Attachment 5

Initial Alternatives Evaluation Results

SAN JOAQUIN RIVER
RESTORATION PROGRAM

5. Initial Alternatives Evaluation Results

This section presents the results of the Initial Alternatives evaluation in numeric format, when applicable. The evaluation results figures presented in Section 5.0 of Appendix A have been created based on these results.

5.1 Project Objectives

Table 5-1 presents the results for the project objectives evaluation of the Initial Alternatives. In some instances, depending on the fish and flow routing, some of the objectives are not met because they are not necessary. For instance, if no fish are passing through the Eastside and Mariposa bypasses, then no improvements would be made to these channels. In that case, instead of noting "no" it does not meet the project objectives, it is noted "not necessary" because no fish would use the channel.

Table 5-1.
Project Objectives Evaluation Results

Project Objectives Evaluation Criteria		Alternative 1			Alternative 2	Alternative 3	Alternative 4		
		B	C	D	A	A	A	B	C
Modifications in San Joaquin River channel capacity necessary to ensure conveyance of at least 475 cfs through Reach 4B		Y	Y	Y	Y	Y	Y	Y	Y
Modifications at the Reach 4B Headgate on the San Joaquin River channel to ensure fish passage and enable flow routing of between 500 cfs and 4,500 cfs into Reach 4B, consistent with any determination made in Paragraph 11(b)(1)	Fish Passage	Y	Y	Y	NN	Y	Y	Y	Y
	Flows 500-4500 cfs	Y	Y	Y	Y	Y	Y	Y	Y
Modifications to the Sand Slough Control Structure to ensure fish passage		Y	Y	Y	Y	Y	Y	Y	Y
Modifications to structures in the Eastside and Mariposa Bypass channels to the extent needed to provide anadromous fish passage on an interim basis until completion of the Phase 2 improvements	Eastside	NN	NN	NN	Y	Y	Y	Y	Y
	Mariposa	NN	NN	NN	Y	NN	Y	Y	Y
Modifications in the Eastside and Mariposa Bypass channels to establish a suitable low-flow channel if the Secretary of the Interior in consultation with the Restoration Administrator determines such modifications are necessary to support anadromous fish migration through these channels	Eastside Reach 2	NN	NN	NN	Y	Y	Y	Y	Y
	Eastside Reach 3	NN	NN	NN	NN	Y	NN	NN	NN
	Mariposa	NN	NN	NN	Y	NN	Y	Y	Y
Modifications in the San Joaquin River channel capacity (incorporating new floodplain and related riparian habitat) to ensure conveyance of at least 4,500 cfs through Reach 4B, unless the Secretary, in consultation with the Restoration Administrator and with the concurrence of NMFS and USFWS, determines that such modifications would not substantially enhance achievement of the Restoration Goal	New Floodplain in River	Y	Y	Y	NN	NO	Y	Y	Y
	4500 cfs capacity in River	Y	Y	Y	NN	NO	NO	NO	NO

Key:
Y = Yes
NO = No
NN = Not Necessary

5.2 Technical Feasibility

Table 5-2 shows the results of the technical feasibility evaluation.

Table 5-2.
Technical Feasibility Evaluation Results

Technical Feasibility Criteria		Alternative 1			Alt 2	Alt 3	Alternative 4		
		B	C	D	A	A	A	B	C
Untested technology in similar conditions	Number of structures	0	0	0	0	0	0	0	0
Estimate of complexity		Low	Low	Low	Low	Med	Med	Med	Med
Implementation timing	Months of Construction	45	45	45	29	27	29	29	29

5.3 Environmental Acceptability

This section presents the results of the Environmental Acceptability evaluation, including biological effects, social effects, physical effects, and regulatory effects.

5.3.1 Biological Effects

Table 5-3 presents the biological effects of the Alternatives on vegetation. This table represents the total amount of different types of vegetation within the project footprint. The study team will work to design the alternatives to allow the vegetation to remain; however, inundation of new areas could affect these areas. Due to data limitations, no vegetation impacts were quantified for Levee Alignment A, although any impacts are expected to be less than Options B through D. Table 5-4 presents the biological effects associated with construction during sensitive wildlife periods (February through September).

Table 5-3.
Biological Effects – Vegetation Impacts

Affected Vegetation Type (Acres)	Alternative 1			Alternative 2	Alternative 3	Alternative 4		
	B	C	D	A	A	A	B	C
Herbaceous	1.65	179.4	180.58	0	0	0	1.65	179.4
Open Water	1.07	1.04	1.41	0	0	0	1.07	1.04
Cottonwood Riparian	0	3.31	7.93	0	0	0	0	3.31
Riparian Scrub	0.43	0.69	0.41	0	0	0	0.43	0.69
Wetland/Marsh	0.13	41.14	41.04	0	0	0	0.13	41.14
Willow Riparian (LD)	0.14	16.15	16.15	0	0	0	0.14	16.15
Willow Riparian	2.03	4.26	4.22	0	0	0	2.03	4.26
Willow Scrub	0.31	0.31	0.31	0	0	0	0.31	0.31
Total	**5.76**	**246.3**	**252.05**	**0**	**0**	**0**	**5.76**	**246.3**

Source: DWR 2002

Table 5-4.
Biological Effects – Construction During Sensitive Wildlife Periods

Construction during Sensitive wildlife Periods (Feb – Sept)	Alternative 1			Alternative 2	Alternative 3	Alternative 4		
	B	C	D	A	A	A	B	C
Total Months	32	32	32	20	18	20	20	20

5.3.2 Social Effects

The total amount of agricultural land that would be removed from production under each of the Initial Alternatives is shown in Table 5-5.

Table 5-5.
Total Acres of Agricultural Lands Affected (Based on 2011 Crops)

Crop Type (Acres)	Alternative 1			Alternative 2	Alternative 3		Alternative 4		
	B	C	D	A	A	B	A	B	C
Alfalfa	409.31	1056.68	2182.39	83.45	83.45	409.31	83.45	409.31	1056.68
Almonds	106.56	139.37	201.14	92.67	92.67	106.56	92.67	106.56	139.37
Cantaloupes	25.31	33.33	74.95	0.00025	0.00025	25.31	0.00025	25.31	33.33
Corn	33.69	95.57	177.31	4.53	4.53	33.69	4.53	33.69	95.57
Cotton	645.74	1753.22	2977.69	60.94	60.94	645.74	60.94	645.74	1753.22
Double Crop Oats/Corn	25.38	132.77	214.51	9.34	9.34	25.38	9.34	25.38	132.77
Double Crop Winter Wheat/ Corn	4.89	10.26	38.47	4.39	4.39	4.89	4.39	4.89	10.26
Dry Bean	1.11	1.24	2.001	n/a	n/a	1.11	n/a	1.11	1.24
Fallow/Idle Cropland	66.93	95.99	141.81	37.21	37.21	66.93	37.21	66.93	95.99
Grapes	4.17	6.46	10.89	2.87	2.87	4.17	2.87	4.17	6.46
Oats	7.69	24.3	50.31	4.15	4.15	7.69	4.15	7.69	24.3
Other Hay	3.34	6.45	10.47	1.62	1.62	3.34	1.62	3.34	6.45
Pistachios	7.79	9.12	14.68	6.51	6.51	7.79	6.51	7.79	9.12
Pomegranates	2.22	2.22	2.89	2.02	2.02	2.22	2.02	2.22	2.22
Tomatoes	351.12	843.05	1323.26	45.33	45.33	351.12	45.33	351.12	843.05
Walnuts	0.44	0.44	1.11	0.44	0.44	0.44	0.44	0.44	0.44
Winter Wheat	151.87	433.52	766.98	14.01	14.01	151.87	14.01	151.87	433.52
Total Acres	**1,848**	**4,644**	**8,191**	**369**	**369**	**1,848**	**369**	**1,848**	**4,644**

Source: USDA NASS 2012

The total loss of agricultural production under each of the Alternatives is presented in Table 5-6.

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Table 5-6.
Loss of Annual Agricultural Production in 2010 Dollars

	Alternative 1			Alt 2	Alternative 3		Alternative 4		
Crop Type	**B**	**C**	**D**	**A**	**A**	**B**	**A**	**B**	**C**
Alfalfa	$379,147.91	$978,813.15	$2,021,569.46	$77,300.56	$77,300.56	$379,147.91	$77,300.56	$379,147.91	$978,813.15
Almonds (Kernel Basis)	$307,530.50	$402,219.65	$580,486.90	$267,444.17	$267,444.17	$307,530.50	$267,444.17	$307,530.50	$402,219.65
Cantaloupes	$71,755.56	$94,492.80	$212,488.30	$0.71	$0.71	$71,755.56	$0.71	$71,755.56	$94,492.80
Corn (Silage Corn)	$29,597.53	$83,960.71	$155,771.41	$3,979.72	$3,979.72	$29,597.53	$3,979.72	$29,597.53	$83,960.71
Cotton (Alcala)	$1,029,602.98	$2,795,429.34	$4,747,790.92	$97,166.05	$97,166.05	$1,029,602.98	$97,166.05	$1,029,602.98	$2,795,429.34
Double Crop									
Oats	$6,187.56	$32,368.90	$52,296.85	$2,277.06	$2,277.06	$6,187.56	$2,277.06	$6,187.56	$32,368.90
Corn (Corn Silage)	$22,296.98	$116,641.87	$188,452.57	$8,205.43	$8,205.43	$22,296.98	$8,205.43	$22,296.98	$116,641.87
Double Crop									
Winter Wheat (Wheat)	$2,475.24	$5,193.44	$19,472.88	$2,222.15	$2,222.15	$2,475.24	$2,222.15	$2,475.24	$5,193.44
Corn (Corn Silage)	$4,295.99	$9,013.67	$33,796.89	$3,856.73	$3,856.73	$4,295.99	$3,856.73	$4,295.99	$9,013.67
Dry Bean (Dry Lima)	$1,468.13	$1,640.07	$2,646.60	N/A	N/A	$1,468.13	N/A	$1,468.13	$1,640.07
Fallow/Idle Cropland	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Grapes (Wine)	$12,586.97	$19,499.24	$32,871.01	$8,662.97	$8,662.97	$12,586.97	$8,662.97	$12,586.97	$19,499.24
Oats (Hay Grain)	$1,874.80	$5,924.26	$12,265.42	$1,011.76	$1,011.76	$1,874.80	$1,011.76	$1,874.80	$5,924.26
Other Hay (Hay Alfalfa)	$3,093.88	$5,974.70	$9,698.46	$1,500.62	$1,500.62	$3,093.88	$1,500.62	$3,093.88	$5,974.70
Pistachios	$71,718.33	$83,962.92	$135,150.84	$59,934.06	$59,934.06	$71,718.33	$59,934.06	$71,718.33	$83,962.92
Pomegranates	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tomatoes (Processing)	$1,046,310.04	$2,512,222.82	$3,943,210.92	$135,079.84	$135,079.84	$1,046,310.04	$135,079.84	$1,046,310.04	$2,512,222.82
Walnuts	$1,493.32	$1,493.32	$3,767.24	$1,493.32	$1,493.32	$1,493.32	$1,493.32	$1,493.32	$1,493.32
Winter Wheat (Wheat)	$76,874.09	$219,440.67	$388,232.62	$7,091.63	$7,091.63	$76,874.09	$7,091.63	$76,874.09	$219,440.67
Total Value	**$3,068,310**	**$7,368,292**	**$12,539,969**	**$677,227**	**$677,227**	**$3,068,310**	**$677,227**	**$3,068,310**	**$7,368,292**

2 Source: USDA NASS 2012; Merced County 2010.

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The Reach 4B Project Alternatives have the potential to affect land, as shown in Table 5-7.

Table 5-7.
Affected Land

Affected Land	Alternative 1			Alternative 2	Alternative 3	Alternative 4		
	B	C	D	A	A	A	B	C
Total Acres	2,985	6,195	10,150	1,265	1,265	1,265	2,985	6,195
Number of Parcels	67	100	139	52	52	52	67	100

5.3.3 Physical Effects

The physical effects of the Reach 4B Project Alternatives are shown in Table 5-8.

Table 5-8.
Physical Effects

Physical Effects Evaluation Criteria		Alternative 1			Alternative 2	Alternative 3	Alternative 4		
		B	C	D	A	A	A	B	C
Air quality: intensity of construction	Average $/month of construction (millions of dollars)	$4.9	$8.7	$13.4	$5.6	$9.3	$8.4	$10.8	$16.9
Noise	Months of Construction	47	47	47	29	27	29	29	29

5.3.4 Regulatory Effects

The miles of disturbed waterways and number of modified flood control structures under the Reach 4B Alternatives are presented in Table 5-9.

Table 5-9.
Channel and Flood Control Structure Modifications

Regulatory Effects Evaluation Criteria	Alternative 1			Alternative 2	Alternative 3	Alternative 4		
	B	C	D	A	A	A	B	C
Disturbed waterway in SJR (Miles)	21	21	21	21	21	21	21	21
Disturbed waterway in Bypasses (Miles)	0	0	0	17.13	23.6	17.13	17.13	17.13
Total Disturbed Waterway (Miles)	**21**	**21**	**21**	**38.13**	**44.6**	**38.13**	**38.13**	**38.13**
Number of modified flood control structures	2	2	2	4	3	4	4	4

5.4 Cost

Table 5-10 shows the available costs for each of the Reach 4B Project Alternatives. The operations and maintenance costs (O&M costs) represent the present value of O&M over a 50-year period. The O&M costs do not include costs for levee maintenance because the O&M would be performed locally. If these costs deviate significantly from current O&M costs, potential changes will need to be considered during future evaluation. The cost of acquiring land is assumed to be $10,000 per acre. This is a preliminary estimate based on information from the Reach 2B Project and will be updated when additional information is available. The revegetation costs are also not yet available; these costs are estimated based on local restoration costs of $4,000 per acre (escalated to account for Reclamation contingencies).

Table 5-10.
Costs (in millions of dollars)

	Alternative 1			Alternative 2	Alternative 3	Alternative 4		
Cost Evaluation Criteria	**B**	**C**	**D**	**A**	**A**	**A**	**B**	**C**
Construction Cost	$61	$64	$67	$105	$99	$113	$87	$89
O&M Costs	$2.8	$2.8	$2.8	$2.3	$7.2	$6.0	$6.0	$6.0
Land Acquisition Costs	$30	$62	$102	$13	$13	$13	$30	$62
Revegetation Costs	$18	$37	$61	$8	$8	$8	$18	$37

5.5 Flood Control

The Reach 4B Project has a constraint that it cannot affect flood control capacity or operational flexibility. All alternatives meet this requirement; however, some may offer a benefit to operational flexibility by increasing the combined capacity of the river and bypasses. Table 5-11 shows the improvements in operational flexibility, indicated by the overall combined capacity of the river and bypass system.

Table 5-11.
Flood Control Operational Flexibility

Improvements in Flood Control Operational Flexibility	Alternative 1			Alternative 2	Alternative 3	Alternative 4		
	B	**C**	**D**	**A**	**A**	**A**	**B**	**C**
Combined design capacity of river and bypass systems (cfs)	23,000	23,000	23,000	16,995	16,995	18,000	18,000	18,000

5.6 Geomorphology/Sediment Transport

Table 5-12 presents the results of the geomorphology/sediment transport evaluation.

Table 5-12.
Geomorphology/Sediment Transport Evaluation

Geomorphology/ Sediment Transport Evaluation Criteria	Alternative 1			Alt 2	Alt 3	Alternative 4		
	B	C	D	A	A	A	B	C
Sediment in equals sediment out (Channel)	Medium (mix of erosion and deposition)	High (mix of erosion and deposition)	Assumed High (mix of erosion and deposition)	Low in SJR (deposition) Medium in EB (mixed)	Medium (mix of erosion and deposition)	Low (mix of erosion and deposition)	Assumed Low (no sediment transport modeling)	Assumed Low (no sediment transport modeling)
Sediment in equals sediment out (floodplain)	High	High	Assumed High	Medium (depositional in EB)	High	Medium (depositional in EB)	Assumed High	Assumed High
Low flow and migration channels (Bypass and main channel) persist without sediment deposition/plugs or excessive channel enlargement	Medium (mix of erosion and deposition)	High (mix of erosion and deposition)	Assumed High (mix of erosion and deposition)	Initially low Maturing to medium in EB (mix of erosion and deposition)	Medium (mix of erosion and deposition)	Low (mix of erosion and deposition)	Assumed Medium (no sediment transport modeling)	Assumed Medium (no sediment transport modeling)
Channel does not headcut or create fish passage barriers	High	High	High	Medium in EB	High in SJR and EB	Low in SJR High in EB	Assumed Medium in SJR (no sediment transport modeling) High in EB (no sediment transport modeling)	Assumed Medium in SJR (no sediment transport modeling) High in EB (no sediment transport modeling)
Pools and bedforms (fishery habitat complexity) can be naturally sustained	Medium	High	High	Low initially Medium After10 yrs	Low/Medium in SJR Low in EB	Medium in SJR Low in EB	Medium/High in SJR Low in EB	Medium/High in SJR Low in EB
Riparian Vegetation Sustainability	High	High	High	Low initially Medium After 10 yrs	Medium in SJR Low in EB	Medium/High in SJR Low in EB	Medium/High in SJR Low in EB	Medium/High in SJR Low in EB

Key:
ESB = Eastside Bypass
SJR = San Joaquin River

5.7 Fisheries

Table 5-13 presents the overall results for most of the fisheries evaluation. Table 5-14 shows the Habitat Suitability Index (HSI) for each alternative. Where there are "zeros" noted in the table, it means that these issues have been eliminated through the engineering designs. All pools at structures are eliminated in Reach 4B1 and the bypasses under the various alternatives. The low flow channel and structural designs ensure that the maximum pool depth is greater than 1 foot for all flows above 45 cfs. All structures and crossings are designed to ensure the velocities are less than 6 feet per second. All fish passage structures were designed to have a zero water surface drop and a maximum 3% slope.

Table 5-13.
Evaluation Criteria for Fisheries

Fisheries Evaluation Criteria				Lifestage	Alternative 1			Alternative 2	Alternative 3	Alternative 4		
					B	C	D	A	A	A	B	C
Fisheries	Predation Issues	Large pools in channel or near structures	Number of pools with average depth > 1.5 m	Juvenile	0	0	0	0	0	0	0	0
	Passage Issues (Adults and Juveniles)	Adequate pool and channel depths	Adults: Habitat area with depths < 1.0 ft	Adults	0	0	0	0	0	0	0	0
			Juveniles: Habitat area with depths < 0.5 ft	Juveniles	0	0	0	0	0	0	0	0
		River channel and bypass channel flow	Adults: Habitat area with velocities > 6.0 ft/sec	Adults	0	0	0	0	0	0	0	0
		Obstructions to migration	Adults: Number of obstructions (culverts, fish ladders, or chutes)	Adults	Medium	Medium	Medium	Medium	Low	Low	Low	Low
			Juveniles: Number of obstructions (ag pump or diversion, culverts, structure that creates a scour pool)	Juveniles	Low	Low	Low	Low	Low	Low	Low	Low
		Water quality barriers	If any part of reach has dissolved oxygen less than 4.5 mg/l or temps > 70^0F then reach is total barrier (**Low**), DO 4.5-5.0 mg/l or temps between 66 and 70^0F partial barrier (**Medium**), DO > 5 mg/L or temps < 66^0F then suitable for passage (**High**).	Adults	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Hydraulic jumps/Vertical Barriers	The number of potential vertical barriers, defined as a change in elevation > 1 ft and a jump pool depth of <1.5 times jump height or <2 ft.	Adults	High	High	High	High	High	High	High	High

Table 5-13.
Evaluation Criteria for Fisheries

Fisheries Evaluation Criteria				Lifestage	Alternative 1			Alternative 2	Alternative 3	Alternative 4		
					B	C	D	A	A	A	B	C
Fisheries	Habitat Complexity	Quality of riparian habitat	Area suitable for riparian recruitment, considering soils and baseflow elevations (acres)	Juveniles	790	1,450	2,100	210	1,000	1,000	1,660	2,390
		Floodplain food production	Floodplain food production indicator	Both	Medium	High	High	Low	Low	Low	Low	Low
	Water Quality	Temperature	Suitable temperatures (less than 64 degrees F) during rearing and migration periods for spring-run and fall-run Chinook fry and smolts	Juveniles	Low	Low	Low	Low	Low	Low	Low	Low
		Relative Pesticide concentration	Number of agricultural returns	Both	39	39	39	22	62	51	51	51

Key:
DO = dissolved oxygen
ft = feet
m = meters
N/A = Not Available due to Insufficient Information
“= inches

Table 5-14.
Index of Suitable Habitat Area (HSI)

	1B	1C	1D	2	3A	4A
Spring-run salmon fry	1059	2057	3092	326	405	561
Fall-run salmon fry	488	720	996	221	299	328
Spring-run salmon juveniles	1045	1817	2549	307	385	512
Fall-run salmon juveniles	441	593	745	188	293	317

1