Attachment
8

Stormwater Flood Management Grant Proposal Littlerock Reservoir Sediment Removal Project Flood Damage Reduction Costs and Benefits

Attachment 8 consists of the following items:

- ✓ **Flood Damage Reduction Costs and Benefits.** Attachment 8 describes and quantifies the benefits and costs of each project in the proposal.

Introduction

This attachment presents the economic analysis for the Littlerock Reservoir Sediment Removal Project (LRSR). A project abstract and of project benefit summary table are followed by the sections as outlined in the PSP: Flood Damage Reduction Benefit Analysis (Section D1), Non-Monetized Benefits Analysis (Section D2), Monetized Benefit Analysis (Section D3), and Project Benefits and Costs Summary (Section D4).

Project Abstract

The LRSR Project proposes to restore the capacity of the reservoir to 3,325 AF through removal of 900,000 net cubic yards (equivalent to 560 AF) of accumulated sediment behind the Littlerock Dam. In addition, the LRSR Project proposes to construct a grade control structure that will prevent sediment loss and headcutting upstream of the Reservoir beyond Rocky Point to protect and preserve habitat for the federally endangered arroyo toad. Water quality, energy, and climate change benefits are also provided by the Project.

Summary Distribution of Project Benefits and Identification of Beneficiaries

The LRSR Project provides multiple benefits to a wide range of beneficiaries. As is shown in Table 8-1 local, regional and statewide benefits come from avoided flood damage, increased water supply, avoided GHG emissions, improved habitat for the endangered Arroyo Toad, improved water quality, increased water supply reliability, and avoided increases in demands on the Delta.

Table 8-1: Project Benefits and Beneficiaries

Project Benefits	Project Beneficiaries
Increased water supplies through restored reservoir capacity	Palmdale Water District and customers
Increased water supply reliability	Palmdale Water District and customers
Avoided increase in demands on the Delta	Statewide residents
Avoided flood damage	Downstream residents and businesses
Improved habitat for endangered Arroyo Toad	General public
Improved water quality	Palmdale Water District and customers

Project Benefits	Project Beneficiaries
Reduced energy consumption	General public
Avoided GHG emissions	General public

Flood Damage Reduction Benefit Analysis (Section D1)

Flooding downstream of the Littlerock Reservoir as a result of water overtopping the Littlerock Dam could cause damage to existing residential structures, warehouses, commercial outbuildings, and garages. By increasing flood protection, this project will reduce the costs of repairing injured buildings and their contents, as well as costs to public areas (e.g., roads).

Hydrologic modeling of flood damages downstream of Littlerock Dam was performed for this analysis by CDM, as detailed in Attachment 7. Downstream flood damages are shown to affect residential, commercial, and industrial structures, as well as roads. Flood damage reduction benefits were estimated with DWR's F-RAM model. Estimated physical flood protection benefits were input (i.e., flood depth in affected structures and miles of inundated road) into F-RAM to estimate the average annual value of flood protection benefits with and without the Project. F-RAM results indicate that without the Project, average annual damages associated with flooding would amount to $57,171. With the Project, average annual damages would be approximately $53,687. Of this $3,484 annual difference, structural damage accounts for $2,892 and road damages account for $592.

Flood damages were estimated for the without- and with-Project conditions for the following categories:

- Residential structure damage
- Commercial structure damage
- Industrial structure damage
- Road damage

Estimates of probability of a storm with a particular return period overtopping Littlerock Dam are shown in Table 8-2, along with the average flood depth above ground level calculated in the CDM analysis. A ratio of depreciated value to replacement value of 60% was assumed based generally on the older age of the structures that will be flooded downstream.

Table 8-2 Average Flood Depths
Littlerock Reservoir Sediment Removal Project
F-RAM Model Inputs:

Hydrologic Event	10-Yr	25-Yr	50-Yr	100-Yr
Exceedance Probability				
Without Project		0.66	1.00	1.00
With Project		0.50	0.88	1.00
Average Flood Depth Above Finished Floors (ft)				
Without Project		0.67	0.96	1.39
With Project		0.54	0.86	1.39

Without- and With-Project Flood Damage Estimates

F-RAM flood damage estimates for the without- and with-project conditions are summarized in Table 8-3. All dollar amounts are in 2012 dollars. Expected Annual Damages (EAD) calculated with F-RAM are shown at the bottom of the table.

Table 8-3 (PSP Table 11)
Littlerock Reservoir Sediment Removal Project
F-RAM Flood Damage Estimates
(2012 Dollars)

Hydrologic Event	10-Yr	25-Yr	50-Yr	100-Yr
Exceedance Probability		0.04	0.02	0.01
Annual Damage to Residential Structures				
Without Project		$561,386	$850,585	$2,251,724
With Project		$425,292	$748,514	$2,251,724
Annual Damage to Commercial Structures				
Without Project		$0	$0	$42
With Project		$0	$0	$42
Annual Damage to Industrial Structures				
Without Project		$80	$122	$122
With Project		$61	$107	$122
Annual Damage to Roads				
Without Project		$53,625	$117,500	$181,250
With Project		$33,750	$91,300	$181,250
Expected Annual Damages				
Without Project				$57,171
With Project				$53,687
Annual Flood Damage Reduction Benefit				$3,484
Notes				

Present Value of Expected Annual Damages

The present value of flood damage reduction benefits are summarized in Table 8-4 (which corresponds to PSP Table 12).Benefits are assumed to commence in 2020 and have useful life of 50 years. Future benefits are discounted using a 6% discount rate.

Table 8-4 (PSP Table 12) Littlerock Reservoir Sediment Removal Project Present Value of Expected Annual Damages (2012 Dollars)			
(a)	Expected Annual Damage Without Project		**$57,171**
(b)	Expected Annual Damage With Project		**$53,687**
(c)	Expected Annual Benefit	(a) – (b)	**$3,484**
(d)	Present Value Coefficient		**15.76**
(e)	**Present Value of Future Benefits Transfer to Table 17, column (d).**	**(c) x (d)**	**$54,917**

Non-Monetized Benefits Analysis (Section D2)

Table 8-5 shows the non-monetized benefits checklist for the project. Narrative descriptions of the benefit categories marked "Yes" are provide following the table.

Table 8-5 (PSP Table 13) Littlerock Reservoir Sediment Removal Project Non-monetized Benefits Checklist		
No.	Question	Enter "Yes", "No" or "Neg"
	Community/Social Benefits **Will the proposal**	
1	**Provide education or technology benefits?**	No
	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?	
2	**Provide social recreation or access benefits?**	No
	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?	
3	**Help avoid, reduce or resolve various public water resources conflicts?**	Yes[2]
	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?	

Table 8-5 (PSP Table 13) Littlerock Reservoir Sediment Removal Project Non-monetized Benefits Checklist		
No.	Question	Enter "Yes", "No" or "Neg"
	- Help meet an existing state mandate (e.g., water quality, water conservation, flood control)?	
4	**Promote social health and safety?**	No[1]
	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?	
5	**Have other social benefits?**	No
	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?	
	Environmental Stewardship Benefits: **Will the proposal**	
6	**Benefit wildlife or habitat in ways that were not quantified in Attachment 7?**	Yes
	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?	
7	**Improve water quality in ways that were not quantified in Attachment 7?**	No[1]
	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?	
8	**Reduce net emissions in ways that were not quantified in Attachment 7?**	No[1]
	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?	
9	**Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3 or D4?**	No
	Sustainability Benefits: **Will the proposal**	
10	**Improve the overall, long-term management of California groundwater resources?**	No

Table 8-5 (PSP Table 13) Littlerock Reservoir Sediment Removal Project Non-monetized Benefits Checklist		
No.	Question	Enter "Yes", "No" or "Neg"
	Examples are not limited to, but may include: - Reduce extraction of non-renewable groundwater? - Promote aquifer storage or recharge?	
11	**Reduce demand for net diversions for the regions from the Delta?**	Yes
12	**Provide a long-term solution in place of a short-term one?**	No
	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?	
13	**Reduce water consumption on a permanent basis?**	No
14	**Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources?**	No[1]
	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 practices with recognized sustainable practices?	
15	**Improve water supply reliability in ways not quantified in Attachment 7?**	No[1]
	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?	
16	**Other (If the above listed categories do not apply, provide non-monetized benefit description)?**	No

[1] This benefit was already addressed as a physical benefit discussed in Attachment 7.
[2] This benefit is described in more detail in Attachment 9.

Narrative Description of Qualitative Benefits

Benefit wildlife or habitat in ways that were not quantified in Attachment 7

Littlerock Creek, which feeds the Reservoir, provides habitat for the federally endangered arroyo toad (Bufo californicus). Previous plans for sediment removal from the Reservoir posed potential risks for

"take" of arroyo toad and degradation of arroyo toad habitat upstream of the Reservoir beyond the Rocky Point area. The LRSR project proposes to construct a soil cement grade control structure at Rocky Point to prevent sediment loss and headcutting of the stream channel upstream of Rocky Point. This grade control structure will minimize the degradation of critical habitat for and incidental "take" of the federally-endangered arroyo toad. In addition, the grade control structure would act as a barrier between human activities (i.e., recreation activities, sediment removal activities, etc.) within the Reservoir and the arroyo toad's habitat upstream of Rocky Point. Protection of the arroyo toad is consistent with USFS Strategy WL 1 (Threatened, Endangered, Proposed, Candidate, and Sensitive Species Management).

Reduce demand for net diversions for the regions from the Delta

Abating SWP imports has additional benefits from reducing dependence on the Sacramento-San Joaquin Delta, which has competing demands for water supply, habitat, and recreation value. The Delta's ability to provide reliable potable water is affected by variable inflows, competing beneficial uses and water rights, water quality standards, regulatory requirements, pumping operations, and other physical factors[1]. By increasing water supply capacity at the Littlerock Reservoir, PWD is avoiding costs associated with the many factors of providing potable water via diversions of the Delta. Additionally, reducing Delta diversions allays the physical damage to species and habitat caused directly or indirectly by water supply infrastructure. This reduction in operations will help to meet Bay Delta environmental goals to restore fish and wildlife species, as well as tidal marshes and flood plains.

The Antelope Valley Region has made it a priority to reduce dependence on imported water supplies received from the Sacramento-San Joaquin Delta (Delta), a priority that is reflected in the Region's 2007 IRWMP Plan. Diversion of water from the Delta to southern California has caused damage to the Bay Delta's ecosystem due to SWP and Central Valley Project operations. In particular, infrastructure used to divert water to southern California directly impacts species (such as the entrainment of aquatic species in pumps) and damages habitats, while operations that reverse river flows impact ecosystems activity. By reducing the Region's reliance on the Bay Delta, diversions will be reduced, thus reducing operations that impact native species and habitats. This reduction in operations will help to meet Bay Delta environmental goals to restore tidal marshes and floodplains, and restore fish and wildlife species.

Improve water supply reliability in ways not quantified in Attachment 7

The reliability of a water supply refers to the ability to consistently meet water demands, even in times of drought or other constraints on source water availability. The Project would help increase the reliability of water use by PWD by substituting local surface water from Littlerock Reservoir for SWP supplies. The SWP Delivery Reliability Report for 2011[2] shows that the long-term reliability of SWP supplies is 60% of the total demand for SWP Table A water, with deliveries during multiple dry year periods averaging 32% to 38% of total demand. In comparison, PWD's 2010 Strategic Water Resources Plan[3] includes a record of Littlerock Creek runoff by year that indicates a reliability of 100% for PWD's 5,500 AFY diversion right during an average year.

Monetized Benefit Analysis (Section D3)

Water supply benefits from increased storage Littlerock Creek runoff in Littlerock Reservoir and avoided social cost of carbon due to avoided imports of SWP water are claimed as monetized benefits in this section.

[1] California Department of Water Resources (DWR). *The 2011 State Water Project Final Delivery Reliability Report.* Bay-Delta Office. June 2012.
[2] California Department of Water Resources (DWR). *The 2011 State Water Project Final Delivery Reliability Report.* Bay-Delta Office. June 2012.
[3] 2010 Palmdale Water District Strategic Water Resources Program: Options Report, RMC, March 2010.

Increased local water supply

PWD's local surface water supply is from Littlerock Dam Reservoir. This water is transferred from the reservoir to Lake Palmdale for treatment and distribution. PWD's imported water is provided by the SWP and is conveyed to Lake Palmdale which acts as a forebay for the District's 35 million gallon per day (mgd) water treatment plant. Lake Palmdale can store approximately 4,250 AF of SWP and Littlerock Dam Reservoir water.

The sediment removal associated with this project will add 560 AF per year of storage space to Littlerock Reservoir. At described in Attachment 7, without this project PWD would need to meet that amount of demand with increased imports of SWP water. PWD has an allocation of SWP Table A water that it is expected to fully utilize before 2015, given the average reliability of SWP water of 60% in a normal year[4]. Permanent exchanges are currently being priced at approximately $7,500/AF, or a 30 year amortized cost of approximately $550/AF[5]. Losses in the Palmdale Ditch between Littlerock Reservoir and Lake Palmdale reach 33%, and so the cost per AF was adjusted to $825 per AF in 2012 dollars.

The cost of imported water has increased in nominal terms anywhere between 5% and 10% annually in recent years, and we use the midpoint of that range escalate annually at 7.5% into the future.[6] Assuming a long term average inflation rate of 2.5% results in a real escalation rate of approximately 5%. Based on these assumptions, we estimate that the project will provide a present benefit of approximately $17.1 million in avoided water import costs over the next 50 years, assuming a 6% discount rate.

Avoided greenhouse gas emissions

Avoidance of purchase and use of additional imported water to meet PWD demands also avoids energy use associated with delivering imported water. The energy required to convey surface water from the Reservoir to PWD's 15-mgd water treatment plant is essentially zero. For imported supplies, West Basin Municipal Water District (WBMWD) has estimated that approximately 3,000 kilowatt-hours (kWh) per AF of energy is required for conveyance and pumping to Southern California SWP contracting agencies. Greenhouse gas (GHG) emissions generated by the energy needed to transport imported SWP water for the Region can be calculated by applying a factor of 0.724 lbs. of CO_2 equivalents per kWh and converting to total tons of CO_2 equivalents, based on the California Action Registry, General Reporting Protocol.[7] By offsetting the demand of 560 AF of imported SWP water, the proposed Project will avoid GHG emissions of 552 metric tons per year of CO_2 equivalents per year.

Avoided energy use can be valued according to environmental impacts due to carbon emissions. The federal Interagency Working Group on Social Cost of Carbon has developed a value for the global damages contributed by each metric ton of CO_2 equivalent emitted. The social cost of carbon is "intended to include (but is not limited to) changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services" (See Appendix I).[8] The working group value is $21.83/MT, with a range from $4.79/MT to $66.20/MT. When the $21.83/MT value is applied to the avoided emissions from imported water through the end of the useful life of the project, the total present value of the avoided cost of CO2 emissions is $126,316.

[4] Palmdale Water District. 2011. Urban Water Management Plan 2010.
[5] RMC, 2010. PWD's *Strategic Water Resources Program: Options Report, RMC, March 2010.*
[6] Palmdale Water District, 2012. Strategic Water Resources Plan. RMC, March 2010.
[7] Climate Action Registry, General Reporting Protocol http://www.climateregistry.org/tools/protocols/general-reporting-protocol.html
[8] Interagency Working Group on Social Cost of Carbon. 2010. Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866. United States Government. February. Available: www.epa.gov/oms/climate/regulations/scc-tsd.pdf. Accessed January 2013.

Summary

The monetized benefits in this section are calculated from avoided imported water purchase costs and avoided social costs of carbon associated with avoided energy use to transport SWP water from the Delta. As is shown in Table 8-6, the present value of monetized benefits from this section is $17.26 million.

Table 8-6 (PSP Table 14)
Littlerock Reservoir Sediment Removal Project
Other Annual Project Benefits
(2012 Dollars)

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**	**Unit $ Value**	**Annual $ Value (f) x (g)**	**Discount Factor**	**Discounted Benefits (h) x (i)**
2012						$825		1.000	
2013						$866		1.000	
2014						$910		0.890	
2015						$955		0.840	
2016						$1,003		0.792	
2017						$1,053		0.747	
2018						$1,106		0.705	
2019						$1,161		0.665	
2020	avoided reservoir capacity loss	acre-feet	560	0	560	1,219	$682,584	0.627	**$ 428,262**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.627	**$ 7,560**
2021	avoided reservoir capacity loss	acre-feet	560	0	560	$1,280	$716,714	0.592	**$ 424,222**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.592	**$ 7,132**
2022	avoided reservoir capacity loss	acre-feet	560	0	560	$1,344	$752,549	0.558	**$ 420,220**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.558	**$ 6,729**
2023	avoided reservoir capacity loss	acre-feet	560	0	560	$1,411	$790,177	0.527	**$ 416,255**

	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,0506	0.527	**$ 6,348**
2024	avoided reservoir capacity loss	acre-feet	560	0	560	$1,482	$829,686	0.497	**$ 412,328**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.497	**$ 5,989**
2025	avoided reservoir capacity loss	acre-feet	560	0	560	$1,556	$871,170	0.469	**$ 408,438**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.469	**$ 5,650**
2026	avoided reservoir capacity loss	acre-feet	560	0	560	$1,633	$914,728	0.442	**$ 404,585**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.442	**$ 5,330**
2027	avoided reservoir capacity loss	acre-feet	560	0	560	$1,715	$960,465	0.417	**$ 400,768**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.417	**$ 5,028**
2028	avoided reservoir capacity loss	acre-feet	560	0	560	$1,801	$1,008,488	0.394	**$ 396,988**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.394	**$ 4,744**
2029	avoided reservoir capacity loss	acre-feet	560	0	560	$1,891	$1,058,912	0.371	**$ 393,242**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.371	**$ 4,475**
2030	avoided reservoir capacity loss	acre-feet	560	0	560	$1,985	$1,111,858	0.350	**$ 389,533**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.350	**$ 4,222**
2031	avoided reservoir capacity loss	acre-feet	560	0	560	$2,085	$1,167,451	0.331	**$ 385,858**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.331	**$ 3,983**
2032	avoided reservoir capacity	acre-feet	560	0	560	$2,189	$1,225,824	0.312	**$ 382,218**

	loss								
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.312	**$ 3,757**
2033	avoided reservoir capacity loss	acre-feet	560	0	560	$2,298	$1,287,115	0.294	**$ 378,612**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.294	**$ 3,545**
2034	avoided reservoir capacity loss	acre-feet	560	0	560	$2,413	$1,351,470	0.278	**$ 375,040**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.278	**$ 3,344**
2035	avoided reservoir capacity loss	acre-feet	560	0	560	$2,534	$1,419,044	0.262	**$ 371,502**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.262	**$ 3,155**
2036	avoided reservoir capacity loss	acre-feet	560	0	560	$2,661	$1,489,996	0.247	**$ 367,997**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.247	**$ 2,976**
2037	avoided reservoir capacity loss	acre-feet	560	0	560	$2,794	$1,564,496	0.233	**$ 364,525**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.233	**$ 2,808**
2038	avoided reservoir capacity loss	acre-feet	560	0	560	$2,933	$1,642,721	0.220	**$ 361,087**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.220	**$ 2,649**
2039	avoided reservoir capacity loss	acre-feet	560	0	560	$3,080	$1,724,857	0.207	**$ 357,680**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.207	**$ 2,499**
2040	avoided reservoir capacity loss	acre-feet	560	0	560	$3,234	$1,811,100	0.196	**$ 354,306**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.196	**$ 2,357**
2041	avoided reservoir	acre-feet	560	0	560	$3,396	$1,901,655	0.185	**$ 350,963**

	capacity loss								
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.185	**$ 2,224**
2042	avoided reservoir capacity loss	acre-feet	560	0	560	$3,566	$1,996,737	0.174	**$ 347,652**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.174	**$ 2,098**
2043	avoided reservoir capacity loss	acre-feet	560	0	560	$3,744	$2,096,574	0.164	**$ 344,372**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.164	**$ 1,979**
2044	avoided reservoir capacity loss	acre-feet	560	0	560	$3,931	$2,201,403	0.155	**$ 341,124**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.155	**$ 1,867**
2045	avoided reservoir capacity loss	acre-feet	560	0	560	$4,128	$2,311,473	0.146	**$ 337,906**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.146	**$ 1,762**
2046	avoided reservoir capacity loss	acre-feet	560	0	560	$4,334	$2,427,047	0.138	**$ 334,718**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.138	**$ 1,662**
2047	avoided reservoir capacity loss	acre-feet	560	0	560	$4,551	$2,548,399	0.130	**$ 331,560**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.130	**$ 1,568**
2048	avoided reservoir capacity loss	acre-feet	560	0	560	$4,778	$2,675,819	0.123	**$ 328,432**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.123	**$ 1,479**
2049	avoided reservoir capacity loss	acre-feet	560	0	560	$5,017	$2,809,610	0.116	**$ 325,334**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.116	**$ 1,395**
2050	avoided	acre-	560	0	560	$5,268	$2,950,091	0.109	**$ 322,264**

	reservoir capacity loss	feet							
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.109	**$ 1,316**
2051	avoided reservoir capacity loss	acre-feet	560	0	560	$5,531	$3,097,595	0.103	**$ 319,224**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.103	**$ 1,242**
2052	avoided reservoir capacity loss	acre-feet	560	0	560	$5,808	$3,252,475	0.097	**$ 316,213**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.097	**$ 1,172**
2053	avoided reservoir capacity loss	acre-feet	560	0	560	$6,098	$3,415,099	0.092	**$ 313,230**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.092	**$ 1,105**
2054	avoided reservoir capacity loss	acre-feet	560	0	560	$6,403	$3,585,853	0.087	**$ 310,275**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.087	**$ 1,043**
2055	avoided reservoir capacity loss	acre-feet	560	0	560	$6,723	$3,765,146	0.082	**$ 307,347**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.082	**$ 984**
2056	avoided reservoir capacity loss	acre-feet	560	0	560	$7,060	$3,953,403	0.077	**$ 304,448**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.077	**$ 928**
2057	avoided reservoir capacity loss	acre-feet	560	0	560	$7,413	$4,151,074	0.073	**$ 301,576**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.073	**$ 875**
2058	avoided reservoir capacity loss	acre-feet	560	0	560	$7,783	$4,358,627	0.069	**$ 298,731**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.069	**$ 826**

2059	avoided reservoir capacity loss	acre-feet	560	0	560	$8,172	$4,576,559	0.065	**$ 295,913**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.065	**$ 779**
2060	avoided reservoir capacity loss	acre-feet	560	0	560	$8,581	$4,805,387	0.061	**$ 293,121**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.061	**$ 735**
2061	avoided reservoir capacity loss	acre-feet	560	0	560	$9,010	$5,045,656	0.058	**$ 290,356**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.058	**$ 693**
2062	avoided reservoir capacity loss	acre-feet	560	0	560	$9,461	$5,297,939	0.054	**$ 287,616**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.054	**$ 654**
2063	avoided reservoir capacity loss	acre-feet	560	0	560	$9,934	$5,562,836	0.051	**$ 284,903**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.051	**$ 617**
2064	avoided reservoir capacity loss	acre-feet	560	0	560	$10,430	$5,840,977	0.048	**$ 282,215**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.048	**$ 582**
2065	avoided reservoir capacity loss	acre-feet	560	0	560	$10,952	$6,133,026	0.046	**$ 279,553**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.046	**$ 549**
2066	avoided reservoir capacity loss	acre-feet	560	0	560	$11,499	$6,439,678	0.043	**$ 276,916**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.043	**$ 518**
2067	avoided reservoir capacity loss	acre-feet	560	0	560	$12,074	$6,761,661	0.041	**$ 274,303**
	avoided CO_2	tons	552	0	552	$21.83	$12,050	0.041	**$ 489**

	emissions								
2068	avoided reservoir capacity loss	acre-feet	560	0	560	$12,678	$7,099,745	0.038	**$ 271,715**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.038	**$ 461**
2069	avoided reservoir capacity loss	acre-feet	560	0	560	$13,312	$7,454,732	0.036	**$ 269,152**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.036	**$ 435**
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$17,260,677**
Comments:									

Project Benefits and Costs Summary (Section D4)

Project Economic Costs

Project economic costs are summarized in Table 8-7. Initial costs for sediment removal total $11,963,233. Direct construction and implementation costs account for $8,242,723 (about 69%) of total capital costs. Project administration, planning, design, environmental documentation and compliance, permitting and legal fees, and contingency costs account for the remainder of the capital budget.

In addition to the 5-year sediment removal period, maintaining the water supply and flood protection capacity will require removing approximately 54,000 cubic yards of sediment annually. At a cost of $15/CY, this amounts to O&M costs of the project of about $810,000 per year. In total, the present value capital and O&M costs associated with the project amount to $17,688,105 over the 50-year project life (the 50-year project period runs from 2020, the first year following the end of sediment removal, through 2069).

Table 8-7 (PSP Table 16)
Littlerock Reservoir Sediment Removal Project
Project Annual Costs
(2012 Dollars)

	Initial Costs Grand Total Cost from Table 6 (row (i), column (d))	Adjusted Grand Total Cost	Annual Costs						Discounting Calculations	
			Admin	Operation	Maintenance	Replace-ment	Other	Total Costs (a) +…+ (g)	Discount Factor (Capital) Present Value Coeff (O&M)	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012	$ 399,517							$399,517	1.000	**$399,517**
2013	$ 409,335							$409,335	0.943	**$386,003**
2014	$ 409,335							$409,335	0.890	**$364,308**
2015	$ 2,125,409							$2,125,409	0.840	**$1,785,344**
2016	$ 2,125,409							$2,125,409	0.792	**$1,683,523**
2017	$ 2,125,409							$2,125,409	0.747	**$1,588,229**
2018	$ 2,125,409							$2,125,409	0.705	**$1,498,330**
2019	$ 2,243,409							$2,243,409	0.665	**$1,491,995**
2020					$810,000			$810,000	0.627	**$508,204**
2021					$810,000			$810,000	0.592	**$479,438**
2022					$810,000			$810,000	0.558	**$452,300**
2023					$810,000			$810,000	0.527	**$426,698**
2024					$810,000			$810,000	0.497	**$402,545**
2025					$810,000			$810,000	0.469	**$379,760**
2026					$810,000			$810,000	0.442	**$358,264**
2027					$810,000			$810,000	0.417	**$337,985**
2028					$810,000			$810,000	0.394	**$318,853**
2029					$810,000			$810,000	0.371	**$300,805**

2030					$810,000			$810,000	0.350	**$283,778**
2031					$810,000			$810,000	0.331	**$267,716**
2032					$810,000			$810,000	0.312	**$252,562**
2033					$810,000			$810,000	0.294	**$238,266**
2034					$810,000			$810,000	0.278	**$224,779**
2035					$810,000			$810,000	0.262	**$212,056**
2036					$810,000			$810,000	0.247	**$200,053**
2037					$810,000			$810,000	0.233	**$188,729**
2038					$810,000			$810,000	0.220	**$178,046**
2039					$810,000			$810,000	0.207	**$167,968**
2040					$810,000			$810,000	0.196	**$158,460**
2041					$810,000			$810,000	0.185	**$149,491**
2042					$810,000			$810,000	0.174	**$141,029**
2043					$810,000			$810,000	0.164	**$133,046**
2044					$810,000			$810,000	0.155	**$125,515**
2045					$810,000			$810,000	0.146	**$118,411**
2046					$810,000			$810,000	0.138	**$111,708**
2047					$810,000			$810,000	0.130	**$105,385**
2048					$810,000			$810,000	0.123	**$99,420**
2049					$810,000			$810,000	0.116	**$93,792**
2050					$810,000			$810,000	0.109	**$88,483**
2051					$810,000			$810,000	0.103	**$83,475**
2052					$810,000			$810,000	0.097	**$78,750**
2053					$810,000			$810,000	0.092	**$74,292**
2054					$810,000			$810,000	0.087	**$70,087**
2055					$810,000			$810,000	0.082	**$66,120**
2056					$810,000			$810,000	0.077	**$62,377**
2057					$810,000			$810,000	0.073	**$58,847**
2058					$810,000			$810,000	0.069	**$55,516**

2059					$810,000			$810,000	0.065	**$52,373**
2060					$810,000			$810,000	0.061	**$49,409**
2061					$810,000			$810,000	0.058	**$46,612**
2062					$810,000			$810,000	0.054	**$43,974**
2063					$810,000			$810,000	0.051	**$41,485**
2064					$810,000			$810,000	0.048	**$39,136**
2065					$810,000			$810,000	0.046	**$36,921**
2066					$810,000			$810,000	0.043	**$34,831**
2067					$810,000			$810,000	0.041	**$32,860**
2068					$810,000			$810,000	0.038	**$31,000**
2069					$810,000			$810,000	0.036	**$29,245**
Total Present Value of Discounted Costs (Sum of Column (j)) Transfer to Table 17, column (c), Proposal Benefits and Costs Summaries										**$17,688,105**
Comments:										

Proposal Benefits and Costs Summary

Project benefits and costs are summarized in Table 8-8.

Table 8-8 (PSP Table 17) Littlerock Reservoir Sediment Removal Project Proposal Benefits and Costs Summary (2012 Dollars)						
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)
Littlerock Dam and Sediment Removal Project	Palmdale Water District	$ 17,688,105	$54,917	$17,260,677	$17,315,594	Benefit to endangered Arroyo Toad, increased water supply reliability, improved water quality through avoided SWP water imports, avoided increase in demands on the Delta, reduced energy consumption

Strategic Water Resources Program: Options Report

Prepared by:

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Wildermuth Environmental

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Table of Contents

Chapter 1 Introduction 1
1.1 Overview 1
1.2 Vision, Goals and Objectives 1
1.3 Planning Timeline and Boundaries 2
Chapter 2 Demand Assessment 3
2.1 Demand Analysis Approach 4
2.2 Demand Forecast Approach 4
2.3 Demand Assessment Conclusions 4
Chapter 3 Options Evaluation 8
3.1 Baseline Supply Evaluation 8
3.2 Conservation 10
3.3 Groundwater 21
3.4 Imported Water 38
3.5 Recycled Water 54
3.6 Water Banking 66
3.7 Littlerock Reservoir 74
Chapter 4 Conclusions and Recommendations 83
Chapter 5 References 86

Appendices

Appendix A Demand and Conservation Model Analysis

Cost for Delivering Water

The recent cost for delivering SWP water to PWD is summarized below in **Table 3-12**. The cost of pumping SWP water is subsidized by DWR. However, if non-SWP water is moved through the system, a non-subsidized power rate may apply.

Table 3-12: Cost to Transport SWP Water to PWD

Charge Description	2007 Charge (per af)
Transportation Charges	
Capital Cost Component	$51
Minimum OMP&R Component	$47
Off-Aqueduct Component	$36
Variable IMP&R Component	$109
Delta Water Charge	$42
Water System Revenue Bond Surcharge	$9
Total Equivalent Unit Charge	**$295**

(DWR Bulletin 132-06, Table B-24)

In addition to the cost of delivering imported water from its source to PWD, PWD will also need to consider supply storage (such as water banking) that will smooth out deliveries and provide supplies during dry years. In general, the cost associated with banking water may range from $200/af to $400/af. Water banking is addressed in further detail in Section 5.5.

Cost and Terms for Obtaining Water

There are various sources of water that might be available to PWD for purchase or lease including:

- Table A allocations from other SWP contractors
- Allocations from Central Valley Project (CVP) contractors
- Other non-SWP or CVP water rights (pre- and post-1914 water rights)
- New developed water (or water rights) including new diversions/capture, conservation (i.e. agricultural savings, canal lining, etc.), and creation of new supplies (e.g. recycled water or desalination)

Table 3-13 summarizes the various sources and types of water available, general duration of availability, and the typical purpose for that type. DWR allows non-SWP water to be conveyed through the California Aqueduct as long as that water meets water quality requirements and capacity is available. Obtaining non-SWP water may require arrangement for additional aqueduct capacity in addition to paying the cost of moving water at non-subsidized power rates.

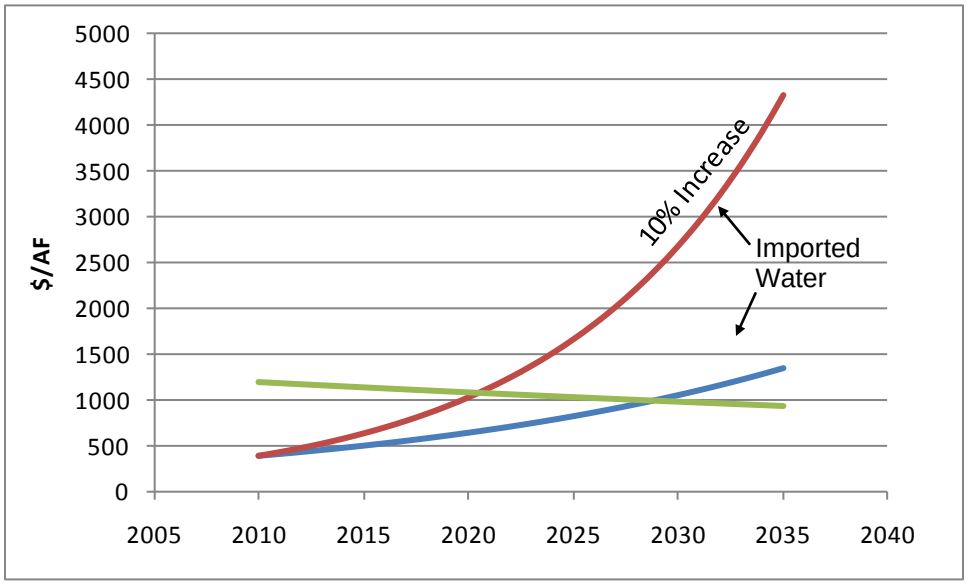
Table 3-13: Description of Exchanges/Transfers Types

Type	Duration	Purpose
Short-Term	1-2 years	Obtain emergency supply or excess wet year water
Long-Term Lease	5-15 years	Fill both normal and dry year needs until permanent supplies can be developed or obtained
Permanent	Permanent	Fill what is expected to be a permanent demand
Wet-year	1 year	Obtain excess water at generally lower cost and stored for future use
Dry-year	1-2 years	Meet short term supply deficit
Table A SWP Water	Short-term to permanent	Priority delivery through the SWP system and cost subsidized by DWR. However, delivery is subject to allocation by DWR
CVP Water	Short-term to permanent	If CVP water is available, may be exchanged through certain SWP contractors who have allocations for both (Subject to allocation by USBR)
Non-SWP Water	Short-term to permanent	Not subject to allocation by DWR, but may be subject to market power cost to transport through SWP - also, delivery priority is lower than SWP water
Pre-1914 water rights	Short-term to permanent	Does not require a permit from the SWRCB which provides for greater flexibility in use and/or sale
Development	Permanent	PWD shares in the cost to develop (or expand) a project elsewhere (e.g. recycled water or desalination) in exchange for imported supply and possibly delivery capacity through the Aqueduct

The costs to acquire imported supplies can vary substantially depending upon supply conditions, demand for supplies, and timing. Recently, supplies for dry-year water and long-term lease water have been priced at approximately $250/af (not including delivery losses). Assuming 1/3 of supply may be lost in transport, the true cost of the supply would be $400/af. Meanwhile, wet-year supplies have historically cost on the order of $50/af. Permanent exchanges are currently being priced at approximately $7,500/af (or a 30 year amortized cost of approximately $550/af assuming 100 percent delivery).

In the future, costs are projected to increase faster than the historical rate of inflation (3 percent) because of the increasing scarcity of readily available supplies (i.e. those now available on the market) and the costs associated with developing new supplies. The cost of these new development projects is expected to range from $400/af for agricultural conservation projects and new diversion/storage projects to as much as $1,000/af and more for desalination and recycled water projects. As such, the anticipated annual increase in the cost of new supplies is expected to increase at between 5 and 10 percent. Curves showing projected costs are shown in **Figure 3-27**. Given the expected price increase, the cost for which PWD could pay to acquire new supplies could match that of ocean desalination sometime between 2020 and 2030.

Figure 3-27: Imported Water and Ocean Desalination Cost Projections



3.4.3 Imported Water Options

Based on the analysis of the opportunities and constraints previously detailed, the following assumptions have been made in developing imported water supply options:

- PWD will acquire non-SWP water on either a long-term or permanent basis up to their current Table A delivery capacity of 21,300 afy. To meet projected demands, this supply will need to be acquired and delivered beginning within the next 2-5 years.
- For future supplies above PWD's current delivery capacity of 21,300 afy, PWD will need to consider different options in order to address the aqueduct capacity issue. These options include:
    - Acquiring either non-SWP water or Table A water from providers upstream of PWD's service area and leasing delivery capacity from one or more SWP contractors south of PWD. This could include either long-term supplies or short-term wet year supplies.
    - Acquiring Table A (and aqueduct capacity) from one or more SWP contractors south of PWD.

From a strategic standpoint, fundamental questions that PWD must answer through the strategic plan include how much water should PWD seek to acquire and when. Based on the opportunities and constraints of importing new supplies to PWD, two general strategic options are available for how PWD may proceed with meeting both its short term needs. These options are:

1. Acquire permanent supply: Acquire up to 35,000 afy (average yield) of imported supply in the short term (<5 years) to meet both short and long term needs. This could be achieved by a combination of permanent transfer as well as multi-year leases.
2. Acquire and bank wet weather water: Acquire approximately 10,000 afy (average yield) now and, in the future, acquire approximately 100,000 af wet year water on the short-term market on average every 5 years. Combined, this would produce 35,000 afy of average yield by 2035.