor predictive ability of the second-order polynomial regressions under the current approach, that subset of models was ultimately not included because the preliminary results indicated the stacked model weights would be near zero. Hence the averaged posterior predictive distributions would not be expected to be sensitive to the exclusion of those models in this case, but their inclusion would have increased the computational time necessary to run and perform the averaging over a larger set of models.

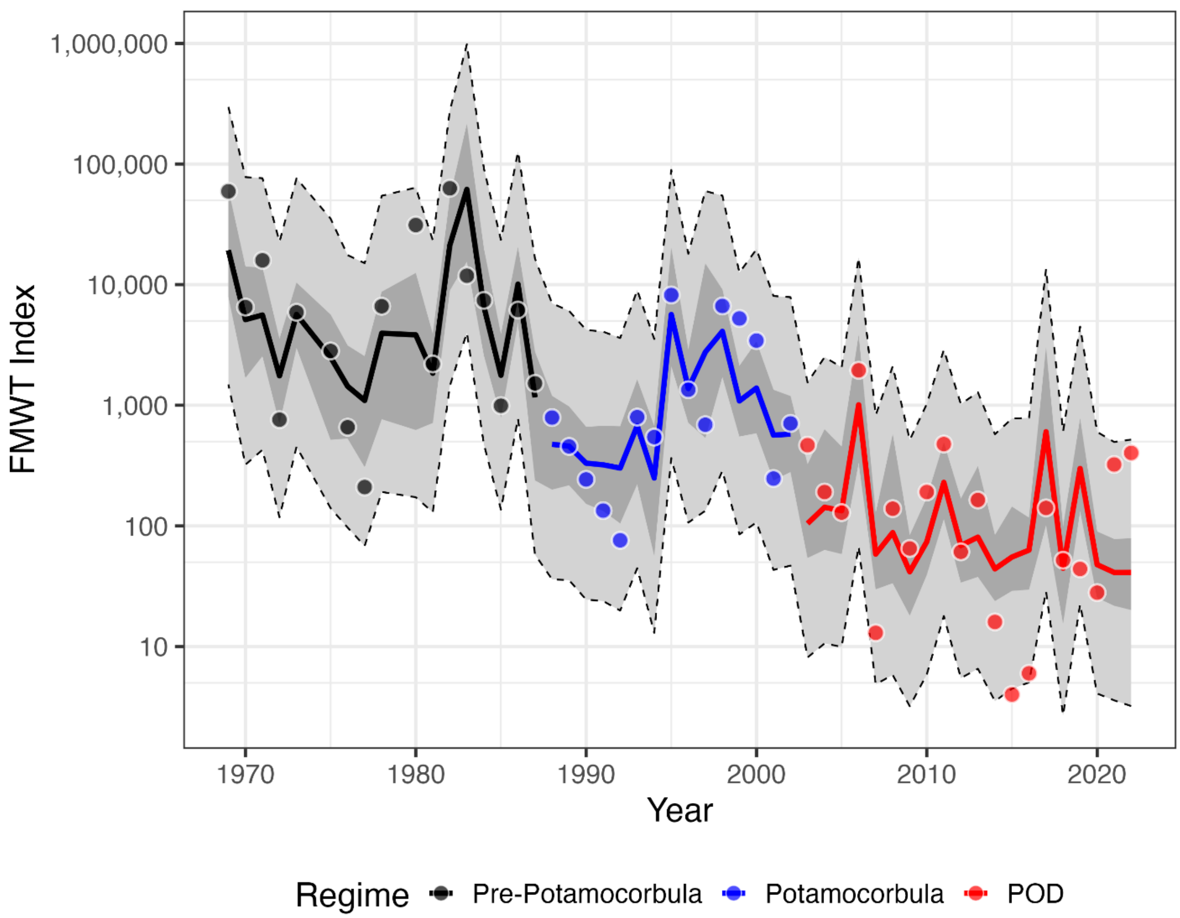
As outlined above, there are several differences between these analyses and those of Nobriga and Rosenfield (2016) that might explain the discrepancy in terms of support (or lack thereof) found for dome-shaped Longfin Smelt productivity as a function of Delta outflow. Firstly, Nobriga and Rosenfield (2016) found support for this relationship fitting models to catch data from the San Francisco Bay Study. In these analyses, on the other hand, the regression models have been fit to the FMWT index of abundance instead. Second, Nobriga and Rosenfield (2016) incorporated covariate values for Delta outflow based on a principal component analysis (the first principal component values) of the z-scored monthly means from December to May. Here, the monthly total outflow (either from December to May, or March to May) were summed, resulting in a total outflow value during each time period each year, and the regression covariate values were calculated as the z-scores of the period-total outflow values taken across years. Third, in addition to examining indices of abundance from different surveys, the annual time periods that have been examined also differ. Nobriga and Rosenfield (2016) examined the relationship between annual indices of Longfin Smelt abundance-at-age and Delta outflow that were available from the Bay Study during 1980–2013. Whereas in these analyses this relationship was examined over a longer period, during 1967–2022, which includes >20 additional years in the comparison with Delta outflow.

Table 6B-105. The Optimal Linear Combination of Model Weights based on Stacking, which Minimizes the Mean Squared Error of the Leave-One-Out Cross Validation for the Resulting Model Averaged Posterior Predictive Distribution across the Twelve Log-Linear Regressions of Longfin Smelt Fall Midwater Trawl Abundance Index. Models are a Function of Delta Outflow (December–May or March–May), Ecological Regime (1967–1987, pre-*Potamocorbula amurensis* invasion; 1988–2002, post-*P. amurensis* invasion; and 2003–2022, Pelagic Organism Decline), and Abundance Index 2 Years Earlier (Log_{10} FMWT(yr – 2))

Log_{10}FMWT Linear Regression Model [a]	Stacking Weight
Dec–May + Regime	0.3949
Mar–May + Regime + Log_{10} FMWT(yr – 2)	0.3218
Dec–May + Regime + Log_{10} FMWT(yr – 2)	0.1920
Dec–May + Log_{10} FMWT(yr – 2)	0.0901
Dec–May + Regime + Dec–May*Regime	0.0010
Mar–May + Log_{10} FMWT(yr – 2)	<0.0001
Mar–May + Regime	<0.0001

Log_{10}FMWT Linear Regression Model [a]	Stacking Weight
Mar–May + Regime + Mar–May*Regime	<0.0001
Dec–May + Regime + Dec–May*Regime + Log_{10} FMWT(yr – 2)	<0.0001
Mar–May + Regime + Mar–May*Regime + Log_{10} FMWT(yr – 2)	<0.0001
Dec–May	<0.0001
Mar–May	<0.0001

[a] An asterisk "*" sign represents an interaction term between Regime and Delta Outflow.

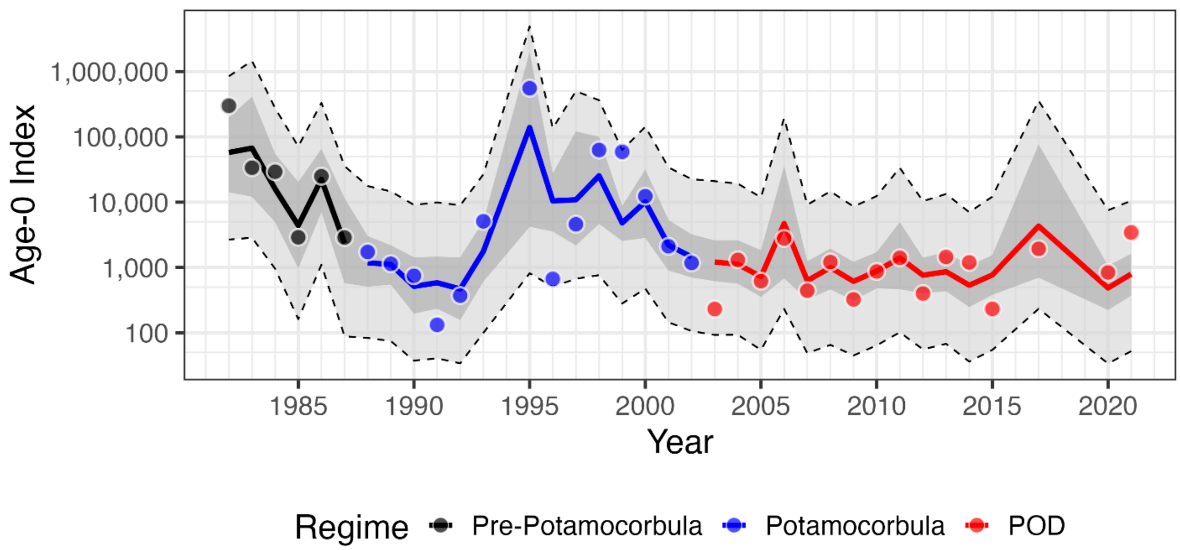


Note: The circles represent the annual historical values of the Fall Midwater Trawl abundance index. The solid lines connect the annual expected values from the stacked Bayesian posterior predictive distribution. Colors correspond to the three modeled regimes. The darker gray ribbon represents the averaged 95% probability interval for draws from the means (in log-space) of the posterior predictive distribution for the Fall Midwater Trawl index value. The lighter gray ribbon with a dashed black outline represents the averaged 95% overall posterior predictive probability interval. The posterior predictive interval for the means has a smaller range than the overall posterior predictive interval because in addition to uncertainty in the estimated mean values, the overall posterior predictive distribution also incorporates uncertainty in the residual error of the model fits (Equations 1 and 2 in Section 6B.13.1.2, "Assessment of Proposed Project").

Figure 6B-400. Stacked Posterior Predictive Distributions for the Log-Linear Regressions of Longfin Smelt Fall Midwater Trawl Abundance Index as a Function of Delta Outflow (December–May), Ecological Regime (1967–1987, pre-*Potamocorbula amurensis* invasion; 1988–2002, post-*Potamocorbula* invasion [shown as *Potamocorbula*]; and 2003–2022, Pelagic Organism Decline), and Abundance Index 2 Years Earlier [Log10 FMWT(yr – 2)])

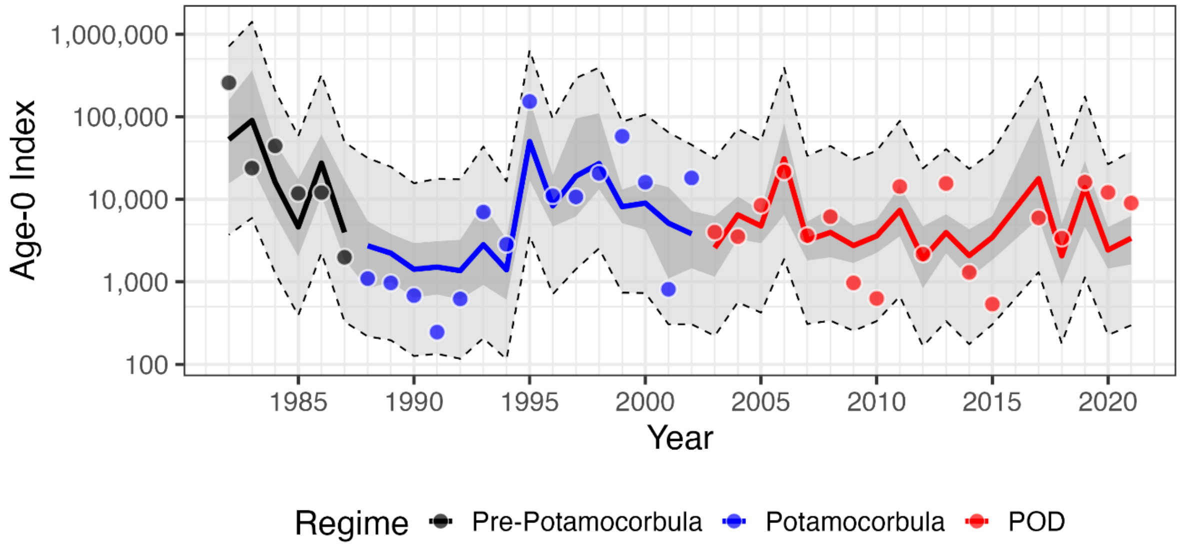
Bay Study Abundance Indices

The approach described above for the FMWT abundance index was applied to each of the San Francisco Bay Study midwater trawl and otter trawl Longfin Smelt Age-0 abundance indices, using data from 1980–2021. See Figure 6B-401 and Figure 6B-402 for model fit and Table 6B-106 and Table 6B-107 for model stacking weights.



Note: The circles represent the annual historical values of the Bay midwater trawl Age-0 abundance index. The solid lines connect the annual expected values from the stacked Bayesian posterior predictive distribution. Colors correspond to the three modeled regimes. The darker gray ribbon represents the averaged 95% probability interval for draws from the means (in log-space) of the posterior predictive distribution for the Bay midwater trawl index value. The lighter gray ribbon with a dashed black outline represents the averaged 95% overall posterior predictive probability interval. The posterior predictive interval for the means has a smaller range than the overall posterior predictive interval because in addition to uncertainty in the estimated mean values, the overall posterior predictive distribution also incorporates uncertainty in the residual error of the model fits.

Figure 6B-401. Stacked Posterior Predictive Distributions for the Log-Linear Regressions of Longfin Smelt Bay Midwater Trawl Age-0 Abundance Index as a Function of Delta Outflow (December–May), Ecological Regime (1980–1987, pre-*Potamocorbula amurensis* invasion; 1988–2002, post-*Potamocorbula* invasion [shown as *Potamocorbula*]; and 2003–2021, Pelagic Organism Decline), and Age-0 Abundance Index 2 Years Earlier [Log10 BMWT(yr – 2)])



Note: The circles represent the annual historical values of the Bay otter trawl Age-0 abundance index. The solid lines connect the annual expected values from the stacked Bayesian posterior predictive distribution. Colors correspond to the three modeled regimes. The darker gray ribbon represents the averaged 95% probability interval for draws from the means (in log-space) of the posterior predictive distribution for the Bay midwater trawl index value. The lighter gray ribbon with a dashed black outline represents the averaged 95% overall posterior predictive probability interval. The posterior predictive interval for the means has a smaller range than the overall posterior predictive interval because in addition to uncertainty in the estimated mean values, the overall posterior predictive distribution also incorporates uncertainty in the residual error of the model fits.

Figure 6B-402. Stacked Posterior Predictive Distributions for the Log-Linear Regressions of Longfin Smelt Bay Otter Trawl Age-0 Abundance Index as a Function of Delta Outflow (December–May), Ecological Regime (1980–1987, pre-*Potamocorbula amurensis* invasion; 1988–2002, post-*Potamocorbula* invasion [shown as *Potamocorbula*]; and 2003–2021, Pelagic Organism Decline), and Age-0 Abundance Index 2 Years Earlier [Log10 BOT(yr – 2)])

Table 6B-106. The Optimal Linear Combination of Model Weights based on Stacking, which Minimizes the Mean Squared Error of the Leave-One-Out Cross Validation for the Resulting Model Averaged Posterior Predictive Distribution across the Twelve Log-Linear Regressions of Longfin Smelt Age-0 Bay Midwater Trawl Abundance Index. Models are a Function of Delta Outflow (December–May or March–May), Ecological Regime (1980–1987, pre-*Potamocorbula amurensis* invasion; 1988–2002, post-*P. amurensis* invasion; and 2003–2021, Pelagic Organism Decline), and Age-0 Abundance Index 2 Years Earlier (Log_{10} BMWT(yr – 2))

Log_{10}BMWT Linear Regression Model [a]	Stacking Weight
Mar–May + Regime + Mar–May*Regime + Log_{10} BMWT(yr – 2)	0.5868
Dec–May + Log_{10} BMWT(yr – 2)	0.3831
Dec–May + Regime + Log_{10} BMWT(yr – 2)	0.0140
Dec–May + Regime	0.0136
Dec–May + Regime + Dec–May*Regime	0.0025
Dec–May + Regime + Dec–May*Regime + Log_{10} BMWT(yr – 2)	<0.0001
Mar–May + Regime + Mar–May*Regime	<0.0001
Mar–May + Regime	<0.0001
Mar–May +Regime + Log_{10} BMWT(yr – 2)	<0.0001
Mar–May	<0.0001
Mar–May + Log_{10} BMWT(yr – 2)	<0.0001
Dec–May	<0.0001

[a] An asterisk "*" sign represents an interaction term between Regime and Delta Outflow.

Table 6B-107. The Optimal Linear Combination of Model Weights based on Stacking, which Minimizes the Mean Squared Error of the Leave-One-Out Cross Validation for the Resulting Model Averaged Posterior Predictive Distribution across the Twelve Log-Linear Regressions of Longfin Smelt Age-0 Bay Otter Trawl Abundance Index. Models are a Function of Delta Outflow (December–May or March–May), Ecological Regime (1980–1987, pre-*Potamocorbula amurensis* invasion; 1988–2002, post-*P. amurensis* invasion; and 2003–2021, Pelagic Organism Decline), and Age-0 Abundance Index 2 Years Earlier (Log_{10} BOT(yr – 2))

Log_{10}BOT Linear Regression Model [a]	Stacking Weight
Mar–May + Log_{10} BOT(yr – 2)	0.5854
Dec–May + Regime + Dec–May*Regime	0.1730
Dec–May	0.1398
Dec–May + Log_{10} BOT(yr – 2)	0.1004
Mar–May + Regime + Mar–May*Regime + Log_{10} BOT(yr – 2)	0.0013
Dec–May + Regime + Log_{10} BOT(yr – 2)	<0.0001
Mar–May + Regime	<0.0001
Mar–May + Regime + Mar–May*Regime	<0.0001
Mar–May + Regime + Log_{10} BOT(yr – 2)	<0.0001
Dec–May + Regime	<0.0001
Dec–May + Regime + Dec–May*Regime + Log_{10} BOT(yr – 2)	<0.0001
Mar–May	<0.0001

[a] An asterisk "*" sign represents an interaction term between Regime and Delta Outflow.

6B.13.1.2 Assessment of Proposed Project

Predictions of the FMWT abundance index under the Proposed Project and Baseline Conditions modeled CalSim 3 outflow scenarios (1922–2022) were generated using the model stacking approach described above to generate a weighted average Bayesian posterior predictive distribution across the set of models considered. Dropping subscripts denoting individual models for simplicity, the general form of the models can be written as:

$$Log_{10}[FMWT_{yr}] \sim N(\mu_{yr}, \sigma^2) \tag{1}$$

$$\mu_{yr} = \beta_{0,i} + \beta_1 Outflow_{yr,j} + \beta_2 Log_{10}\left[FMWT_{yr-2}\right] + \beta_3 Regime_i * Outflow_{yr,j} \tag{2}$$

where:

$Log_{10}[FMWT_{yr}]$ is the model predicted Log_{10} value of the fall midwater trawl index in water year *yr*;

μ_{yr} is the expected fall midwater trawl index in water year *yr* (the stacked posterior predictive distribution for μ_{yr} is shown as the dark grey ribbon in Figure 6B-107);

σ^2 is the residual variance parameter (the stacked posterior predictive distribution including the residual variance is shown as the light grey ribbon in Figure 6B-107);

$\beta_{0,i}$ represents the intercept parameter estimated for each regime: Pre-*Potamocorbula* (i = 1); *Potamocorbula* (i = 2); and POD (i = 3). For models without a regime covariate, a single intercept is estimated across all years instead, i.e., β_0 is substituted for $\beta_{0,i}$;

β_1 represents the slope parameter estimated for the relationship between the fall midwater trawl index and Delta outflow;

$Outflow_{yr,j}$ is the normalized[14] outflow level during water year *yr*, and *j* denotes the outflow level during either the December through May, or the March through May period;

β_2 represents the slope parameter estimated for the relationship between the expected fall midwater trawl index and the value of that index 2 years prior. For models without the parental stock covariate, $\beta_2 = 0$, and;

β_3 represents the interaction covariate (the difference in slopes) with respect to the estimated effect of outflow on the FMWT index of abundance during different regimes. For models without this interaction term, $\beta_3 = 0$.

[14] Normalized outflow values for each CalSim 3 scenario were calculated by subtracting the mean and dividing by the standard deviation of observed Delta outflow values (1967–2020).

For those models that included the Log_{10} FMWT(yr – 2) parental stock size covariate (Table 6B-105), the starting parental stock size in 1922 and 1923 was set at a FMWT index value of 118.2, corresponding to the mean index value from 2013 through 2022. Given the starting values for the FMWT index (in the relevant models), the recursive nature of the regression formula was used to generate the expected FMWT index value in successive years from the posterior predictive distribution two years prior. For all models, predictions were conditional on the estimated relationship between the FMWT index and Delta outflow (in December–May, or March–May, depending on the model), and for those models that included a regime covariate, draws from the posterior predictive distributions were conditioned on estimates during the POD regime.

As an example, starting in 1924, draws from the posterior predictive distribution for models including the parental stock size covariate were generated by first substituting the normalized 1924 December–May (or March–May) CalSim 3 outflow value for each alternative. Draws from the posterior distributions for the regression parameters and the starting value for $Log_{10}[FMWT_{1922}]$ were then used to generate the posterior predictive distribution for the FMWT index in 1924 (μ_{1924}). This value was then substituted into Equation 1, and the posterior distribution for the residual variance parameter was used to generate draws from the pointwise posterior predictive distributions for the FMWT index.[15] This process was iterated over each successive year, substituting the derived μ_{yr-2} values for $Log_{10}[FMWT_{yr-2}]$ to calculate μ_{yr}, and to generate the annual posterior predictive distributions for the FMWT index under each alternative. For models that did not include the parental stock size covariate, the posterior predictive distributions were generated based on the corresponding CalSim 3 outflow values for the monthly period corresponding to the individual model estimates, and likewise conditioned on covariate estimates during the POD regime for models that included a regime covariate (or the constant intercept parameter β_0, for models without the regime covariate). As noted above in the description of the model stacking approach, draws from the posterior predictive distribution for each model were sampled in proportion to the stacking model weights, to generate a weighted average posterior predictive distribution across the models considered. Summaries were then calculated by grouping the stacked annual posterior predictive distributions by water year type and calculating the means and credible intervals for each aggregated water year type posterior predictive distribution.

The same approach used for the FMWT abundance index was also applied to each of the analyses using the Bay Study midwater and otter trawl abundance indices. Starting values for abundance indices were 1,142.9 (midwater trawl) and 4,993.4 (otter trawl), representing the geometric mean abundance indices for 2013–2021.

6B.13.2 Results

The results of the analysis are presented and discussed in Chapter 6.

[15] "$\sim N$" in Eqn. 1 denotes a normal (Gaussian) distribution.

6B.14 San Joaquin River Adult Fall-Run Chinook Salmon Straying Analysis Based on Marston et al. (2012)

Straying rates of adult fall-run Chinook salmon from the San Joaquin River region—the southern tributaries of the San Joaquin River including the Stanislaus, Tuolumne, and Merced rivers—into tributaries of the Sacramento River region were estimated by Marston et al. (2012) under the assumption that in-river releases of coded-wire-tagged Merced River hatchery fall-run Chinook Salmon juveniles would allow inferences to be made of wild-origin Chinook straying rates from these tributaries. Estimated annual straying rates for fish released at inland locations upstream of the Delta averaged 18 percent and ranged from 0 percent to more than 70 percent; straying rates were even greater for fish released in the Delta and Bay. These straying rates are appreciably higher than straying rates estimated by the same authors for Chinook Salmon released as juveniles in the Sacramento River upstream of the Delta (0.1 percent). Marston et al. (2012) compared various statistical models to explain straying rate as a function of various flow terms hypothesized to be relevant during the San Joaquin River region fall-run Chinook Salmon adult upstream migration period, including San Joaquin River mean base flows and pulse flows, south Delta exports, OMR flows, the ratio of exports to San Joaquin River pulse flows, as well as the potential impacts from the south Delta barrier operations. The analyses suggested that models including exports and pulse flow, either as a ratio, or as separate terms, appear to explain as much or more of the variability in stray rate as models with other hydrological variables (e.g., OMR flows). Overall, Marston et al. (2012:14) concluded the following from their analysis.

> In conclusion, since the biology of salmon indicates that a model including San Joaquin River flow is biologically necessary (salmon navigate based upon juvenile river imprinting), we must include San Joaquin River flow in a management model. There are several ways to link flow and exports to stray rates. Whether or not to include either co-variate (flow and exports), and how, depends entirely upon the objective. If the objective is explanation, then a model that includes both flow and exports independent of one another is warranted ... Alternatively, if the goal is pure prediction, then a model that has flow alone… is acceptable given that flow is the only variable associated with San Joaquin River salmon stray rates at a statistically significant level. However, since we cannot say with statistical certainty whether flow or exports is the primary determinant influencing San Joaquin River salmon stray rates, exports can also be included in the management model in the form of an E:I ratio.

The impact analysis contained in Chapter 6 used Equation 2 of Marston et al. (2012:14) to estimate potential changes in straying rate of San Joaquin River region fall-run Chinook Salmon adults as a function of south Delta combined exports to San Joaquin River inflow ratio:

$$Straying\ Rate = \frac{1}{1 + e^{-\left(-3.25 + 2.41 \ln\left(\frac{Export\ Pulse\ Flow}{SJR\ Pulse\ Flow}\right) - (0.64 Age3) - (1.01 Age4)\right)}}$$

where *Straying Rate* is the percentage of San Joaquin River region fall-run Chinook Salmon adults that stray to the Sacramento River region; *San Joaquin River Pulse Flow* is the highest 10-day average San Joaquin River flow at Vernalis (cfs) during October–November; *Export Pulse Flow* is the average south Delta exports during the October–November San Joaquin River pulse flow period; and *Age3* and *Age4* are indicators of fish age, so that Age3 = 1 if calculating the straying rate for Age 3 adults and Age3 = 0 otherwise, for example.

Note that setting Age3 and Age4 equal to zero results in estimation of straying rate for Age-2 adults. Equation 2 of Marston et al. (2012) was used instead of Equation 1 because it allows straying rate to be estimated as a function of export and inflow, thereby allowing potential differences between project alternatives to be examined.

CalSim 3 modeling data were used to provide flow and export inputs to the equation above. CalSim 3 provides monthly average flow ("'base flow," as defined by Marston et al. 2012) and export data, whereas the above equation requires flow and exports during pulse periods, and so conversions from the monthly-average CalSim 3 base flows (or exports) to pulse flows (or exports) were developed from flow and export data provided by Marston et al. (2012:Table 7 of their Methods Appendix). The conversion relationships developed from Marston et al.'s (2012) San Joaquin River flow data and export data are shown in Figure 6B-403 and Figure 6B-404. These conversions were developed from Marston et al.'s (2012) appendix and were not published in their paper. These conversions were applied to the CalSim 3 modeling data. Also, Marston et al. (2012) included Contra Costa Water District diversions at Rock Slough and Old River in their definition of south Delta exports; estimates of these diversions were not included in this effects analysis because modeling estimates from CalSim 3 were not available. Given that historical Contra Costa diversions were small in relation to the SWP/CVP south Delta export facilities (i.e., 1–2 percent), omission of Contra Costa diversions does not affect the results to any great extent.

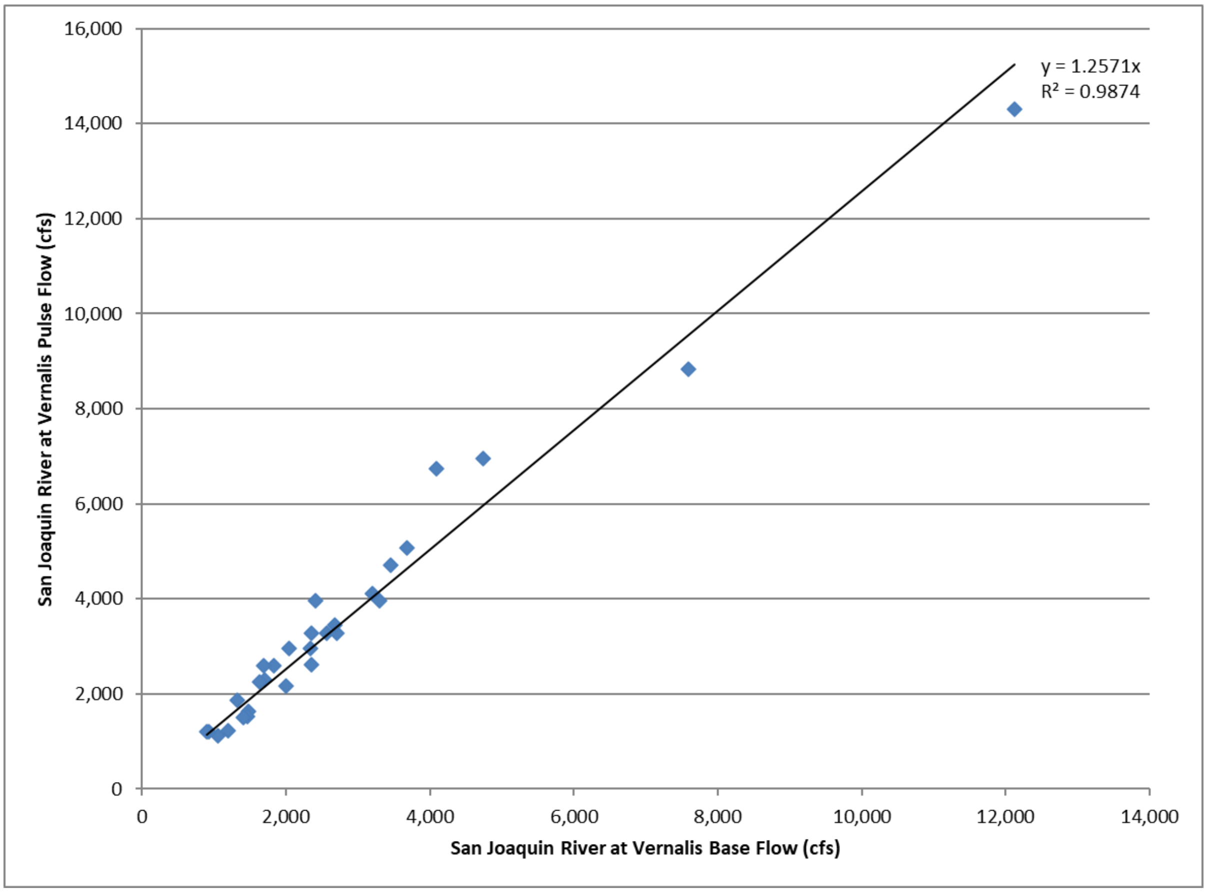


Figure 6B-403. Relationship between San Joaquin River at Vernalis 10-Day Average Highest October–November Pulse Flow and Average October–November Base Flow (cfs)

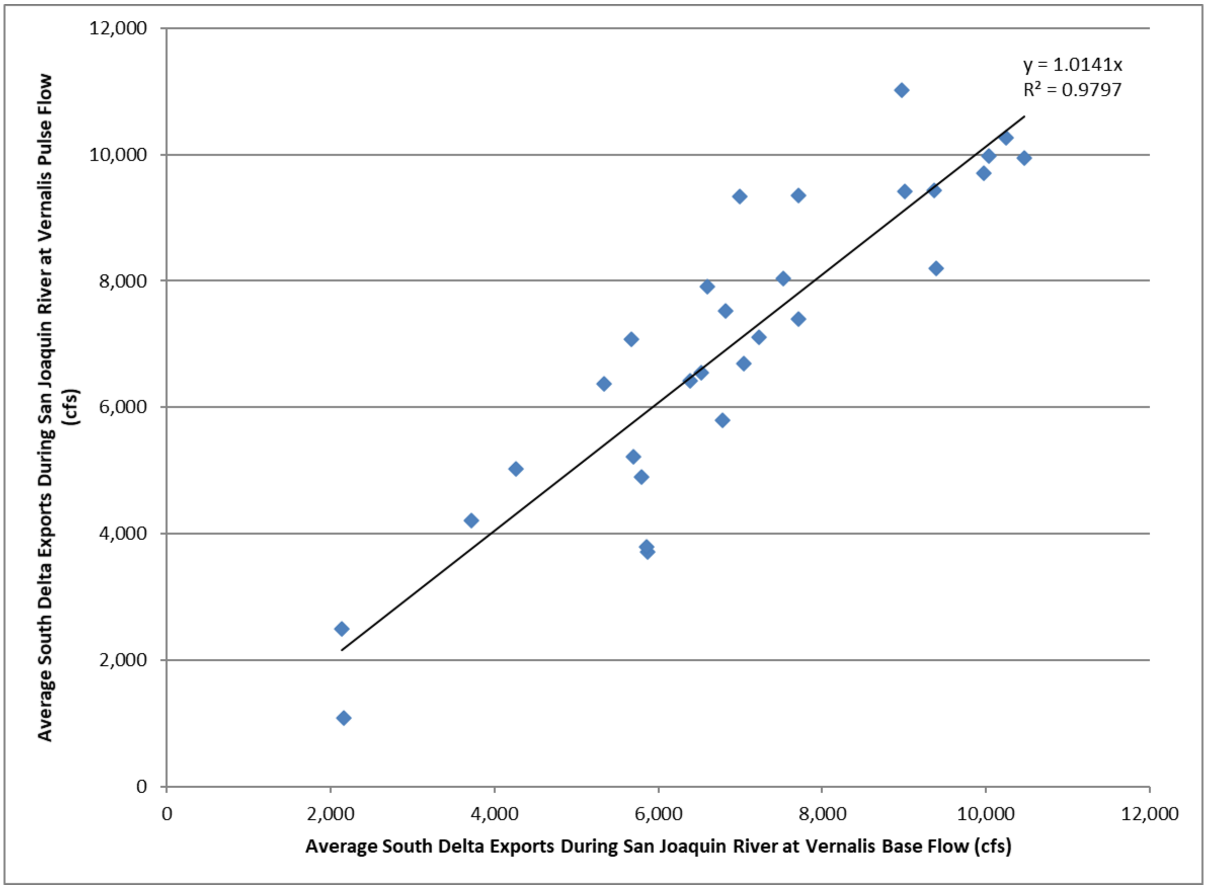


Figure 6B-404. Relationship between South Delta Exports During San Joaquin River at Vernalis 10-Day Average Highest October–November Pulse Flow and Average October–November South Delta Exports During Base Flow Period (cfs)

Annual estimates of straying for each modeled scenario were calculated as weighted annual means of three annual age-specific straying rate estimates, with age-specific weights based on an assumed ratio of 32 percent age 2: 55 percent age 3: 13 percent age 4 (California Department of Fish and Game 2005: 38). The relationship of south Delta exports to inflow ratio to age-specific percentage straying rate of San Joaquin River region adult fall-run Chinook Salmon as estimated from the equation above is illustrated for the range of export to inflow values examined by Marston et al. (2012) in Figure 6B-405. Straying rates increase as export to inflow ratio increases, and younger fish stray more than older fish (although there is some uncertainty related to this, as other studies do not show this pattern, as reviewed by Marston et al. [2012]): there is very little straying with fewer exports than San Joaquin River inflow (i.e., export to inflow ratio less than 1), whereas high levels of exports (export to inflow ratio ~4–6) result in more than 50 percent of adults straying, and the highest export to inflow ratio observed by Marston et al. (2012) is predicted to result in nearly 80 percent of 2-year-olds straying and nearly 60 percent of 4-year-olds straying, with 3-year-olds intermediate to these values.

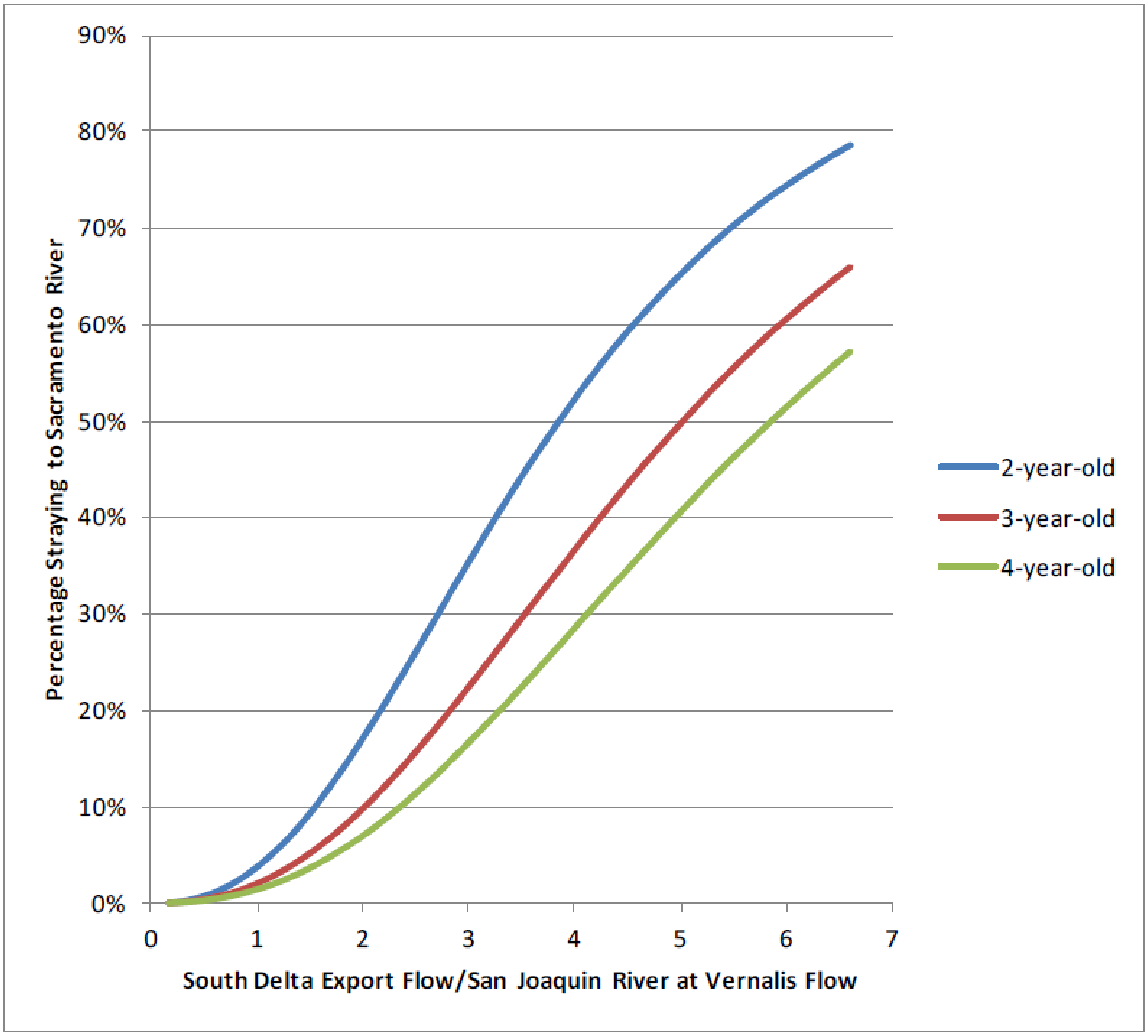


Figure 6B-405. Age-Specific Straying Rate of Adult San Joaquin River Region Fall-Run Chinook Salmon as a Function of the Ratio of October–November Average South Delta Export Flow to San Joaquin River Flow at Vernalis

6B.15 White Sturgeon Delta Outflow–Year Class Strength Regression

6B.15.1 Methods

The analysis of White Sturgeon year-class strength as a function of Delta outflow updated a prior method by ICF International (2016:5-197–5-205). Historical data for White Sturgeon year-class index for 1980–2020 obtained from CDFW were regressed against historical mean Delta outflow data from Dayflow[16] from March through July and from April through May (Table 6B-108).

Table 6B-108. Historical Data Used to Develop Regressions of White Sturgeon Year-Class Strength versus Mean Delta Outflow Data (cfs) for March–July and April–May

Year	Year-Class Index	March–July Delta Outflow (cfs)	April–May Delta Outflow (cfs)
1980	11.1	35,060	24,652
1981	21.8	11,478	10,375
1982	719.7	64,722	99,295
1983	599.6	119,942	108,220
1984	40.7	15,798	12,836
1985	44.0	6,911	7,072
1986	23.5	49,947	30,923
1987	8.5	8,261	5,517
1988	0.0	5,451	7,983
1989	0.0	14,130	9,497
1990	0.0	5,248	6,826
1991	0.0	7,946	3,783
1992	0.0	5,854	4,732
1993	72.5	33,974	34,585
1994	0.0	7,006	8,044
1995	348.6	92,926	94,501
1996	161.0	40,478	44,059
1997	46.7	15,662	13,266
1998	327.7	72,580	77,724
1999	18.2	30,309	28,753
2000	0.0	31,258	24,678
2001	0.0	11,539	10,942
2002	0.0	11,153	12,762
2003	0.0	20,299	32,159
2004	19.1	20,857	17,137
2005	0.0	31,406	40,624
2006	234.6	84,048	129,578

16 https://data.cnra.ca.gov/dataset/dayflow

Year	Year-Class Index	March–July Delta Outflow (cfs)	April–May Delta Outflow (cfs)
2007	30.2	9,580	10,327
2008	0.0	8,193	8,867
2009	0.0	12,255	13,994
2010	0.0	17,082	22,611
2011	48.8	59,129	65,740
2012	11.1	15,209	20,012
2013	0.0	9,165	11,444
2014	0.0	6,863	6,013
2017	284.0	66,842	85,730
2018	0.0	19,282	27,057
2019	66.0	59,427	67,608
2020	0.0	8,470	10,200

cfs = cubic feet per second.

The two regressions were:

- Log_{10}(Year class index+1) = 0.169 + 0.0000275 March–July Delta outflow (cfs), $r^2 = 0.59$, $P < 0.0001$
- Log_{10}(Year class index+1) = 0.246 + 0.0000227 April–May Delta outflow (cfs), $r^2 = 0.56$, $P < 0.0001$

These regressions were applied to the CalSim 3-modeled scenarios using R statistical software (R Core Team 2023).

6B.15.2 Results

The results of the analysis are presented and discussed in Chapter 6.

6B.16 Delta Outflow–Abundance Index Regressions (Starry Flounder, Striped Bass, American Shad, and California Bay Shrimp)

Several linear regressions between abundance indices[17] of various Delta species and Delta outflow were used to compare the modeled scenarios. The approach was similar to that employed by Kimmerer et al. (2009) but focused on historical data from 2003 to the most recently available year (2022 for most species) to represent the most recent ecological regime following the POD and considered Delta outflow as opposed to X2. The statistically significant (P<0.05) resulting

[17] Abundance indices for striped bass, and American shad were from https://apps.wildlife.ca.gov/FMWT, accessed 28 June 2023. Abundance indices for age 1+ starry flounder were provided by Burns (pers. comm.). California bay shrimp (*Crangon franciscorum*) abundance indices were developed from data downloaded from https://filelib.wildlife.ca.gov/Public/BayStudy/, accessed 30 August 2023. Historical Delta outflow data were from Dayflow.

regressions (see below) were applied to CalSim 3-modeled Delta outflow outputs for the modeled scenarios. (The regression for California Bay Shrimp was not statistically significant and so comparison of scenarios was not undertaken for this species.) The analyses were conducted with R statistical software (R Core Team 2023).

- Striped Bass (2003–2022): $\log_e$(Fall midwater trawl index) = -1.272 + 0.610*$\log_e$(April–June Delta outflow, cfs), r^2 = 0.54, P = 0.0002
- American Shad (2003–2022): $\log_e$(Fall midwater trawl index) = -1.260 + 0.794*$\log_e$(February–June Delta outflow, cfs), r^2 = 0.43, P = 0.0017
- Starry Flounder (2003–2022): $\log_e$(Age 1+ bay otter trawl abundance index) = -5.883 + 1.050*$\log_e$(prior year March–June Delta outflow, cfs), r^2 = 0.26, P = 0.0356
- California Bay Shrimp (2003–2016): $\log_e$(Bay otter trawl catch per 1,000 m^2 in May–November) = 2.408 + 0.306*$\log_e$(March–May Delta outflow, cfs), r^2 = 0.09, P = 0.3012

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6B.17.2 Personal Communications

Perry, Russell. Research Fisheries Biologist, Quantitative Fisheries Ecology Section, USGS Western Fisheries Research Center, Columbia River Research Laboratory, Cook, WA. March 30, 2023—Email containing R code and R dataset for through-Delta survival calculations sent to Marin Greenwood, Aquatic Ecologist, ICF, Sacramento, CA.

Reece, Kevin. Senior Environmental Scientist, Water Projects Planning and Management Branch, Division of Operations and Maintenance, California Department of Water Resources, Sacramento, California. July 21 and September 1, 2023—Emails containing Excel files with genetically identified winter-run and spring-run Chinook Salmon loss data sent to Marin Greenwood, Aquatic Ecologist, ICF, Sacramento, CA.

Smith, Peter. U.S. Geological Survey. 2012—Spreadsheet with Old and Middle River daily flows for WY 1979-2012, sent to Lenny Grimaldo, U.S. Bureau of Reclamation, Sacramento, CA.

Smith, William. Statistician, San Francisco Bay-Delta Fish and Wildlife Office, US Fish and Wildlife Service, Sacramento, CA. February 13, 2023—Email containing R code (<LCME postprocessing predictions for DCP.R>) for LCME model sent to Marin Greenwood, Aquatic Ecologist, ICF, Sacramento, CA.