1.0 Flood reduction benefit

The primary benefit from this project is flood damage reduction (FDR). Additional benefits are in the form of increased water storage. FDR benefits are explained in Section 2 while increased water storage benefits are explained in Section 3. FDR benefits have been considered by comparing three events in the without-project scenario with the same events in the with-project scenario.

1.1 Without-project baseline

In the "without project" scenario, an extreme meteorological event is projected to cause an outflow in the vicinity of 126,500 cfs (see Figures 7.1 and 7.5 in Attachment 7). Since the spillway capacity is only approximately 106,500 cfs (see Figure 7.2 in Attachment 7), it is expected that such an event would cause a rise in water elevation in the reservoir leading to overtopping of the dam embankment and dam failure. Such a failure would cause a significantly large flood wave to travel downstream.

The three events considered are:

1. A 100-year flow, which causes no dam failure
2. The threshold flow of 121,000 cfs that causes overtopping and dam failure
3. PMF flow of 126,500 cfs that also causes dam failure but no significant addition damages as compared with Item 2 in this list

1.2 With-project scenario

In the "with project" scenario, the 100-year flow will still not cause any damage. The threshold flow of 121,000 cfs will not cause dam failure, but it will still cause flood damage that would occur as a natural result of limited floodplain capacity downstream. However, the damage arising out of this event will be significantly less than that arising out of a dam breach. Similarly, the PMF flow of 126,500 cfs will not cause dam failure but will cause "natural" flooding downstream.

2.0 Calculation of Expected Annual Damages using F-RAM

An F-RAM model was run to calculate the avoided damages that would result from this project. The basis of the damages is the Emergency Action Plan map (see Figure 7.3) which shows the extents of flooding caused by dam failure. Based on the floodplain boundaries, the amount of land in each of the four affected counties (Yuba, Placer, Sutter, Sacramento) was calculated.

The exact nature of the calculations, assumptions behind counting of residential units and other F-RAM parameters is explained in Attachment 7. Attachment 8-1 shows the input parameters for the F-RAM model. As Attachment 8-1 shows, the higher magnitude events in both without- and with-project scenarios do have damage associated with them. However, the damages arising out of the with-project scenario (i.e., where the dam does not fail) are significantly less than the without-project scenario. Therefore, FDR benefits are calculated on basis of the difference in damages between the two scenarios.

Based on the above methodology, the F-RAM model (which is attached in Attachment 8) calculates the Expected Annual Damages (EAD) that can be avoided with the project to be $5,134,254. The BCA

summary from the F-RAM model is provided in Attachment 8-2.

Table 8.1 summarizes the results of the analysis in terms of expected annual damages:

Figure 8.1 Present value of EAD Benefits

Present Value of Expected Annual Damage Benefits			
Project: Camp Far West Spillway Improvement Project			
(a)	Expected Annual Damage Without Project [1]		**$13,325,915**
(b)	Expected Annual Damage With Project [1]		**$8,132,882**
(c)	Expected Annual Benefit	(a) – (b)	**$5,193,032**
(e)	**Present Value of Future Benefits** **6% discount rate; 50-year period of analysis**	**(c) x (d)**	**$81,851,853**

3.0 Non-Monetized benefit analysis

Attachment 8-3 shows non-monetized benefits based on Table 13 of Exhibit D of PSP. The non-monetized benefits claimed are:

1. Promotion of social health and safety
    a. Reduce risk to life from dam failure or flooding
2. Improve the overall, long-term management of California groundwater resources
    a. Promote aquifer storage by providing irrigators with replacement surface water
3. Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources
    a. Replace groundwater (which requires pumping which requires carbon-intensive energy) with surface water supplied by gravity or minimal pumping

4.0 Monetized benefit analysis

As explained in Attachment 7, the project will lead to an additional 9,830 acre-feet of water storage. This additional surface water helps SSWD avoid the cost of additional water supply purchases. Attachment 8-4 shows the annual cost of the avoided project ("avoided project" being the procurement of additional water supply).

Discount factors in accordance with Table 9 of Exhibit D of PSP have been used. As Attachment 8-4 shows, the total present value of benefits arising out of additional water supply is $1,936,037.

5.0 Proposal benefits and cost summary

Table 8.2 shows a summary of costs and benefits based on Table 17 of Exhibit D of PSP. The total present value of project costs is $5,750,563 while the total present value of benefits is $83,787,890.

Figure 8.2 Proposal benefits and costs summary

Proposal Benefits and Costs Summary Proposal: Camp Far West Spillway Improvement Project Agency: South Sutter Water District						
Project	Project Proponent	Total Present Value Project Costs	Total Present Value Project Benefits			From Section D2 – Briefly describe the main Non-monetized benefits
			From Section D2 – Flood Damage Reduction	From Section D3 – Monetized	Total	
(a)	(b)	(c)	(d)	(e)	(f) = (d) + (e)	(g)
Camp Far West Spillway Improvement Project	South Sutter Water District	$ 5,750,563	$81,851,853	$ 1,936,037	$83,787,890	1. Promotion of public safety through reduction of dam failure damage risk 2. Promote aquifer storage by providing irrigators with replacement surface water 3. Promote energy savings by replacing groundwater (which requires pumping which requires carbon-intensive energy) with surface water supplied by gravity or minimal pumping

Inputs

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Project Name: Camp Far West Spillway Improvement Project

Cost of Project: $ 5,750,563

Description: The proposed improvement consists of lowering the existing uncontrolled spillway from 300 ft to 296.5 ft and installing pneumatically operated spillway gates (Obermeyer Gates) which allow storing water up to the 305 ft level when there is no flood risk (i.e., "sunny day scenario"). This incremental storage does not inundate any additional areas but keeps the reservoir footprint under water on a more consistent basis; during a 100-year storm event, the project allows the reservoir to be maintained approximately 3 feet lower than compared with the existing condition. The proposed project, when completed, will reduce the probability of downstream flooding caused in extreme meteorological approach the PMF level. Without the project, the existing spillway capacity is projected to be overwhelmed, leading to dam failure and sudden inundation downstream.

Number of Events Modeled: 3

	Without Project						With Project					
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
Average Return Interval (ARI)	100	6000	10000				100	6000	10000			
Annual Probability of Exceedance	0.010	0.0002	0.0001	#DIV/0!	#DIV/0!	#DIV/0!	0.010	0.0002	0.0001	#DIV/0!	#DIV/0!	#DIV/0!
Probability of Levee Failure	1.00	1.00	1.00				0.00	1.00	1.00			
Water Surface Elevation - channel (f)	56.0	83.9	83.9				56.0	76.9	76.9			
Flood Warning Time (hours)	8	2	2	0	0		8	8	8	0	0	
Flood Experience	N	Y	Y	N	N		N	Y	Y	N	N	
Period of Inundation (days)	0	4	4				0	3	3			
HEC-FIA DATA INPUTS	N											
Residential Structural Damages ($)												
Residential Contents Damages ($)												
Residential Debris & Cleanup ($)												
Commercial Structural Damages ($)												
Commercial Contents Damages ($)												
Commercial Debris & Cleanup ($)												
Industrial Structural Damages ($)												
Industrial Contents Damages ($)												
Industrial Debris & Cleanup ($)												
Agricultural Structural Damages ($)												
Agricultural Contents Damages ($)												
Agricultural Debris & Cleanup ($)												
Residential Properties												
Ratio Depreciated Value to Replacement Value	54%	54%	54%				54%	54%	54%			
Average Flood depth above ground level (f)	0.00	13.30	13.30				0.00	9.98	9.98			
Rural - Res: Homesteads												
Rural - Other: Barns, sheds												
Urban Res: Single story (no base)	0	11000	11000				0	8250	8250			
Urban Res: Single story (basement)												
Urban Res: Two plus story (no base)												
Urban Res: Two plus story (basement)												
Mobile home												
Commercial Properties												
Ratio Depreciated Value to Replacement Value												
Average Flood depth above ground level (f)												
low value — building area inundated (sq.f.)												
medium value — building area inundated (sq.f.)												
high value — building area inundated (sq.f.)												
Industrial Properties												
Ratio Depreciated Value to Replacement Value												
Average Flood depth above ground level (f)												
low value — building area inundated (sq.f.)												
medium value — building area inundated (sq.f.)												
high value — building area inundated (sq.f.)												
Agricultural Production												
Corn — ac.												
Rice — ac.	0	98448	98448				0	73836	73836			
Walnuts — ac.												
Almonds — ac.												
Cotton — ac.												
Tomatoes — ac.												
Wine Grapes — ac.												
Alfalfa — ac.												
Pasture — ac.												
Safflower — ac.												
Sugar Beets — ac.												
Beans — ac.												
Other — ac.												
Roads												
length of arterial roads inundated (miles)	0	13.5	13.5				0	10.1	10.1			
length of major roads inundated (miles)	0	25.0	25.0				0	18.8	18.8			
length of minor roads inundated (miles)												
length of unsealed roads inundated (miles)												

HEC-FIA model was not prepared

Extrapolate Y-intercept: N

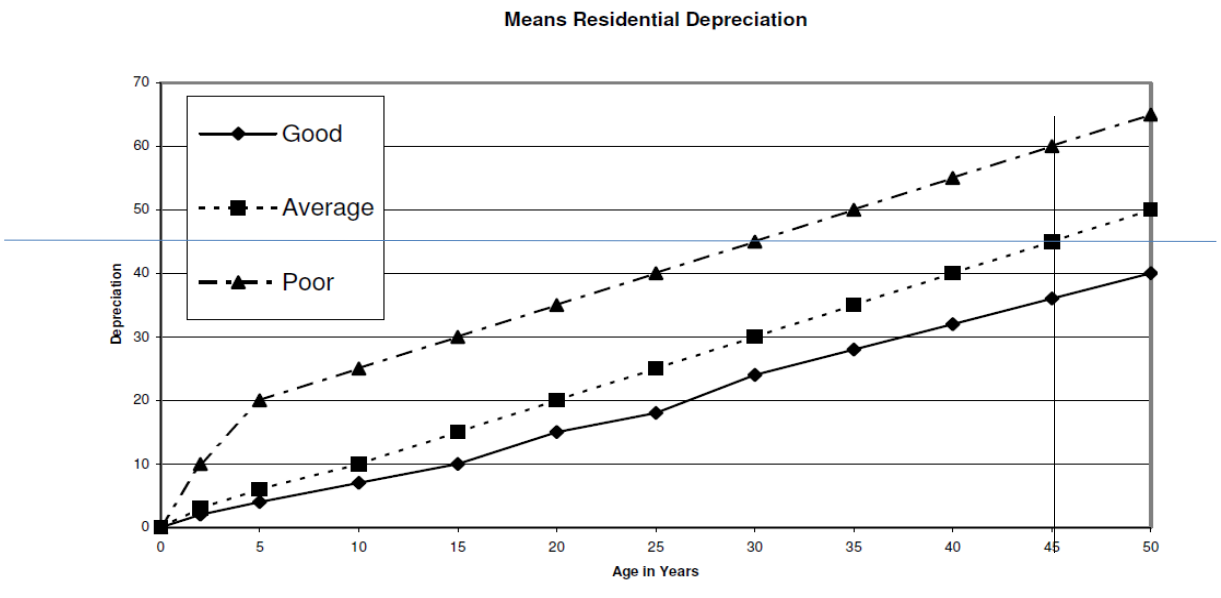

Figure 14.2 Single Family Residential Depreciation Models (Means, 2002)

Summary of Cost-Benefit Analysis

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Project Name: **Camp Far West Spillway Improvement Project**

Description: The proposed improvement consists of lowering the existing uncontrolled spillway from 300 ft to 296.5 ft and installing pneumatically operated spillway gates (Obermeyer Gates) which allow storing water up to the 305 ft level when there is no flood risk (i.e., "sunny day scenario"). This incremental storage does not inundate any additional areas but keeps the reservoir footprint under water on a more consistent basis; during a 100-year storm event, the project allows the reservoir to be maintained approximately 3 feet lower than compared with the existing condition. The proposed project, when completed, will reduce the probability of downstream flooding caused in extreme meteorological approach the PMF level. Without the project, the existing spillway capacity is projected to be overwhelmed, leading to dam failure and sudden inundation downstream.

Proposed project capital cost:	$ 5,750,563	[Note: construction costs which are assumed to occur in one year.]
Change in annual O&M costs:	$ -	[Note: the change in annual O&M costs compared to without project condi
PV of future O&M costs:	$ -	(at 6% discount rate over 50 years)
PV of future costs	$ 5,750,563	[Note: the sum of capital costs plus the PV of O&M costs.]

Benefits

	Actual	Potential	
EAD without project	$ 13,325,915	$ 14,231,264	[Note: for stormwater projects use "Potential" damage which ignores st
EAD with project	$ 8,132,882	$ 9,476,198	
Annual Benefit:	$ 5,193,032	$ 4,755,067	
PV of Future Benefits:	$ 81,851,853	$ 74,948,699	(at 6% discount rate over 50 years)

Cost-Benefit Analysis

	Actual	Potential	
Net Present Value (NPV)	$ 76,101,290	$ 69,198,136	(at 6% discount rate over 50 years)
Benefit:Cost Ratio	14.234	13.033	

NPV Sensitivity to Discount Rate:

	Actual	Potential
4%	$ 105,807,117	$ 96,398,658
5%	$ 89,053,049	$ 81,057,580
6%	$ 76,101,290	$ 69,198,136
7%	$ 65,917,159	$ 59,872,906
8%	$ 57,778,319	$ 52,420,473

Non-monetized Benefits Checklist		
No.	Question	Enter "Yes", "No" or "Neg"
	Community/Social Benefits **Will the proposal**	
1	**Provide education or technology benefits?**	
	Examples are not limited to, but may include: - Include educational features that should result in water supply, water quality, or flood damage reduction benefits? - Develop, test or document a new technology for water supply, water quality, or flood damage reduction management? - Provide some other education or technological benefit?	No
2	**Provide social recreation or access benefits?**	
	Examples are not limited to, but may include: - Provide new or improved outdoor recreation opportunities? - Provide more access to open space? - Provide some other recreation or public access benefit?	No
3	**Help avoid, reduce or resolve various public water resources conflicts?**	
	Examples are not limited to, but may include: - Provide more opportunities for public involvement in water management? - Help avoid or resolve an existing conflict as evidenced by recurring fines or litigation? - Help meet an existing state mandate (e.g., water quality, water conservation, flood control)?	No
4	**Promote social health and safety?**	
	Examples are not limited to, but may include: - Increase urban water supply reliability for fire-fighting and critical services following seismic events? - Reduce risk to life from dam failure or flooding? - Reduce exposure to water-related hazards?	Yes
5	**Have other social benefits?**	
	Examples are not limited to, but may include: - Redress or increase inequitable distribution of environmental burdens? - Have disproportionate beneficial or adverse effects on disadvantaged communities, Native Americans, or other distinct cultural groups?	No
	Environmental Stewardship Benefits: **Will the proposal**	
6	**Benefit wildlife or habitat in ways that were not quantified in Attachment 7?**	
	Examples are not limited to, but may include: - Cause an increase in the amount or quality of terrestrial, aquatic, riparian or wetland habitat? - Contribute to an existing biological opinion or recovery plan for a listed special status species? - Preserve or restore designated critical habitat of a listed species? - Enhance wildlife protection or habitat?	No
7	**Improve water quality in ways that were not quantified in Attachment 7?**	
	Examples are not limited to, but may include: - Cause an improvement in water quality in an impaired water body or sensitive habitat? - Prevent water quality degradation? - Cause some other improvement in water quality?	No
8	**Reduce net emissions in ways that were not quantified in Attachment 7?**	
	Examples are not limited to, but may include: - Reduce net production of greenhouse gasses? - Reduce net emissions of other harmful chemicals into the air or water?	No
9	**Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3 or D4?**	
	Sustainability Benefits: **Will the proposal**	
10	**Improve the overall, long-term management of California groundwater resources?**	
	Examples are not limited to, but may include: - Reduce extraction of non-renewable groundwater? - Promote aquifer storage or recharge?	Yes
11	**Reduce demand for net diversions for the regions from the Delta?**	
12	**Provide a long-term solution in place of a short-term one?**	
	Examples are not limited to, but may include: - Replace a temporary water supply with a more permanent supply? - Replace a temporary water quality solution with a more permanent solution? - Replace temporary flood control management with a more permanent solution? - Replace temporary habitat with a more permanent solution?	No
13	**Reduce water consumption on a permanent basis?**	
14	**Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources?**	
	Examples are not limited to, but may include: - Reduce net energy use on a permanent basis? - Increase renewable energy production? - Include new buildings or modify buildings to include certified LEED features? - Provide a net increase in recycling or reuse of materials? - Replace unsustainable land or water management practices with recognized sustainable practices?	Yes
15	**Improve water supply reliability in ways not quantified in Attachment 7?**	
	Examples are not limited to, but may include: - Provide a more flexible mix of water sources? - Reduce likelihood of catastrophic supply outages? - Reduce supply uncertainty? - Reduce supply variability?	No

Annual Costs of Avoided Projects Project: Camp Far West Spillway Improvement Project						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
Year	Alternative (Avoided Project Name): Avoided water supply purchases Avoided Project Description: Without project an additional 9,830 acre-feet of water would not be available				Discount Factor	Discounted Costs (e) x (f)
	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)		
2012		$ 115,503		$ 115,503	1.000	$ 115,503
2013		$ 115,503		$ 115,503	0.943	$ 108,965
2014		$ 115,503		$ 115,503	0.890	$ 102,797
2015		$ 115,503		$ 115,503	0.840	$ 96,978
2016		$ 115,503		$ 115,503	0.792	$ 91,489
2017		$ 115,503		$ 115,503	0.747	$ 86,310
2018		$ 115,503		$ 115,503	0.705	$ 81,425
2019		$ 115,503		$ 115,503	0.665	$ 76,816
2020		$ 115,503		$ 115,503	0.627	$ 72,468
2021		$ 115,503		$ 115,503	0.592	$ 68,366
2022		$ 115,503		$ 115,503	0.558	$ 64,496
2023		$ 115,503		$ 115,503	0.527	$ 60,845
2024		$ 115,503		$ 115,503	0.497	$ 57,401
2025		$ 115,503		$ 115,503	0.469	$ 54,152
2026		$ 115,503		$ 115,503	0.442	$ 51,087
2027		$ 115,503		$ 115,503	0.417	$ 48,195
2028		$ 115,503		$ 115,503	0.394	$ 45,467
2029		$ 115,503		$ 115,503	0.371	$ 42,894
2030		$ 115,503		$ 115,503	0.350	$ 40,466
2031		$ 115,503		$ 115,503	0.331	$ 38,175
2032		$ 115,503		$ 115,503	0.312	$ 36,014
2033		$ 115,503		$ 115,503	0.294	$ 33,976
2034		$ 115,503		$ 115,503	0.278	$ 32,053
2035		$ 115,503		$ 115,503	0.262	$ 30,238
2036		$ 115,503		$ 115,503	0.247	$ 28,527
2037		$ 115,503		$ 115,503	0.233	$ 26,912
2038		$ 115,503		$ 115,503	0.220	$ 25,389
2039		$ 115,503		$ 115,503	0.207	$ 23,952
2040		$ 115,503		$ 115,503	0.196	$ 22,596
2041		$ 115,503		$ 115,503	0.185	$ 21,317
2042		$ 115,503		$ 115,503	0.174	$ 20,110
2043		$ 115,503		$ 115,503	0.164	$ 18,972
2044		$ 115,503		$ 115,503	0.155	$ 17,898
2045		$ 115,503		$ 115,503	0.146	$ 16,885
2046		$ 115,503		$ 115,503	0.138	$ 15,929
2047		$ 115,503		$ 115,503	0.130	$ 15,027
2048		$ 115,503		$ 115,503	0.123	$ 14,177
2049		$ 115,503		$ 115,503	0.116	$ 13,374
2050		$ 115,503		$ 115,503	0.109	$ 12,617
2051		$ 115,503		$ 115,503	0.103	$ 11,903
2052		$ 115,503		$ 115,503	0.097	$ 11,229
2053		$ 115,503		$ 115,503	0.092	$ 10,594
2054		$ 115,503		$ 115,503	0.087	$ 9,994
2055		$ 115,503		$ 115,503	0.082	$ 9,428
2056		$ 115,503		$ 115,503	0.077	$ 8,895
2057		$ 115,503		$ 115,503	0.073	$ 8,391
2058		$ 115,503		$ 115,503	0.069	$ 7,916
2059		$ 115,503		$ 115,503	0.065	$ 7,468
2060		$ 115,503		$ 115,503	0.061	$ 7,045
2061		$ 115,503		$ 115,503	0.058	$ 6,647
2062		$ 115,503		$ 115,503	0.054	$ 6,270
					Total Present Value of Discounted Costs (Sum of Column (g))	$1,936,037
					(%) Avoided Cost Claimed by Project	100%
					Total Present Value of Discounted Avoided Project Costs Claimed by alternative Project (Total Present Value of Discounted Costs x % Avoided Cost Claimed by Project)	$1,936,037