Appendix 12M
Sturgeon Analysis

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APPENDIX 12M
Sturgeon Analysis

12M.1 Overview

This appendix describes the approach used to compute White and Green Sturgeon age-0 Year Class Strength in the Delta, for analysis of the Sites Reservoir Project (Project) action alternatives (alternatives) for the Draft Environmental Impact Report/Environmental Impact Statement (DEIR/EIS). It includes a summary of the methodology and results used in the detailed evaluation of the alternatives. Results were used or referenced in Chapter 12 Aquatic Biological Resources. The fisheries impact assessment and methodology is described in Chapter 12 Aquatic Biological Resources and in Appendix 12B Fisheries Impact Assessment Methodology and Appendix 12C Fisheries Impact Summary.

12M.1.1 Introduction

The analytical framework used to evaluate the alternatives is summarized in Chapter 5 Guide to the Resource Analyses and Appendix 6B Water Resources System Modeling. Assumptions used in modeling the alternatives are summarized in Appendix 6A Modeling of Alternatives. The methodology described provides an approach to quantify the potential White and Green Sturgeon age-0 Year Class Strength in the Delta based on the average March to July Delta Outflow. In evaluating the alternatives, the average March to July average Delta outflow is presented, with a decrease in flow indicating a potential impact on sturgeon year class strength.

12M.1.2 Sturgeon Analysis Methodology

Estimated Delta outflow from the CalSim II model was used to analyze the potential effects on sturgeon. The evaluation method used to assess the influence of Delta outflow on sturgeon was developed using the hypothesized relationship between Delta outflow and the age-0 Year Class Index (YCI) from the Bay Study in the presentation by Gingras et al. (2014) at the annual IEP Workshop. In that presentation, the relationship between the age-0 YCI and mean Delta outflow was examined for a variety of time periods with a strong relationship shown for the period when white sturgeon are spawning and when young white sturgeon are migrating downstream (March-July). Their analysis using a generalized linear model indicated that there is threshold at about 50,000 cfs, such that year classes are generally strong when flows are above the threshold (Gingras et al., 2014).

For this analysis, the mean Delta outflow during the March to July period for each year was calculated from the CalSim II output and used as an indicator of potential year class strength. This same values were used as an indicator of the likelihood of producing a strong year class of sturgeon by examining the number of years (over the 82-year CalSim II simulation) that mean (March-July) Delta outflow would exceed a threshold of 50,000 cfs.

The hypothesized relationships between White Sturgeon and Delta outflow was used as a surrogate for Green Sturgeon. It is recognized that while White Sturgeon have unique biology and ecology compared to Green Sturgeon, the mechanisms underlying this relationship for White Sturgeon are assumed to be similar to those for Green Sturgeon. The analysis presented in this appendix does not include other mechanisms such as temperature and habitat that may influence Green Sturgeon differently than White

Sturgeon. The impact analysis in Chapter 12 Aquatic Biological Resources takes into account both temperature and Delta outflow analysis results.

12M.2 Results

This section includes the results of the Sturgeon Analysis for the alternatives evaluated in the DEIR/EIS. The fisheries impact assessment and methodology is described in Chapter 12 Aquatic Biological Resources and in Appendix 12B Fisheries Impact Assessment Methodology and Appendix 12C Fisheries Impact Summary.

12M.2.1 Introduction

Modeling results are presented in tabular format for the sturgeon analysis. The results show the average March to July Delta Outflow for long-term average and for each water year type (SWRCB D-1641 40-30-30 Index).

12M.2.2 Comparisons

Summary tables and exceedance plots of the Sturgeon Analysis are provided for the following comparisons:

- Alternative A compared to No Action Alternative
- Alternative B compared to No Action Alternative
- Alternative C compared to No Action Alternative
- Alternative D compared to No Action Alternative

12M.3 References

Gingras, M., J. DuBois, and M. Fish. 2014. *Impact of Water Operations and Overfishing on White Sturgeon*. Presentation at the IEP Annual Workshop, Folsom, CA. 27 February 2014.

Sturgeon Analysis
Results

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Alternative A Compared to No Action Alternative

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Table AQ-13-3

White Sturgeon Year Class Strength

Long-term Average and Average by Water Year Type

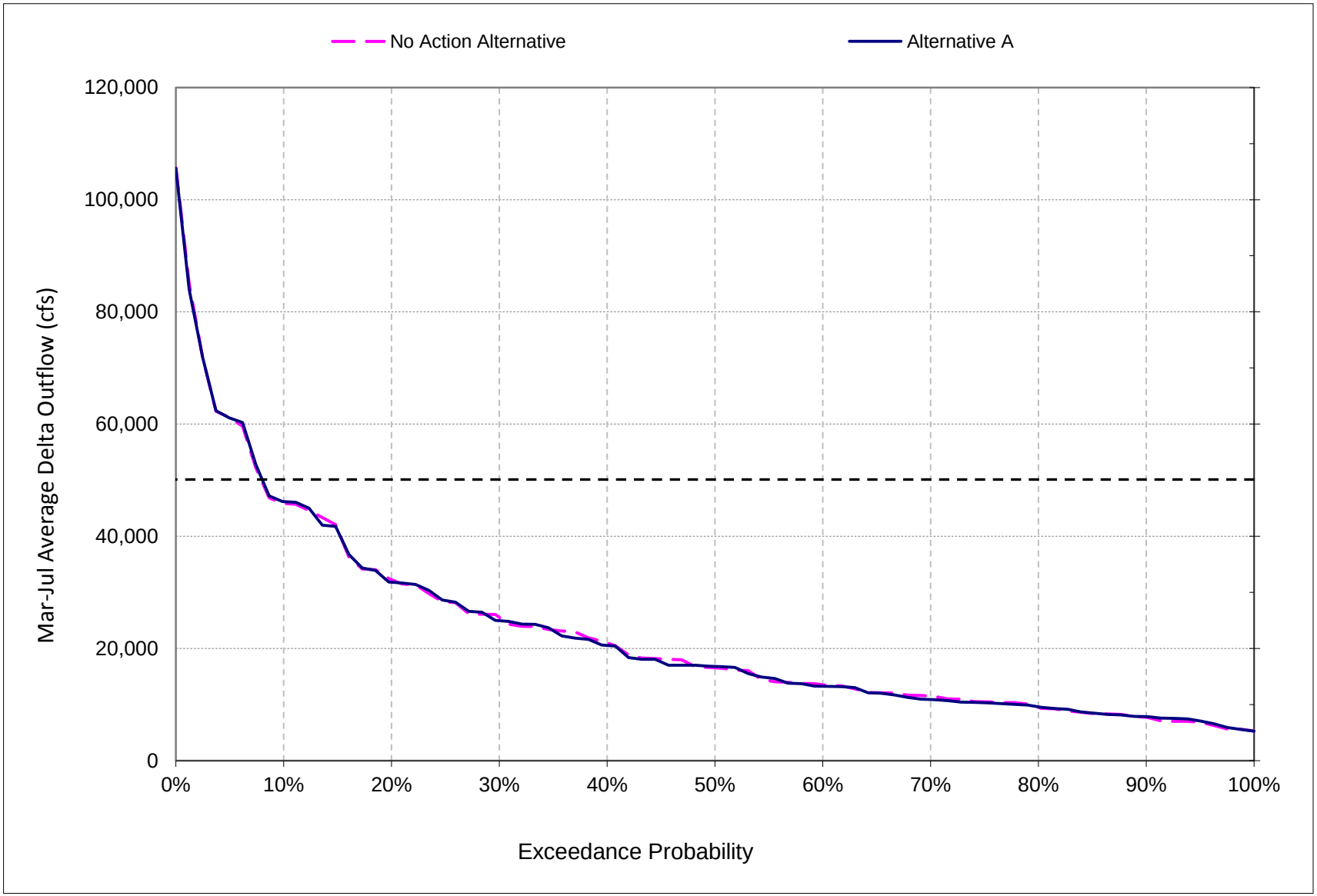
Analysis Period	Mar-Jul Average Delta Outflow (cfs)
Long-term	
Full Simulation Period[1]	
No Action Alternative	23,060.5
Alternative A	23,016.7
Difference	-43.8
Percent Difference[3]	0.0
Water Year Types[2]	
Wet (32%)	
No Action Alternative	41,513.3
Alternative A	41,687.0
Difference	173.7
Percent Difference	0.0
Above Normal (15%)	
No Action Alternative	25,939.7
Alternative A	25,825.1
Difference	-114.6
Percent Difference	0.0
Below Normal (17%)	
No Action Alternative	15,178.2
Alternative A	14,995.6
Difference	-182.7
Percent Difference	0.0
Dry (22%)	
No Action Alternative	11,171.2
Alternative A	10,919.0
Difference	-252.2
Percent Difference	0.0
Critical (15%)	
No Action Alternative	7,230.3
Alternative A	7,261.0
Difference	30.7
Percent Difference	0.0

1 Based on the 82-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999)

3 Relative difference of the monthly average

Figure AQ-13-3
White Sturgeon Year Class Strength
Probability of Exceedance



Alternative B Compared to No Action Alternative

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Table AQ-13-5

White Sturgeon Year Class Strength

Long-term Average and Average by Water Year Type

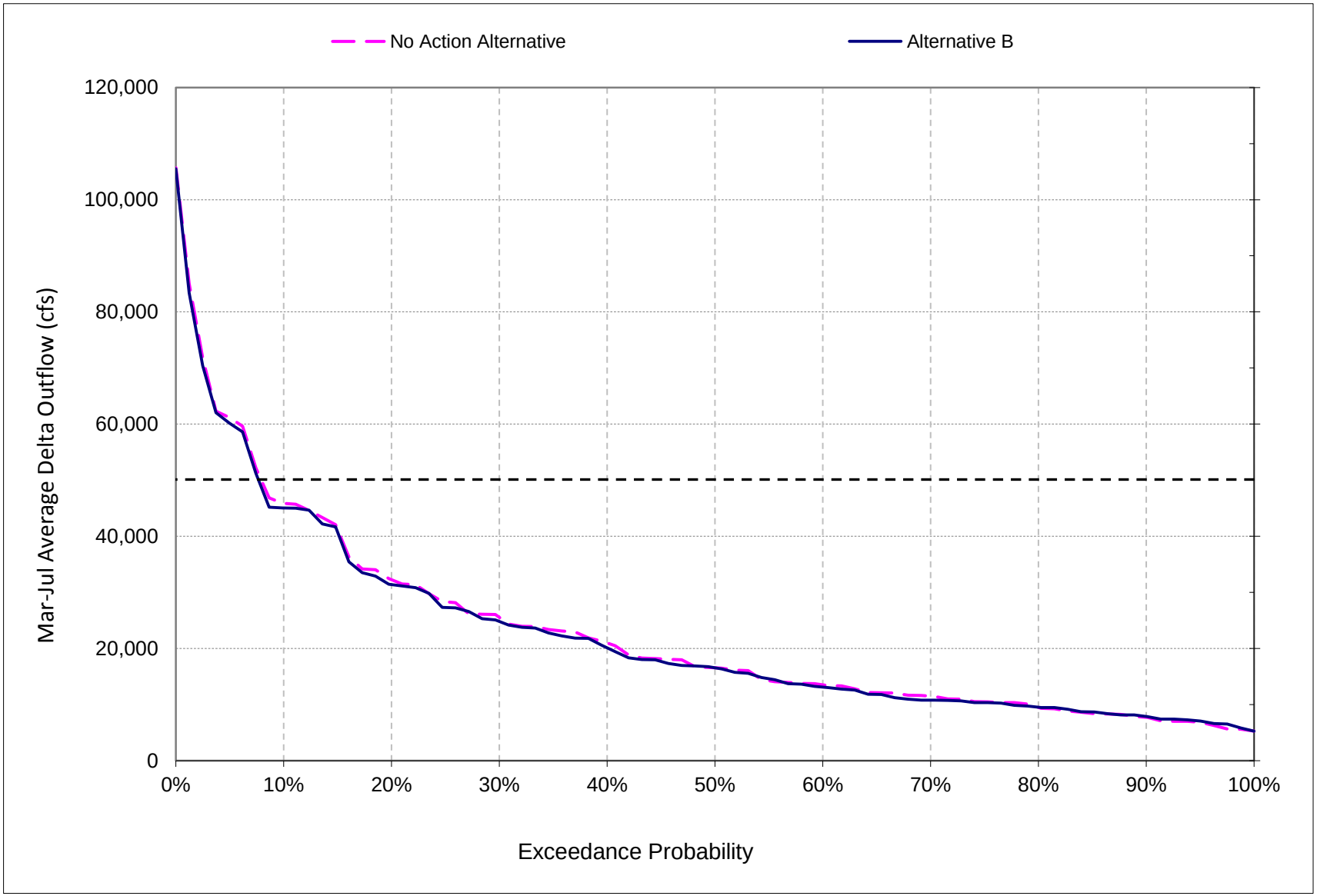
Analysis Period	Mar-Jul Average Delta Outflow (cfs)
Long-term	
Full Simulation Period[1]	
No Action Alternative	23,060.5
Alternative B	22,691.3
Difference	-369.2
Percent Difference[3]	0.0
Water Year Types[2]	
Wet (32%)	
No Action Alternative	41,513.3
Alternative B	40,964.9
Difference	-548.3
Percent Difference	0.0
Above Normal (15%)	
No Action Alternative	25,939.7
Alternative B	25,328.6
Difference	-611.1
Percent Difference	0.0
Below Normal (17%)	
No Action Alternative	15,178.2
Alternative B	14,768.0
Difference	-410.2
Percent Difference	0.0
Dry (22%)	
No Action Alternative	11,171.2
Alternative B	10,923.1
Difference	-248.1
Percent Difference	0.0
Critical (15%)	
No Action Alternative	7,230.3
Alternative B	7,357.5
Difference	127.2
Percent Difference	0.0

1 Based on the 82-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999)

3 Relative difference of the monthly average

Figure AQ-13-5
White Sturgeon Year Class Strength
Probability of Exceedance



Alternative C Compared to No Action Alternative

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Table AQ-13-7

White Sturgeon Year Class Strength

Long-term Average and Average by Water Year Type

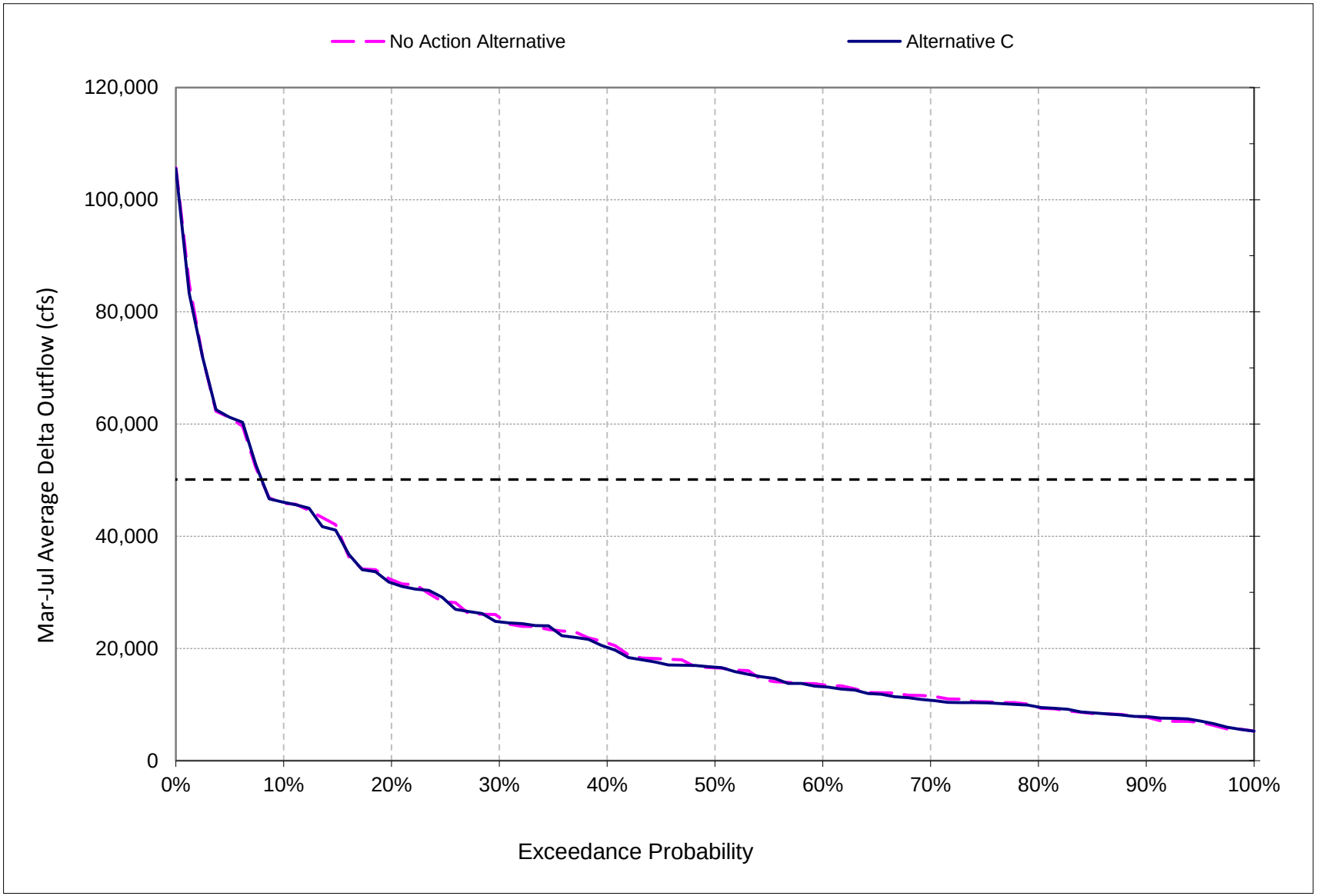
Analysis Period	Mar-Jul Average Delta Outflow (cfs)
Long-term	
Full Simulation Period[1]	
No Action Alternative	23,060.5
Alternative C	22,892.2
Difference	-168.4
Percent Difference[3]	0.0
Water Year Types[2]	
Wet (32%)	
No Action Alternative	41,513.3
Alternative C	41,542.7
Difference	29.4
Percent Difference	0.0
Above Normal (15%)	
No Action Alternative	25,939.7
Alternative C	25,565.6
Difference	-374.1
Percent Difference	0.0
Below Normal (17%)	
No Action Alternative	15,178.2
Alternative C	14,840.1
Difference	-338.1
Percent Difference	0.0
Dry (22%)	
No Action Alternative	11,171.2
Alternative C	10,851.6
Difference	-319.6
Percent Difference	0.0
Critical (15%)	
No Action Alternative	7,230.3
Alternative C	7,264.1
Difference	33.8
Percent Difference	0.0

1 Based on the 82-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999)

3 Relative difference of the monthly average

Figure AQ-13-7
White Sturgeon Year Class Strength
Probability of Exceedance



Alternative D Compared to No Action Alternative

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Table AQ-13-9

White Sturgeon Year Class Strength

Long-term Average and Average by Water Year Type

Analysis Period	Mar-Jul Average Delta Outflow (cfs)
Long-term	
Full Simulation Period[1]	
No Action Alternative	23,060.5
Alternative D	22,840.3
Difference	-220.3
Percent Difference[3]	0.0
Water Year Types[2]	
Wet (32%)	
No Action Alternative	41,513.3
Alternative D	41,475.1
Difference	-38.2
Percent Difference	0.0
Above Normal (15%)	
No Action Alternative	25,939.7
Alternative D	25,541.3
Difference	-398.4
Percent Difference	0.0
Below Normal (17%)	
No Action Alternative	15,178.2
Alternative D	14,828.6
Difference	-349.6
Percent Difference	0.0
Dry (22%)	
No Action Alternative	11,171.2
Alternative D	10,781.4
Difference	-389.8
Percent Difference	0.0
Critical (15%)	
No Action Alternative	7,230.3
Alternative D	7,198.9
Difference	-31.4
Percent Difference	0.0

1 Based on the 82-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999)

3 Relative difference of the monthly average

Figure AQ-13-9
White Sturgeon Year Class Strength
Probability of Exceedance