Chapter 7 Alternative Evaluation

This chapter describes the evaluation of physical improvements, economics, and the four P&G accounts for the NODOS/Sites Reservoir Project alternatives.

Evaluation of Physical Accomplishments

This section discusses the predicted physical accomplishments of each alternative and evaluates the relative strengths and weaknesses of each plan. All alternatives were modeled using CALSIM II and a variety of supporting models (see Figure 7-1 and Figure 7-2) to evaluate their performance. It is anticipated that the specific beneficiaries would be better defined for the Final Feasibility Report. This better definition would support a more detailed assessment of physical accomplishments and benefits.

Table 7-1 summarizes the increases in deliveries associated with the project objectives for each of the alternatives. As the table indicates, the ability to increase deliveries varies for each alternative. These variances arise from the following project features:

- The size of the reservoir (More deliveries are possible with a larger reservoir.)
- The addition of a new intake (Delevan Intake) (The increased ability to divert water results in an increased ability to deliver water.)

The nature of project operations (Approximately 90 percent of the water released to increase deliveries for water supply is exported under Alternatives A, B, and C. Approximately 50 percent of the water released is exported under Alternative D.) Alternative D operations also tend to favor providing benefits for anadromous fish, whereas Alternatives A, B, and C emphasize improved environmental water quality in the Delta. Alternatives C and D have similar infrastructure, and the differences in deliveries for these two alternatives are the result of project operations. Figure 7-3 shows the proportional deliveries for water supply and Delta environmental water quality that would be achieved with the action alternatives.

Dry and Critical years are as defined in SWRCB D-1641 40-30-30 Dry and Critical years for the period October 1921 through September 2003. The long-term Average annual amounts also cover the period October 1921 through September 2003.

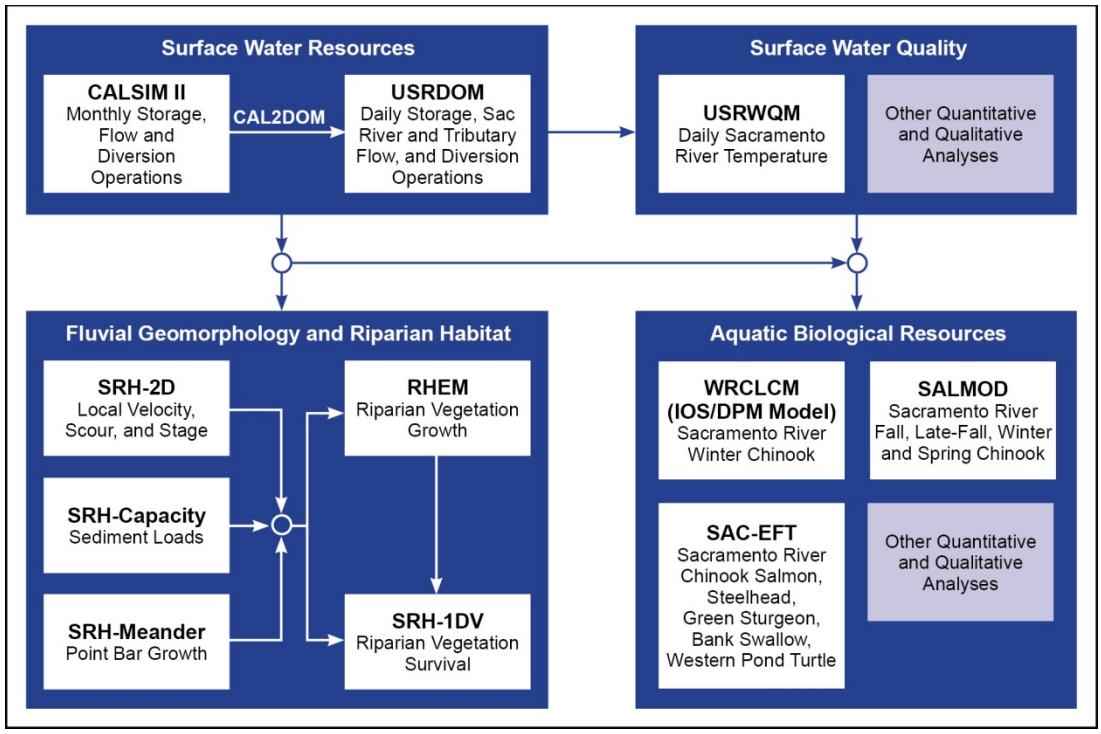

Figure 7-1. Modeling Framework for Alternative Evaluation – System Level

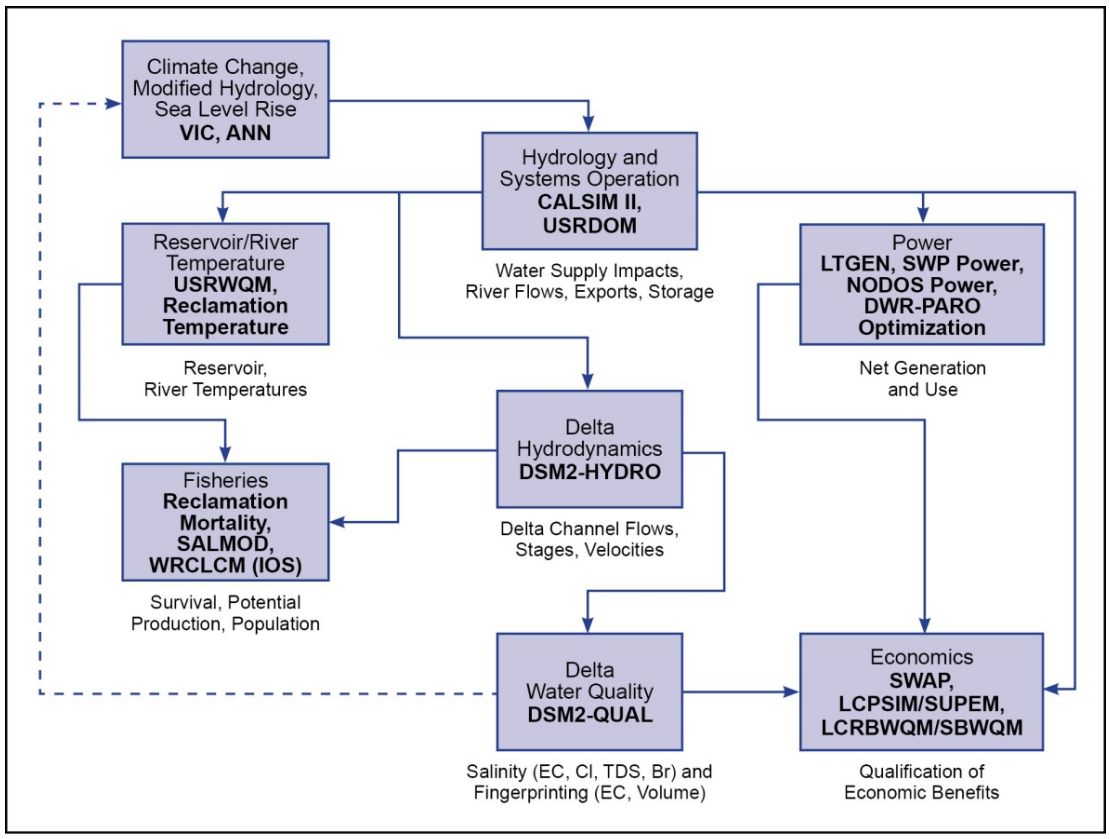

Figure 7-2. Modeling Framework for Alternative Evaluation – Watershed Level

Table 7-1. Increased Long-Term and Dry/Critical Year Deliveries

Objectives and Accomplishments (above No Project Alternative conditions) [a]	Alternative A		Alternative B		Alternative C		Alternative D	
	Average (TAF)	Dry and Critical (TAF)	Average (TAF)	Dry and Critical (TAF)	Average (TAF)	Dry and Critical (TAF)	Average (TAF)	Dry and Critical (TAF)
Alternative Facilities	1.3 MAF Reservoir New Intake		1.8 MAF Reservoir No New Intake		1.8 MAF Reservoir New Intake		1.8 MAF Reservoir New Intake	
Alternative Operation	Export Focus		Export Focus		Export Focus		Sac Valley Focus	
Supplemental Deliveries in SWP Service Area	**122**	**267**	**130**	**248**	**134**	**291**	**116**	**228**
NOD Ag	0	2	0	1	-1	-3	1	4
NOD M&I	1	2	1	2	1	3	1	2
SOD Ag	30	57	34	55	36	67	28	51
SOD M&I	91	206	95	190	98	224	86	171
Supplemental Deliveries in CVP Service Area	**47**	**67**	**11**	**22**	**38**	**55**	**109**	**190**
NOD Ag	19	28	12	14	25	30	97	169
NOD M&I	2	1	0	0	2	1	1	0
SOD Ag	25	37	-1	8	10	22	11	21
SOD M&I	1	1	0	0	1	1	0	0
Sub-Total Deliveries for Water Supply	**169**	**334**	**141**	**270**	**172**	**346**	**225**	**418**
Incremental Level 4 alternative water supply for refuges	44	22	72	37	74	37	48	24
Water supply for Delta environmental water quality/salmonid improvement [b]	212	208	216	217	242	255	174	163
Sub-Total Deliveries for Environmental Benefits	**256**	**230**	**288**	**254**	**316**	**292**	**222**	**187**
Total Deliveries	**425**	**564**	**429**	**524**	**488**	**638**	**447**	**605**
Additional end-of-September storage in Shasta (TAF)	101	139	106	180	108	175	132	198

[a] Increases in deliveries above the No Project Alternative, including supplies for agriculture, M&I, and environmental purposes. Dry and Critical period average is the average quantity for the combination of the SWRCB's D-1641 40-30-30 Dry and Critical years for the period October 1921 to September 2003. The "Average (TAF)" is for this period.

[b] Releases from Sites Reservoir to the Delta solely for environmental benefit. This quantity excludes any water released for export or carriage water requirements. No specific releases were dedicated to water quality improvements for M&I or agriculture.

Ag = agriculture
CVP = Central Valley Project
D-1641 = Water Rights Decision 1641 Revised (SWRCB 2000)
M&I = municipal and industrial
MAF = million acre-feet
SWP = State Water Project
SWRCB = State Water Resources Control Board
TAF = thousand acre-feet

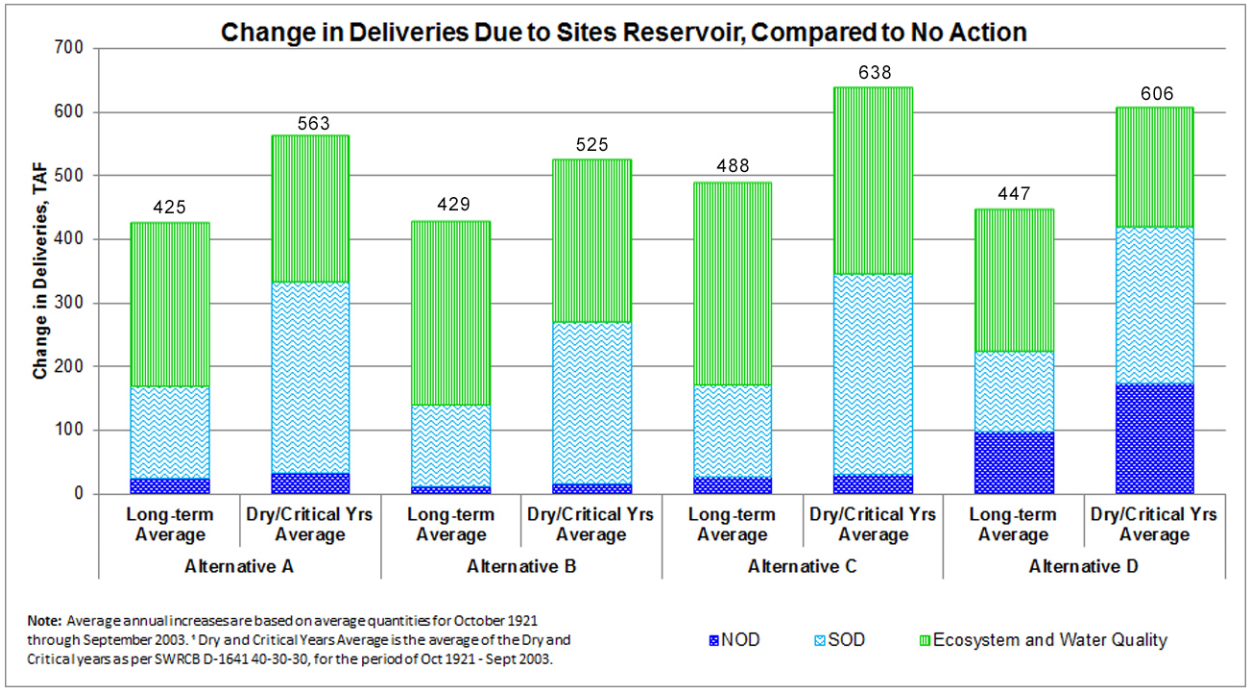

Figure 7-3. Increased Deliveries for Water Supply and Environmental Purposes with Respect to No Project Alternative

Improving System Flexibility, Water Supply, and Water Supply Reliability (Primary Objective)

The amount of total stored water defines the capacity of each alternative to meet the NODOS project flexibility objective. Table 7-2 lists the amount of stored water that would be maintained at Sites Reservoir.

Table 7-2. Water Stored in Sites Reservoir

Parameter	Alternative A (1.3 MAF)	Alternative B (1.8 MAF)	Alternative C (1.8 MAF)	Alternative D (1.8 MAF)
End-of-May Storage (TAF)				
Average Annual	985	1,235	1,441	1,447
Dry and Critical	680	803	1,031	1,051

MAF = million acre-feet
TAF = thousand acre-feet

Figure 7-4 provides a summary of the systemwide (i.e., CVP and SWP reservoirs) increases in storage for the four alternatives. Both the long-term average and the driest periods' average end-of-May storage are provided. This additional storage (800 to 1,500 TAF) appreciably increases the flexibility of system operations to respond to CVP and SWP system needs. Alternatives C and D provide the greatest increase in storage throughout the system.

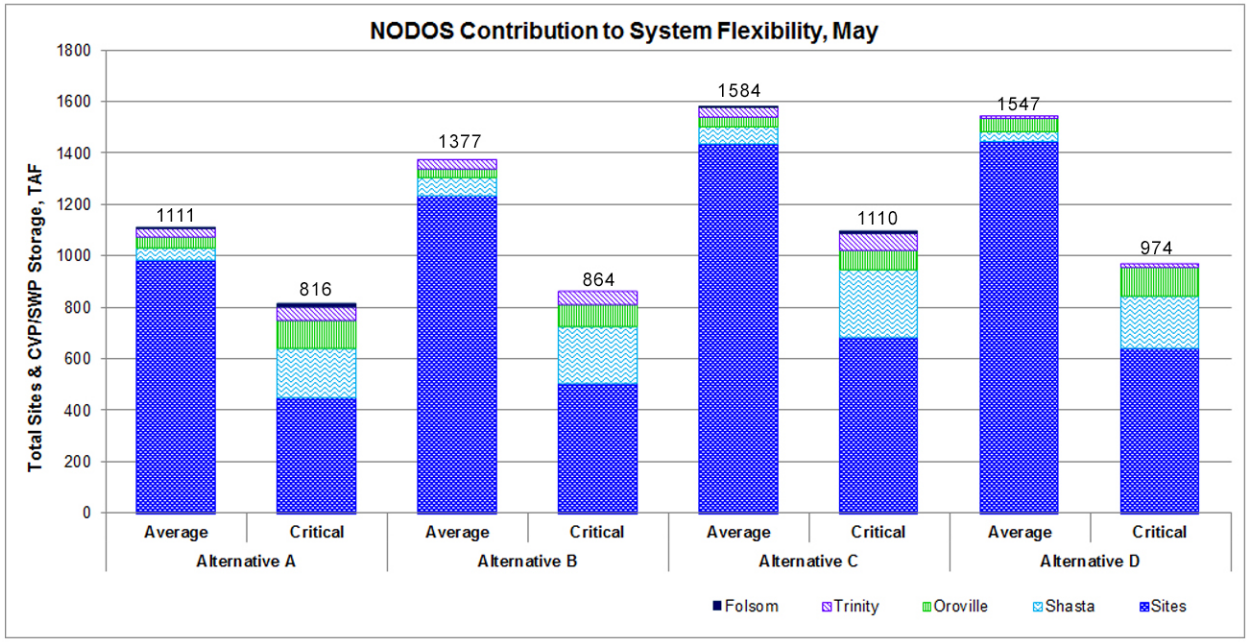

Figure 7-4. Increases in Average End of May Storage in Sites, CVP, and SWP Reservoirs

The following assumptions were made regarding deliveries.

- Under Alternatives A, B, and C, all deliveries would be provided as either CVP or SWP water.
- Under Alternative D, water would be delivered by the Authority. New agreements with Reclamation and DWR to cover conveyance costs would be needed by contractors south of the Delta in the CVP and SWP service areas. Although water transfers would be facilitated by all alternatives, the CALSIM model for Alternative D includes more extensive transfers of Sites Project water from Northern to Southern California. This is consistent with the *California Water Action Plan 2016 Update* (NRA, CDFA, and CalEPA n.d.) strategy to "provide safe and effective water transfers" to manage and prepare for droughts.

Increases in water made available for agricultural and M&I use over the long-term Average and Dry and Critical years were used to evaluate the alternatives with respect to water supply and water supply reliability (see Table 7-1). The water supply objective is measured as a long-term Average change and a Dry/Critical year change in water deliveries.

CVP Contractors would experience modest increases in water made available, with the highest increases realized under Alternative A, followed by Alternatives C and B, in decreasing order. Although existing CVP contractors would receive water under Alternative D, deliveries would be provided by the Authority. The most notable increases in CVP deliveries would occur in Dry years, ranging from an additional 22 TAF/year under Alternative B to 67 TAF/year under Alternative A. Alternative B provides appreciably less water supply due to the absence of the Delevan Intake.

The ability of Sites Reservoir to increase deliveries to SWP contractors in years with less than an 85 percent allocation of contract amounts was evaluated with an emphasis on years below 65 percent allocation. On average, the increases are modest; however, during Critical years (approximately 15 percent of all years fall into the Critical-year category), increases in deliveries range from 228 to 294 TAF/year. Alternative C provides the greatest increases in deliveries to the SWP, followed by Alternatives A and B, in that order. Existing SWP contractors would receive increased deliveries under Alternative D, but the deliveries would be provided by the Authority. Alternative C, with both the additional intake and the larger reservoir, is the best performer.

Increasing Table A deliveries in the action alternatives might take pumping priority over Article 21 exports. SWP contractors could experience a small reduction in Article 21 deliveries. (CALSIM II results show a decrease of 1 to 2 TAF in average Article 21 deliveries from the No Action Alternative for Alternatives A, B, C, and D.)

Alternative D would provide additional non-CVP water to Sites Reservoir participants in the Sacramento Valley. This new supply of 79 TAF on average and up to 182 TAF in Critical years is unique to Alternative D.

Key findings regarding water supply and water supply reliability include the following:

- Alternative D provides the highest average long-term annual delivery increases (224 TAF) and Dry and Critical year increases (418 TAF).
- Alternatives A and C provide similar average long-term annual increases in water supply. However, during Dry/Critical years, Alternative C provides appreciably more water.

Incremental Level 4 Water Supply for Wildlife Refuges (Primary Objective)

The alternatives would provide a reliable source of incremental Level 4 water supply for wildlife refuges. Water is currently purchased both north of the Delta (3.35 TAF/year maximum) and south of the Delta (101.09 TAF/year maximum) to supplement refuge water supplies to achieve the incremental Level 4 objective. The Sites Reservoir alternatives could provide increased long-term water supplies, ranging from 44 TAF under Alternative A to 74 TAF under Alternative C. The ability to provide full incremental Level 4 water supply is reduced in Dry and Critical years (an additional 22 to 37 TAF could be delivered in Dry and Critical years). This water supply would be new water (not CVP water), diverted into Sites Reservoir pursuant to the Sites Project water rights.

Survival of Anadromous Fish and Other Aquatic Species (Primary Objective)

Several operational actions were included in the CALSIM operations model for the alternatives to improve conditions in ways that would support anadromous fish and other aquatic species (Figure 7-5). Most of the improvements for salmonids would occur in the Sacramento River between Keswick Dam and Red Bluff. Actions to benefit fish in this portion of the river include:

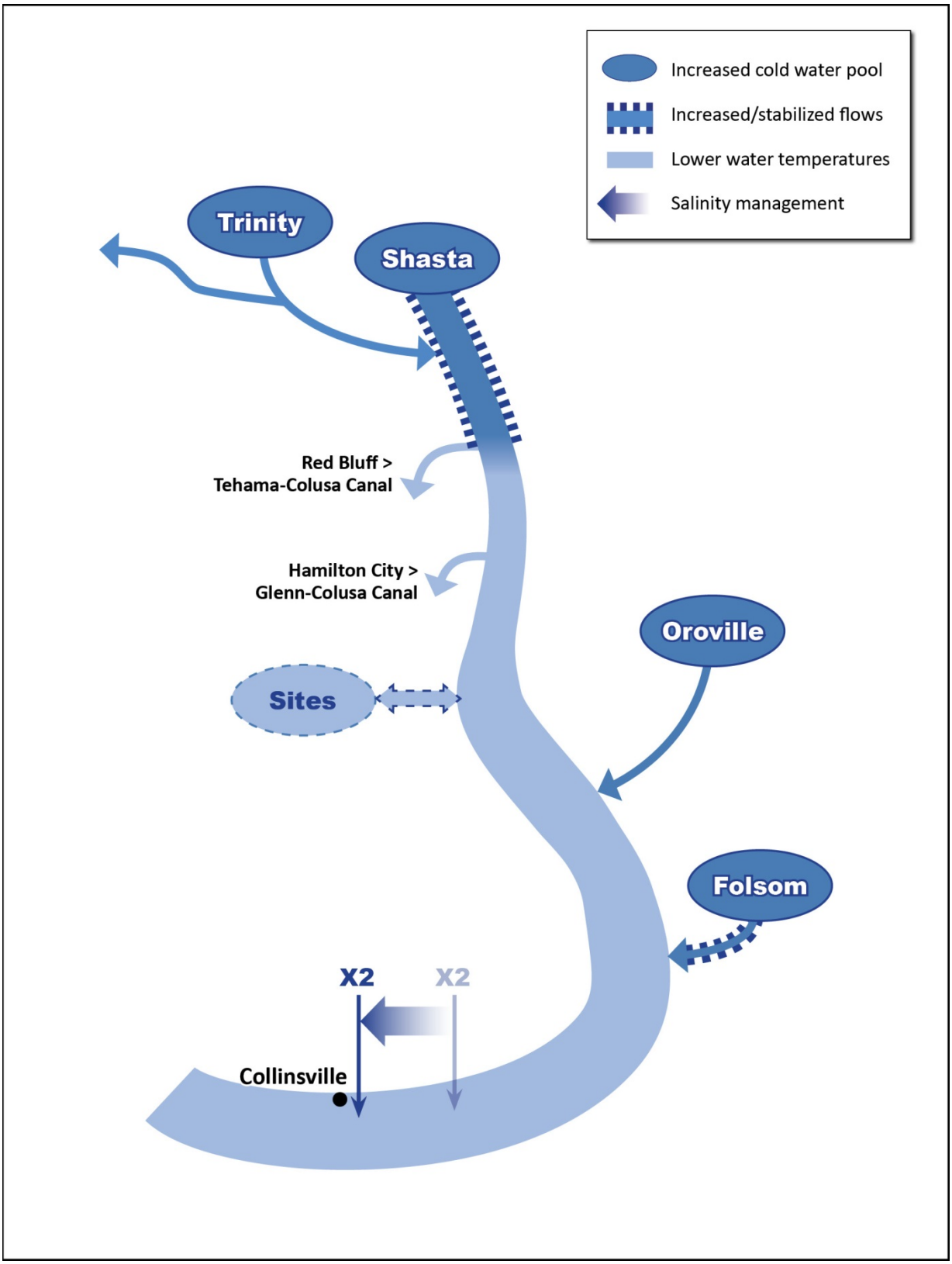

Figure 7-5. Conceptual Model of Benefits to Anadromous Fish from Sites Reservoir Project

- Shasta Lake coldwater pool improvement
- Augmentation of Sacramento River flows for temperature control
- Augmentation of Sacramento River fall flows to support migration and reduce dewatering of redds

Water temperature is one of the principal drivers for salmonid production. Evidence suggests a strong correlation between daytime migratory activity and water temperature. There are optimum temperatures for survival and growth that minimize mortality. However, as temperatures reach maximum threshold values, fish stress levels and fish mortality increase. Each of the NODOS project action alternatives increases the coldwater pool at Shasta Lake. Augmenting flows in the Sacramento River would also reduce isolation events to support the migration of fish. Water flow and net river discharge have been shown to be highly influential in the rates at which young salmon migrate.

Improvements in habitat conditions for anadromous fish in the Sacramento River were directly evaluated through the use of SALMOD. SALMOD evaluates the linkage between habitat dynamics (i.e., flow and temperature) and smolt growth, movement, and survival between Keswick Dam and Red Bluff (Figure 7-6). SALMOD also was used to quantify the effects of flow and temperature regimes for the alternatives on annual production potential. SALMOD is habitat-based, and only examines the juvenile (freshwater) life history phase, but it provides output for all four Sacramento Chinook stocks (winter, spring, fall, and late-fall run).

SALMOD results indicated that water temperature changes had a greater effect on mortality than river flow changes. Sites Reservoir would have beneficial temperature effects for all four Chinook salmon stocks. Figure 7-7 shows the simulated increase in juvenile Chinook salmon based on SALMOD results.

All alternatives would improve the survival of anadromous fish populations (all Chinook stocks) in the Sacramento River. Modeling results suggest that Alternative D would be the most beneficial to anadromous fish, followed closely by Alternative C. Operations focused on increasing end-of-September storage in Shasta appear to provide the greatest benefit to Chinook salmon. Alternative B provides the least benefit to anadromous fish.

Delta Water Quality (Primary Objective)

All alternatives improve water quality in the Delta and in Delta exports. This section evaluates the ability of the alternatives to provide these benefits.

Delta Environmental Water Quality

Increased flows through the Delta and through San Francisco Bay provide a wide range of environmental benefits. These flows increase estuarine habitat, reduce entrainment, and improve food availability for anadromous fish and other estuarine-dependent species (e.g., Delta smelt, longfin smelt, Sacramento splittail, starry flounder, and California bay shrimp). The SWRCB has concluded that the best available science suggests that current Delta flows are insufficient to protect public trust resources, including fish populations (SWRCB 2010).

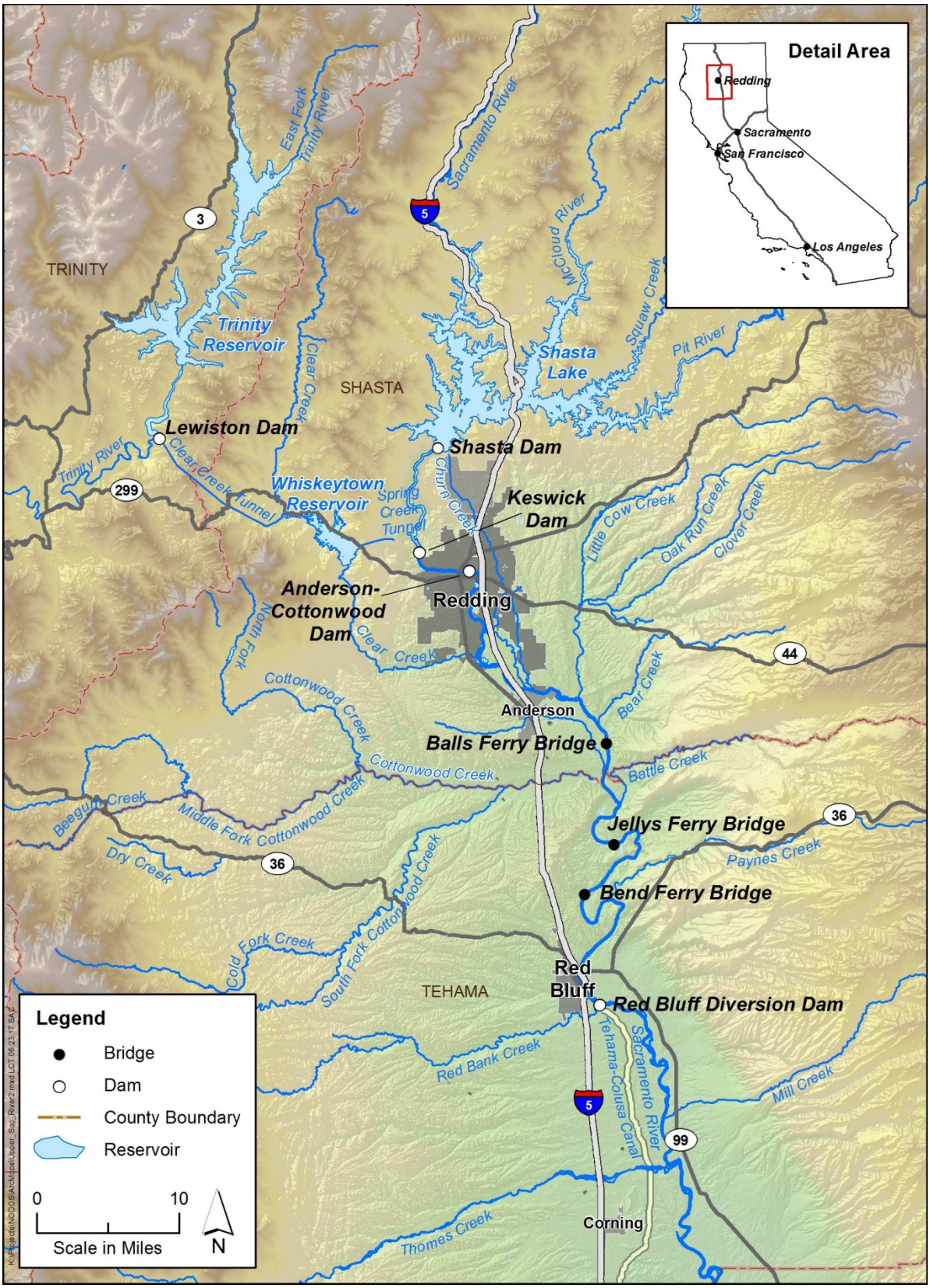

Figure 7-6. Area of Salmon Habitat Improvement Evaluated by SALMOD Model

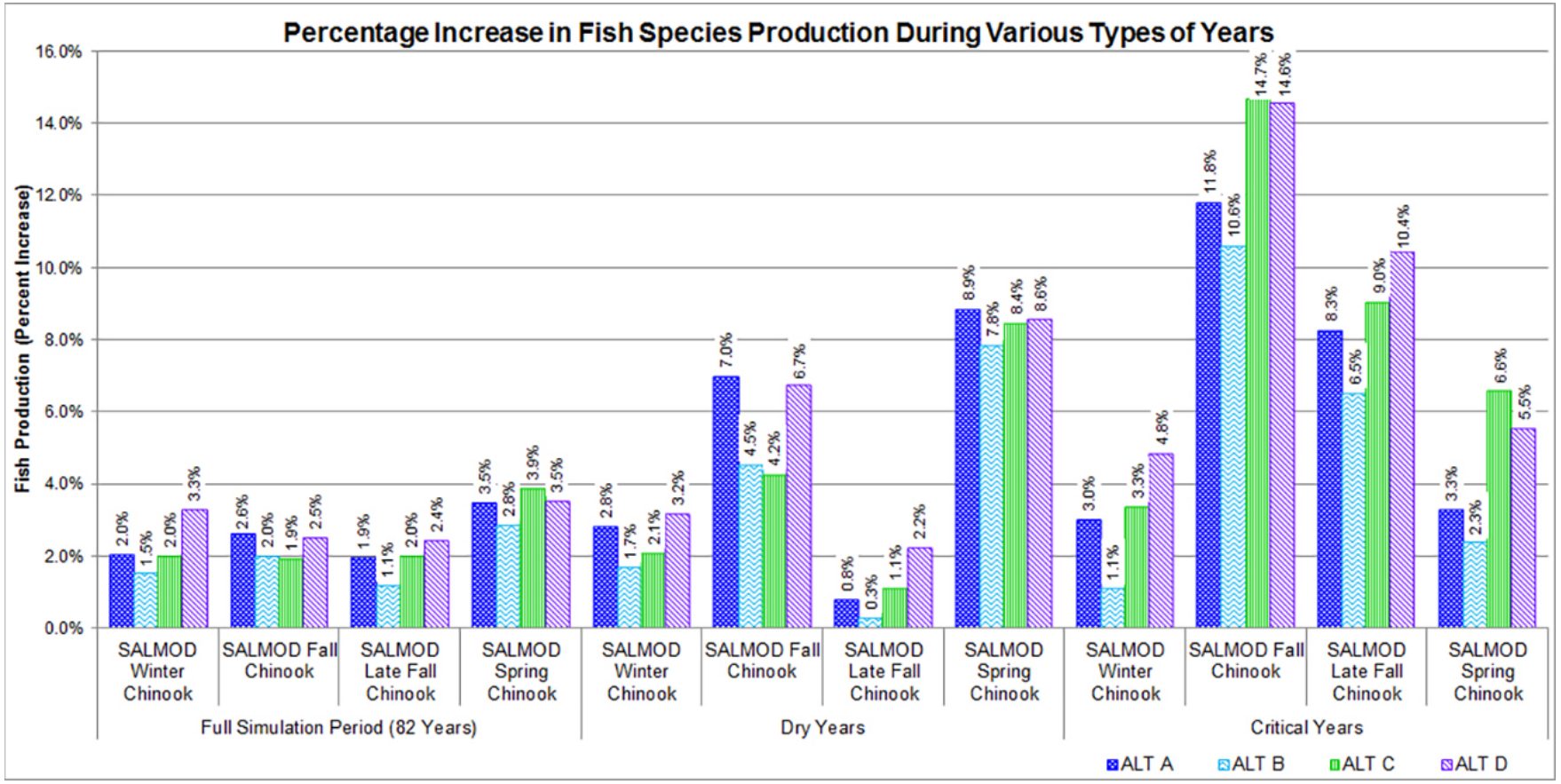

Figure 7-7. Anticipated Effects of Alternatives A, B, C, and D Compared to No Project Alternative on Sacramento River Chinook Salmon Juvenile Production (SALMOD Model)