San Francisco Bay Regional Water Enhancement Program

Attachment 8

Benefits and Cost Analysis

Association of Bay Area Governments

Proposition 84

Integrated Regional Water Management

Round 2, Implementation Grant Application

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Introduction

The San Francisco Bay Regional Water Enhancement Program Proposition 84, Round 2 Implementation Proposal (Proposal) is comprised of 19 integrated/multi-benefit projects involving over 50 agencies and organizations around the nine-county San Francisco Bay Area. Collectively, the projects will provide economically significant and robust water supply, water quality, habitat restoration, and flood protection benefits to the San Francisco Bay Region and the state. The physical and monetized economic benefits of each of the 19 projects were evaluated using the DWR Method, according to the project benefit analysis options selection process described in the PSP. Under the DWR Method, benefit analysis options are: D1 – Cost Effectiveness Analysis; D2 – Non-Monetized Benefit Analysis; D3 – Monetized Benefits Analysis; and D4 – Flood Damage Reduction Benefit Analysis. The projects evaluated under each option are listed in **Table 8-1**.

Table 8-1: DWR Method Analysis Options Used for Project Benefit Evaluations

Project ID#	Project Name	D1	D2	D3	D4
1	Bay Area Regional Conservation and Education Program		X	X	
2	East Bayshore Recycled Water Project Phase 1A (Emeryville)		X	X	
3	Lagunitas Creek Watershed Sediment Reduction and Management Project		X	X	
4	Marin/Sonoma Conserving Our Watersheds: Agricultural BMP Projects		X	X	
5	Napa Milliken Creek Flood Damage Reduction and Fish Passage Barrier Removal		X		X
6	North Bay Water Reuse Program – Sonoma Valley CSD 5th Street East/McGill Road Recycled Water Project		X	X	
7	Oakland Sausal Creek Restoration Project		X	X	
8	Pescadero Water Supply and Sustainability Project	X	X	X	
9	Petaluma Flood Reduction, Water & Habitat Quality, and Recreation Project for Capri Creek		X		X
10	Redwood City Bayfront Canal and Atherton Channel Flood Improvement and Habitat Restoration Project		X		X
11	Regional Groundwater Storage and Recovery Project - South Westside Basin, Northern San Mateo County		X	X	
12	Richmond Breuner Marsh Restoration Project		X	X	
13	Roseview Heights Infrastructure Upgrades for Water Supply and Quality Improvement, Santa Clara County		X	X	

14	San Francisco Bay Climate Change Pilot Projects Combining Ecosystem Adaptation, Flood Risk Management and Wastewater Effluent Polishing		X	X	
15	San Francisco International Airport Industrial Waste Treatment Plant and Reclaimed Water Facility		X	X	
16	San José Green Streets & Alleys Demonstration Projects		X	X	
17	San Pablo Rheem Creek Wetlands Restoration Project		X	X	
18	St. Helena Upper York Creek Dam Removal and Ecosystem Restoration Project		X	X	
19	Students and Teachers Restoring a Watershed (STRAW) Project—North and East Bay Watersheds		X	X	

The project benefit-cost analysis results are presented with primary benefit groups, which are: Water Supply, Water Quality, Habitat Restoration, and Flood Protection, as listed in **Table 8-2**.

Table 8-2: Project List by Primary Benefit Type

Primary Project Benefit	Project ID#	Project Proponent	Project Title
Water Supply	1	Zone 7	Bay Area Regional Conservation and Education Program
	2	EBMUD	East Bayshore Recycled Water Project Phase 1A (Emeryville)
	6	Sonoma Valley CSD	North Bay Water Reuse Program – Sonoma Valley CSD 5th Street East/McGill Road Recycled Water Project
	8	San Mateo County	Pescadero Water Supply and Sustainability Project
	11	SFPUC	Regional Groundwater Storage and Recovery Project Phase 1A - South Westside Basin, Northern San Mateo County
	13	Roseview Heights MWC	Roseview Heights Infrastructure Upgrades for Water Supply and Quality Improvement, Santa Clara County
	15	CCSF Airport Commission	San Francisco International Airport Reclaimed Water Facility
Water Quality	14	ABAG	San Francisco Bay Climate Change Pilot Projects Combining Ecosystem Adaptation, Flood Risk Management and Wastewater Effluent Polishing
	16	City of San José	San José Green Streets & Alleys Demonstration Projects
	19	PRBO	Students and Teachers Restoring a Watershed (STRAW) Project—North and East Bay Watersheds

Habitat Restoration	3	Marin MWD	Lagunitas Creek Watershed Sediment Reduction and Management Project
	4	Marin RCD	Marin/Sonoma Conserving Our Watersheds: Agricultural BMP Projects
	7	City of Oakland	Oakland Sausal Creek Restoration Project
	12	East Bay Regional Park District	Richmond Breuner Marsh Restoration Project
	17	Contra Costa Water District	San Pablo Rheem Creek Wetlands Restoration Project
	18	City of St. Helena	St. Helena Upper York Creek Dam Removal and Ecosystem Restoration Project
Flood Protection	5	Napa County	Napa Milliken Creek Flood Damage Reduction and Fish Passage Barrier Removal
	9	City of Petaluma	Petaluma Flood Reduction, Water & Habitat Quality, and Recreation Project for Capri Creek
	10	City of Redwood City	Redwood City Bayfront Canal and Atherton Channel Flood Improvement and Habitat Restoration Project

The results from the analysis are presented using the PSP format for prescribed tables, including Table 11 – Statement of Cost-Effectiveness (DAC Projects only) Table 12 – Non-Monetized Benefits Checklist, Table 15 - Annual Benefit, Table 16 - Annual Costs of Avoided Projects, Table 18 – Present Value of Expected Annual damage Reduction Benefits (Flood Damage Reduction Projects only), and Table 19 – Annual Costs of Project. Table 12 and Table 19 were completed for all projects included in this Proposal. In many cases, Table 15 is not completed because the project is claiming monetized benefits based upon avoided costs of future projects. In these instances, Table 16 is completed for economic benefits based on avoided future project costs. If monetized benefits are not claimed based on costs of future projects, only Table 15 is completed.

Supporting documentation for the analyses conducted for this Proposal is included in the appendices to Attachment 8.

PSP Table 20, included below, presents the summary of benefits and costs for the entire Proposal.

PSP Table 20 – Proposal Benefits and Costs Summary
Proposal: San Francisco Bay Regional Water Enhancement Program
Agency: Association of Bay Area Governments

(a)	(b)	(c)	Total Present Value Project Benefits (d)	(e)	(f)	(g)	(h)	(i)	(j)
Project Name and Number	**Project Proponent**	**Total Present Value Project Costs**	**From Section D3 Monetized**	**From Section D4 Flood Damage Reduction**	**Total** (f)= (d)+(e)	**Project Net Present Value** (g) = (f) - (c)	**Project Benefit-Cost Ratio** h = (f)/(c)	**From Section D1 Cost Effectiveness Analysis, Cost Savings**	**From Section D2 Primary Non-monetized benefits**
Primary Benefit: Water Supply									
1. Bay Area Regional Conservation and Education Program	Zone 7 Water Agency	$4,765,578	$8,111,677	N/A	$8,111,677	$3,346,099	1.70	N/A	The project provides recreation benefits, reduces water supply demand, benefits disadvantaged communities, supports habitat for sensitive species, reduces stormwater and wastewater discharges to the San Francisco Bay, increases water retention, reduces runoff and chemical usage, promotes lawn conversion, and includes educational programs about irrigation technology, water conservation strategies, and water-efficient landscaping techniques.
2. East Bayshore Recycled Water Project Phase 1A (Emeryville)	EBMUD	$6,443,055	$6,075,661	N/A	$6,075,661	-$367,394	0.94	N/A	The project increases recycled water delivered to customers, provides public education, involves a disadvantaged community, benefits the Delta, improves flood management, helps to realize TMDL goals for the Bay, involves research into indoor recycled water usage, and reduces potable water demand, wastewater discharges to the San Francisco Bay, and the risk of severe rationing during prolonged droughts.
6. North Bay Water Reuse Program—Sonoma Valley CSD 5th Street East/McGill Road Recycled Water Project	Sonoma Valley County Sanitation District	$2,368,907	$5,101,721	N/A	$5,101,721	$2,732,814	2.15	N/A	The project provides water conservation and stewardship education, increases the use and public knowledge of recycled water, allows for public involvement, alleviates long-term water supply concerns, improves surface water quality and water flows, benefits aquatic and riparian habitat quality, provides additional opportunities for outdoor recreation, improves the aesthetics and drought-resistance of athletic fields, reduces pollutant loading and discharges into the North San Pablo Bay, assists with long-term groundwater management and groundwater aquifer protection, and improves water quality in Sonoma Creek. In the long term, it may also contribute to increased dissolved oxygen, decreased turbidity, and reduced emissions.
8. Pescadero Water Supply and Sustainability Project	County of San Mateo Department of Public Works and Parks	$907,690	$1,987,045	N/A	$1,987,045	$1,079,355	2.19	The proposed Project addresses four benefits: 1. Water supply enhancement 2. Water reliability 3. Groundwater improvement 4. Water conservation Alternatives were considered and the proposed project is the most cost effective alternative.	The project provides redundancy and reliability of water supplies, provides water-efficient devices and a critical water supply need, helps a disadvantaged community, reduces groundwater extraction, and involves public outreach and water conservation education efforts. It may also indirectly reduce energy consumption.
11. Regional Groundwater Storage and Recovery Project Phase 1A - South Westside Basin, Northern San Mateo County	SFPUC	$77,330,043	$90,877,285	N/A	$90,877,285	$13,547,242	1.18	N/A	The project helps to avoid public water resource conflicts, provides more oversight of groundwater management, prevents salinity intrusion, promotes aquifer storage of water, improves local water supplies, and creates a more flexible water supply source portfolio. It may also reduce energy consumption and greenhouse gas production.

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(a)	(b)	(c)	Total Present Value Project Benefits (d)	(e)	(f)	(g)	(h)	(i)	(j)
Project Name and Number	**Project Proponent**	**Total Present Value Project Costs**	**From Section D3 Monetized**	**From Section D4 Flood Damage Reduction**	**Total** (f)= (d)+(e)	**Project Net Present Value** (g) = (f) - (c)	**Project Benefit-Cost Ratio** h = (f)/(c)	**From Section D1 Cost Effectiveness Analysis, Cost Savings**	**From Section D2 Primary Non-monetized benefits**
13. Roseview Heights Infrastructure Upgrades for Water Supply and Quality Improvement, Santa Clara County	Roseview Heights MWD	$442,352	$483,652	N/A	$483,652	$41,300	1.09	N/A	The project reduces the risk of water system failure, meets standards for firefighting water supplies, increases water quality reliability, and reduces long-term emissions, demand for Delta water, and amounts of chlorine used for water treatment.
15. San Francisco International Airport Reclaimed Water Facility	City and County of San Francisco, Airport Commission	$16,552,246	$29,226,909	N/A	$29,226,909	$12,674,663	1.77	N/A	The project incorporates new technologies, reduces water demand on the Hetch Hetchy system, secures the airport during a drought, upgrades outdated infrastructure, results in the discharge of cleaner water, and increases reuse of existing wastewater for non-potable purposes.
Primary Benefit: Water Quality									
14. San Francisco Bay Climate Change Pilot Projects Combining Ecosystem Adaptation, Flood Risk Management and Wastewater Effluent Polishing	ABAG	$5,186,287	$6,273,078	N/A	$6,273,078	$1,086,791	1.21	N/A	The project retains recreational and access benefits, reduces nutrient loading, helps to defend against flooding associated with sea level rise, brings jobs and educational opportunities to low-income communities, increases carbon sequestration, ensures stewardship of the wetlands, provides important seasonal terrestrial habitat, and involves public meetings and outreach. It has the potential to radically improve water quality in the San Francisco Bay and Delta Regions at a lower cost and with a smaller energy footprint.
16. San José Green Streets & Alleys Demonstration Projects	City of San José	$2,480,455	$851,712	N/A	$851,712	-$1,628,743	0.34	N/A	The project demonstrates approaches for retrofitting existing streets for stormwater treatment and flow reduction, fosters local understanding of the relationship between street runoff and the condition of local waterways, improves streetscape, provides water quality education opportunities, prevents illegal dumping associated with the alleys, benefits a disadvantaged community, improves water quality through stormwater infiltration, alleviates water quality concerns, and may reduce emissions and energy consumption.
19. Students and Teachers Restoring a Watershed (STRAW) Project—North and East Bay Watersheds	PRBO Conservation Science	$552,767	$7,863,629	N/A	$7,863,629	$7,310,862	14.23	N/A	The project involves an educational and professional development program, implements habitat restoration projects that accommodate climatic uncertainty, provides volunteer opportunities and public access to landscapes, improves community environmental stewardship, increases waterway function in regard to stormwater treatment and flood control, benefits disadvantaged communities, increases the amount and quality of riparian and wetland/upland transition zone habitat—including critical habitat, improves water quality and carbon sequestration, and provides long-term solutions to water quality and habitat degradation.
Primary Benefit: Habitat Restoration									
3. Lagunitas Creek Watershed Sediment Reduction and Management Project	Marin Municipal Water District	$892,137	$2,753,671	N/A	$2,753,671	$1,861,534	3.09	N/A	The project benefits recreational users of State Parks and the National Park Service, helps to avoid future conflicts between land and resource owners, increases the reliability of critical water services, benefits listed salmonids, creates opportunities for reintroduction and increased access for steelhead and coho, involves stewardship and coordinated watershed management, includes proactive road stabilization, and improves water quality, riparian habitat, and fish passage.

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(a)	(b)	(c)	Total Present Value Project Benefits (d)	(e)	(f)	(g)	(h)	(i)	(j)
Project Name and Number	**Project Proponent**	**Total Present Value Project Costs**	**From Section D3 Monetized**	**From Section D4 Flood Damage Reduction**	**Total** (f)= (d)+(e)	**Project Net Present Value** (g) = (f) - (c)	**Project Benefit-Cost Ratio** h = (f)/(c)	**From Section D1 Cost Effectiveness Analysis, Cost Savings**	**From Section D2 Primary Non-monetized benefits**
4. Marin/Sonoma Conserving Our Watersheds: Agricultural BMP Projects	Marin Resource Conservation District	$726,522	$2,184,321	N/A	$2,184,321	$1,457,799	3.01	N/A	The project involves collaboration with and education of local ranchers about water issues, includes cutting-edge carbon sequestration research, allows public involvement through public forums, improves instream flows and water quality, implements TMDL-required ranch water quality plans, reduces sediment and microbial contamination, increases carbon sequestration and stormwater infiltration, and benefits a small family farm community, riparian habitats, and wildlife communities in and adjacent to the watershed area.
7. Oakland Sausal Creek Restoration Project	City of Oakland	$2,483,868	$4,325,570	N/A	$4,325,570	$1,841,702	1.74	N/A	The project involves outdoor environmental education and stewardship opportunities, benefits recreation and public safety, provides community-building activities, positively affects a disadvantaged community, increases channel capacity, creates restored stream channel and improved riparian habitat, alleviates flooding, and improves the aesthetics and environmental quality of the park.
12. Richmond Breuner Marsh Restoration Project	East Bay Regional Park District	$15,659,943	$30,986,624	N/A	$30,986,624	$15,326,681	1.98	N/A	The project creates/improves habitat for special status species, provides recreation and public education, affects disadvantaged communities, and reduces polluted runoff through natural vegetation filtration.
17. San Pablo Rheem Creek Wetlands Restoration Project	Contra Costa Water District	$1,595,810	$3,892,880	N/A	$3,892,880	$2,297,070	2.44	N/A	The project provides more community open space, benefits disadvantaged communities, prevents commercial construction that would increase emissions, increases wildlife habitat, buffers the effects of sea level rise, improves stormwater quality, reduces flooding, and returns historic functions and values of the land.
18. St. Helena Upper York Creek Dam Removal and Ecosystem Restoration Project	City of St. Helena	$3,897,527	$9,455,340	N/A	$9,455,340	$5,557,813	2.43	N/A	The project reduces emissions, serves as a local example of dam removal and channel restoration, creates a public pathway with interpretive signage, improves downstream water quality, eliminates potential for fish kills and aquatic habitat impairments related to the dam, removes the threat of catastrophic dam failure, and restores aquatic habitat connectivity, natural riparian corridor, and delivery of coarse sediment downstream.
Primary Benefit: Flood Protection									
5. Napa Milliken Creek Flood Damage Reduction and Fish Passage Barrier Removal	Napa County	$1,211,345	$0	$1,528,731	$1,528,731	$317,386	1.26	N/A	The project increases the amount of fish spawning and rearing habitat, restores natural stream functions, addresses long-term flooding issues, and improves fish passage, riparian habitat, and water diversion approaches.
9. Petaluma Flood Reduction, Water & Habitat Quality, and Recreation Project for Capri Creek	City of Petaluma	$1,003,813	$0	$1,446,447	$1,446,447	$442,634	1.44	N/A	The project provides habitat enhancement, groundwater recharge, emissions capture, recreation, watershed preservation education, community stewardship, flood risk reduction, and water quality improvements.
10. Redwood City Bayfront Canal and Atherton Channel Flood Improvement and Habitat Restoration Project	Redwood City	$3,903,856	$0	$8,560,385	$8,560,385	$4,656,529	2.19	N/A	The project involves public access trails, alleviates flooding concerns, improves the quality of water released to the Bay, increases seasonal wetland habitat, and fosters bird habitat.
	Total	**$148,404,201**	**$210,450,775**	**$11,535,563**	**$221,986,338**	**$73,582,137**	**1.50**		

Proposal Benefits and Costs Summary

San Francisco Bay Area IRWM Plan (2006) identifies the following regional goals for the Bay Area's integrated water management plan:

- Contribute to the promotion of economic, social, and environmental sustainability
- Contribute to improved water supply reliability
- Contribute to the protection and improvement of hydrologic function
- Contribute to the protection and improvement of the quality of water resources
- Contribute to the protection of public health, safety, and property
- Contribute to the creation, protection, enhancement, and maintenance of environmental resources and habitats

The projects included in this Proposal were specifically selected for their direct alignment with these Bay Area IRWM Plan goals.

The *Water Supply* projects will conserve over 2,500 acre-feet of water annually; provide a more secure or higher-quality water supply to local communities, including a disadvantaged community; store 35,000 acre-feet for drought supply; and provide recycled wastewater for agricultural and commercial uses. Combined, the benefit-cost ratio for the water supply projects included in this Proposal is 1.30.

The *Water Quality* projects will improve water quality by creating new or restoring existing habitat, including demonstration wastewater treatment wetlands and demonstration stormwater treatment techniques for urban streets and alleyways. Combined, the benefit-cost ratio for the water quality projects included in this Proposal is 1.82.

The *Habitat Restoration* projects provide or improve salmonid and trout passage in urban and rural stretches of creeks; they also improve water quality by removing sediment and debris in impaired watersheds with established TMDLs; and they will create and preserve wetlands and streams in disadvantaged communities. Combined, the benefit-cost ratio for the habitat restoration projects included in this Proposal is 2.12.

The *Flood Protection* projects collectively will provide increased flood protection for over 250 residences, improve fish passage, and support bay tidal pond and marsh habitat restoration. Combined, the benefit-cost ratio for the flood protection projects included in this Proposal is 1.89.

The overall Proposal will provide significant economic value to the San Francisco Bay Region and the State. The present value of the costs for all projects proposed for the San Francisco Bay Region is $148,404,201. The present value of the quantifiable benefits for all projects is $221,986,338. The net present value of the projects is $73,582,137. Therefore, the total benefit-cost ratio of the Proposal is **1.50**.

Water Supply Projects

The seven projects included in this section provide water supply benefits through implementation of water conservation programs to improve water use efficiency throughout the San Francisco Bay Area. These projects span all sub-regions in the San Francisco Bay IRWM Region, including the Bay Area Regional Conservation and Education Program (Project 1) which covers the entire region. The projects included in this section will implement water conservation, potable water demand offset, groundwater management, and water supply reliability improvement goals. Collectively, The projects will conserve over 2,500 acre-feet of water annually; provide a more secure or higher-quality water supply to local communities, including a disadvantaged community; store 35,000 acre-feet for drought supply; and provide recycled wastewater for agricultural and commercial uses. Combined, the benefit-cost ratio for the water supply projects included in this Proposal is 1.30.

Project 1 – Bay Area Regional Conservation and Education Program 9

Project 2 – East Bayshore Recycled Water Project Phase 1A (Emeryville) 23

Project 6 – North Bay Water Reuse Program – Sonoma Valley CSD 5th Street East/McGill Road Recycled Water Project 29

Project 8 – Pescadero Water Supply and Sustainability Project 38

Project 11 – Regional Groundwater Storage and Recovery Project Phase 1A - South Westside Basin, Northern San Mateo County 51

Project 13 – Roseview Heights Infrastructure Upgrades for Water Supply and Quality Improvement, Santa Clara County 57

Project 15 – San Francisco International Airport Reclaimed Water Facility 66

Project 1 – Bay Area Regional Conservation and Education Program

Project Benefits

With Project Condition: This project will implement nine regional conservation programs over a three-year period. The programs are:

1. High Efficiency Toilet Rebates
2. High Efficiency Clothes washer Rebates
3. Residential Home Water Use Reports
4. Weather-based Irrigation Controller Rebates for single-family customers
5. Weather-based Irrigation Controller Rebates for multi-family and commercial customers
6. Water Efficient Landscape Rebates (turf replacement)
7. Large Landscape Irrigation System Retrofits (irrigation system upgrade)
8. Water Efficiency Sustainable Landscape Education Program (landscape training)
9. Mobile Water Lab Agricultural Irrigation Surveys

This project will extend ongoing implementation of the Phase I Water Conservation Project incentive program elements and add more extensive landscape educational and training elements.

Expected water savings vary in magnitude and duration by program. Cumulatively, the programs are expected to reduce potable water demands in the Bay Area over the next 30 years by 8,940 AF. The average annual demand reduction over this period is 298 AFY. The majority of water savings, however, will be realized in the first 10 years following project implementation.

Without Project Condition: Under the without-project condition, the expected reductions in potable water demands would not be fully realized. Some reductions in demand would occur due to natural replacement of toilets and clothes washers with more efficient models. These naturally-occurring efficiency gains have been netted out of the with-project water savings estimates, as described below.

D2 Non-Monetized Project Benefits

Non-monetizable project benefits, including community and social benefits, environmental stewardship benefits, and sustainability benefits are identified, as applicable to this project, in the PSP Table 12 "Non-Monetized Benefits Checklist" below.

Table 12—Non-Monetized Benefits Checklist Project 1: Bay Area Regional Conservation and Education Program			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
1	**Provide educational or technological benefits?**	Yes	Implementation of educational components of the project will result in water supply benefits (reduced water supply demand). Water Supply is a D3 Monetized Benefit
2	**Provide social recreation or access benefits?**	Yes	Potentially, numerous parks will be targeted, which will benefit some disadvantaged communities within Alameda County. These parks will include bio swales, areas for recreation, and Bay-friendly planting, and they will encourage wildlife and biodiversity.
3	**Help avoid, reduce, or resolve various public water resource conflicts?**	Yes	The project will reduce regional dependence on imported water supplies by reducing water supply demand. The project will also increase regional water supply reliability by reducing the risk of severe rationing during prolonged droughts.
4	**Promote social health and safety?**	Yes	The project will reduce regional dependence on imported water supplies by reducing water supply demand. The project will also increase regional supply reliability by reducing the risk of severe rationing during prolonged droughts.
5	**Have other social benefits?**	Yes	The educational elements of the project are directed toward disadvantaged communities in the project area.

Table 12—Non-Monetized Benefits Checklist Project 1: Bay Area Regional Conservation and Education Program			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Environmental Stewardship Benefits: Will the proposal:			
6	**Benefit wildlife or habitat in ways that are not quantified?**	Yes	Reduced water demand within the Agencies' water supply areas will result in increased water availability, which will help support wildlife, aquatic ecosystems, and habitat restoration, particularly for sensitive species in the SF Bay Area and Tuolumne River watersheds (Saltwater Harvest Mouse, California Clapper rail, Delta Smelt, Splittail, Steelhead, Chinook salmon, fresh water shrimp, and Coho Salmon). The Water-Efficient Landscape and Weather-Based Irrigation Controller Rebate Program will promote environmental sustainability and improve environmental habitat by reducing fertilizer, herbicide and pesticide laden water runoff into local streams, affecting wildlife. The educational programs provide practical information, tools, and guidelines that facilitate landscape and garden creation. These landscapes and gardens encourage biodiversity and healthy soils, which provide habitat for native invertebrates, including the variety of threatened or endangered species in the area.
7	**Improve water quality in ways that are not quantified?**	Yes	The project will reduce imported water demand from the Tuolumne River and Delta, thus benefitting those resources, improving water quality. The Mobile Water Lab implements water conservation practices in agricultural operations, which may decrease pollution discharge from irrigation systems. It will also reduce the potential greenhouse gas impacts from the transport and landfilling of plant debris. The Water-Efficient Landscape and Weather-Based Irrigation Controller Rebate Program will promote environmental sustainability and improve water quality in the San Francisco Bay by reducing fertilizer, herbicide and pesticide laden water runoff into local streams. The High Efficiency Washer Program will reduce energy use and carbon emissions by reducing pumping and treatment for water and wastewater and reducing hot water end use. The Bay-Friendly educational program promotes compost as a means to increase water retention and reduce runoff, chemical inputs of fertilizers, and pesticides.
8	**Reduce net emissions in ways that are not quantified?**	Yes	Lawn conversion, promoted by the Bay-Friendly educational program, will reduce greenhouse gases by up to 50 tons of CO_2 equivalent per acre of lawn converted (Edwards, 2010).
9	**Provide other environmental stewardship benefits?**	No	

Table 12—Non-Monetized Benefits Checklist Project 1: Bay Area Regional Conservation and Education Program			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Sustainability Benefits: Will the proposal:			
10	**Improve the overall, long-term management of California groundwater resources?**	Yes	No measurable effects on groundwater resources would occur. Implementation of Mobile Water Lab recommendations may reduce groundwater use/demand and may decrease the leaching of nutrients to groundwater.
11	**Reduce demand for net diversions for the region from the Delta?**	Yes	The project will reduce regional dependence on imported water supplies by reducing water supply demand. The project will reduce imported water demand and discharge to the SF Bay.
12	**Provide a long-term solution in place of a short-term one?**	Yes	The project will reduce regional dependence on imported water supplies by reducing water supply demand. The project will also increase regional supply reliability by reducing the risk of severe rationing during prolonged droughts.
13	**Promote energy savings or replace fossil-fuel-based energy sources with renewable energy and resources?**	Yes	No direct effects on energy resources will occur; however, the educational programs may indirectly result in energy savings. The Bay-Friendly educational program teaches professionals and home gardeners to implement sustainable landscape design and maintenance practices that promote energy conservation and reduce waste to landfill. Practices taught include reusing recycled/recovered materials and locating recycled-content products (including locally recycled compost and mulch). The Mobile Water Lab may result in reductions in energy usage and costs if landowners and managers implement the water conservation recommendations.
14	**Improve water supply reliability in ways not quantified?**	Yes	D3 Monetized Benefit
15	**Other**		

D3 Monetized Project Benefits

Quantifiable Project Benefits: Normal- and dry-year water supply valued at the weighted-average avoided water supply cost for water supply agencies participating in the regional program.

Estimated annual water savings by program are summarized in **Project 1-Table A** below. These estimates are based on the following data and assumptions.

Toilet Rebates: The project will provide rebates for 2,300 high-efficiency toilets. The average water savings per toilet at the time of replacement is estimated at 18.34 gallons per day. Average per toilet savings is derived from ULF toilet savings equations published by CUWCC (California Urban Water Conservation Council, 2004).[1] The reduced form equations are derived from empirical studies of ULFT savings prepared by A&N Technical Services and relate per toilet water savings to persons per household (PPH). The reduced form estimate of ULFT savings (in gallons per day) for single family toilets is:

$$S_{ULFT} = 6.693 \times PPH - 0.529 \times PPH^2 + 7.826$$

Two adjustments are made to the unit savings. The first scales up the estimate to account for an HET's lower flush volume (1.28 gpf) compared to a ULFT (1.6 gpf). The second scales down the estimate to adjust for the fact that toilets replaced today flush less water (3.26 gpf), on average, than toilets replaced when the original ULF savings studies were completed in the early 1990s (about 4 gpf).

Following replacement, unit water savings are exponentially decayed at a rate of 4% per year to account for the likelihood a toilet replaced by the program would have been replaced with an HET at a later date under the without-project condition due to plumbing code requirements. This is why the toilet water savings shown in Table 1 decrease over time.

Clothes washer Rebates: The project will provide rebates for 5,750 Tier 3 high-efficiency clothes washers. Unit savings (in gallons per year) are based on the difference between average water use for new washers, as forecasted by the United States Department of Energy, and Tier 3 washers with an average water factor of 3.5. Unit savings are calculated as:

$$S = \left(WF_{\text{avg}} - WF_{T3}\right) \times CU \times \text{Cycles}$$

For the above equation, WF_{avg} is the average water factor of new washers, WF_{T3} is the water factor for Tier 3 washers, *CU* is the average capacity of new washers, and Cycles is the average number of washer cycles per single-family residence. Values for CU and Cycles are taken from Department of Energy and EPA, respectively (U.S. Environmental Protection Agency, 2012; U.S. Department of Energy, 2010).[2] The

[1] California Urban Water Conservation Council. 2004. *BMP Costs & Savings Study: A Guide to Data and Methods for Cost-Effectiveness Analysis of Urban Water Conservation Best Management Practices.* Sacramento, CA: California Urban Water Conservation Council. See page 2-58.
[2] U.S. Department of Energy. 2010. *Clothes Washer Materials in Support of Stakeholder Negotiations.* Retrieved September 9, 2011, from U.S. DOE Energy Efficiency and Renewable Energy: http://www1.eere.energy.gov/buildings/appliance_standards/residential/docs/nia_cw_neg_scenarios_a_b.xls; U.S.

average without-project WF of 6.33 is derived from Department of Energy clothes washer market forecasts for top and front load clothes washers (U.S. Department of Energy, 2010). In the without-project condition, DOE market forecasts indicate Tier 3 washers are expected to comprise 10% of new washer purchases. Water savings for these washers are not counted in with-project savings estimate since they would have occurred in the without-project condition. Savings are estimated to persist for 12 years, the average useful life of a new washer (U.S. Department of Energy, 2010).

Home Water Report: Using the WaterSmart service, the project will provide home water use reports to 203,882 households throughout the Bay Area as part of each participating utility's billing cycle. Preliminary performance evaluations of WaterSmart effectiveness indicate savings in the range of 4% to 6% (East Bay Municipal Utility District, 2013; WaterSmart Software, Inc., 2011).[3] Because these results are preliminary, a 2% savings rate is conservatively assumed for this project. Annual water savings per household are based on average daily use of 350 gpd, the norm for Bay Area single family households. Because home water use reports are a new program, there is not good empirical information on the persistence of savings. This analysis assumes savings will persist for up to five years, decaying at an annual rate of 20% per year. This is consistent with persistence of savings observed for home water surveys (California Urban Water Conservation Council, 2004).[4]

Single-Family Weather-Based Irrigation Controller Rebates: The project will replace standard irrigation timers controlling an estimated 3,145 sprinkler stations. Weather-based irrigation controllers (WBICs) are expected to reduce station water use by 10% on average (Aquacraft, Inc., 2009).[5] Expected water savings per sprinkler station are 1,268 gallons/year. This assumes an average irrigated area of 450 square feet per station and average water use of about 28 gallons per year per square foot under the without-project condition. This is equivalent to a pre-project application rate of 3.74 AFY/acre. This is considered a conservative estimate of without-project water use. CCWD (1994) observed application rates in excess of 7 AFY/acre on poorly managed landscapes. Water savings are assumed to persist for 10 years, the average useful life of an irrigation timer.

Multi-family and Commercial Weather-Based Irrigation Controller Rebates: The project will replace standard irrigation timers controlling an estimated 4,200 sprinkler stations. Weather-based irrigation controllers (WBICs) are expected to reduce station water use by 10% on average (Aquacraft, Inc., 2009; EBMUD). Expected water savings per sprinkler station are 3,383 gallons/year. For commercial and multi-family landscapes, an average irrigated area of 1,200 square feet per station is assumed. The other water use assumptions are the same as single-family. Water savings are assumed to persist for 10 years, the average useful life of an irrigation timer.

Environmental Protection Agency. 2012. *CalculatorConsumerClotheswasherBulk.xls.* Retrieved from U.S. EPA Energystar Website: http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorConsumerClotheswasherBulk.xls

[3] East Bay Municipal Utility District. 2013. *Home Water Report Pilot Study: Preliminary Water Savings Data Summary.* Oakland, California: East Bay Municipal Utility District; WaterSmart Software, Inc. 2011. *Case Study: Sonoma County.* San Francisco, California: WaterSmart Software, Inc.

[4] California Urban Water Conservation Council. 2004. *BMP Costs & Savings Study: A Guide to Data and Methods for Cost-Effectiveness Analysis of Urban Water Conservation Best Management Practices.* Sacramento, CA: California Urban Water Conservation Council.

[5] Aquacraft, Inc. (2009). *Evaluation of California Weather-Based "Smart" Irrigation Controller Programs.* Boulder, Colorado: Aquacraft, Inc.

Landscape Replacement Rebates: The project will use rebates to incentivize the replacement of 1,385,000 square feet of turf with xeriscape or other drought-tolerant landscaping. Replacing turf with xeriscape is expected to save 24.9 gallons per square foot annually.[6] Turf targeted for replacement is assumed to be irrigated by automatic timer (but not a WBIC) with an average application rate of 37.4 gallons per square foot per year. This is equivalent to an application rate of 5 AFY/acre. Xeriscape is assumed to be irrigated by a drip irrigation system with an average application rate of 12.5 gallons per square foot per year. This is equivalent to an application rate of 1.7 AFY/acre. Water savings are assumed to persist for 10 years.

Large Landscape Irrigation Retrofit Grants: The project will fund grants for irrigation system upgrades for systems irrigating a total of 330,000 square feet of landscape within SFPUC's retail service area. Expected savings are 13.1 gallons per square foot annually and are based on results from previous large landscape irrigation system upgrade projects done by SFPUC. Water savings from irrigation system upgrades are assumed to persist for 20 years.[7]

Sustainable Landscape Education: The program will implement landscape education programs for homeowners and professional landscapers. Training for professional landscapers will include a certification component. The project will implement 20 homeowner workshops and 10 professional landscaper trainings with certification. The project will also provide landscape education and information via social media. An estimated 800 homeowners and 400 professional landscapers are expected to participate in the workshops and trainings. Education materials delivered via social media are expected to reach 20,000 individuals. Expected program savings are based on the estimated percentage of participants making substantive changes to existing or planned landscapes to save water. These percentages are 5% for homeowners participating in workshops, 10% for professional landscapers participating in training and certification, and 0.75% of individuals accessing landscape education and information via social media. Unit savings are expressed in terms of lawn area conversion equivalents. Residential and commercial site lawn areas are estimated to average 800 and 5,000 square feet, respectively. Unit savings per square foot of converted lawn area are expected to be the same as estimated for the landscape replacement rebates program.

Mobile Water Lab Agricultural Irrigation Surveys: The program will implement 48 on-site agricultural irrigation system evaluations in Napa and Sonoma Counties. Based on program experience for a similar program previously operated in Sonoma County, average site area is 10 acres, average pre-evaluation site water use is 1.23 AFY/acre, average post-evaluation site water savings is 0.18 AFY/acre, and half of evaluated sites implement savings recommendations. This yields an average water savings of 44.2 AFY. Irrigation system water savings are assumed to persist for 10 years.

[6] Turf is assumed to be irrigated by automatic timer (but not a WBIC) with an average application rate of 37.4 gallons per square foot per year. This is equivalent to an application rate of 5 AFY/acre. Xeriscape is assumed to be irrigated by a drip irrigation system with an average application rate of 12.5 gallons per square foot per year. This is equivalent to an application rate of 1.7 AFY/acre.

[7] Savings life is based on a programmatic review of past equipment upgrade projects and the SFPUC Parks Water Conservation Plan (2009) guidance provided by SFPUC's landscape design consultants (J. Ortiz, SFPUC, personal communication, 2/25/13.)

Project 1 - Table A: Estimated Water Savings in Acre-Feet										
Year	Toilet Rebates	Washer Rebates	Home Water Report	WBIC SF	WBIC MF/CII	Landscape Replace. Rebates	Large Landscape Irrigation Retrofit	Sustainable Landscape Education	Mobile Water Lab	Total
2015	47.3	64.1	799.3	12.2	43.6	106.0	13.3	27.5	44.2	1,157.5
2016	45.4	64.1	1,462.8	12.2	43.6	106.0	13.3	27.5	44.2	1,819.0
2017	43.5	64.1	1,138.2	12.2	43.6	106.0	13.3	27.5	44.2	1,492.7
2018	41.8	64.1	813.7	12.2	43.6	106.0	13.3	27.5	44.2	1,166.4
2019	40.1	64.1	423.3	12.2	43.6	106.0	13.3	27.5	44.2	774.4
2020	38.5	64.1	98.8	12.2	43.6	106.0	13.3	27.5	44.2	448.2
2021	37.0	64.1		12.2	43.6	106.0	13.3	27.5	44.2	347.9
2022	35.5	64.1		12.2	43.6	106.0	13.3	27.5	44.2	346.4
2023	34.1	64.1		12.2	43.6	106.0	13.3	27.5	44.2	345.0
2024	32.7	64.1		12.2	43.6	106.0	13.3	27.5	44.2	343.6
2025	31.4	64.1					13.3			108.8
2026	30.2	64.1					13.3			107.6
2027	29.0						13.3			42.2
2028	27.8						13.3			41.1
2029	26.7						13.3			40.0
2030	25.6						13.3			38.9
2031	24.6						13.3			37.9
2032	23.6						13.3			36.9
2033	22.7						13.3			36.0
2034	21.8						13.3			35.1
2035	20.9									20.9
2036	20.0									20.0
2037	19.2									19.2
2038	18.5									18.5
2039	17.7									17.7
2040	17.0									17.0
2041	16.3									16.3
2042	15.7									15.7
2043	15.1									15.1
2044	14.5									14.5

Avoided Water Supply Cost

Expected program water savings are valued using the water-savings-weighted-average avoided cost of water of the participating water agencies. Agency avoided water costs are summarized in **Project 1-Table B**, below. The water-savings-weighted-average avoided cost is $1,321/AF. Also, see supporting water cost savings information provided with Attachment 4, Budget.

Project 1-Table B: Water Agency Avoided Water Supply Cost

Agency	Share of Project Savings (%)	Avoided Cost ($/AF)	Basis for Avoided Cost
ACWD	2.99%	$1,962	The marginal source of supply for ACWD (a BAWSCA member agency) is SFPUC wholesale water. Avoided cost is set to the current wholesale rate plus $200/AF for variable costs of treatment and distribution.
BAWSCA	11.03%	$1,962	The marginal source of supply for BAWSCA member agencies is SFPUC wholesale water. Avoided cost is set to the current wholesale rate plus $200/AF for variable costs of treatment and distribution.
CCWD	7.34%	$750	Based on analysis of likely water transfer cost of $500/AF done internally by CCWD in 2005 plus $250/AF for transmission, treatment, and distribution.
City of Napa	1.94%	$1,920	Water supply projects which are options for City of Napa in the absence of conservation and regional recycling projects are documented in the Phase 3 Engineering and Economic/Financial Analysis Report: North San Pablo Bay Restoration and Reuse Project (CDM, Inc., 2008).[8] The estimated cost of alternative supply is $1,920/AF (CDM, Inc., 2008;. p. 9-4). Avoided cost was updated from 2008 to 2012 dollars using DWR provided update factor of 1.04. Note that in CDM (2008) annualized supply cost is calculated using a 3% real discount rate. Applying DWR's 6% real discount rate would increase the avoided cost to $3,134/AF. The lower estimate is used for valuing water supply benefits for this project.

[8] CDM, Inc. (2008). *Phase 3 Engineering and Economic/Financial Analysis Report: North San Pablo Bay Restoration and Reuse Project.* North Bay Water Reuse Authority, Sonoma County Water Agency, U.S. Bureau of Reclamation.

Project 1-Table B: Water Agency Avoided Water Supply Cost			
Agency	**Share of Project Savings (%)**	**Avoided Cost ($/AF)**	**Basis for Avoided Cost**
EBMUD	16.74%	$1,337	EBMUD's Water Supply Management Plan 2040 (WSMP) sets the district's supply strategy for the next 30 years (East Bay Municipal Utility District, 2012).[9] This strategy is comprised of baseline investments in conservation and recycling plus investment in supplemental supplies. The supplemental supply investments represent the district's marginal cost of new water supply. Six supplemental supply sources are identified, encompassing investments in transfers, groundwater banking, local groundwater development, surface storage expansion, and desalination. Supplemental supply costs range from $630/AF to $1,970/AF (2009 dollars). The average cost is $1,042/AF (2009 dollars). Since the plan does not assign priority or expected yield to the six supplemental sources, the average cost constitutes an appropriate estimate of the district's avoided supply cost. Updating to 2012 dollars using DWR's update factor, this cost is $1,073/AF. The variable costs of transmission, treatment and distribution, are added since recycled and conservation water costs are measured from the customer tap. Transmission cost will vary depending on source, but are expected to be comparable to the variable transmission cost for Mokelumne River water, which is $144/AF (Sect. 5.3.4, WSMP, Appendix D). Variable cost of treatment is $67/AF (Table 5-5, WSMP, Appendix D). Variable cost of distribution is $53/AF (Sect. 5.3.6, WSMP, Appendix D). Total avoided cost is $1,337.
Napa/Sonoma RCDs	4.09%	$1,920	Water supply projects which are options for City of Napa in the absence of conservation and regional recycling projects are documented in the Phase 3 Engineering and Economic/Financial Analysis Report: North San Pablo Bay Restoration and Reuse Project (CDM, Inc., 2008). The estimated cost of alternative supply is $1,920/AF (CDM, Inc., 2008;. p. 9-4). Avoided cost was updated from 2008 to 2012 dollars using DWR provided update factor of 1.04. Note that in CDM (2008) annualized supply cost is calculated using a 3% real discount rate. Applying DWR's 6% real discount rate would increase the avoided cost to $3,134/AF. The lower estimate is used for valuing water supply benefits for this project.
SCVWD	35.42%	$957	Based on the cost of purchasing additional contract entitlements from willing SWP or CVP contractors (Santa Clara Valley Water District, 2012).[10]
SFPUC	2.46%	$3,168	This project is a component of SFPUC's Water System Improvement Program (WSIP). Without the project, SFPUC would need to develop alternative supplies or incur water shortages of 10%–20% in dry years (San Francisco Public Utilities Commission, 2011).[11] SFPUC estimates an average cost of $4,000/AF for alternative supply (MCC Project

[9] East Bay Municipal Utility District. (2012). *Water Supply Management Program 2040 Plan.* Oakland, California: East Bay Municipal Utility District.
[10] Santa Clara Valley Water District. (2012). *Santa Clara Valley Water District 2012 Water Supply and Infrastructure Master Plan.* San Jose, California: Santa Clara Valley Water District. See page 64, footnote 45.
[11] San Francisco Public Utilities Commission. (2011). 2010 Urban Water Management Plan. San Francisco: San Francisco Public Utilities Commission.

Project 1-Table B: Water Agency Avoided Water Supply Cost			
Agency	**Share of Project Savings (%)**	**Avoided Cost ($/AF)**	**Basis for Avoided Cost**
			Costs.xlsx). This cost was compared against SFPUC customer WTP for supply in normal and dry years estimated by Hamilton and Sunding (Sunding & Hamilton, 2010).[12] WTP given 15% rationing is $6,800/AF (2010 dollars). WTP given no rationing is $2,182/AF (2010 dollars). Without the WSIP, rationing is expected in about 20% of years (San Francisco Public Utilities Commission, 2011). Average WTP is therefore about $3,106/AF. Updating from 2010 to 2012 dollars using the inflator in PSP Table 14, the estimated average WTP $3,168/AF. Since average WTP is less than average cost of alternative supply, it is used to value conservation water savings.
Solano County	1.63%	$200	Estimated costs of future supply were not available for Solano County. Therefore, water savings in Solano County are valued at the variable avoided costs for treatment and distribution.
Sonoma County	3.48%	$1,952	Water supply projects which are options for Sonoma County in the absence of conservation and regional recycling projects are documented in the Phase 3 Engineering and Economic/Financial Analysis Report: North San Pablo Bay Restoration and Reuse Project (CDM, Inc., 2008). The estimated cost of alternative supply is $1,952/AF (CDM, Inc., 2008;. p. 9-4). Avoided cost was updated from 2008 to 2012 dollars using DWR provided update factor of 1.04. Note that in CDM (2008) annualized supply cost is calculated using a 3% real discount rate. Applying DWR's 6% real discount rate would increase the avoided cost to $3,186/AF. The lower estimate is used for valuing water supply benefits for this project.
Zone 7	10.34%	$1,200	Mid-point cost of new or additional surface water supply for the near or mid-term (Zone 7 Water Agency, 2011).[13]
Bay Friendly Coalition	2.54%	$1,521	The simple average avoided cost of participating water supply agencies is used since water savings from the Bay Friendly Sustainable Landscape Education program may be realized throughout the greater Bay Area.
Weighted Average		**$1,321**	

[12] Sunding, D., & Hamilton, S. (2010). *Residential Loss from Urban Water Shortages in California.* Sacramento, CA.: California Urban Water Agencies.
[13] Zone 7 Water Agency. (2011). *2011 Water Supply Evaluation: A Risk-Based Approach to Evaluating Zone 7 Water Agency's Water Supply System.* Livermore, California: Zone 7 Water Agency. See page 118.

Value of Water Supply Benefits

Annual water supply benefits for the Bay Area Regional Water Conservation and Education Program are calculated as the product of expected water savings and the weighted-average avoided water cost, as summarized in the following PSP Table 15 for Project 1. The present value (in 2012) of water supply benefits is $8,111,677.

PSP Table 15 – Annual Benefit Project 1 – Bay Area Regional Conservation and Education Program									
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit (Units)	Without Project [1]	With Project	Change Resulting from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Present Value Coefficient	Discounted Benefits (h) x (i)
2012	Water Supply	AF	0	0.0	0.0		$0	1.000	**$0**
2013	Water Supply	AF	0	0.0	0.0		$0	0.943	**$0**
2014	Water Supply	AF	0	0.0	0.0		$0	0.890	**$0**
2015	Water Supply	AF	0	1,157.5	1,157.5	$1,321	$1,529,140	0.840	**$1,283,896**
2016	Water Supply	AF	0	1,819.0	1,819.0	$1,321	$2,403,122	0.792	**$1,903,498**
2017	Water Supply	AF	0	1,492.7	1,492.7	$1,321	$1,971,992	0.747	**$1,473,587**
2018	Water Supply	AF	0	1,166.4	1,166.4	$1,321	$1,540,958	0.705	**$1,086,314**
2019	Water Supply	AF	0	774.4	774.4	$1,321	$1,023,001	0.665	**$680,354**
2020	Water Supply	AF	0	448.2	448.2	$1,321	$592,147	0.627	**$371,520**
2021	Water Supply	AF	0	347.9	347.9	$1,321	$459,590	0.592	**$272,031**
2022	Water Supply	AF	0	346.4	346.4	$1,321	$457,635	0.558	**$255,541**
2023	Water Supply	AF	0	345.0	345.0	$1,321	$455,759	0.527	**$240,088**
2024	Water Supply	AF	0	343.6	343.6	$1,321	$453,958	0.497	**$225,603**
2025	Water Supply	AF	0	108.8	108.8	$1,321	$143,767	0.469	**$67,403**
2026	Water Supply	AF	0	107.6	107.6	$1,321	$142,107	0.442	**$62,854**
2027	Water Supply	AF	0	42.2	42.2	$1,321	$55,812	0.417	**$23,288**
2028	Water Supply	AF	0	41.1	41.1	$1,321	$54,282	0.394	**$21,368**
2029	Water Supply	AF	0	40.0	40.0	$1,321	$52,813	0.371	**$19,613**
2030	Water Supply	AF	0	38.9	38.9	$1,321	$51,403	0.350	**$18,009**
2031	Water Supply	AF	0	37.9	37.9	$1,321	$50,050	0.331	**$16,542**
2032	Water Supply	AF	0	36.9	36.9	$1,321	$48,750	0.312	**$15,201**

PSP Table 15 – Annual Benefit

Project 1 – Bay Area Regional Conservation and Education Program

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project [1]**	**With Project**	**Change Resulting from Project (e) – (d)**	**Unit $ Value**	**Annual $ Value (f) x (g)**	**Present Value Coefficient**	**Discounted Benefits (h) x (i)**
2033	Water Supply	AF	0	36.0	36.0	$1,321	$47,503	0.294	**$13,973**
2034	Water Supply	AF	0	35.1	35.1	$1,321	$46,305	0.278	**$12,850**
2035	Water Supply	AF	0	20.9	20.9	$1,321	$27,592	0.262	**$7,223**
2036	Water Supply	AF	0	20.0	20.0	$1,321	$26,488	0.247	**$6,542**
2037	Water Supply	AF	0	19.2	19.2	$1,321	$25,429	0.233	**$5,925**
2038	Water Supply	AF	0	18.5	18.5	$1,321	$24,412	0.220	**$5,366**
2039	Water Supply	AF	0	17.7	17.7	$1,321	$23,435	0.207	**$4,860**
2040	Water Supply	AF	0	17.0	17.0	$1,321	$22,498	0.196	**$4,401**
2041	Water Supply	AF	0	16.3	16.3	$1,321	$21,598	0.185	**$3,986**
2043	Water Supply	AF	0	15.1	15.1	$1,321	$19,905	0.164	**$3,269**
2044	Water Supply	AF	0	14.5	14.5	$1,321	$19,108	0.155	**$2,961**
								Total Present Value of Discounted Benefits Based on Unit Value	**$8,111,677**

Comments: [1] Water savings from plumbing code requirements and other sources under the without-project condition have been netted out of the with-project savings estimates. Therefore no water savings are reported for the without-project condition.

Project Cost

Total project implementation cost is $5,258,171, with 40% of expenditures expected in 2013, 50% in 2014, and 10% in 2015. The present value of program implementation costs are summarized in PSP Table 19 for Project 1. The present value (in 2012) of program implementation cost is $4,765,578.

PSP Table 19—Annual Costs of Project Project 1: Bay Area Regional Conservation and Education Program										
	Initial Costs Grand Total Cost from Table 7	Adjusted Grant Total Cost	Annual Costs						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2012								$0	1.000	**$0**
2013	$2,103,268							$2,103,268	0.943	**$1,984,215**
2014	$2,629,086							$2,629,086	0.890	**$2,339,877**
2015	$525,817							$525,817	0.840	**$441,486**
Total Present Value of Discounted Costs (Sum of column (j))										**$4,765,578**

Project Benefit-Cost Ratio

The present value of water supply benefits for Project 1 is $8,111,677. The present value economic cost is $4,765,578. Project net present value is $3,346,099 and the project benefit-cost ratio is 1.70.

Project 2 – East Bayshore Recycled Water Project Phase 1A (Emeryville)

Project Benefits

With Project Condition: The EBRWP Phase 1A (Emeryville) will build on the previous Phase 1 project, which was completed in October 2012. This is the next phase of a multi-phased project that can ultimately provide up to 2.5 MGD of recycled water to the East Shore area in portions of multiple cities. The EBRWP Phase 1A (Emeryville) involves extending the recycled water pipeline developed in Phase 1 to users located in the Emeryville area. This project will offset 50 AFY of potable demand initially. Once the segment of the transmission network connecting Berkeley and Albany is completed in 2016, the project will offset 360 AFY of potable demand. The pipeline is expected to have a 50-year useful life.

Without Project Condition: If the proposed project is not implemented, the EBRWP will not be operated at its design capacity. Demand on other EBMUD supply sources will increase and the EBMUD supply portfolio will be less diversified. Without the project, there is a higher probability that EBMUD will need to implement rationing during prolonged droughts. Without the project, EBMUD wastewater discharged to the Bay will increase by 360 AFY compared with the project.

D2 Non-Monetized Project Benefits

Non-monetizable project benefits, including community and social benefits, environmental stewardship benefits, and sustainability benefits are identified, as applicable to this project, in the PSP Table 12 "Non-Monetized Benefits Checklist" below.

PSP Table 12—Non-Monetized Benefits Checklist Project 2: East Bayshore Recycled Water Project Phase 1A (Emeryville)			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
1	**Provide educational or technological benefits?**	Yes	Extending the recycled water pipeline will allow more recycled water to be delivered to customers. EBMUD will install signage at customer sites to indicate that sites are irrigated with recycled water. This will alert the public that recycled water is used on site, which is part of EBMUD's public education and outreach program.
2	**Provide social recreation or access benefits?**	No	

PSP Table 12—Non-Monetized Benefits Checklist Project 2: East Bayshore Recycled Water Project Phase 1A (Emeryville)			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
3	**Help avoid, reduce, or resolve various public water resource conflicts?**	Yes	The project uses recycled water in place of potable water for beneficial uses, which will reduce potable water demand and thereby reduce regional dependence on imported water. (EBMUD's potable water supply can originate from either the Mokelumne River—which is a tributary to the Delta—or the Sacramento River at Freeport.) The project will also increase regional supply reliability by reducing the risk of severe rationing during prolonged droughts.
4	**Promote social health and safety?**	Yes	D3 Monetized Benefit
5	**Have other social benefits?**	Yes	The educational elements of the project are directed toward the public, including the disadvantaged community of West Oakland in the project area.
Environmental Stewardship Benefits: Will the proposal:			
6	**Benefit wildlife or habitat in ways that are not quantified?**	Yes	The project will: ▪ increase flows to the Delta by reducing the need for water from the Mokelumne River, a tributary to the Delta; ▪ reduce the need to divert Sacramento River water at Freeport during a drought, thereby benefitting the Delta; ▪ increase Mokelumne instream flows for environmental uses; ▪ improve flood management by reducing demand for the Mokelumne River supply; and ▪ incorporate resource stewardship by reducing imported potable water demand and treated wastewater discharge to the SF Bay.
7	**Improve water quality in ways that are not quantified?**	Yes	The project will reduce treated wastewater discharge to the SF Bay and help realize TMDL goals for the SF Bay.
8	**Reduce net emissions in ways that are not quantified?**	Yes	EBMUD is also evaluating supplemental supply options other than recycling, including desalination. Compared to desalination, this recycled water project will reduce greenhouse gas production. (Temporary) Construction equipment and vehicles used for the project will emit greenhouse gases.

PSP Table 12—Non-Monetized Benefits Checklist Project 2: East Bayshore Recycled Water Project Phase 1A (Emeryville)			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
9	**Provide other environmental stewardship benefits?**	Yes	The project will: ▪ increase flows to the Delta by reducing the need for water from the Mokelumne River, a tributary to the Delta; ▪ reduce the need to divert Sacramento River water at Freeport during a drought, thereby benefitting the Delta; ▪ increase Mokelumne instream flows for environmental uses; ▪ improve flood management by reducing demand for the Mokelumne River supply; and ▪ incorporate resource stewardship by reducing imported potable water demand and treated wastewater discharge to the SF Bay.
Sustainability Benefits: Will the proposal:			
10	**Improve the overall, long-term management of California groundwater resources?**	No	The project has no direct effects on groundwater resources.
11	**Reduce demand for net diversions for the region from the Delta?**	Yes	The project will: ▪ use recycled water in place of potable water for beneficial uses, which will reduce potable water demand and thereby reduce regional dependence on imported water. ▪ increase flows to the Delta by reducing the need for water from the Mokelumne River, a tributary to the Delta; ▪ reduce the need to divert Sacramento River water at Freeport during a drought; ▪ maximize the use of a sustainable local resource.
12	**Provide a long-term solution in place of a short-term one?**	Yes	The project uses recycled water in place of potable water for beneficial uses, which will reduce potable water demand and thereby reduce regional dependence on imported water. The project will also increase regional supply reliability by reducing the risk of severe rationing during prolonged droughts.
13	**Promote energy savings or replace fossil-fuel-based energy sources with renewable energy and resources?**	No	

PSP Table 12—Non-Monetized Benefits Checklist Project 2: East Bayshore Recycled Water Project Phase 1A (Emeryville)			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
14	**Improve water supply reliability in ways not quantified?**	Yes	D3 Monetized Benefit
15	**Other**	No	

D3 Monetized Project Benefits

Quantifiable Project Benefits: Avoided costs are development of the supplemental water supplies identified in the district's Water Supply Management Program 2040 Plan if recycled water and conservation development fall short of targeted levels (East Bay Municipal Utility District, 2012).[14] The expected cost of these supply alternatives is valued at $1,337/AF (2012 dollars).

Calculation of Annual Water Supply Benefit:
EBMUD's Water Supply Management Program 2040 (WSMP) sets the district's supply strategy for the next 30 years. This strategy is comprised of baseline investments in conservation and recycling plus investment in supplemental supplies. The supplemental supply investments represent the district's marginal cost of new water supply. Six supplemental supply sources are identified, encompassing investments in transfers, groundwater banking, local groundwater development, surface storage expansion, and desalination. Supplemental supply costs range from $630/AF to $1,970/AF (2009 dollars). The average cost is $1,042/AF (2009 dollars). Since the plan does not assign priority or expected yield to the six supplemental sources, the average cost constitutes an appropriate estimate of the district's avoided supply cost. Updating to 2012 dollars using DWR's update factor, this cost is $1,073/AF. The variable costs of transmission, treatment, and distribution are added since recycled and conservation water costs are measured from the customer tap. The transmission cost will vary depending on the source, but it is expected to be comparable to the variable transmission cost for Mokelumne River water, which is $144/AF (Sect. 5.3.4, WSMP, Appendix D). The variable cost of treatment is $67/AF (Table 5-5, WSMP, Appendix D). The variable cost of distribution is $53/AF (Sect. 5.3.6, WSMP, Appendix D). The total avoided cost is $1,337/AF.

The annual project yield is 50 AFY in 2015 and 2016, and it will be 360 AFY thereafter. The project has a 50-year useful life.

The present value of the annual water supply benefit over the project useful life is $6,075,661. This information is summarized in PSP Table 15 for Project 2, below.

[14] East Bay Municipal Utility District. (2012). *Water Supply Management Program 2040 Plan.* Oakland, California: East Bay Municipal Utility District.

PSP Table 15 – Annual Benefit Project 2 – East Bayshore Recycled Water Project Phase 1A (Emeryville)									
(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)**	**Present Value Coefficient**	**Discounted Benefits (h) x (i)**
2012								1.000	
2013								0.943	
2014								0.890	
2015	Water Supply	AF	0	50	50	$1,337	$66,850	0.840	**$56,129**
2016	Water Supply	AF	0	50	50	$1,337	$66,850	0.792	**$52,951**
2017-2065	Water Supply	AF	0	360	360	$1,337	$481,320	12.396	**$5,966,581**
Total Present Value of Discounted Benefits Based on Unit Value									**$6,075,661**

Project Cost

Project costs from Table 7 (Attachment 4) are augmented in column (b) to include the expected cost of the Emeryville to Albany transmission line that will allow delivery of the full 360 AFY of projected yield. Operating costs are based on actual costs of EBMUDs existing tertiary treatment facility and average $842/AF. Operating costs are calculated over the 50-year useful life of the transmission lines. The present value of capital and operating economic costs is $6,443,055. The Annual project costs are summarized n PSP Table 19 for Project 2, below.

PSP Table 19—Annual Costs of Project

Project 2: East Bayshore Recycled Water Project Phase 1A (Emeryville)

	Initial Costs Grand Total Cost from Table 7	Adjusted Grant Total Cost[1]	Annual Costs						Discounting Calculations	
			Admin	Operations[2]	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2012								$0	1.000	**$0**
2013	$481,712							$481,712	0.943	**$454,445**
2014	$1,200,000							$1,200,000	0.890	**$1,067,996**
2015	$360,000			$42,100				$402,100	0.840	**$337,611**
2016		$1,000,000		$42,100				$1,042,100	0.792	**$825,441**
2017-2065[3]				$303,120				$303,120	12.396	**$3,757,562**
Total Present Value of Discounted Costs (Sum of column (j))										**$6,443,055**

Comments:
[1] Expected cost of Phase 1A (Emeryville) transmission line to deliver recycled water to Berkeley and Albany need to realize the full 360 AFY yield.
[2] Annual variable costs of tertiary water treatment and delivery are estimated by EBMUD at $842/AF based on costs to operate existing system.
[3] O&M costs calculated over 50 year useful life of pipeline.

Project Benefit-Cost Ratio

Present value of annual water supply benefits for Project 1A (Emeryville) is $6,075,661. Present value of project economic costs is $6,443,055. Project net present value is -$367,394 and the project benefit-cost ratio is 0.94.

Project 6 – North Bay Water Reuse Program – Sonoma Valley CSD 5th Street East/McGill Road Recycled Water Project

Project Benefits

With Project Condition: The Sonoma Valley CSD 5th Street East/McGill Road Recycled Water Project, a Phase 2 component of North Bay Water Reuse Program (NBWRP), consists of two recycled water sub-projects located in Sonoma Valley. The total recycled water yield from the project is approximately 200 AFY. The purpose of the project is to provide high quality recycled water for agricultural, urban, and environmental uses and to expand the recycled water system throughout the greater North San Pablo Bay Area. The project will reduce reliance on local surface water and groundwater supplies and reduce the amount of treated effluent releases to North San Pablo Bay and its tributaries. The project will add 9,420 linear feet of 6, 8, and 10-inch diameter recycled water pipeline connected to an existing 18" diameter recycled water pipeline and provide up to 200 acre-feet per year of recycled water for agricultural and urban uses. Treatment of wastewater is identical in the without- and with-project conditions (SVCSD WWTP treats all it effluent to a tertiary level approved for recycled water) and the pumping cost difference is negligible. Annual project costs are therefore limited to pipeline O&M. The pipeline is expected to have a 50-year useful life.

Without Project Condition: The without-project condition represents the reasonably foreseeable actions that would be taken by members of the North Bay Water Reuse Authority (NBWRA) and other agencies involved in the study area's water supply, in absence of the NBWRP. Non-recycled water supply projects which are options for the region in the absence of the NBRWRP are documented in the Phase 3 Engineering and Economic/Financial Analysis Report: North San Pablo Bay Restoration and Reuse Project (CDM, Inc., 2008). Under the without-project, potable water customers in the Sonoma County portion of the NBRWRP's service area (including the City of Sonoma), would receive water from Sonoma County Water Agency's (SCWA's) Water Supply, Transmission, and Reliability Project (WSTRP) or similar project. Agricultural water users in Sonoma Valley would continue to use local surface waters and pump groundwater.[15] The WSTRP is anticipated to provide incremental increases of 690 AFY to Sonoma over 2005-2006 Russian River deliveries.[16] The estimated cost of WSTRP water is $1,952/AF.[17]

Under the without-project condition, agricultural users would rely on current supplies for irrigation. Groundwater pumping in Sonoma Valley groundwater basins is increasing. It was estimated that from 1975 to 2000, 17,300 AF were lost from total groundwater storage. Projected increases in demands are estimated to result in a further reduction of approximately 16,000 to 22,000 AF from storage in the groundwater basin (SCWA 2007[18]). Declining groundwater levels could result in potential adverse effects of increased salinity intrusion, potential land subsidence, losses in stream flows, environmental damages, and increasing extraction, well deepening, and replacement costs. Groundwater

[15] CDM (2008), p. 6-3.
[16] Ibid., p. 6-4.
[17] Ibid., p. 9-4. Updated from 2008 to 2012 dollars using DWR provided update factor of 1.04. CDM (2008) calculated annualized supply cost of the WSTRP using a 3% real discount rate. Applying a 6% real discount rate, as required by DWR, would increase the WSTRP cost to $3,186/AF.
[18] Sonoma County Water Agency (SCWA), 2007. Sonoma Valley Groundwater Management Plan.

would not be a sustainable supply in the future if current pumping patterns continue. The Sonoma Valley Groundwater Management Plan identifies potential activities to increase groundwater sustainability, including storm water recharge, groundwater banking, and conservation/demand reduction (SCWA 2007). Cost per AF for groundwater banking and stormwater recharge is expected to be similar in magnitude to the WSTRP supply cost.[19]

D2 Non-Monetized Project Benefits

Non-monetizable project benefits, including community and social benefits, environmental stewardship benefits, and sustainability benefits are identified, as applicable to this project, in the PSP Table 12 "Non-Monetized Benefits Checklist" below.

PSP Table 12—Non-Monetized Benefits Checklist Project 6: North Bay Water Reuse Program—Sonoma Valley CSD 5th Street East/McGill Road Recycled Water Project			
No.	**Question**	**Yes, No, or Neg**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
1	**Provide educational or technological benefits?**	Yes	Although the 5th Street East/McGill Road Recycled Water Project does not have a specific educational component included in this funding request, the project will provide opportunities for recycled water education. The 5th Street branch will provide recycled water for the Sonoma Valley High School athletic fields, providing a natural opportunity to introduce students to recycled water concepts. While it is difficult to measure the cause-and-effect relationship between educational efforts and a specific water-supply or water-quality outcome, increasing the public's understanding may increase support for future water recycling projects, resulting in additional benefits. The project will also increase public knowledge of the use of recycled water for agricultural irrigation and urban landscape irrigation.

[19] CDM (2008), p. 9-5.

PSP Table 12—Non-Monetized Benefits Checklist Project 6: North Bay Water Reuse Program—Sonoma Valley CSD 5th Street East/McGill Road Recycled Water Project			
No.	**Question**	**Yes, No, or Neg**	**Explanation of Benefit**
2	**Provide social recreation or access benefits?**	Yes	The project will reduce surface water diversion from Sonoma Creek and its tributaries, thereby improving surface water quality and increasing outdoor recreation opportunity. Sonoma Creek is subject to a TMDL Implementation Plan to reduce sediment and improve fish habitat. The project will have a positive effect on fish populations by reducing groundwater pumping and surface water diversion, resulting in increased water flows in the creek. The 5th Street branch terminates at the Sonoma Valley High School and will provide water to irrigate the athletic fields. Because recycled water is drought-resistant, these areas will not be subject to water shortages during dry years. Thus, lands affected by the project will remain green throughout the year. This will improve the aesthetics of the lands and increase recreational opportunities.
3	**Help avoid, reduce, or resolve various public water resource conflicts?**	Yes	A public meeting will be held, which will provide an opportunity for the public to become involved in the recycled water project. The project will help meet state mandates concerning discharge of treated wastewater into North San Pablo Bay. By reducing discharges into the Bay, the project reduces the total pollutant loading into surface waters.
4	**Promote social health and safety?**	Yes	The construction of the water supply improvements will increase reliability of critical services by offsetting potable water consumption from the Russian River and local groundwater. This will lessen demand on the existing potable water system during periods of drought or high water demand.
5	**Have other social benefits?**	No	
Environmental Stewardship Benefits: Will the proposal:			
6	**Benefit wildlife or habitat in ways that are not quantified?**	Yes	Reducing groundwater pumping and surface water diversion will allow stream flows to remain in the Russian River and Sonoma Creek. This benefits the aquatic and riparian habitat quality. Fish and wildlife beneficial uses in these water bodies—such as cold freshwater habitat, estuarine habitat, fish migration, preservation of rare and endangered species, fish spawning, riparian and wetland wildlife habitat—are of statewide significance. Both Sonoma Creek and the Russian River are listed as impaired and are home to sensitive and endangered species.

PSP Table 12—Non-Monetized Benefits Checklist Project 6: North Bay Water Reuse Program—Sonoma Valley CSD 5th Street East/McGill Road Recycled Water Project			
No.	**Question**	**Yes, No, or Neg**	**Explanation of Benefit**
7	**Improve water quality in ways that are not quantified?**	Yes	The project will improve water quality in Sonoma Creek by reducing groundwater pumping and surface water diversion. Sonoma Creek exceeds the amount of sediment allowed by water quality standards: the classification was prompted by native fish population declines. The Sonoma Creek Sediment TMDL addresses this water quality issue, identifies pollutant sources, and specifies actions required. One action is to increase summer flows by creating a groundwater management plan (adopted GWMP in 2007) and maintaining groundwater levels. The project's reduction of groundwater pumping contributes to one goal of the TMDL Implementation Plan. D3 Monetized Benefit: Increased recycled water use will reduce wastewater discharges and provide pollutant-loading reductions.
8	**Reduce net emissions in ways that are not quantified?**	Neg (Temporary); Yes (Long-term)	The project will cause a temporary increase in vehicle miles traveled during construction, which will increase greenhouse gas emissions. Producing recycled water also requires energy. However, the SVCSD WWTP currently treats all water to a tertiary level approved for recycled water. Therefore, there will be no increase in energy use resulting from the water treatment. Additionally, studies have shown that recycled water uses less energy per acre-foot than most other water supply options. The Natural Resources Defense Council has stated that recycled water is less energy intensive than other water supply options, with the exception of some local surface water. Therefore, the project will reduce net emissions in the long-term by utilizing a more energy-efficient source of water as an alternative to groundwater and surface water pumping.
9	**Provide other environmental stewardship benefits?**	No	

PSP Table 12—Non-Monetized Benefits Checklist Project 6: North Bay Water Reuse Program—Sonoma Valley CSD 5th Street East/McGill Road Recycled Water Project			
No.	**Question**	**Yes, No, or Neg**	**Explanation of Benefit**
Sustainability Benefits: Will the proposal:			
10	**Improve the overall, long-term management of California groundwater resources?**	Yes	A Groundwater Management Plan has been completed for Sonoma Valley, and elements from the Plan are being implemented. The Groundwater Management Plan references a 2006 USGS study that indicates that more than half of Sonoma Valley's water demand was met with pumping groundwater (57%). Groundwater use has increased dramatically, and net losses in overall groundwater storage have been accumulating. Using recycled water will reduce groundwater pumping, thereby improving the overall, long-term management of California's groundwater resources. The project will also contribute to groundwater aquifer protection by reducing groundwater pumping, which will slow salinity intrusion caused by overdraft and climate change. In addition, the Sonoma Valley CSD is in the process of preparing a Salt and Nutrient Management Plan. The goal is to look at long-term water management in the Valley, including basin-wide water quality monitoring, water recycling goals and objectives, salt and nutrient source identification, basin loading, salt mitigation strategies, and anti-degradation analysis.
11	**Reduce demand for net diversions for the region from the Delta?**	No	
12	**Provide a long-term solution in place of a short-term one?**	Yes	D3 Monetized Benefit
13	**Promote energy savings or replace fossil-fuel-based energy sources with renewable energy and resources?**	Yes	The project will provide a net increase in water recycling use in Sonoma Valley, which will reduce the need to pump potable water from the Russian River and groundwater. Recycled water is a sustainable source of water that is unaffected by weather patterns.
14	**Improve water supply reliability in ways not quantified?**	Yes	D3 Monetized Benefit

PSP Table 12—Non-Monetized Benefits Checklist Project 6: North Bay Water Reuse Program—Sonoma Valley CSD 5th Street East/McGill Road Recycled Water Project			
No.	**Question**	**Yes, No, or Neg**	**Explanation of Benefit**
15	**Other**	Yes	Climate change: Long-term climate change poses substantial water supply risks to the Bay Area. While there is controversy surrounding climate change, evidence suggests that the Bay Area's climate will get hotter and that the Bay Area's primary source of water storage—Sierra Nevada snowpack—will get smaller. Water recycling provides an economically feasible, alternative water source that is not dependent on climate or weather. Long-term climate change also poses a risk to groundwater aquifers. As sea levels rise, salinity intrusion becomes more of a concern. The project will contribute to groundwater aquifer protection by reducing groundwater pumping, which will slow salinity intrusion.

D3 Monetized Project Benefits

Quantifiable Project Benefits:

- Avoided capital costs to construct and operate the WSTRP, groundwater banking, and stormwater recharge projects. The cost of these supply alternatives is valued at the expected cost of the WSTRP -- $1,952/AF (2012 dollars). Annual O&M costs were not included as avoided costs, but would add roughly 10% to the total avoided costs.
- Avoided purchases of nitrogen-based fertilizer by agricultural producers receiving recycled water.

Calculation of Annual Water Supply Benefit

- Reasonably foreseeable actions that would be taken by members of the NBWRA and other agencies involved in the study area's water supply, in absence of the NBWRP are documented in the Phase 3 Engineering and Economic/Financial Analysis Report: North San Pablo Bay Restoration and Reuse Project (CDM, Inc., 2008). This study concluded potable water customers in the Sonoma County portion of the NBRWRP's service area (including the City of Sonoma), would receive water from Sonoma County Water Agency's (SCWA's) Water Supply, Transmission, and Reliability Project (WSTRP) or similar project at an estimated cost of $1,952/AF.
- For agricultural water uses, the study concluded groundwater would not be a sustainable supply in the future if current pumping patterns continue and investments in storm water recharge, groundwater banking, and conservation/demand reduction would be required to stabilize groundwater levels in the region. The cost for groundwater management projects is uncertain but expected to be similar in magnitude to the cost per AF estimated for WSTRP supply.

- The annual water supply benefit of the project is the product of the project's yield and the alternative cost of supply. The project's yield is 50 AFY in 2015-16, 200 AFY in 20-17-2064, and 150 AFY in 2065-2066. The alternative cost of supply under the without-project condition is $1,952 (CDM, Inc., 2008).
- The pipeline has a 50-year useful life with the McGill segment coming on line in 2015 and the 5th St. segment coming on line in 2017. The present value of the annual water supply benefit over the project useful life is $5,024,703.

Calculation of Avoided Fertilizer Costs

- Estimated concentrations of nitrogen, phosphorous, and potassium in lbs per AF of recycled water from the project are 27.2, 13.6, and 27.2, respectively.[20]
- Commercial values for nitrogen, phosphorous, and potassium fertilizer in dollars per lb are $0.43, $0.73, and $0.30, respectively.[21] The concentration-weighted average commercial value per lb of fertilizer is $0.44.
- Each AF of water delivers the equivalent of 68 lbs of fertilizer with an average value of $0.44 per lb, or $29.92 per AF (2009 dollars).
- The annual value of avoided fertilizer cost is the product of the project water supply yield and the value of fertilizer per AF. This value is $5,984.
- The present value of the annual fertilizer benefit over the 50-year useful life of the project is $77,018.

[20] Asano, T. 1981. Evaluation of Agricultural Irrigation Projects using Reclaimed Water. Agreement 8-179-215-2. Office of Water Recycling. California State Water Resources Control Board, Sacramento, CA. updated to 2006 using the national fertilizer price index. Updated from 2006 to 2009 based on the Consumer Price Index (CPI).
[21] Commercial fertilizer prices provided by applicant.

Summary of Monetized Project Benefits

Water Supply Benefit	$5,024,703
Avoided Fertilizer Costs	$77,018
Total	$5,101,721

This information is detailed in PSP Table 15 for Project 6, below.

PSP Table 15 – Annual Benefit
Project 6 – North Bay Water Reuse Program – Sonoma Valley CSD 5th Street East/McGill Road Recycled Water Project

(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)**	**Present Value Coefficient**	**Discounted Benefits (h) x (i)**
2015-2016	Water Supply	AF	0	50	50	$1,952	$97,600	1.632	**$159,255**
2015-2016	Avoided Fertilizer Application [1]	Lbs	0	3400	3400	$0.44	$1,496	1.632	**$2,441**
2017-2064	Water Supply	AF	0	200	200	$1,952	$390,400	12.396	**$4,839,510**
2017-2064	Avoided Fertilizer Application [1]	Lbs	0	13600	13600	$0.44	$5,984	12.396	**$74,179**
2065-2066	Water Supply	AF	0	150	150	$1,952	$292,800	0.089	**$25,937**
2065-2066	Avoided Fertilizer Application [1]	Lbs	0	10200	10200	$0.44	$4,488	0.089	**$398**
Total Present Value of Discounted Benefits Based on Unit Value									**$5,101,721**

Comments: [1] Estimated concentrations of nitrogen, phosphorous, and potassium in lbs per AF of recycled water from the project are 27.2, 13.6, and 27.2, respectively. Total fertilizer concentration is 68 lbs per AF. Commercial values for nitrogen, phosphorous, and potassium fertilizer in dollars per lb are $0.43, $0.73, and $0.30, respectively. The concentration-weighted average commercial value per lb of fertilizer is $0.44

Project Cost

Project economic costs are shown in the table below.

PSP Table 19—Annual Costs of Project Project 6: North Bay Water Reuse Program—Sonoma Valley CSD 5th Street East/McGill Road Recycled Water Project										
	Initial Costs Grand Total Cost from Table 7	Adjusted Grant Total Cost[1]	Annual Costs						Discounting Calculations	
			Admin	Operation[2]	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012	$163,700	-$163,700						$0	1.000	**$0**
2013	$437,550							$437,550	0.943	**$412,783**
2014	$747,100							$747,100	0.890	**$664,916**
2015	$771,050		$360		$7,200			$778,610	0.840	**$653,736**
2016	$440,600		$360		$7,200			$448,160	0.792	**$354,985**
2017-2064			$1,080		$21,600			$22,680	12.396	**$281,148**
2065-2066			$720		$14,400			$15,120	0.089	**$1,339**
Total Present Value of Discounted Costs (Sum of column (j))										**$2,368,907**

Comments:
[1] Costs incurred in 2012 treated as sunk.
[2] Treatment of wastewater is identical in the without- and with-project conditions (SVCSD WWTP treats all it effluent to a tertiary level approved for recycled water) and the pumping cost difference is negligible. Annual project costs are therefore limited to pipeline administration and maintenance costs.

Project Benefit-Cost Ratio

Present value of annual water supply and fertilizer benefits is $5,101,721. Present value of project economic costs is $2,368,907. Project net present value is $2,732,814 and the project benefit-cost ratio is 2.15.

Project 8 – Pescadero Water Supply and Sustainability Project

Project Benefits

With Project Condition: The existing well draws from a shallow portion of the aquifer that is projected to fail between 2018 and 2020. The water level in the well has been declining steadily over the past 10 years. This may have been a factor in a recent water system outage in 2011. The pump failed unexpectedly, and it is suspected that the water level may have declined past the level of the pump, resulting in the pump pumping too much air and failing. This project will construct a new well that will draw from a deeper portion of the aquifer that has an estimated aquifer life of at least 50 years based on current pumping rates of 24 AFY on average and a drawdown of 0.6 feet per year. The project would also construct a 140,000 gallon storage tank and implement a conservation program. The new well and storage tank would be a long-term solution for providing water supply to CSA 11 customers in Pescadero.

Without Project Condition: The County has determined the next best alternative to the new well and tank would be surface water from Lake Lucerne, Butano Creek, or Pescadero Creek. This alternative would require procuring surface water rights, obtaining permits, purchasing land, testing water, and constructing new transmission lines, a storage tank, a water treatment system, and a booster pump station. The estimated cost to construct the water treatment plant, tank, booster pump station, and pipeline is $1.7 million, which is about $0.8 million greater than the proposed groundwater well. This cost does not include the potential costs for land purchase, water rights, water permits, and water testing. Construction of domestic wells is not considered a viable alternative due to health concerns related to water quality.[22]

[22] Prior to 1993, the Town of Pescadero's water supply was from individual domestic wells, surface water impoundments, and locally derived groundwater from wells installed in the alluvial aquifer of Pescadero and Butano Creeks. In the 1970's and 1980's, it was discovered that these sources contain relatively high concentrations of nitrate, bacteria, and other naturally occurring salts. This resulted in the development of CSA 11 as a public water supply source.

D1 Cost-Effectiveness Analysis

The Cost Effectiveness Analysis method was applied to one Disadvantaged Community (DAC) project that may qualify for a funding match waiver: the Pescadero Water Supply and Sustainability Project (Project 8). PSP Table 11, below, is completed for this project. To provide further support for Project 8, potential non-monetized and monetized project benefits were evaluated. The results of these analyses are presented in Sections D2 and D3.

PSP Table 11 – Statement of Cost-Effectiveness Project 8: Pescadero Water Supply and Sustainability Project	
Question 1	***What are the types of benefits provided? Explain in as much detail as possible:*** The proposed Project addresses four benefits: ▪ Water supply enhancement ▪ Water reliability ▪ Groundwater improvement ▪ Water conservation **Water Supply Enhancement:** One of the primary benefits of the project would be a source of potable water for County Service Area 11 (CSA 11) water users within the Town of Pescadero by constructing a new 150 gallon per minute (gpm) municipal well and 140,000 gallon water storage tank. The existing two domestic wells are located in a shallow portion of the Pigeon Point Formation aquifer, which is expected to decline below the level of the existing wells within 5 to 7 years (Todd Engineers, 2002, pg 1, 10, 16; HydroScience Engineers, 2013). The CSA 11 customers have no other sustainable and affordable source of potable water supply to take the place of the existing water system. The new well would be drilled to reach a deeper portion of the aquifer, 100 feet below mean sea level, in order to access a larger potable water source. The new well is projected to last at least 50 years with a production capacity of 100 to 150 gpm (HydroScience Engineers, 2013). This new well would meet CSA 11's long-term water supply needs. The Project would be constructed on an existing tank and well site and on previously disturbed, high-traffic areas. Therefore, impacts would be minimized during construction. The impact to the aquifer would remain the same or decrease because the groundwater pumping would alternate between the existing production well located in the shallow portion of the aquifer and the proposed new well in the deeper portion of the aquifer, allowing recharge to occur between pumping (HydroScience Engineers, 2013). **Water Reliability:** The project has another primary benefit, which involves increasing the reliability of the current water system by adding redundancy in the form of an additional well, an additional storage tank, and improvements in the existing alarm system. The additional well and storage tank would provide a reliable redundant potable water system in the event of a single pump failure. The County would also save considerable emergency costs. The new and fully functioning alarm system would properly notify the system's operators of a pump failure or low tank level. This would help prevent a full water outage because the operators may have enough time to respond to issues. The new well and existing production well would be operated in a lead/lag alternating

	system. This would allow the pumps and tanks to undergo routine maintenance. **Groundwater improvement:** As stated above, the existing production well (Well No. 1) and the new well would be operated in a lead/lag system. This will allow the groundwater at Well No. 1 and the new well to recharge in between pumping and slow down the rate of withdrawal over time. This operation would spread the impact of groundwater pumping between two different parts of the aquifer and spread the impact out over time (HydroScience Engineers, 2013). This is a secondary benefit to the Project. **Water Conservation:** The County would like to implement either a rebate program for customers to purchase high efficiency toilets, urinals, and washers, or provide and install these items at little to no cost to the customer. These devices would reduce the overall water demand for CSA 11 and help it to become a more sustainable water system. This is a secondary benefit to the Project.
Question 2	***What are the physical benefits for the project compared to the without-project condition?*** **Water Supply:** The project will provide reliable and emergency water supply to about 100 customers that would be at risk of having no potable water if the system fails in the next five to seven years. The estimated pumping rate of the new aquifer is 100 to 150 gpm for at least 50 years (HydroScience Engineers, 2013). **Water Reliability:** The project would also provide an additional 140,000 gallons of storage, which is equivalent to about 5.5 days of water supply, assuming a demand of 25,500 gpd (Winzler & Kelly 2009 Fire Flow Analysis, Table 1). **Groundwater improvement:** The existing shallow portion of the aquifer at Well No. 1 has the potential to be recharged after pumping is reduced at Well No. 1. The deeper portion of the aquifer for the new well would be impacted by pumping. However, the deeper portion of the aquifer is potentially subject to recharge by local stream flow, in addition to direct rainfall, and is a potentially more sustainable source of supply (HydroScience Engineers, 2013). **Water Conservation:** Installing approximately 60 high efficiency toilets/urinals and 40 high efficiency washers that replace low efficiency devices could reduce the annual water demand by approximately 2 AFY. Water conservation efforts will extend the life of the aquifer beyond the estimated 50 years (HydroScience Engineers, 2013).
Question 3	***Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified:***
	If yes, list the methods (including the proposed project) and estimated costs. 1. The County has considered that the next best alternative to the new well and tank would be surface water from Lake Lucerne, Butano Creek, or Pescadero Creek. This alternative could require procuring surface water rights, obtaining permits, constructing a storage tank and water treatment system, booster pump station, purchasing land, water testing, and constructing new transmission lines. The estimated cost of this alternative just to construct the water treatment plant, tank, booster pump station and pipeline is $1.7 million. This cost does not include the potential costs for land purchase, water

	rights, water permits, and water testing. This alternative cost is higher than the estimated cost of the proposed well project ($825,000), therefore, the County elected to pursue the proposed well project. 2. A previous water supply planning study was conducted in 1976, which detailed several options for water supply. (Koretsky King Associates. 1976. Community Water Plan for the Town of Pescadero County of San Mateo. Pg. S-1, S-2, S-4, 1-7, 1-10, 2-3, 3-7, 3-10, 6-3, 7-14, 7-16, 8-3) The objective of this study was to develop a preliminary engineering design and cost estimate for a community water system. At the time of this study, Pescadero residents obtained drinking water through private wells and bottled water. High nitrate and bacteriological levels in the private wells led to health and safety concerns. This study was based on a minimum population of 1200 persons for a water distribution system and 2000 persons for water source facilities and a demand of 322 AFY. Under these assumptions, groundwater was not considered a viable water source due to limited capacity and low water quality. The recommended alternative was to divert winter surface water from Butano Creek into a 1000 AF reservoir dam located in Arroyo de Los Frijoles canyon. The water would be treated at a modular water treatment plant and delivered to individual users in Pescadero. The estimated capital cost was $1.3 million and the estimated O&M cost was $30,000 per year, in 1976 dollars. This option is not considered feasible or cost effective due to several reasons: ▪ Current environmental climate is not conducive to surface water storage (dams) ▪ Estimated capital cost in 1976 dollars is greater than current estimated cost of proposed Project and does not include the cost of environmental studies, design, water rights, or land procurement ▪ Procurement of water rights and easements can be a lengthy, uncertain, and expensive process ▪ Option is not necessarily applicable because it assumes a much larger population and demand than currently exists. Groundwater is a feasible water supply option. 3. 1986 Water System Study: *Water System for the Pescadero Rural Service Center*, County of San Mateo, Kennedy/Jenks/Chilton, 1986, Pg. 1-1, 1-2, Table 7 The objective of this study was to develop a project description and preliminary design options for a water system to serve the entire community of Pescadero. As discussed above, residents were still obtaining water from private wells and bottled water at the time of this study. Safety concerns were still applicable due to the high level of nitrates and bacteria from the private wells. The study examined four water system alternatives which included a combination of surface water, groundwater, water treatment, and groundwater treatment systems. The most economical option was a groundwater well that produced potable quality water that did not require reverse osmosis treatment for high chlorides ($28/month/average user in 1986 dollars). The existing potable water system was constructed based on the results of this study. It is not considered cost-effective to pursue the other options discussed in the study, since they were considerably more expensive ($45, $47, and $70/month/average use in 1986 dollars) and complicated. The proposed project includes a replacement groundwater well as the most cost effective alternative for a reliable and high quality potable water supply for CSA 11.
Question 4	***If the proposed project is not the least cost alternative, why is it the preferred alternative? Provide an explanation of any***

	accomplishments of the proposed project that are different from the alternative project or methods. The proposed project is the most cost effective alternative.

References Cited:

County of San Mateo, Department of Public Works. 2011. Pescadero Community Water System – County Service Area No. 11 (CSA11) August 2011 Water Outage Report.

HydroScience Engineers, Inc. 2013. Technical Memorandum #1: Water Supply Reliability. Pg. 1-6.

Kennedy/Jenks/Chilton, 1986. Water System for the Pescadero Rural Service Center County of San Mateo, Pg. 1-1, 1-2, Table 7.Koretsky King Associates. 1976. Community Water Plan for the Town of Pescadero County of San Mateo. Pg. S-1, S-2, S-4, 1-7, 1-10, 2-3, 3-7, 3-10, 6-3, 7-14, 7-16, 8-3.San Mateo Local Agency Formation Commission. 2011. Municipal Service Review and Sphere of Influence Update for County Service Area 11 (Pescadero). October 12. Pg. 2-12.

Todd Engineers. 2002. Assessment of Source Water for the Pescadero Water System - CSA 11. Prepared for Department of Public Works, San Mateo County, California. Pg. 1, 10, 16.

Winzler & Kelly Consulting Engineers. 2009. Pescadero Fire Flow Analysis. May 1. Table 1.

D2 Non-Monetized Project Benefits

Non-monetizable project benefits, including community and social benefits, environmental stewardship benefits, and sustainability benefits are identified, as applicable to this project, in the PSP Table 12 "Non-Monetized Benefits Checklist" below.

PSP Table 12—Non-Monetized Benefits Checklist Project 8: Pescadero Water Supply and Sustainability Project			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
1	**Provide educational or technological benefits?**	Yes	The County will conduct public outreach and education efforts related to water conservation. The goal of these efforts is to reduce water demands and protect the long-term viability of the local groundwater supply. CSA 11 residents will receive information about water-efficient devices.
2	**Provide social recreation or access benefits?**	No	
3	**Help avoid, reduce, or resolve various public water resource conflicts?**	Yes	D3 Monetized Benefit Implementation of the water conservation program will help meet the State's goals of water conservation and reuse. The water conservation program will either be an incentive-based rebate program for water-efficient devices (i.e., washers, toilets, and urinals) or an installation program in which the County provides and installs water-efficient devices at little to no cost to the customer. The installation of water-efficient devices may reduce CSA 11's water demand by approximately 2 AFY.
4	**Promote social health and safety?**	Yes	D3 Monetized Benefit
5	**Have other social benefits?**	Yes	The project is for a disadvantaged community and will provide a critical water supply need. The project also includes a water conservation program that will provide residents with high-efficiency toilets, urinals, and washers.
Environmental Stewardship Benefits: Will the proposal:			
6	**Benefit wildlife or habitat in ways that are not quantified?**	No	
7	**Improve water quality in ways that are not quantified?**	No	
8	**Reduce net emissions in ways that are not quantified?**	No	

PSP Table 12—Non-Monetized Benefits Checklist Project 8: Pescadero Water Supply and Sustainability Project			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
9	**Provide other environmental stewardship benefits?**	No	
Sustainability Benefits: Will the proposal:			
10	**Improve the overall, long-term management of California groundwater resources?**	Yes/No/Neg	D3 Monetized Benefit The project reduces groundwater extraction at the shallow portion of the aquifer at existing Well No. 1 and Well No. 2, which are drilled to a depth near the mean sea level. The decrease in groundwater levels seems to occur locally due to the well pumping; therefore, recharge of the aquifer at this depth is possible if pumping is reduced (Todd Engineers, p. 8). The project increases groundwater extraction at the new well, which will be drilled to about 100 feet below the mean sea level. However, the existing production well (Well No. 1) and the new well would be operated in a lead/lag alternating system. This will allow the groundwater at Well No. 1 and the new well to recharge in between pumping and slow down the rate of withdrawal over time. This operation would spread the impact of groundwater pumping between two different parts of the aquifer and spread the impact out over time (HydroScience Engineers, 2013).
11	**Reduce demand for net diversions for the region from the Delta?**	No	
12	**Provide a long-term solution in place of a short-term one?**	Yes	D3 Monetized Benefit
13	**Promote energy savings or replace fossil-fuel-based energy sources with renewable energy and resources?**	Yes	People who participate in the water conservation program may also reduce their energy consumption, because certain devices may also be more energy efficient (e.g., washers).
14	**Improve water supply reliability in ways not quantified?**	Yes	D3 Monetized Benefit
15	**Other**		

D3 Monetized Project Benefits

Quantifiable Project Benefits:

- Avoided capital costs to construct a surface water treatment plant, water storage tank, booster pump stations and transmission pipeline
- Groundwater pumping costs avoided as result of implementing water conservation program
- Energy purchase costs avoided as result of lower energy requirements to pump groundwater than to treat and pump surface water

Avoided Capital Costs for Alternative Surface Water System

- In the without-project condition, the County will need to construct a surface water treatment facility, storage tank, pump station, and transmission pipeline. Capital costs for these items are summarized in **Project 8-Table A**, below.
- The surface water system would be constructed in 2014 and online starting in 2015. The 2012 present value of avoided capital costs is $1,539,197.

Project 8 – Table A
Avoided Capital Costs for Alternative Surface Water System

Capital Item	Cost (2012 dollars)	Source of Estimate
Water Treatment Plant (200 gpm capacity)	$1,228,790	Reference costs for the water treatment plant were taken from the Lake Berryessa Resort Improvement District (LBRID) bid prices in 2008. Costs were escalated to 2012 dollars. This type of treatment system was considered comparable assuming that CSA 11 will need to meet the Enhanced Surface Water Treatment Rule (EPA), which requires a 4 log removal of viruses and operates primarily unmanned. Higher flows were assumed so that the treatment plant can operate outside of peak hours to save energy costs. The quoted cost was converted to 2012 dollars using a DWR-provided price index factor of 1.03.
140,000 Gallon Storage Tank	$87,352	▪ 42' D x 16' H nominal sidewall height factory, coated bolted carbon steel ▪ potable water storage tank designed in accordance with AWWA D103-09 Specifications, embedded base ▪ setting ring, and center-supported 1:12 slope roof ▪ price quote prepared by Accelerated Environmental Services, Inc., January 2013. Quoted cost converted to 2012 dollars using a DWR-provided price index factor of 0.943.
Pipeline, 4" HDPE	$288,300	9,610 LF of pipe at $30/LF
Pump Station, 200 gpm	$125,000	This assumes a factory-assembled Pump Station with Starter and Control Panel. The price quote was prepared by HydroScience Engineers, Inc., February 2013. The quoted cost converted to 2012 dollars using a DWR-provided price index factor of 0.943.
Total Cost	$1,729,442	

Avoided Capital Replacement Costs

- Annual capital replacement costs for the surface water system are estimated at 2% of initial capital cost, or approximately $34,600/yr (HydroScience Engineers, Inc., February 2013).
- Over the 30-year useful life of the surface water system, the present value of avoided capital replacement cost is $423,736.

Avoided Energy Purchase Costs

- Treating and distributing an acre-foot of water from the alternative surface water system is estimated to require an additional 285 KWh/AF compared to the proposed groundwater well (HydroScience Engineers, Inc., February 2013).
- System average daily demand is 25,500 gallons and annual system production is 24 AF, yielding avoided energy purchases of 8,151 KWh/yr.
- Estimated water savings from proposed replacement of toilets, urinals, and clothes washers and avoided energy requirements for avoided groundwater pumping are summarized in **Project 8-Table B** below. Estimated water savings assume replacement of 60 toilets and 40 clothes washers with high-efficiency models. Savings calculations for toilets are based on an average flush volume of 3.26 gpf for existing non-ULF toilets and 1.28 gpf for replacement toilets. Toilet savings are exponentially decayed at a rate of 4% per year to account for replacement of toilets via plumbing code requirements under the without-project condition. Savings calculations for clothes washers assume an average water factor of 6.3 for newly purchased clothes washers under the without-project condition and an average water factor of 3.5 for new clothes washers purchased through the conservation rebate program. The average water factor for the without-project condition is based on DOE's clothes washer market share forecasts for horizontal and vertical axis residential clothes washers.[23] Rebated clothes washers are assumed to have a 12-year average life per Vickers (2002).[24] Per capita toilet and washer usage rates are based on Bay Area averages, as reported in Aquacraft (2011).[25]
- Avoided energy purchases are valued at $0.203/KWh, the average price for electricity in the Bay Area.[26]
- Over the 30-year useful life of the project, the present value of avoided energy purchase costs is $24,112.

Project 8-Table B Conservation Program Avoided Energy Purchases				
	Conservation Program Savings (AF)			KWh
Year	Toilets/Urinals	Washers	Total	Savings
2012				
2013				
2014				

[23] U.S. Department of Energy. 2010. Clothes Washer Materials in Support of Stakeholder Negotiations. Retrieved September 9, 2011, from U.S. DOE Energy Efficiency and Renewable Energy: http://www1.eere.energy.gov/buildings/appliance_standards/residential/docs/nia_cw_neg_scenarios_a_b.xls
[24] Vickers, A. 2002. *Handbook of Water Use and Conservation.* Amherst, MA: WaterPlow Press.
[25] Aquacraft, Inc. 2011. *California Single Family Home Water Use Efficiency Study.* Sacramento, CA: California Department of Water Resources.
[26] Bureau of Labor Statistics, U.S. Department of Labor. 2013. News Release: "Average Energy Prices, San Francisco Area—January 2013." www.bls.gov/ro0/cpisanf_energy.pdf

Project 8-Table B Conservation Program Avoided Energy Purchases				
	Conservation Program Savings (AF)			KWh
Year	Toilets/Urinals	Washers	Total	Savings
2015	1.23	0.45	1.68	566
2016	1.18	0.45	1.63	549
2017	1.14	0.45	1.58	533
2018	1.09	0.45	1.54	518
2019	1.05	0.45	1.49	503
2020	1.01	0.45	1.45	489
2021	0.96	0.45	1.41	475
2022	0.93	0.45	1.37	462
2023	0.89	0.45	1.34	450
2024	0.85	0.45	1.30	438
2025	0.82	0.45	1.27	426
2026	0.79	0.45	1.23	415
2027	0.76		0.76	255
2028	0.73		0.73	244
2029	0.70		0.70	235
2030	0.67		0.67	225
2031	0.64		0.64	216
2032	0.62		0.62	208
2033	0.59		0.59	199
2034	0.57		0.57	191
2035	0.54		0.54	184
2036	0.52		0.52	176
2037	0.50		0.50	169
2038	0.48		0.48	162
2039	0.46		0.46	156
2040	0.44		0.44	150
2041	0.43		0.43	144
2042	0.41		0.41	138
2043	0.39		0.39	132
2044	0.38		0.38	127

Other O&M

System O&M is outsourced by the County through a fixed price contract. O&M costs other than those for energy will be the same for the surface and groundwater systems (HydroScience Engineers, Inc., February 2013); therefore, they are not included in the calculation of net benefits.

Summary of Monetized Project Benefits

Avoided Alternative Project Costs:	
Surface Water System Construction	$1,539,197
Surface Water System Capital Replacement	$423,736
Electricity Purchases	$24,112
Total	$1,987,045

This information is detailed in PSP Table 15 for Project 8, below.

PSP Table 16 – Annual Costs of Avoided Projects							
Project 8 – Pescadero Water Supply and Sustainability Project							
	Costs					**Discounting Calculations**	
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**
	Alternative (Avoided Project Name): Pescadero surface water supply system						
	Avoided Project Description: Construction of surface water treatment facility, storage tank, booster pump, and transmission line						
Year	**Avoided Capital Costs**	**Avoided Replacement Costs[3]**	**Avoided Operations and Maintenance Costs[4]**	**Avoided Energy Purchases[1]**	**Total Cost Avoided for Individual Alternatives (b) + (c) + (d)**	**Present Value Coefficient**	**Discounted Costs (e) x (f)**
2014	$1,729,442				$1,729,442	0.890	**$1,539,197**
2015-2044		$34,589			$34,589	12.251	**$423,736**
2015-2044[1]				$1,887	$1,887	12.251	**$23,116**
2015-2044[2]				$81	$81	12.251	**$996**
Total Present Value of Discounted Costs							**$1,987,045**
(%) Avoided Cost Claimed by Project							**100%**
Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project							**$1,987,045**

Comments:
[1] Net increase in annual energy cost for surface system compared to groundwater system.
[2] Average annual avoided energy cost due to implementation of conservation program.
[3] Replacement costs estimated at 2% of direct construction costs of surface water system.
[4] O&M costs other than for energy are the same for the surface and groundwater systems and therefore are not included in the calculation of net benefits.

Project Cost

Project capital costs total $825,356 in 2012 dollars. The project is constructed in 2014 and will be online in 2015. The present value of capital cost for the with-project condition is $734,564. Annual capital replacement costs for the well are estimated at 2% of direct construction cost for the well and tank, or approximately $14,000/yr (HydroScience Engineers, Inc., February 2013). The present value of capital replacement costs over the 30 year project life is $173,126. The total present value of project economic costs is $907,690, as shown in PSP Table 19 for Project 8, below.

PSP Table 19—Annual Costs of Project
Project 8: Pescadero Water Supply and Sustainability Project

	Initial Costs Grand Total Cost from Table 7	Adjusted Grant Total Cost	Annual Costs						Discounting Calculations	
			Admin	Operation & Maintenance[1]	Maintenance	Replacement[2]	Other	Total Costs (a) +…+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2014	$825,356							$825,356	0.890	**$734,564**
2015-2044						$14,132		$14,132	12.251	**$173,126**
Total Present Value of Discounted Costs (Sum of column (j))										**$907,690**

Comments:
[1] O&M costs other than for energy are the same for the surface and groundwater systems and therefore are not included in the calculation of net benefits.
[2] Annual replacement costs estimated at 2% of direct construction costs for well and tank.

Project Benefit-Cost Ratio

The present value of avoided surface supply system costs is $1,987,045. The present value of project economic costs is $907,690. The project net present value is $1,079,355, and the project benefit-cost ratio is 2.19.

Project 11 – Regional Groundwater Storage and Recovery Project Phase 1A - South Westside Basin, Northern San Mateo County

Project Benefits

With Project Condition: This project will implement a groundwater storage program in the South Westside Basin on the San Francisco Peninsula. The project will put water into the basin during normal and wet years and take water from the basin in dry years. Up to 60,500 AF will be stored in the basin for dry year supply enhancement. Water is expected to be put into the basin in 44% of the years and taken out of the basin in 24% of the years. No operations are expected in 32% of the years. The expected take rate is 7.2 MGD (8065 AFY) and the expected put rate is 5.52 MGD (6,183 AFY). Annual O&M costs for take and put operations are estimated at $3,784,307 and $901,446, respectively (2012 dollars).

Without Project Condition: This project is a component of SFPUC's Water System Improvement Program (WSIP). Without the project, SFPUC would need to develop an alternative dry year supply or incur system wide shortage greater than 20 percent in dry years (San Francisco Public Utilities Commission, 2011).[27] SFPUC customer willingness-to-pay (WTP) for dry year water supply is estimated at $6,800/AF (Sunding & Hamilton, 2010). The expected cost for alternative dry year supply is estimated at $4,000/AF. Since the cost for alternative dry year supply is lower than customer WTP, it is used to value the dry year water supply under the with-project condition.

D2 Non-Monetized Project Benefits

Non-monetizable project benefits, including community and social benefits, environmental stewardship benefits, and sustainability benefits are identified, as applicable to this project, in the PSP Table 12 "Non-Monetized Benefits Checklist" below.

PSP Table 12—Non-Monetized Benefits Checklist Project 11: Regional Groundwater Storage and Recovery Project Phase 1A—South Westside Basin, Northern San Mateo County			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
1	**Provide educational or technological benefits?**	Yes	Water management education and tours of a well will be provided to school children.
2	**Provide social recreation or access benefits?**	No	

[27] San Francisco Public Utilities Commission (SFPUC). 2011. *2010 Urban Water Management Plan for the City and County of San Francisco* (UWMP). June. Table 23.

PSP Table 12—Non-Monetized Benefits Checklist Project 11: Regional Groundwater Storage and Recovery Project Phase 1A—South Westside Basin, Northern San Mateo County			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
3	**Help avoid, reduce, or resolve various public water resource conflicts?**	Yes	- Reducing demand on Hetch Hetchy Regional Water Supply system during droughts. - The creation of an operating committee for the project will increase groundwater management coordination in the South Westside Basin. - The SFPUC cooperated in the development of the South Westside Basin Groundwater Management Plan with regional partner agencies (cities of Daly City and San Bruno, and California Water Service Company).
4	**Promote social health and safety?**	Yes	Provide an additional water supply during critical dry years and during emergencies (earthquakes or other emergencies that could disrupt the SFPUC's drinking water supplies).
5	**Have other social benefits?**	No	
Environmental Stewardship Benefits: Will the proposal:			
6	**Benefit wildlife or habitat in ways that are not quantified?**	No	
7	**Improve water quality in ways that are not quantified?**	Yes	The project will assist in preventing salinity intrusion/water quality degradation.
8	**Reduce net emissions in ways that are not quantified?**	Yes	Neutral offset expected. Benefits accrued during "put" years when water infiltrates and fills the basin (greenhouse gas reduction), will be offset by "take" years when pumping would occur (increase in energy use).
9	**Provide other environmental stewardship benefits?**	No	
Sustainability Benefits: Will the proposal:			
10	**Improve the overall, long-term management of California groundwater resources?**	Yes	- Project is designed to deliver surface water in wet periods to offset pumping, which allows groundwater to accumulate - Promotes aquifer storage of water - Assist in preventing salt water intrusion into groundwater basin - Creates operating committee for pumping oversight. While the South Westside Basin Groundwater Management Plan already guides groundwater management in the region, the operating committee will provide added coordination.

PSP Table 12—Non-Monetized Benefits Checklist Project 11: Regional Groundwater Storage and Recovery Project Phase 1A—South Westside Basin, Northern San Mateo County			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
11	**Reduce demand for net diversions for the region from the Delta?**	No	
12	**Provide a long-term solution in place of a short-term one?**	Yes	The project will improve local water supply reliability, which will provide a long-term benefit to adaptation during drought.
13	**Promote energy savings or replace fossil-fuel-based energy sources with renewable energy and resources?**	Yes	Neutral offset expected. Benefits accrued during "put" years when water infiltrates and fills the basin (greenhouse gas reduction), will be offset by "take" years when pumping would occur (increase in energy use).
14	**Improve water supply reliability in ways not quantified?**	Yes	Water supply reliability benefits are a D3 Monetized Benefit The project will also promote reduced risk of salt water intrusion and associated groundwater quality degradation.
15	**Other**	No	

D3 Monetized Project Benefits

Quantifiable Project Benefits: Dry-year water supply.

Calculation of Annual Water Supply Benefit

- Take operations are assumed to begin no sooner than 2018. Water is assumed to be taken out of the basin in 24% of the years. During take years, an average of 8,065 AF will be taken out of the basin.
- Without the project, SFPUC would need to develop an alternative dry year supply or incur system wide shortage greater than 20 percent in dry years (San Francisco Public Utilities Commission, 2011).[28] SFPUC customer willingness-to-pay (WTP) for dry year water supply is estimated at $6,800/AF (Sunding & Hamilton, 2010).[29] The expected cost for alternative dry year supply is estimated at $4,000/AF.[30]

[28] San Francisco Public Utilities Commission (SFPUC). 2011. *2010 Urban Water Management Plan for the City and County of San Francisco* (UWMP). June. Table 23.
[29] This estimate assumes shortages in dry years without the WSIP would average 15%, the midpoint of the shortage range reported in SFPUC's 2010 UWMP.
[30] SFPUC avoided water supply project cost estimates (MCC Project Costs spreadsheet).

Since the cost for alternative dry year supply is lower than customer WTP, it is used to value the dry year water supply under the with-project condition.

- The expected present value (in 2012) of dry-year water supply over the 50-year operational life of the project is $90,877,285.[31]

Summary of Monetized Project Benefits

The total estimated water supply benefit is $90,877,285, as detailed in PSP Table 15 for Project 11.

PSP Table 15 – Annual Benefit Project 11 – Regional Groundwater Storage and Recovery Project Phase 1A - South Westside Basin, Northern San Mateo County									
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project [1]**	**Change Resulting from Project (e) – (d)**	**Unit $ Value [2]**	**Annual $ Value (f) x (g)**	**Present Value Coefficient**	**Discounted Benefits (h) x (i)**
2017-2066	Water Supply	AF	0	1,820	1,820	$4,000	$7,278,993	12.485	**$90,877,285**
Total Present Value of Discounted Benefits Based on Unit Value									**$90,877,285**
Comments: [1] Expected annual dry-year supply based on 10,000 run monte carlo simulation of project operation over 50-year operational life starting in 2017. [2] Based on SFPUC expected cost for alternative dry year supply (see MCC Project Costs.xlsx).									

[31] Based on 10,000 run monte carlo simulation. This assumes project put operations begin no earlier than 2017 and take operations begin no earlier than 2018. Water supply benefits are therefore evaluated over a 49-year period from 2018 to 2066.

Project Cost

Project economic costs are taken from project costs provided by the applicant. Economic costs are summarized in the table below and are based on the following:

- The upfront capital cost of the project is $87,600,730.[32] Project expenditures to date total $18,470,971.[33] Past expenditures for management, planning, environmental review, design, etc., can be treated as sunk costs because they do not have salvageable market value outside the context of this project. The remaining economic cost of investment is therefore $69,129,759. The expected schedule of remaining capital investment is summarized in PSP Table 19 for Project 11, below. The expected present value (in 2012) of remaining capital investment is $59,511,037.
- Annual O&M costs for take and put operations are estimated at $3,784,307 and $901,446, respectively (2012 dollars).[34] Take operations are expected to occur in 24% of the years and to start no earlier than 2018. Put operations occur in normal and wet years if basin storage is below 60,500 AF. The first put operation is assumed to occur in 2017 with certainty. After 2017 put operations are dictated by the storage balance and year type (e.g. dry, normal, or wet). Expected annual O&M is approximately $1,427,248.[35] The expected present value (in 2012) of O&M costs over the 50-year operational life of the project is $17,819,006.
- Expected present value of project economic costs (capital + O&M) is $77,330,043.

[32] SFPUC project capital cost estimate (GSR Spending Plan by phase by year-02222013.xlsx).
[33] Ibid.
[34] MWH, Inc. November 2008. Conjunctive Use Project, Conceptual Engineering Report.
[35] Based on monte carlo simulation with 10,000 model runs.

PSP Table 19—Annual Costs of Project

Project 11: Regional Groundwater Storage and Recovery Project Phase 1A - South Westside Basin, Northern San Mateo County

	Initial Costs Grand Total Cost from Table 7	Adjusted Grant Total Cost[1]	Annual Costs						Discounting Calculations	
			Admin	Operations[2]	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2012								$0	1.000	**$0**
2013	$1,711,130	$4,988,491						$6,699,621	0.943	**$6,320,397**
2014	$1,711,131	$21,228,201						$22,939,332	0.890	**$20,415,924**
2015		$31,441,948						$31,441,948	0.840	**$26,399,266**
2016		$8,048,859						$8,048,859	0.792	**$6,375,450**
2017-2066				$1,427,248				$1,427,248	12.485	**$17,819,006**
Total Present Value of Discounted Costs (Sum of column (j))										**$77,330,043**

Comments:
[1] Expected schedule of remaining project capital costs. Project costs for planning, permitting, and engineering occurring before 2013 are treated as sunk costs.
[2] Average annual O&M costs for put and take operations based on 10,000 run monte carlo simulation of project operation.

Project Benefit-Cost Ratio

Expected present value of dry-year water supply is $90,877,285. Present value of project economic costs is $77,330,043. Project net present value is $13,547,242 and the project benefit-cost ratio is 1.18.

Project 13 – Roseview Heights Infrastructure Upgrades for Water Supply and Quality Improvement, Santa Clara County

Project Benefits

With Project Condition: Replace two leaking and seismically unsafe redwood storage tanks and connected water mains at the end of their useful service lives. New tanks and a new main will be constructed in 2014 and online in 2015.

Without Project Condition: Extend the service life of the redwood storage tanks and mains an additional 10 years by periodically replacing temporary tank liners to reduce leakage and repairing main breaks. Storage tanks will remain seismically unsafe and are predicted to fail in the event of an earthquake of magnitude 6.9 or greater. Their service lives cannot be extended beyond 10 years. At that point, the tanks and connected mains will have to be replaced.[36]

D2 Non-Monetized Project Benefits

Non-monetizable project benefits, including community and social benefits, environmental stewardship benefits, and sustainability benefits are identified, as applicable to this project, in the PSP Table 12 "Non-Monetized Benefits Checklist" below.

PSP Table 12—Non-Monetized Benefits Checklist Project 13: Roseview Heights Infrastructure Upgrades for Water Supply and Quality Improvement, Santa Clara County			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
1	**Provide educational or technological benefits?**	No	
2	**Provide social recreation or access benefits?**	No	
3	**Help avoid, reduce, or resolve various public water resource conflicts?**	Yes	The project will meet public water demand standards, including for firefighting water supplies. D3 Monetized Benefit: reduced the risk of the potential catastrophic failure of existing, aging water systems (tanks and pipelines).
4	**Promote social health and safety?**	Yes	D3 Monetized Benefit

[36] Personal communication, Roseview Heights Mutual Water Company

PSP Table 12—Non-Monetized Benefits Checklist Project 13: Roseview Heights Infrastructure Upgrades for Water Supply and Quality Improvement, Santa Clara County			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
5	**Have other social benefits?**	No	
Environmental Stewardship Benefits: Will the proposal:			
6	**Benefit wildlife or habitat in ways that are not quantified?**	No	
7	**Improve water quality in ways that are not quantified?**	Yes	New water tanks reduce the amount of chlorine used for treatment. With the system upgrades, more reliable water quality will be provided to RHMWC's customers. Water quality improvements include less debris and insects entering water tanks, a higher likelihood of achieving required chlorine residual at the farthest ends of distribution system, and better TTHM and HAA5 results when there is no chlorine versus redwood organics interaction.
8	**Reduce net emissions in ways that are not quantified?**	Yes	Project construction will result in emissions. However, project implementation will reduce annual emissions by 25%, as the upgraded water storage and transmission system requires less pumping energy.
9	**Provide other environmental stewardship benefits?**	No	
Sustainability Benefits: Will the proposal:			
10	**Improve the overall, long-term management of California groundwater resources?**	No	
11	**Reduce demand for net diversions for the region from the Delta?**	Yes	RHMWC purchases water from SJ Water (SJW), which is supplied in this service area by imported water treated at the Penitencia Water Treatment Plant. A portion of SJW's water supply is from the Delta. The RHMWC project will result in less water purchased from SJW, which translates to less demand for Delta water.

PSP Table 12—Non-Monetized Benefits Checklist Project 13: Roseview Heights Infrastructure Upgrades for Water Supply and Quality Improvement, Santa Clara County			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
12	**Provide a long-term solution in place of a short-term one?**	Yes	The project will reduce the risk of the potential catastrophic failure of existing, aging water systems (tanks and pipelines). The short-term fix in place to alleviate water leakage consists of poly liner installed in redwood water tanks. The long-term fix is to install new water storage tanks.
13	**Promote energy savings or replace fossil-fuel-based energy sources with renewable energy and resources?**	Yes	Project implementation will reduce annual emissions by 25% from existing (unfixed) levels, as the upgraded water storage and transmission system requires less pumping energy.
14	**Improve water supply reliability in ways not quantified?**	Yes	D3 Monetized Benefit
15	**Other**	No	

D3 Monetized Project Benefits

Quantifiable Project Benefits:

- Avoided Expected Annual Damage (EAD) to residential structures from seismically induced tank collapse
- Avoided Expected Annual Water Shortage Costs to residences losing water supply from seismically induced tank collapse
- Avoided water purchases that would be incurred in the without project condition
- Avoided energy purchases that would be incurred in the without project condition
- Avoided annual O&M costs that would be incurred in the without project condition

Avoided Residential Structure EAD from Seismically Induced Tank Collapse

- USGS has estimated a 63% probability of an earthquake of magnitude 6.9 or greater in the Bay Area in the next 30 years.[37] The probability in any given year is approximately 3.26%. The Hayward and San Andreas faults pose the largest risks. The project site is

[37] http://earthquake.usgs.gov/regional/nca/ucerf/

adjacent to the Hayward fault.

- Based on engineering studies, Roseview Heights MWC estimates the existing redwood tanks will fail in an earthquake of magnitude 6.9 or greater. The annual probability of tank failure is therefore estimated to be approximately 3.26%.
- Five residential structures downslope from the tanks would be severely damaged in the event of tank collapse. The current market value of the five homes is $4.1 million.[38] The average ratio of structure value to total value in the Bay Area is 35%. Therefore, the structure value at risk is $1.44 million.[39] The residential structures are relatively new and well maintained. Depreciated structural value is therefore assumed to be equivalent to the estimated structure value at risk. The extent of damage to the structures following tank collapse will vary. This analysis assumes on average structural damage will equal 60% of the structure value at risk.
- Given these assumptions, the expected annual damage to residential structures under the without project condition is $28,000.[40]
- The present value of expected annual damages to residential structures over the 10 year period in which tank service life would be extended under the without project condition is $183,413.

Avoided Expected Annual Water Shortage Costs from Seismically Induced Tank Collapse

- In the event of tank collapse, 53 homes served by Roseview Heights MWD will lose water supply.[41] Emergency measures will be taken to provide a basic level of water service to affected households. For this analysis, it is assumed affected households will receive 20 gallons per person per day or an average of 77 gallons per household per day.[42] The assumed level of emergency water service is taken from Brozovic, et al.[43]
- Average water use per household under normal conditions is 408 gallons per day. A shortage cost of $396 per household per day is estimated based on the change in consumer surplus between normal daily water use and emergency daily water use. Following the methodology of Brozovic, et al., the change in consumer surplus is estimated with a constant elasticity of demand function, a demand elasticity of -0.2, and an average water price under normal conditions $3.70/ccf. The demand elasticity for single family residential water use in the Bay Area is taken from Sunding and Hamilton (2010).[44] The water price is the average rate paid by Roseview Heights MWC residential customers. The total daily shortage cost for the 53 homes losing normal water service is $21,000

[38] Home values per Zillow (www.zillow.com/home/10156-Bon-Vista-Ct.,-san-jose,-ca_rb)
[39] Kuminoff, N. and J. Pope (2012). *The Value of Residential Land and Structures during the Great Housing Boom and Bust*. Draft with revisions for Land Economics: April, 2012 http://www.public.asu.edu/~nkuminof/KP_Land_forthcoming.pdf
[40] Results have been rounded to the nearest thousand dollars.
[41] Personal communication, Roseview Heights Mutual Water Company
[42] Twice the level of basic water requirements for human activities, per P.H. Gleick. "Basic water requirements for human activities: Meeting basic needs." *Water International*, 21:83–92, 1996.
[43] Brozovic, N., D. Sunding, & D. Zilberman (2006). "Estimating Business and Residential Water Supply Interruption Losses from Catastrophic Events." *Water Resources Research, Vol. 43*.
[44] Sunding, D., & Hamilton, S. (2010). *Residential Loss from Urban Water Shortages in California.* Sacramento, CA: California Urban Water Agencies.

per day.

- Roseview Heights MWC has estimated restoring normal service following catastrophic failure of the tanks would require 30 plus days. The analysis assumes a 30-day outage. Total shortage cost for a 30-day outage is $630,000.
- As described previously, the annual probability of tank failure is estimated to be approximately 3.26%. The expected annual shortage cost is therefore $26,000 per year.
- The present value of expected annual shortage cost over the 10 year period in which tank service life would be extended under the without project condition is $134,604.

Avoided Water Purchases

- Under the without project conditions, the water tanks and connected mains would continue to leak. Leakage has been estimated by Roseview Heights at 300,000 gallons per month.[45]
- Roseview purchases water from San Jose Water Company at a cost of $2.70/ccf. The annual avoided cost of water purchases is $13,000.
- The analysis assumes water cost will escalate at a real rate of 2.82%. This is the average difference in escalation rates between the CPI All Urban Price Index and the CPI Water & Sewer Service Price Index over the previous 10 years, as published by the U.S. Bureau of Labor Statistics.
- The present value of additional water purchases over the 10 year period in which tank service life would be extended under the without project condition is $95,494.

Avoided Energy Purchases

- Under the without project condition, the water tanks and connected mains would continue to leak. Leakage has been estimated by Roseview Heights at 300,000 gallons per month.[46]
- Roseview has estimated that pumping under the without project condition would require an additional 9500 KWh per year in electricity purchases. The average cost of electricity in the Bay Area is $0.203/KWh.[47]
- The annual cost of additional energy purchases under the without project condition is approximately $2,000 per year.
- The present value of additional energy purchases over the 10 year period in which tank service life would be extended under the without project condition is $12,633.

[45] Personal communication, Roseview Heights Mutual Water Company
[46] Personal communication, Roseview Heights Mutual Water Company
[47] www.bls.gov/ro0/cpisanf_energy.pdf

Avoided O&M

- Under the without project condition, the temporary liner for the 70,000 gallon tank would require replacement in 2015 and 2021 at a cost of $30,000 per replacement. The temporary liner for the 10,000 gallon tank would requirement replacement in 2019 at a cost of $15,000 per replacement.
- Tank cleaning costs under the without project condition would average $500 and $333 per year for the 70,000 and 10,000 gallon tanks, respectively.
- Additional O&M costs, which address repairs to the redwood tanks and main breaks under the without project condition, are expected to average $2,000 and $5,000 per year, respectively.
- Under the with-project condition, additional O&M costs for painting, cleaning, and inspection of the new tanks is estimated to average $7,050 per year.
- The present value of additional O&M for the without-project condition is $103,689. The present value of additional O&M for the with-project condition is $46,181. The present value of avoided O&M cost for the with-project condition is therefore $57,509.

Summary of Monetized Project Benefits

Monetized project benefits are shown in PSP Table 15 for Project 13. The annual cost of deferred replacement of tanks and mains (avoided project) is shown in PSP Table 16 for Project 13.

PSP Table 15 – Annual Benefit Project 13 – Roseview Heights Infrastructure Upgrades for Water Supply and Quality Improvement, Santa Clara County							
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Year	Avoided Residential Structure EAD	Avoided Residential Water Shortages EAD	Avoided Water Purchases	Avoided Energy Purchases	Total Annual Benefit	Present Value Coefficient	Present Value Benefits (f) x (g)
2012					$0	1.000	$0
2013					$0	0.943	$0
2014					$0	0.890	$0
2015	$28,000	$20,549	$12,995	$1,929	$63,472	0.840	$53,292
2016	$28,000	$20,549	$13,361	$1,929	$63,838	0.792	$50,566
2017	$28,000	$20,549	$13,738	$1,929	$64,215	0.747	$47,985
2018	$28,000	$20,549	$14,125	$1,929	$64,602	0.705	$45,542
2019	$28,000	$20,549	$14,523	$1,929	$65,001	0.665	$43,229
2020	$28,000	$20,549	$14,933	$1,929	$65,410	0.627	$41,039
2021	$28,000	$20,549	$15,354	$1,929	$65,831	0.592	$38,965
2022	$28,000	$20,549	$15,787	$1,929	$66,264	0.558	$37,002
2023	$28,000	$20,549	$16,232	$1,929	$66,709	0.527	$35,142
2024	$28,000	$20,549	$16,690	$1,929	$67,167	0.497	$33,380
Total Present Value of Discounted Benefits Based on Unit Value							**$426,143**

PSP Table 16 – Annual Costs of Avoided Projects Project 13 – Roseview Heights Infrastructure Upgrades for Water Supply and Quality Improvement, Santa Clara County						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
	Alternative (Avoided Project Name): Deferred Replacement of Tanks and Mains					
	Avoided Project Description: Install poly liner in 10K gallon tank, replace poly liner in 70K gallon tank.					
Year	**Avoided Capital Costs**	**Avoided Replacement Costs**	**Avoided Operations and Maintenance Costs**	**Total Cost Avoided for Individual Alternatives (b) + (c) + (d)**	**Discount Factor**	**Discounted Costs (e) x (f)**
2012					1.000	
2013					0.943	
2014					0.890	
2015			$30,450	$30,450	0.840	$25,566
2016			$450	$450	0.792	$356
2017			$783	$783	0.747	$585
2018			$783	$783	0.705	$552
2019			$15,783	$15,783	0.665	$10,497
2020			$783	$783	0.627	$491
2021			$30,783	$30,783	0.592	$18,221
2022			$783	$783	0.558	$437
2023			$783	$783	0.527	$413
2024	$1,125,500 [1]		$783	$1,126,283	0.497	$559,728
					Total Present Value of Discounted Costs	**$616,848**
					(%) Avoided Cost Claimed by Project	**100%**
					Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project	**$616,848**
Comment: [1] Cost of new tanks deferred 10 years to 2024						

Project Cost

The project capital costs total $1,125,500 in 2012 dollars. The project will be constructed in 2014 and online in 2015. The present value of capital cost for the with-project condition is $1,001,695. Under the without-project condition, capital costs of the project would be deferred 10 years. The project would be constructed in 2024 and online in 2025. The present value of capital cost for the without-project condition is $559,339. The net capital cost for the with-project condition is therefore $442,352. See PSP Table 19 for Project 13 below.

PSP Table 19—Annual Costs of Project Project 13: Roseview Heights Infrastructure Upgrades for Water Supply and Quality Improvement, Santa Clara County										
			Annual Costs						Discounting Calculations	
Year	Initial Costs Grand Total Cost from Table 7	Adjusted Grant Total Cost [1]	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012									1.000	
2013									0.943	
2014	$1,125,500							$1,125,500	0.890	**$1,001,695**
2024		-$1,125,500						-$1,125,500	0.497	**-$559,339**
Total Present Value of Discounted Costs (Sum of column (j))										**$442,352**
Comments: [1] Adjustment for avoided cost of tank and main replacement in 2024 under the without project condition.										

Project Benefit-Cost Ratio

The present value of benefits for the with-project condition is $483,652. The present value of net capital costs for the with-project condition is $442,352. The project net present value is $41,300, and the project benefit-cost ratio is 1.09.

Project 15 – San Francisco International Airport Reclaimed Water Facility

Project Benefits

With Project Condition: The project will treat up to 0.65 MGD from SFO's combined sanitary, industrial and stormwater effluent sources with micro filtration and hypochlorite disinfection to satisfy Title 22 reclaimed water criteria. This project will provide the necessary infrastructure needed to reuse 100% of treated effluent at the airport terminals for non-potable reuse.

Without Project Condition: Under the without-project condition, SFO will not build the tertiary treatment facility. Up to 1.0 MGD of effluent will continue to be treated and discharged to the San Francisco Bay. The airport's water demands will continue to be fully served by SFPUC.

D2 Non-Monetized Project Benefits

Non-monetizable project benefits, including community and social benefits, environmental stewardship benefits, and sustainability benefits are identified, as applicable to this project, in the PSP Table 12 "Non-Monetized Benefits Checklist" below.

PSP Table 12—Non-Monetized Benefits Checklist Project 13: San Francisco International Airport Reclaimed Water Facility			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
1	**Provide educational or technological benefits?**	Yes	The City and County of San Francisco Airport Commission is developing a new state-of-the-art reclaimed water facility. This project will use advanced treatment membrane filtration technologies to treat wastewater to tertiary standards.
2	**Provide social recreation or access benefits?**	No	
3	**Help avoid, reduce, or resolve various public water resource conflicts?**	Yes	The project will reduce water demand on the Hetch Hetchy system by using 100% of treated effluent at the airport terminals for non-potable reuse. This will help to support the airport water demands during a drought.
4	**Promote social health and safety?**	Yes	The project will reduce water demand on the Hetch Hetchy system by using 100% of treated effluent at the airport terminals for non-potable reuse.
5	**Have other social benefits?**	No	
Environmental Stewardship Benefits: Will the proposal:			
6	**Benefit wildlife or habitat in ways that are not quantified?**	Yes	The project will discharge less treated wastewater to San Francisco Bay.

PSP Table 12—Non-Monetized Benefits Checklist Project 13: San Francisco International Airport Reclaimed Water Facility			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
7	**Improve water quality in ways that are not quantified?**	Yes	The project will discharge less treated wastewater that will benefit overall San Francisco Bay water quality and wildlife habitat.
8	**Reduce net emissions in ways that are not quantified?**	Neg	Project construction and operations will result in increased emissions.
9	**Provide other environmental stewardship benefits?**	No	
Sustainability Benefits: Will the proposal:			
10	**Improve the overall, long-term management of California groundwater resources?**	No	
11	**Reduce demand for net diversions for the region from the Delta?**	No	
12	**Provide a long-term solution in place of a short-term one?**	Yes	D3 Monetized Benefit
13	**Promote energy savings or replace fossil-fuel-based energy sources with renewable energy and resources?**	Yes/Neg	The project will involve the sustainable reuse of water supplies. However, the advanced treatment methods used may require more energy to operate.
14	**Improve water supply reliability in ways not quantified?**	Yes	D3 Monetized Benefit
15	**Other**	No	

D3 Monetized Project Benefits

Quantifiable Project Benefits:

- Avoided SFPUC water supply purchase costs
- Avoided variable wastewater treatment and discharge costs

Calculation of Annual Water Supply Benefit

- Currently SFO water demands are served entirely by SFPUC. The current volumetric rate for non-residential SFPUC customers is $5.40/ccf, or $2,352/AF.
- SFPUC water costs have been escalating in recent years at a rate much greater than general inflation. Since 2009, SFPUC rates have increased at an annual average rate of 12.8%. This corresponds to an inflation-adjusted annual escalation rate of about 12%. While it is unlikely SFPUC rates will continue to increase at this rate, they are expected to continue to outpace inflation. For this analysis, it is assumed SFPUC rates will escalate at a real rate of 2.82%. This is the average difference in escalation rates between the CPI All Urban Price Index and the CPI Water & Sewer Service Price Index over the previous 10 years, as published by the U.S. Bureau of Labor Statistics. Rate escalation is capped at $4,000/AF to match the upper-bound cost of new supply projects SFPUC scores as favorable in its future water supply project cost rankings (Ritchie, 2012).[48]
- The recycled water facility will displace 0.65 mgd of potable water demand when it comes online in 2017. Production is forecast to increase by 0.01 mgd per year (San Francisco Department of Public Works, 2009).[49]
- The project will allow the airport to avoid the purchase of 21,563 AF of SFPUC water over the 25-year operational life of the facility. The present value of avoided water purchases is $28.3 million.

Calculation of Avoided Variable Wastewater Discharge Costs

- The project will avoid effluent discharge pumping costs and NBSU fees.
- Avoided effluent discharge pumping costs are based on the prorated share of historical energy and O&M costs for the main effluent pump. The avoided cost is $46,534 for 0.65 mgd in 2017. This cost is escalated each year by the increase in recycled water production.
- Avoided North Bayside System Unit (NBSU) discharge fees are based on the prorated share of discharge fees paid by SFO to NBSU for wastewater discharge. The avoided cost is $30,000 in 2017. This cost is escalated each year by the increase in recycled water production.

[48] Ritchie, S. *Water Supply and Demand: Planning for the Future*. San Francisco Public Utilities Commission. July 10, 2012, page 29. The cutoff price is listed in the document as $4500 in 2018 dollars. This has been adjusted to 2012 dollars assuming an annual inflation rate of 2%.
[49] San Francisco Depart of Public Works. *San Francisco International Airport Recycled Water Project Alternatives Analysis Report*, Prepared for San Francisco Airport Commission, June 2009.

- The present value of avoided wastewater discharge costs over the 25-year project life is $883,116.

Summary of Monetized Project Benefits

Monetized project benefits are shown in PSP Table 15 for Project 15. The annual cost of deferred replacement of tanks and mains (avoided project) is shown in PSP Table 16 for Project 15.

Water Supply Benefit	$28,343,793
Avoided Wastewater Treatment Cost	$883,116
Total	$29,226,909

PSP Table 15 – Annual Benefit Project 15 – San Francisco International Airport Reclaimed Water Facility									
(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)**	**Present Value Coefficient**	**Discounted Benefits (h) x (i)**
2017	Water Supply	AF	0	728.1	728.1	$2,629	$1,914,158	0.747	$1,430,370
2018	Water Supply	AF	0	739.3	739.3	$2,703	$1,998,027	0.705	$1,408,530
2019	Water Supply	AF	0	750.5	750.5	$2,778	$2,085,093	0.665	$1,386,706
2020	Water Supply	AF	0	761.7	761.7	$2,856	$2,175,468	0.627	$1,364,915
2021	Water Supply	AF	0	772.9	772.9	$2,936	$2,269,269	0.592	$1,343,177
2022	Water Supply	AF	0	784.1	784.1	$3,018	$2,366,617	0.558	$1,321,507
2023	Water Supply	AF	0	795.3	795.3	$3,103	$2,467,638	0.527	$1,299,921
2024	Water Supply	AF	0	806.5	806.5	$3,190	$2,572,460	0.497	$1,278,434
2025	Water Supply	AF	0	817.7	817.7	$3,279	$2,681,218	0.469	$1,257,060
2026	Water Supply	AF	0	828.9	828.9	$3,371	$2,794,050	0.442	$1,235,811
2027	Water Supply	AF	0	840.1	840.1	$3,465	$2,911,098	0.417	$1,214,699
2028	Water Supply	AF	0	851.3	851.3	$3,562	$3,032,510	0.394	$1,193,736
2029	Water Supply	AF	0	862.5	862.5	$3,662	$3,158,439	0.371	$1,172,932
2030	Water Supply	AF	0	873.7	873.7	$3,764	$3,289,043	0.350	$1,152,296
2031	Water Supply	AF	0	884.9	884.9	$3,870	$3,424,484	0.331	$1,131,836
2032	Water Supply	AF	0	896.1	896.1	$3,978	$3,564,931	0.312	$1,111,562
2033	Water Supply	AF	0	907.3	907.3	$4,000	$3,629,266	0.294	$1,067,568
2034	Water Supply	AF	0	918.5	918.5	$4,000	$3,674,072	0.278	$1,019,574
2035	Water Supply	AF	0	929.7	929.7	$4,000	$3,718,878	0.262	$973,592
2036	Water Supply	AF	0	940.9	940.9	$4,000	$3,763,683	0.247	$929,549
2037	Water Supply	AF	0	952.1	952.1	$4,000	$3,808,489	0.233	$887,373
2038	Water Supply	AF	0	963.3	963.3	$4,000	$3,853,295	0.220	$846,993
2039	Water Supply	AF	0	974.5	974.5	$4,000	$3,898,101	0.207	$808,341
2040	Water Supply	AF	0	985.7	985.7	$4,000	$3,942,906	0.196	$771,351
2041	Water Supply	AF	0	996.9	996.9	$4,000	$3,987,712	0.185	$735,959
Total Present Value of Discounted Benefits Based on Unit Value									**$28,343,793**

PSP Table 16 – Annual Costs of Avoided Projects Project 15 – San Francisco International Airport Reclaimed Water Facility						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(f)	(g)	(h)
	Alternative (Avoided Project Name): Effluent Pumping and NBSU Fees					
	Avoided Project Description: Avoided effluent pumping cost and discharge fees. Avoided costs scaled by level of RW production.					
Year	**Avoided Capital Costs**	**Avoided Replacement Costs**	**Avoided Operations and Maintenance Costs**	**Total Cost Avoided for Individual Alternatives (b) + (c) + (d)**	**Present Value Coefficient**	**Discounted Costs (e) x (f)**
2017			$76,534	$76,534	0.747	**$57,191**
2018			$77,711	$77,711	0.705	**$54,784**
2019			$78,889	$78,889	0.665	**$52,466**
2020			$80,066	$80,066	0.627	**$50,235**
2021			$81,244	$81,244	0.592	**$48,088**
2022			$82,421	$82,421	0.558	**$46,024**
2023			$83,599	$83,599	0.527	**$44,039**
2024			$84,776	$84,776	0.497	**$42,131**
2025			$85,954	$85,954	0.469	**$40,298**
2026			$87,131	$87,131	0.442	**$38,538**
2027			$88,308	$88,308	0.417	**$36,848**
2028			$89,486	$89,486	0.394	**$35,226**
2029			$90,663	$90,663	0.371	**$33,669**
2030			$91,841	$91,841	0.350	**$32,176**
2031			$93,018	$93,018	0.331	**$30,744**
2032			$94,196	$94,196	0.312	**$29,371**
2033			$95,373	$95,373	0.294	**$28,055**
2034			$96,551	$96,551	0.278	**$26,793**
2035			$97,728	$97,728	0.262	**$25,585**
2036			$98,905	$98,905	0.247	**$24,428**
2037			$100,083	$100,083	0.233	**$23,319**
2038			$101,260	$101,260	0.220	**$22,258**
2039			$102,438	$102,438	0.207	**$21,242**
2040			$103,615	$103,615	0.196	**$20,270**
2041			$104,793	$104,793	0.185	**$19,340**
				Total Present Value of Discounted Costs		**$883,116**

(%) Avoided Cost Claimed by Project	**100%**
Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project	**$883,116**

Project Cost

Project economic costs are summarized in PSP Table 19 for Project 15.

- Total capital costs for the tertiary treatment facility are summarized in column (a).
- The San Francisco Airport Commission will also have to construct the distribution system for the recycled water. This cost, which is not part of the grant application, is listed in column (b). The estimate is taken from the Alternatives Analysis Report.[50]
- Annual O&M costs are listed in column (d). Annual O&M costs for the 0.65 mgd production level are taken from the Alternatives Analysis Report.[51] This cost is escalated each year by the increase in recycled water production.
- Major capital replacement is expected to be on a 10-year cycle starting in 2026. Replacement cost is Table B-2 of the Alternatives Analysis Report and is estimated at $1,433,000. The annualized equivalent replacement cost assuming a 10-year replacement cycle and 6% discount rate is shown in column (f).
- The total present value economic cost of the project over its 25-year useful life is $15,917,608.

PSP Table 19—Annual Costs of Project
Project 15: San Francisco International Airport Reclaimed Water Facility

	Initial Costs Grand Total Cost from Table 7	Adjusted Grant Total Cost[1]	Annual Costs[2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement[3]	Other	Total Costs (a) +…+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2012								$0	1.000	**$0**
2013								$0	0.943	**$0**
2014								$0	0.890	**$0**
2015	$3,012,436							$3,012,436	0.840	**$2,529,299**
2016	$3,012,436	$3,912,000						$6,924,436	0.792	**$5,484,802**
2017				$660,000				$660,000	0.747	**$493,190**
2018				$670,154				$670,154	0.705	**$472,432**

[50] San Francisco Depart of Public Works. San Francisco International Airport Recycled Water Project Alternatives Analysis Report, Prepared for San Francisco Airport Commission, June 2009. pg. 7-4 Scenario 3.
[51] Ibid. pg. 7-4 Scenario 3.

PSP Table 19—Annual Costs of Project Project 15: San Francisco International Airport Reclaimed Water Facility										
	Initial Costs Grand Total Cost from Table 7	Adjusted Grant Total Cost[1]	Annual Costs[2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement[3]	Other	Total Costs (a) +…+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2019				$680,308				$680,308	0.665	**$452,443**
2020				$690,462				$690,462	0.627	**$433,204**
2021				$700,615				$700,615	0.592	**$414,693**
2022				$710,769				$710,769	0.558	**$396,890**
2023				$720,923				$720,923	0.527	**$379,773**
2024				$731,077				$731,077	0.497	**$363,323**
2025				$741,231				$741,231	0.469	**$347,518**
2026				$751,385		$194,699		$946,083	0.442	**$418,454**
2027				$761,538		$194,699		$956,237	0.417	**$399,004**
2028				$771,692		$194,699		$966,391	0.394	**$380,416**
2029				$781,846		$194,699		$976,545	0.371	**$362,654**
2030				$792,000		$194,699		$986,699	0.350	**$345,684**
2031				$802,154		$194,699		$996,853	0.331	**$329,473**
2032				$812,308		$194,699		$1,007,006	0.312	**$313,989**
2033				$822,462		$194,699		$1,017,160	0.294	**$299,203**
2034				$832,615		$194,699		$1,027,314	0.278	**$285,085**
2035				$842,769		$194,699		$1,037,468	0.262	**$271,606**
2036				$852,923		$194,699		$1,047,622	0.247	**$258,740**
2037				$863,077		$194,699		$1,057,776	0.233	**$246,460**
2038				$873,231		$194,699		$1,067,930	0.220	**$234,742**
2039				$883,385		$194,699		$1,078,083	0.207	**$223,560**
2040				$893,538		$194,699		$1,088,237	0.196	**$212,892**
2041				$903,692		$194,699		$1,098,391	0.185	**$202,715**
Total Present Value of Discounted Costs (Sum of column (j))										**$16,552,246**

Comments:
[1] Capital costs for RW distribution system (Alternative Analysis Report, p. 7-4).
[2] Annual costs are increased each year in proportion to the increase in recycled water production.
[3] Capital replacement costs from Table B-2 of TM 4. Capital replacement cost of $1,433,000 on a 10-year cycle starting in 2026. Annualized replacement cost (10-year life, 6% discount rate) shown in table.

Project Benefit-Cost Ratio

Present value of water supply benefits and avoided wastewater costs is $29,226,909. Present value of project economic costs is $16,552,246. Project net present value is $12,674,663 and the project benefit-cost ratio is 1.77.

Water Quality Projects

The projects included in this section will provide water quality benefits throughout the San Francisco Bay Area. These projects have the potential to influence water quality in San Francisco Bay IRWM Region by addressing discharges associated with wastewater treatment (Project 14), stormwater runoff (Project 16), and from agricultural land use practices (Project 19). These projects will improve water quality by creating new or restoring existing habitat, including demonstration wastewater treatment wetlands and demonstration stormwater treatment techniques for urban streets and alleyways. They will serve as demonstrations for future water quality improvement efforts with the potential for implementation region-wide. Combined, the benefit-cost ratio for the water quality projects included in this Proposal is 1.82.

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Project 14 – San Francisco Bay Climate Change Pilot Projects Combining Ecosystem Adaptation, Flood Risk Management and Wastewater Effluent Polishing

Project Benefits

With Project Condition: The Oro Loma seepage ecotone slope will be the first Bay Area project to replicate an engineered equivalent of moist grassland/bayland ecotone of broad, flat alluvial fans that were historically graded into the tidal marshes of most of South San Francisco Bay. This demonstration project will inform a regional strategy to assist POTWs and population around the Bay to recognize benefits of climate change adaptation strategies and implement large-scale seepage ecotone slope projects around the Bay.

A key outcome of this project involves treatment facility retrofits to support wetlands accretion. In addition, the project will incorporate a dual use: average flow wetland and peak flow storage pond. The project will restore 10 acres of historical moist grassland/baylands ecotone while treating reclaimed wastewater from equalization facilities and increasing resilience to sea level rise. The wet weather equalization facility consists of a storage basin surrounded by a containment berm. The basin would serve as a wet-weather equalization facility to provide temporary storage of treated water during infrequent peak wastewater flows associated with large storm events. The proposed facility would provide capacity to store up to 8 million gallons of secondary treated wastewater for up to 6 hours. This will allow a reduction in peak flows discharged to the East Bay Discharger's Authority (EBDA) pipeline from 69 mgd to 59 mgd, which in turn will allow Oro Loma Sanitary District to construct a smaller capacity nutrient processing facility at a capital cost savings of $7,080,725. In addition, with flow equalization on line in 2014, the Oro Loma District can reduce its capacity allocation from 69 to 59 mgd, with a corresponding decrease in its EBDA capacity charges of $56,700 per year.

Additionally, the ecotone will provide nutrient removal of flow routed through it. The configuration is expected to eliminate the electrical and chemical costs associated with conventional nutrient treatment that is expected to start in 2018. Based upon projected power and chemical expenses of $2,009,000 per year, routing 1% of the plant (36.5 million gallons per year) flow through the ecotone will avoid the expense of conventional treatment at a savings of $20,090 per year. Beginning in 2018, the total annual avoided O&M expenses will therefore be $76,790 ($56,700 + $20,090) per year.

Lastly, the project will analyze the outcomes and develop strategies and plans for additional pilot projects. Potential future pilot projects may be implemented at Union Sanitary District and/or Novato Sanitary District, and other wastewater treatment plants. These projects will involve facility retrofits to support wetlands accretion.

Without Project Condition: The no project alternative would first result in the consideration of a conventional, deep, concrete basin. However, the estimated cost of this type of basin is $16,000,000. Given that this cost exceeds the present worth of the ongoing EBDA savings and reduced capital expense associated with a smaller nutrient removal facility, the District would choose to construct a higher capacity nutrient removal facility at an additional cost of $7,080,725. The no project alternative would also result in higher annual O&M costs (described previously) and the loss of wildlife habitat in the natural wetland system, and the Bay Area will lose time in exploring a promising response to global sea level rise.

D2 Non-Monetized Project Benefits

Non-monetizable project benefits, including community and social benefits, environmental stewardship benefits, and sustainability benefits are identified, as applicable to this project, in the PSP Table 12 "Non-Monetized Benefits Checklist" below.

PSP Table 12—Non-Monetized Benefits Checklist Project 14: San Francisco Bay Climate Change Pilot Projects Combining Ecosystem Adaptation, Flood Risk Management and Wastewater Effluent Polishing			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
1	**Provide educational or technological benefits?**	Yes	The Oro Loma seepage ecotone slope will be the first Bay Area project to create an engineered equivalent of moist grassland/bayland ecotone of broad, flat alluvial fans that historically graded into the tidal marshes of most of South San Francisco Bay. The project will also serve as a "proof of concept" for a leading alternative to global sea level rise. The alternative is environmentally friendly, cost effective, and adaptable to a wide range of potential sea rise scenarios. The project's outreach component includes ▪ development and dissemination of program material in print and electronic form; ▪ meetings with prospective POTW and land use management agency partners to keep them updated about progress and discuss program findings; ▪ meetings with regional policy makers to inform them about program details, including costs and benefits; ▪ meetings with community and civic organizations to build understanding and support for the project; ▪ meetings with state and federal elected officials who are ultimately responsible for oversight of program authorization and funding; and ▪ outreach to key news media providers to promote broad public awareness of and support for the project.
2	**Provide social recreation or access benefits?**	Yes	The Hayward Shoreline provides significant wildlife viewing and public access benefits via the Bay Trail. Without a response to sea level rise, these recreational and access benefits will be cut off or flooded. The proposed project will provide similar benefits, but in a new, more resilient, and sustainable manner.

PSP Table 12—Non-Monetized Benefits Checklist Project 14: San Francisco Bay Climate Change Pilot Projects Combining Ecosystem Adaptation, Flood Risk Management and Wastewater Effluent Polishing			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
3	**Help avoid, reduce, or resolve various public water resource conflicts?**	Yes	The project's primary function is to demonstrate a low cost and environmentally friendly response to sea level rise. The project's secondary function is to reduce nutrients, which will help to alleviate concerns regarding the role of nutrient loading in the SF Bay and Delta Regions if implemented on a regional scale.
4	**Promote social health and safety?**	Yes	The primary function of the project/ecotone is to provide a robust, environmentally friendly, and modest cost defense against flooding associated with sea level rise.
5	**Have other social benefits?**	Yes	The pilot project will bring additional jobs to a lower-income region of the San Francisco Bay Area as well as provide opportunities for children from lower-income households to learn about the wetland habitats that surround their community. The Oro Loma service area serves a population with incomes 40% below the Bay Area average.
Environmental Stewardship Benefits: Will the proposal:			
6	**Benefit wildlife or habitat in ways that are not quantified?**	Yes	D3 Monetized Benefit: Historically, moist grasslands (lowland wet grassland and sedge-rush meadows) were prevalent along the Estuary and in the San Lorenzo Watershed. Replication of this now-rare, groundwater-seep-dependent ecotone are expected to provide important seasonal terrestrial habitat for nesting mallards, wading birds (herons and egrets), foraging raptors, and salt marsh harvest mouse (spring foraging habitat and increasingly important terrestrial high tide refuge), particularly as sea level rises.

7	**Improve water quality in ways that are not quantified?**	Yes	D3 Monetized Benefit: Seepage flow through an ecotone slope is an effective, low-cost, low-energy, and environmentally sustainable method that nearly eliminates nutrient loadings and other contaminants of emerging concern from the receiving waters. If successful, the project has the potential to radically improve water quality in the San Francisco Bay and Delta Regions at a lower cost and energy footprint than traditional treatment methods.
8	**Reduce net emissions in ways that are not quantified?**	Yes	The project will promote the sequestration of carbon from growth of new vegetation at the project site and at other marshes where the project will prevent future flooding from sea level rise. If implemented on a region-wide basis, the project will decrease the required energy and chemical load associated with traditional nutrient removal technologies.
9	**Provide other environmental stewardship benefits?**	Yes	The project involves coordination with resource managers (Hayward Recreational Park District and East Bay Regional Park Trail) to ensure stewardship of the wetlands around the East Bay and greater Bay Area.
Sustainability Benefits: Will the proposal:			
10	**Improve the overall, long-term management of California groundwater resources?**	No	
11	**Reduce demand for net diversions for the region from the Delta?**	No	
12	**Provide a long-term solution in place of a short-term one?**	Yes	The proposed ecotone slope's primary function is to provide an environmentally friendly, adaptable, and robust defense against flooding associated with sea level rise. During dry weather periods, urban stormwater can be routed through the ecotone slope to provide treatment of common fertilizer, hydrocarbon, and sediment-based pollutants. The proposed pilot project on the Oro Loma site will incorporate this concept by routing stormwater from an industrialized area into the ecotone.
13	**Promote energy savings or replace fossil-fuel-based energy sources with renewable energy and resources?**	Yes	Both the demonstration and future region-wide implementation of an ecotone slope will significantly reduce the energy and chemical demands of providing nutrient removal treatment.
14	**Improve water supply reliability in ways not quantified?**	No	
15	**Other**	No	

D3 Monetized Project Benefits

Quantified Project Benefits:

- Avoided cost of constructing a larger capacity nutrient removal facility
- Avoided annual EBDA capacity charges and nutrient removal O&M costs
- Restoration of 7.8 acres of wetland and ecotone slope habitat

Wetland and Ecotone Slope Restoration

- This project will restore approximately 7.8 acres of wetland and ecotone slope habitat.
- Economic values for restored riparian and wetland habitat vary widely and depend on many factors. At the very low end of the value range, Chiabai et al. (2009) report a value of $128/acre/yr for restored riparian.[52] Woodward & Wui (2001) report values between $218 and $2,256/acre/yr for freshwater wetland, and Kazmierczak (2001) reports values between $289 and $524/acre/yr for coastal zone wetland.[53] In the Bay-Delta, the average cost for restoration of riparian and wetland habitat estimated by BDCP is $1,730/acre/yr.[54] Prices for riparian and wetland mitigation bank credits suggest much higher values. Riparian and wetland mitigation bank credit prices reported by ICF International for the United States as a whole average $3,700/acre/yr, while in California the average price is $9,700/acre/yr.[55] In the Bay Area, mitigation credit prices for riparian and wetland habitat currently cost more than $40,000/acre/yr.[56]
- For this analysis, a value of $2,000/acre/yr is assumed. This is the midpoint between the BDCP average cost for riparian and wetland habitat restoration and the upper-end of the value range reported in Woodward and Wui (2001). Although credit bank prices indicate much greater values, particularly in the Bay Area, these prices include underlying market value of the land and may involve more comprehensive levels of critical habitat services than will be realized by this project.
- Benefits are assumed to start in 2017 and are counted over a 50-year period. The present value (in 2012) of annual wetland and

[52] Chiabai, A., C. Travisi, H. Ding, et al. 2009. *Economic Valuation of Forest Ecosystem Services' Methodology and Monetary Estimates*. Fondazione Eni Enrico Mattei Working Paper No. 2009. 12. All values reported in 2012 dollars.
[53] Woodward, W. and Y. Wui. 2001. "Economic Value of Wetland Services: A Meta-Analysis." *Ecological Economics* 37: 257-270; Kazmierczak, R.F. 2001. "Economic Linkages Between Coastal Wetlands and Habitat/Species Protection: A Review of Value Estimates Reported in the Published Literature." Louisiana State University Agricultural Center. Baton Rouge, Louisiana.
[54] Based on a capital cost of $27,300/acre (excluding land acquisition costs) annualized with a 6% discount rate and annual O&M of $45/acre.
[55] www.icf.com/insights/webinars/2012/12/recording-mitigation-banking-regulatory-ceqa-process. Annualized mitigation credit values based on a 6% discount rate.
[56] Based on current credit prices quoted for Springtown Natural Community Reserve, Newark Mitigation Bank, and San Francisco Bay Wetland District. Based on an average credit price of $725,000/acre annualized with a 6% discount rate.

ecotone slope habitat benefits is $194,764.

Avoided Cost of Nutrient Removal Facility

- The Oro Loma Sanitary District is planning to add a nutrient removal facility to its existing treatment facility. Under the without project condition, the facility is expected to cost $48,857,000 (HDR Design Report, July 2012). With flow equalization the capacity of the nutrient removal facility can be reduced from 69 mgd to 59 mgd.
- The present value (in 2012) capital cost savings is of the smaller facility is $4,991,632.

Avoided EBDA Capacity Charges and Nutrient Removal O&M costs

- With flow equalization on line in 2014, the Oro Loma District can reduce its EBDA capacity allocation from 69 to 59 mgd, with a corresponding decrease in its EBDA capacity charges of$56,700 per year.
- Additionally, the ecotone slope will provide nutrient removal of flow routed through it. The configuration is expected to eliminate the electrical and chemical costs associated with conventional nutrient treatment that is expected to start in 2018. Based upon projected power and chemical expenses of $2,009,000 per year, routing 1% of the plant flow through the ecotone will avoid the expense of conventional treatment at a savings of $20,090 per year.[57]
- The present value (in 2012) of avoided EBDA capacity charges and nutrient removal O&M costs over the 50-year life of the project is $1,086,682.

Summary of Monetized Project Benefits

The present values of stormwater and dry weather nuisance flow treatment and riparian habitat restoration are summarized below, and in PSP Table 15 for Project 14 and PSP Table 16 for Project 14.

Benefit Category	Present Value (2012 Dollars)
Wetland and Ecotone Slope Restoration	$194,764
Avoided Cost of Nutrient Removal Facility	$4,991,632
Avoided EBDA Capacity Charges and Nutrient Removal O&M costs	$1,086,682
Total	$6,273,078

[57] Gerges, Hany, PhD. 2012. *Oro Loma Nutrient Removal Study*. HDR Engineering, Page 37, Table 12. July.

PSP Table 15 – Annual Benefit Project 14 – San Francisco Bay Climate Change Pilot Projects Combining Ecosystem Adaptation, Flood Risk Management and Wastewater Effluent Polishing									
(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)**	**Present Value Coefficient**	**Discounted Benefits (h) x (i)**
2017-2066	Restored Wetland/ Upland Habitat	Acres	2.2	10.0	7.8	$2,000	$15,600	12.48	**$194,764**
Total Present Value of Discounted Benefits Based on Unit Value									**$194,764**

PSP Table 16 – Annual Costs of Avoided Projects Project 14 – San Francisco Bay Climate Change Pilot Projects Combining Ecosystem Adaptation, Flood Risk Management and Wastewater Effluent Polishing						
	Costs				**Discounting Calculations**	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
	Alternative (Avoided Project Name): Nutrient Removal Facility **Avoided Project Description**: The Oro Loma Sanitary District would construct and operate a nutrient removal facility to reduce nutrient concentrations in discharged wastewater.					
Year	**Avoided Capital Costs**	**Avoided Replacement Costs**	**Avoided Operations and Maintenance Costs**	**Total Cost Avoided for Individual Alternatives (b) + (c) + (d)**	**Present Value Coefficient**	**Discounted Costs (e) x (f)**
2012				$0	1.000	$0
2013				$0	0.943	$0
2014			$56,700	$56,700	0.890	$50,463
2015			$56,700	$56,700	0.840	$47,606
2016			$56,700	$56,700	0.792	$44,912
2017			$56,700	$56,700	0.747	$42,370
2018	$7,080,725		$76,790	$7,157,515	0.705	$5,045,766
2019-2066			$76,790	$76,790	11.033	$847,197

Total Present Value of Discounted Costs	**$6,078,313**
(%) Avoided Cost Claimed by Project	**100%**
Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project	**$6,078,313**

Project Cost

Project costs are summarized in the following table. The project capital cost is $5,365,125.[58] Annual O&M for the wetland and ecotone slope is expected to run $10,000/yr to be paid by the Oro Loma District. The present value (in 2012) of capital and O&M economic costs is $5,186,287, as shown in PSP Table 19 for Project 14.

PSP Table 19 – Annual Costs of Project

Project 14: San Francisco Bay Climate Change Pilot Projects Combining Ecosystem Adaptation, Flood Risk Management and Wastewater Effluent Polishing

			Annual Costs						Discounting Calculations	
Year	**Initial Costs Grand Total Cost from Table 7**	**Adjusted Grant Total Cost[1]**	**Admin**	**Operation**	**Maintenance**	**Replacement**	**Other**	**Total Costs** (a) +…+ (g)	**Present Value Coefficient**	**Discounted Project Costs** (h) x (i)
	(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2012									1.000	
2013	$5,365,125							$5,365,125	0.943	**$5,061,439**
2014								$0	0.890	**$0**
2015								$0	0.840	**$0**
2016								$0	0.792	**$0**
2017-2066				$10,000				$10,000	12.485	**$124,849**
Total Present Value of Discounted Costs (Sum of column (j))										**$5,186,287**

Comments:
[1] Annual O&M for the wetland and ecotone slope is estimated at $10,000/yr. Funding source for annual operations and maintenance is the Oro Loma USD.

[58] Expected project costs are derived from ESA PWA (2012). Oro Loma Wet Weather Equalization, Treatment Wetland and Ecotone Demonstration Project: Initial Feasibility Study. Table 4.

Project Benefit-Cost Ratio

The present value of benefits for the with-project condition is $6,273,078. The present value of project economic costs for the with-project condition is $5,186,287. The project net present value is $1,086,791, and the project benefit-cost ratio is 1.21.

Project 16 – San José Green Streets & Alleys Demonstration Projects

Project Benefits

With Project Condition: The Green Street component of this project will focus on Chynoweth Avenue. The project involves the reconstruction of a residential street to eliminate excess lane width while constructing new bioretention areas on both sides of the street to treat runoff where no treatment exists. The project would treat at least 50,600 square feet of street area, including eliminating approximately 13,500 square feet of existing impervious pavement and a barren dirt median that currently contributes sediment to the storm drain system. The Green Alley component of the project will also evaluate the feasibility of replacing existing surfaces and constructing underground infiltration features in alleys in the Spartan-Keys neighborhood just south of downtown San Jose. The Martha Gardens Green Alley Pilot Project will be implemented as a demonstration project and is located within the Spartan-Keys neighborhood. This pilot project will replace at least 35,000 square feet of existing pavement in an alley with green concrete (high-recycled content, lighter-colored concrete): to install four-foot-wide, porous pavers and an infiltration trench along the middle of the alley and to install five drywells to capture excess water. The project includes approximately 11,000 square feet of biotreatment areas, treating approximately 35,000 square feet of impervious surface (existing pavement/ sidewalk and new sidewalk). The project also includes approximately 4,400 square feet of permeable pavers. The project is expected to have an equivalent stormwater treatment capacity of 300,000 gallons/year of water with potential pollutants such as metals (lead, zinc, and copper), hydrocarbons, oil, and grease, and the project will result in infiltration of more than 699,500 gallons of stormwater annually.

Without Project Condition: If the project is not constructed, conventional repavement and street sweeping will be applied to the alleyways in the Spartan-Keys neighborhood. The project's stormwater retention and treatment benefits will not be realized.

D2 Non-Monetized Project Benefits

Non-monetizable project benefits, including community and social benefits, environmental stewardship benefits, and sustainability benefits are identified, as applicable to this project, in the PSP Table 12 "Non-Monetized Benefits Checklist" below.

PSP Table 12—Non-Monetized Benefits Checklist Project 16: San José Green Streets & Alleys Demonstration Projects			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
1	**Provide educational or technological benefits?**	Yes	Different street types, each in a specific urban setting, will be used to demonstrate a range of approaches for retrofitting existing streets for stormwater treatment and flow reduction. This suite of individual projects will serve as a comprehensive demonstration of retrofits of the most common types of streets in the Bay Area and will demonstrate the integration of LID features across a range of land uses settings and street morphologies. Each project will include measurements of the pollutant-removal and flow-reduction performance of specific LID features through pre- and post-project water monitoring. Both individually and together, the projects will provide design examples that any city can apply to its own streets. The community education and engagement aspect of the project will foster local understanding of the relationship between street runoff and the condition of local waterways and San Francisco Bay.
2	**Provide social recreation or access benefits?**	Yes	The project will improve the streetscape for pedestrians and cyclists. The Chynoweth project's green street improvements will be adjacent to a future park. This project will essentially create a "green street" gateway to the park. This will provide an excellent opportunity for water quality educational elements where bioretention areas will interface with the park. The alleyway improvements support the neighborhoods goal to turn these alleys into a network of vibrant streets oriented towards pedestrian and bicyclist, and that encourage community gathering.
3	**Help avoid, reduce, or resolve various public water resource conflicts?**	No	

PSP Table 12—Non-Monetized Benefits Checklist Project 16: San José Green Streets & Alleys Demonstration Projects			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
4	**Promote social health and safety?**	Yes	D3 Monetized Benefit Additionally, improvements constructed through this project will turn the course of these alleys from community nuisance to community asset. Increased use of the alleys by residents will also deter crime and other illegal activities and will increase public safety in the neighborhood.
Community/Social Benefits: Will the proposal:			
5	**Have other social benefits?**	Yes	The project will retrofit (at least) alleys in a disadvantaged community with LID permeable pavement and infiltration facilities to eliminate sediment and ponding in the alleys, improve stormwater quality, and make the alleys a community amenity. The current condition of alleyways in the Spartan Keyes neighborhood is an ongoing concern of residents, and the Spartan-Keyes Neighborhood Improvement Plan identifies improving the condition of the alleys with new pavement and proper drainage as a top ten neighborhood improvement and blight reduction objective. The Plan envisions that redevelopment of these alleys will create a positive pedestrian environment and will increase community interaction.
Environmental Stewardship Benefits: Will the proposal:			
6	**Benefit wildlife or habitat in ways that are not quantified?**	Yes	San José will pursue Bay-Friendly certification for the projects' landscape design and maintenance.
7	**Improve water quality in ways that are not quantified?**	Yes	D3 Monetized Benefit: The project will benefit water quality by providing bioretention treatment and allowing infiltration of untreated street runoff to remove sediment and other pollutants of concern, thus reducing flow and pollutant loads to downstream water bodies.
8	**Reduce net emissions in ways that are not quantified?**	Yes	Infiltration of stormwater will replenish local groundwater aquifer and reduce energy and emissions resulting from import of non-local water supplies.
9	**Provide other environmental stewardship benefits?**	Yes	Successful completion of this project will demonstrate how green infrastructure improvements can complement pedestrian and cyclist safety to create true green streets. Multi-modal street improvements tend to be handled by transportation planners and are often contemplated separately from stormwater. This will show how the two disciplines can converge and deliver multiple benefits from a single project.

PSP Table 12—Non-Monetized Benefits Checklist Project 16: San José Green Streets & Alleys Demonstration Projects			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Sustainability Benefits: Will the proposal:			
10	**Improve the overall, long-term management of California groundwater resources?**	Yes	Stormwater infiltration provided by the project will benefit groundwater resources.
11	**Reduce demand for net diversions for the region from the Delta?**	No	
12	**Provide a long-term solution in place of a short-term one?**	Yes	The project will alleviate water quality concerns from increased sediment load and urban runoff pollutant loads to Coyote Creek and Guadalupe River.
13	**Promote energy savings or replace fossil-fuel-based energy sources with renewable energy and resources?**	Yes	NRDC and UCSB found that implementation of LID practices that emphasize rainwater harvesting—which include infiltration of water into the ground as well as capture in rain barrels or cisterns for later use onsite—in urbanized areas of Southern California and limited portions of San Francisco Bay area has the potential to increase local water supplies. The water savings can translate to energy savings and emissions reductions. The alley project will also use green concrete, which is a high-recycled content, light-colored concrete. Use of light-colored concrete can also result in less heat absorption and reduce the urban heat island effect in the surrounding area.
14	**Improve water supply reliability in ways not quantified?**	No	
15	**Other**	None	

D3 Monetized Project Benefits

Quantified Project Benefits:

- Avoided costs of conventional repavement and street sweeping of alleyways in Spartan-Keys neighborhood
- Water quality value of stormwater retention and treatment

Water Quality Value of Stormwater Retention and Treatment

- The proposed project is expected to have an equivalent stormwater treatment capacity of 13,685 gallons/year of water with potential pollutants, such as metals (lead, zinc, copper), hydrocarbons, oil, and grease.
- Stormwater treatment costs vary significantly. Riley (2009) estimated an average treatment cost of $0.0094/gallon for a small-scale stormwater and dry weather runoff treatment facility recently constructed in Santa Monica. Weiss et al. (2005) evaluated typical costs for a range of stormwater treatment technologies, including dry detention basins, wet detention basins, sand filters, constructed wetlands, bioretention filters, infiltration trenches, and swales. Costs ranged between $0.019 and $0.28/gallon with a midpoint cost of $0.13/gallon.[59]
- Using the small-scale stormwater and dry weather runoff treatment facility described in Riley (2009) as the alternative cost for an equivalent level of stormwater treatment capacity, the treatment of 300,000 gpy of stormwater has a value of $2,825/yr.
- The present value of stormwater treatment over the 30-year expected life of the street improvements is $32,144.

Avoided Cost of Repavement and Street Sweeping

- Without the project, the alleyways in the Spartan-Keys neighborhood would be repaved at an estimated cost of $910,000.[60]
- Without the project, annual street sweeping costs of $850/yr for the repaved alleyways would also be incurred.[61]
- The present value of avoided costs (in 2012) is $819,567.

[59] Peter T. Weiss, John S. Gulliver, Andrew J. Erickson. 2005. *The Cost and Effectiveness of Stormwater Management Practices.* Department of Civil Engineering, University of Minnesota. MN/RC – 2005-23. http://www.lrrb.org/pdf/200523.pdf

[60] Avoided costs for conventional improvements to the alleyway segments to build the needed storm sewer infrastructure and repavement. Costs estimated by the City of San Jose Public Works Department.

[61] Note this avoided cost is offset by project O&M cost for street sweeping of alleyway segments included in Table 19.

Summary of Monetized Project Benefits

The present values of stormwater and dry weather nuisance flow treatment and avoided alleyway repavement and street sweeping costs are summarized below, and in PSP Table 15 for Project 16 and PSP Table 16 for Project 16.

Benefit Category	Present Value (2012 Dollars)
Stormwater Treatment Capacity	$32,144
Avoided Repavement of Alleyways	$809,897
Avoided Street Sweeping	$9,671
Total	$851,712

PSP Table 15 – Annual Benefit Project 16 – San José Green Streets & Alleys Demonstration Projects									
(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)**	**Present Value Coefficient**	**Discounted Benefits (h) x (i)**
2015-2039	Stormwater and Dry Weather Nuisance Runoff Treatment Capacity	Gallons	0	300,000	300,000	$0.0094	$2,825	11.377	**$32,144**
Total Present Value of Discounted Benefits Based on Unit Value									**$32,144**

PSP Table 16 – Annual Costs of Avoided Projects Project 16 – San José Green Streets & Alleys Demonstration Projects						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
Year	**Alternative (Avoided Project Name):** Conventional Street and Alley Improvements				Present Value Coefficient	Discounted Costs (e) x (f)
	Avoided Project Description: Conventional improvements to the alleyway segments to build the needed storm sewer infrastructure and repavement					
	Avoided Capital Costs[1]	Avoided Replacement Costs	Avoided Operations and Maintenance Costs[2]	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)		
2012				$0	1.000	**$0**
2013				$0	0.943	**$0**
2014	$910,000			$910,000	0.890	**$809,897**
2015-2039			$850	$850	11.377	**$9,671**
Total Present Value of Discounted Costs						**$819,567**
(%) Avoided Cost Claimed by Project						**100%**
Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project						**$819,567**

Comments:
[1] Avoided costs for conventional improvements to the alleyway segments to build the needed storm sewer infrastructure and repavement. Costs estimated by City of San Jose Public Works department.
[2] Avoided costs of street sweeping of alleyway segments without the project. Note this avoided cost is offset by project O&M cost for street sweeping of alleyway segments included in Table 19.

Project Cost

Project costs are summarized below. In addition to the installation costs shown in column (a), the project will incur annual maintenance costs of $8,550 per year. The City of San Jose has estimated an annualized maintenance cost for bioretention areas to be $2,100 per year per 1,200 square foot area. The green street improvements will create at least 4,400 square feet of bioretention areas. Based on that rate, the estimated annual maintenance cost is $7,700. Maintenance of the permeable pavement included in the green street and green alleys will consist of biannual vacuuming with either a vacuum sweeper or regenerative air sweeper and is estimated to cost $850. This is based on the fully loaded cost of $53/hr for a Street Sweeper Operator and an estimated total of 16 hours per year to sweep the green street and alleys. See PSP Table 19 for Project 16 below.

PSP Table 19 – Annual Costs of Project
Project 16: San José Green Streets & Alleys Demonstration Projects

			Annual Costs						Discounting Calculations	
	Initial Costs Grand Total Cost from Table 7	Adjusted Grant Total Cost[1]	Admin	Operation	Maintenance[1]	Replacement	Other	Total Costs (a) +…+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2012									1.000	
2013	$397,500							$397,500	0.943	**$375,000**
2014	$2,173,000							$2,173,000	0.890	**$1,933,962**
2015	$79,500							$79,500	0.840	**$66,750**
2015-2044					$8,550			$8,550	12.251	**$104,743**
Total Present Value of Discounted Costs (Sum of column (j))										**$2,480,455**

Comments:
[1] City has estimated an annualized maintenance cost for bioretention areas to be $2,100 per year per 1,200 square foot area. The green street improvements will create at least 4,400 square feet of bioretention areas. Based on that rate, estimated annual maintenance cost is $7,700. Maintenance of the permeable pavement included in the green street and green alleys will consist of biannual vacuuming with either a vacuum sweeper or regenerative air sweeper and is estimated to cost $850. This is based on fully loaded cost of Street Sweeper Operator is $53/hr and estimated total of 16 hrs per year to sweep the green street and alleys.

Project Benefit-Cost Ratio

The present value of benefits for the with-project condition is $851,712. The present value of project economic costs for the with-project condition is $2,480,455. The project net present value is -$1,628,743, and the project benefit-cost ratio is 0.34.

It is noted that the primary benefits associated with the demonstration and educational aspects of this project are non-monetizable. This project will retrofit alleys in a disadvantaged community with LID permeable pavement and infiltration facilities to eliminate sediment and ponding in the alleys, improve stormwater quality, and make the alleys a community amenity. The current condition of alleyways in the Spartan Keyes neighborhood is an ongoing concern of residents, and the Spartan-Keyes Neighborhood Improvement Plan identifies improving the condition of the alleys with new pavement and proper drainage as a top ten neighborhood improvement and blight reduction objective. The Plan envisions that redevelopment of these alleys will create a positive pedestrian environment and will increase community interaction.

Different street types, each in a specific urban setting, will be used to demonstrate a range of approaches for retrofitting existing streets for stormwater treatment and flow reduction. This suite of individual projects will serve as a comprehensive demonstration of retrofits of the most common types of streets in the Bay Area and will demonstrate the integration of LID features across a range of land uses settings and street morphologies. Each project will include measurements of the pollutant-removal and flow-reduction performance of specific LID features through pre- and post-project water monitoring. Both individually and together, the projects will provide design examples that any city can apply to its own streets.

The community education and engagement aspect of the project will foster local understanding of the relationship between street runoff and the condition of local waterways and San Francisco Bay. These benefits are not captured in this monetized benefit-cost evaluation, but will result in valuable contributions to regional and statewide water resource and land management goals.

Project 19 – Students and Teachers Restoring a Watershed (STRAW) Project—North and East Bay Watersheds

Project Benefits

With Project Condition: STRAW restoration projects will create new riparian habitat in denuded and degraded watershed areas in Marin, Sonoma, Napa, Solano, and Alameda Counties. This funding will result in a minimum of 17 acres of riparian habitat, based on a minimum of 15,000 linear feet with a 50 foot average width.

Without Project Condition: Under the without project condition, the STRAW riparian restoration objectives would not be realized.

D2 Non-Monetized Project Benefits

Non-monetizable project benefits, including community and social benefits, environmental stewardship benefits, and sustainability benefits are identified, as applicable to this project, in the PSP Table 12 “Non-Monetized Benefits Checklist” below.

PSP Table 12—Non-Monetized Benefits Checklist Project 19: Students and Teachers Restoring a Watershed (STRAW) Project—North and East Bay Watersheds			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
1	**Provide educational or technological benefits?**	Yes	D3 Monetized Benefit This project provides these benefits through ▪ development and assessment of modified practices to ensure restoration designs and resulting projects adapt to a changing climate and ▪ implementation of an innovative and time-tested educational and professional development program. Classes receive additional in-class and/or field activities as requested by their teacher to supplement traditional curriculum. Topics include macroinvertebrates, water quality, ornithology, geology, and mapping. Restoring degraded ecological conditions has been identified as a strategy for preparing for climate change (U.S. EPA, 2012). The restoration of riparian areas has been specifically identified because it can enhance connectivity, provide thermal refugia, and build upon existing resiliency (Seavy, 2009). Thus, habitat restoration projects should be designed to accommodate climatic uncertainty. The implementation of STRAW's "climate smart" designs will ensure that these projects will be as robust and resilient as possible and will provide the opportunity to educate land managers, public agencies, and the general public about the importance of these projects as a successful and concrete means of adapting to climate change. In an independent evaluation, it was found that participating in STRAW allows "students to apply and deepen their academic skills and knowledge by doing professional quality restoration work. STRAW brings learning alive, integrating all subjects in something that has value and makes sense. It creates enthusiastic engagement and long-term retention for students as their competence and leadership are recognized. They bring their compassion and strength to bear on a project that benefits their local community and watershed, beginning a lifelong commitment to compassionate action and good citizenship. We want to engender a populace of capable, resilient lifelong learners. In addition, we know that some students who have participated in STRAW have been inspired to go on to careers in science" (Glazebrook, 2007).

PSP Table 12—Non-Monetized Benefits Checklist Project 19: Students and Teachers Restoring a Watershed (STRAW) Project—North and East Bay Watersheds			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
2	**Provide social recreation or access benefits?**	Yes	Participation in STRAW restoration days provides the public access to a variety of Bay Area public and private landscapes. This project will provide 3,500 Bay Area citizens the opportunity to restore and enjoy many different properties around the Bay.
3	**Help avoid, reduce, or resolve various public water resource conflicts?**	No	
4	**Promote social health and safety?**	Yes	Habitat restoration increases waterway function with regard to stormwater treatment and flood control. Restored waterways provide (1) lasting flood protection through flood prevention design practices that maximize native vegetation while removing/discouraging species prone to channel blockage and (2) stormwater treatment improvements through filtration by established native vegetation (D3 Monetized Benefit).
5	**Have other social benefits?**	Yes	STRAW will engage all communities in the North, East, and West San Francisco Bay Area regardless of socioeconomic or ethnic background. STRAW engages approximately 3,500 community volunteers annually, over half of which come from disadvantaged communities (using the standard of Title I schools in the California State school system). Social Engagement: STRAW is a highly regarded community catalyst that brings together students, teachers, land managers, ranchers, and restoration professionals around the shared goal of improved watershed health. STRAW provides the unique opportunity for community members to actively participate in improving watershed health. The STRAW program has a steady increase in participation from all stakeholders, and demand is substantially larger than our current capacity.

PSP Table 12—Non-Monetized Benefits Checklist Project 19: Students and Teachers Restoring a Watershed (STRAW) Project—North and East Bay Watersheds			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Environmental Stewardship Benefits: Will the proposal:			
6	**Benefit wildlife or habitat in ways that are not quantified?**	Yes	D3 Monetized Benefit: STRAW restoration projects will increase the amount and quality of riparian and wetland/upland transition zone habitat. In addition, projects will contribute to expanding critical habitat for the listed species California Clapper Rail (*Rallus longirostris obsoletus*), Salt Marsh Harvest Mouse (*Reithrodontomys raviventris*), and California Freshwater Shrimp (*Syncaris pacifica*), along with countless other species. The STRAW project will restore a minimum of 30,000 linear feet of creek and levee banks annually. Each planting day will improve habitat quality through revegetation and invasive plant removal along creek banks and wetlands. Project design and implementation adheres to BMP and methodologies listed above.
7	**Improve water quality in ways that are not quantified?**	Yes	Water quality resources will be improved through decreased sedimentation, nutrient and metals uptake, and cooler water temperatures. Creek and levee banks will be stabilized, which will lead to improved flood control and water quality.
8	**Reduce net emissions in ways that are not quantified?**	Yes	The installation of native vegetation in denuded areas will increase the area's ability to sequester atmospheric carbon. STRAW projects are currently being evaluated by the University of California Cooperative Extension to quantify actual sequestration values. The study is slated for completion by June 2013.
9	**Provide other environmental stewardship benefits?**	Yes	Direct community involvement in environmental stewardship: STRAW is a highly regarded community catalyst that brings together students, teachers, land managers, ranchers, and restoration professionals around the shared goal of improved watershed health. This collaborative approach is proven to maximize long-term project success and community buy-in—versus projects that happen in isolation—and regularly results in increased community support and the creation of new projects. The STRAW program has a steady increase in participation from all stakeholders, and demand is substantially larger than our current capacity.
Sustainability Benefits: Will the proposal:			
10	**Improve the overall, long-term management of California groundwater resources?**	No	

PSP Table 12—Non-Monetized Benefits Checklist Project 19: Students and Teachers Restoring a Watershed (STRAW) Project—North and East Bay Watersheds			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
11	**Reduce demand for net diversions for the region from the Delta?**	No	
12	**Provide a long-term solution in place of a short-term one?**	Yes	STRAW projects provide many long-term solutions to water quality and habitat degradation. 1. Climate Change: "Climate smart" designs will ensure there is adequate redundancy of design components so that the resulting project will be resilient enough to handle the climatic uncertainty ahead. 2. Flood Control: Projects will provide lasting flood protection through flood prevention design practices that maximize native vegetation while removing/discouraging species prone to channel blockage. 3. Water Quality: Projects will provide stormwater treatment improvements through filtration by established native vegetation, increasing the riparian and wetland areas' abilities to absorb and retain sediment, excess nutrients, and other pollutants. 4. Social Engagement: STRAW is a highly regarded community catalyst that brings together students, teachers, land managers, ranchers, and restoration professionals around the shared goal of improved watershed health. This collaborative approach and opportunity for direct action increases community support for restoration projects and can unite disparate groups with shared ecological goals.
13	**Promote energy savings or replace fossil-fuel-based energy sources with renewable energy and resources?**	No	
14	**Improve water supply reliability in ways not quantified?**	No	
15	**Other**	No	

D3 Monetized Project Benefits

Quantified Project Benefits:

- Improved water quality via natural treatment of urban stormwater and dry weather nuisance runoff prior to discharge into the Bay
- Restoration of 17 acres and 15,000 linear feet of riparian habitat in Bay Area creeks

Natural Treatment of Urban Stormwater and Dry Weather Runoff

- Restored riparian corridors in urban watersheds can improve water quality by removing nutrients, improving dissolved oxygen, storing sediment and regulating temperatures, among other benefits (Riley, 2009).[62]
- Riley (2009) estimates that fully functioning riparian corridors in urbanized watersheds in the Bay Area can provide up to 0.064 MGD of treatment capacity for stormwater and dry weather nuisance runoff per 1,000 linear feet of riparian corridor. Restoration of 15,000 linear feet of riparian corridor via the STRAW project could therefore provide up to 0.96 MGD of treatment capacity for stormwater and dry weather nuisance runoff.
- Stormwater treatment costs vary significantly. Riley (2009) estimated an average treatment cost of $0.009/gallon for a small-scale stormwater and dry weather runoff treatment facility recently constructed in Santa Monica. Weiss et al (2005) evaluated typical costs for a range of stormwater treatment technologies, including dry detention basins, wet detention basins, sand filters, constructed wetlands, bioretention filters, infiltration trenches, and swales. Costs ranged between $0.019 and $0.28/gallon with a midpoint cost of $0.13/gallon.[63]
- Using the low end of the treatment cost range, the alternative cost of treatment for 15,000 linear feet of fully functioning riparian corridor in urbanized watersheds is approximately $3.2 million/yr.
- Treatment efficacy of riparian corridors can vary significantly and depends on many factors (Riley, 2009). To account for the considerable uncertainty in the treatment effectiveness of STRAW restored riparian corridors, the estimated level of treatment capacity is reduced by three-fourths to 0.24 MGD. The annual value of stormwater treatment capacity provided by STRAW restored riparian corridors is reduced by an equivalent amount to $0.8 million/yr.
- Stormwater treatment benefits are counted over 30 years to match the typical useful life for a stormwater treatment facility.
- It is assumed it will take up to 5 years following restoration of riparian habitat until treatment benefits are fully realized by STRAW restoration projects. Therefore, for the purposes of the economic analysis, treatment benefits are assumed to commence no sooner

[62] Riley, A. (2009). *Putting A Price On Riparian Corridors As Water Treatment Facilities.* Oakland, CA: California Regional Water Quality Control Board, San Francisco Bay Region.
[63] Peter T. Weiss, John S. Gulliver, Andrew J. Erickson. 2005. *The Cost and Effectiveness of Stormwater Management Practices*. Department of Civil Engineering, University of Minnesota. MN/RC – 2005-23. http://www.lrrb.org/pdf/200523.pdf

than 2020 and to last through 2049.

- Given these assumptions, the present value of stormwater and dry weather nuisance flow treatment benefits is $7,552,379.

Riparian Habitat Restoration

- This project will restore approximately 17 acres of riparian habitat.
- Economic values for restored riparian and wetland habitat vary widely and depend on many factors. At the very low end of the value range, Chiabai et al. (2009) report a value of $128/acre/yr for restored riparian.[64] Woodward & Wui (2001) report values between $218 and $2,256/acre/yr for freshwater wetland and Kazmierczak (2001) reports values between $289 and $524/acre/yr for coastal zone wetland.[65] In the Bay-Delta, the average cost for restoration of riparian and wetland habitat estimated by BDCP is $1,730/acre/yr.[66] Prices for riparian and wetland mitigation bank credits suggest much higher values. Riparian and wetland mitigation bank credit prices reported by ICF International for the US as a whole average $3,700/acre/yr, while in California the average price is $9,700/acre/yr.[67] In the Bay Area, mitigation credit prices for riparian and wetland habitat currently cost about $40,000/acre/yr.[68]
- For this analysis, a value of $2,000/acre/yr is assumed. This is the midpoint between the BDCP average cost for riparian and wetland habitat restoration and the upper-end of the value range reported in Woodward and Wui (2001). Although credit bank prices indicate much greater values, particularly in the Bay Area, these prices include underlying market value of the land and may involve more comprehensive levels of critical habitat services than will be realized by riparian restoration brought about through STRAW restoration projects.
- Full riparian habitat benefits are assumed to commence in 2020 following a five-year establishment period. The 2012 present value of annual riparian habitat benefits over 30 years is $311,250.

[64] Chiabai, A., C. Travisi, H. Ding, et al. 2009. *Economic Valuation of Forest Ecosystem Services' Methodology and Monetary Estimates*. Fondazione Eni Enrico Mattei Working Paper No. 2009. 12. All values reported in 2012 dollars.
[65] Woodward, W. and Y. Wui. 2001. "Economic Value of Wetland Services: A Meta-Analysis." *Ecological Economics* 37: 257-270; Kazmierczak, R.F. 2001. "Economic Linkages Between Coastal Wetlands and Habitat/Species Protection: A Review of Value Estimates Reported in the Published Literature." Louisiana State University Agricultural Center. Baton Rouge, Louisiana.
[66] Based on a capital cost of $27,300/acre (excluding land acquisition costs) annualized with a 6% discount rate and annual O&M of $45/acre.
[67] www.icf.com/insights/webinars/2012/12/recording-mitigation-banking-regulatory-ceqa-process. Annualized mitigation credit values based on a 6% discount rate.
[68] Based on current credit prices quoted for Springtown Natural Community Reserve, Newark Mitigation Bank, and San Francisco Bay Wetland District. Based on an average credit price of $700,000/acre annualized with a 6% discount rate.

Summary of Monetized Project Benefits

The present values of stormwater and dry weather nuisance flow treatment and riparian habitat restoration are summarized below, and in PSP Table 15 for Project 19.

Benefit Category	Present Value (2012 Dollars)
Stormwater Treatment Capacity	$7,552,379
Riparian Habitat Restoration	$311,250
Total	$7,863,629

Table 15 – Annual Benefit
Project 19 – Students and Teachers Restoring a Watershed (STRAW) Project—North and East Bay Watersheds

(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)**	**Present Value Coefficient**	**Discounted Benefits (h) x (i)**
2020-2049	Stormwater and Dry Weather Nuisance Runoff Treatment Capacity	Gallons	0	87,600,000	87,600,000	$0.0094	$825,000	9.15	**$7,552,379**
2016-2045	Riparian Habitat Restoration	Acres	0	17	17	$2,000	$34,000	9.15	**$311,250**
Total Present Value of Discounted Benefits Based on Unit Value									**$7,863,629**

Project Cost

Project capital costs total $625,000 in 2012 dollars. Project implementation will start in 2013 and end in 2016. The present value of project implementation costs is based on the schedule of expenditures in the Annual Costs table of the project information sheet. The present value of project capital cost in 2012 is $552,767. The present value of project economic costs is therefore $552,767. See PSP Table 19 for Project 19 below.

Table 19 – Annual Costs of Project
Project 19: Students and Teachers Restoring a Watershed (STRAW) Project—North and East Bay Watersheds

			Annual Costs						Discounting Calculations	
	Initial Costs Grand Total Cost from Table 7	Adjusted Grant Total Cost	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2012									1.000	
2013	$228,250							$228,250	0.943	**$215,330**
2014	$206,500							$206,500	0.890	**$183,784**
2015	$103,250							$103,250	0.840	**$86,691**
2016	$43,500							$43,500	0.792	**$34,456**
2017	$43,500							$43,500	0.747	**$32,506**
Total Present Value of Discounted Costs (Sum of column (j))										**$552,767**

Project Benefit-Cost Ratio

The present value of benefits for the with-project condition is $7,863,629. The present value of project economic costs for the with-project condition is $552,767. The project net present value is $7,310,862, and the project benefit-cost ratio is 14.23.

Habitat Restoration Projects

The six habitat restoration projects that comprise this section will contribute to region-wide habitat enhancement efforts in urban, open space, and rural agricultural areas. These projects include a range of habitat restoration, protection, and preservation efforts, which will benefit native fish and wildlife populations in the region. These projects also include recreation and environmental education goals. They will provide or improve salmonid and trout passage in urban and rural stretches of creeks; they also improve water quality by removing sediment and debris in impaired watersheds with established TMDLs; and they will create and preserve wetlands and streams in disadvantaged communities. Combined, the benefit-cost ratio for the habitat restoration projects included in this Proposal is 2.12.

Project 3 – Lagunitas Creek Watershed Sediment Reduction and Management Project 104

Project 4 – Marin/Sonoma Conserving Our Watersheds: Agricultural BMP Projects 114

Project 7 – Oakland Sausal Creek Restoration Project 122

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Project 17 – San Pablo Rheem Creek Wetlands Restoration Project 140

Project 18 – St. Helena Upper York Creek Dam Removal and Ecosystem Restoration Project 147

Project 3 – Lagunitas Creek Watershed Sediment Reduction and Management Project

Project Benefits

With Project Condition: The project will implement improvements to three stream crossings of the Cross Marin Trail, which runs parallel to Lagunitas Creek and which crosses tributaries to it. The three sites are identified as: Big Bend - Site #100; Jewell Creek - Sites # 111 & #112; and Eucalyptus - Site #115. The improvement will entail replacing the old, failing, and undersized culverts at each of these crossings, with larger culverts or arch culverts. The new culverts will all be sized for the 100-year storm event. The project improvements will stop erosion and reduce sediment loss, secure the Nicasio Transmission Line (NTL), a major water supply transmission pipeline, stabilize the recreational trail, and improve fish passage. The project is an element of Marin Municipal Water District (MMWD)'s Lagunitas Creek Stewardship Plan and it is an important recovery action in the State's Recovery Strategy for CA Coho Salmon and the federal Recovery Plan for Central CA Coastal Coho Salmon. Lagunitas Creek supports the largest and most stable population of endangered coho salmon in Central California; it also supports a robust population of threatened steelhead trout. These plans call for reducing sedimentation into Lagunitas Creek and improving fish passage. The project will improve spawning and rearing habitat in the main stem of Lagunitas Creek and provide access to 2,375 lineal feet of spawning and rearing habitat in tributary streams. Tributary streams will also provide important winter refuge for juvenile and adult salmonids during high flow events in Lagunitas Creek.

Without Project Condition: Culverts are not replaced until one of the culverts fails. The annual probability of at least one culvert failing is 10%. The probability of culverts failing *i* years from today is therefore:

$$P(\text{culvert fails } i \text{ years from today}) = 0.1 \times 0.9^{i-1}$$

Until the culverts are replaced, MMWD will continue to incur annual culvert maintenance and repair costs of $15,000/yr. After the culverts are replaced, annual O&M costs will fall to $5,000/yr. Waiting for the culverts to fail will add $100,000 in emergency response and repair costs plus the value of lost water supply from the NTL pipeline to the cost of replacement.

D2 Non-Monetized Project Benefits

Non-monetizable project benefits, including community and social benefits, environmental stewardship benefits, and sustainability benefits are identified, as applicable to this project, in the PSP Table 12 "Non-Monetized Benefits Checklist" below.

PSP Table 12—Non-Monetized Benefits Checklist Project 3: Lagunitas Creek Watershed Sediment Reduction and Management Project			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
1	**Provide educational or technological benefits?**	No	
2	**Provide social recreation or access benefits?**	Yes	The project will benefit recreational users of State Parks and National Park Service lands through the greater stability and reliability of the Cross-Marin Trail (and a portion of the Bay Area Ridge Trail), which is an established and very popular recreational trail for hikers, cyclists, and equestrians.
3	**Help avoid, reduce, or resolve various public water resource conflicts?**	Yes	The project will help avoid future conflicts between land and resource owners regarding liability and responsibility for potential failures.
4	**Promote social health and safety?**	Yes	The construction of the project will increase the reliability of critical services, as potable water is identified as critical infrastructure.
5	**Have other social benefits?**	No	
Environmental Stewardship Benefits: Will the proposal:			
6	**Benefit wildlife or habitat in ways that are not quantified?**	Yes	D3 Monetized Benefit. The project will: ▪ improve water quality and riparian habitat by strictly minimizing persistent and catastrophic erosion into the creek, which supports endangered species (coho, steelhead); ▪ implement actions called for in the State's Recovery Strategy for California Coho Salmon and the Federal Recovery Plan for the Central California Coast Coho Salmon; ▪ improve fish passage into additional tributary stream reaches; ▪ benefit listed salmonids by reducing sediment loading into the creek, which will improve instream habitat, increase populations; and ▪ replace failing culverts in salmonid-supporting tributaries, which will allow fish passage to additional habitat and create the opportunity for reintroduction and increased access for steelhead and coho.
7	**Improve water quality in ways that are not quantified?**	Yes	D3 Monetized Benefit: The project will improve water quality by reducing fine sediment loading due to chronic erosion and catastrophic events, which will reduce turbidity.

PSP Table 12—Non-Monetized Benefits Checklist Project 3: Lagunitas Creek Watershed Sediment Reduction and Management Project			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
8	**Reduce net emissions in ways that are not quantified?**	Neg	The project will utilize construction equipment that emits greenhouse gases.
9	**Provide other environmental stewardship benefits?**	Yes	The project is a natural resource stewardship project that will include effective collaboration between public agencies—the National Park Service, California State Parks, and MMWD—which will result in coordinated watershed management.
Sustainability Benefits: Will the proposal:			
10	**Improve the overall, long-term management of California groundwater resources?**	No	
11	**Reduce demand for net diversions for the region from the Delta?**	No	
12	**Provide a long-term solution in place of a short-term one?**	Yes	The project includes proactive road stabilization, which will help avoid future catastrophic road failures and, in some cases, destruction of public water supply.
13	**Promote energy savings or replace fossil-fuel-based energy sources with renewable energy and resources**	No	
14	**Improve water supply reliability in ways not quantified?**	Yes	The project will benefit water supply reliability by stabilizing a water transmission pipeline and replacing failed culverts at high-priority sites along a major water transmission pipeline. The repairs will reduce the potential for failure at these sites and will consequently reduce the likelihood of catastrophic potable water supply outages.
15	**Other**		

D3 Monetized Project Benefits

Quantifiable Project Benefits:

- Avoided future costs of emergency repairs to the NTL and replacement of the at-risk culverts
- Avoided future O&M costs of culverts
- Value of reduced loading of fine sediments in Lagunitas Creek
- Value of salmonids fish spawning and rearing habitat

Present Values: Future benefits under both the with- and without-project conditions are assumed to start in 2016. In the calculations below, future benefits and costs are discounted back to 2012 to conform to PSP requirements.

Avoided Future Costs of Emergency Repairs to the NTL and Replacement of the At-Risk Culverts

- Under the without-project condition, the culverts will be replaced when at least one of the culverts fails; therefore, the timing of culvert replacement is uncertain. MMWD estimates the annual probability of at least one culvert failing is 10%.[69] The probability density function for replacing the culverts *i* years from today is therefore:

$$P(\text{culvert replaced } i \text{ years from today}) = 0.1 \times 0.9^{i-1}$$

- MMWD estimates emergency repairs will cost in the range of $100,000 to stabilize the site following culvert failure and make emergency repairs to the NTL. Following a culvert failure, MMWD would replace the failed culvert and the other two at-risk culverts at an estimated cost of $960,000 (2012 dollars).
- MMWD estimates 8 hours would elapse following failure of the NTL before water entering the pipeline could be shut off. The estimated spill volume, based on the pipeline's capacity between where water enters the pipeline and the location of the at-risk culverts, is 9,110 ccf. The spilled water has a current value of $30,974 based on MMWD's Tier 1 wholesale water rate of $3.40/ccf.
- The cost of emergency response and culvert replacement, including the value of lost water supply, is therefore $1,090,974.
- The expected present value cost (in 2012) of replacing the culverts under the without-project condition is therefore:

$$E[PV(\text{Culvert Replacement})] = \frac{\sum_{i=1}^{100} 0.1 \times 0.9^{i-1} \frac{\$1{,}090{,}974}{1.06^{i}}}{1.06^{(2015-2012)}} = \$572{,}500$$

[69] One site is already showing signs of failure (culvert collapsing, mass wasting of fill in stream crossing). The others are at high risk.

Avoided Annual Maintenance Costs

- Regular maintenance of the existing culverts is required, including debris removal during and following storm events. MMWD currently spends $15,000/yr on maintaining and repairing the existing culverts. Culvert replacement is expected to reduce maintenance costs to $5,000/yr.
- The expected present value cost (in 2012) of culvert O&M under the without-project condition is therefore:

$$E[PV(\text{Culvert O\&}M)] = \frac{\sum_{i=1}^{100} 0.1 \times 0.9^{i-1}\left[\sum_{j=1}^{i-1}\frac{\$15{,}000}{1.06^{j}} + \sum_{k=i}^{100}\frac{\$5{,}000}{1.06^{k}}\right]}{1.06^{(2015-2012)}} = \$116{,}985$$

Value of Salmonid Spawning and Rearing Habitat

- The project is an element of MMWD's Lagunitas Creek Stewardship Plan and it is an important recovery action in the State's Recovery Strategy for CA Coho Salmon and the federal Recovery Plan for Central CA Coastal Coho Salmon. Lagunitas Creek supports the largest and most stable population of endangered coho salmon in Central California; it also supports a robust population of threatened steelhead trout. These plans call for reducing sedimentation into Lagunitas Creek and improving fish passage.
- The project will restore salmonid spawning and rearing habitat by reducing discharge of fine sediments into Lagunitas creek. Sedimentation, particularly by fine sediments, has been identified as being detrimental to the habitat of Lagunitas Creek for coho and steelhead. The State Water Resources Board has identified Lagunitas Creek as being impaired by sediment and is in the process of preparing a sediment TMDL for Lagunitas Creek.
- The project will also extend habitat by providing access to tributary streams that are blocked by the existing culverts. DFG has conducted habitat assessments of the tributary streams to Lagunitas Creek where this project will be implemented; specifically, they evaluated the streams at the Jewell Creek and Eucalyptus sites. They have recommended managing these streams for anadromous salmonids (including facilitating fish passage) and they observed steelhead in the Jewell Creek tributary. Winter refuge habitat can also be enhanced in these tributaries.
- The expected increase in the adult salmonids population with the project is 207 fish. The expected increase is based on the following calculations:
    - The project will restore 1.19 miles of spawning habitat.
    - Nest (redd) density in the project area is 2 redds/0.2 miles (Stillwater Sciences, 2008).[70]
    - Average fecundity is 2,600 eggs per female (Stillwater Sciences, 2008).

[70] Stillwater Sciences. (2008). *Lagunitas limiting factors analysis; limiting factors for coho salmon and steelhead.* Point Reyes Station, California: Prepared by Stillwater Sciences, Berkeley, California for Marin Resource Conservation District.

- Survival rate for salmonids from egg stage to adult stage in Lagunitas Creek averages 0.5% (Stillwater Sciences, 2008).
- Expected increase in adult salmonids population due to increase in spawning habitat is 155 fish (1.19 x 2/0.2 x 2600 x 0.005).
- Fine sediment deposition and lack of winter refuge habitat are primary limiting factors for survival of fry and juvenile salmonids in Lagunitas creek (Stillwater Sciences, 2008).
- The project will restore 1.19 miles of rearing habitat.
- Juvenile salmonids density in the project area is 58 fish/0.02 miles (Stillwater Sciences, 2008).
- Survival rate for salmonids from juvenile to adult stage in Lagunitas Creek averages 1.5% (Stillwater Sciences, 2008).
- Expected increase in adult salmonids population due to increase in fry and juvenile rearing habitat is 52 fish (1.19 x 58/0.02 x 0.015).
- Studies of household willingness-to-pay (WTP) to preserve and increase anadromous fish populations have estimated a range of values. When stated in terms of Californian's aggregate annual WTP per fish, estimates range from a low of $500 to a high of $9,300, with higher values associated with more recent WTP studies (Olsen, Richards, and Scott 1991; Loomis 1996; Bell, Huppert, and Johnson 2003).[71]
- To avoid overestimating potential benefits and to account for inherent uncertainty in both the expected increase in the adult salmonids population and WTP estimates, a value of $2,000 per fish is used to value the restoration of fish spawning and rearing habitat in Lagunitas Creek.[72] The annual benefit is therefore $414,000.
- Under the with-project condition the present value of annual benefits is:

$$PV(\text{Fish})_{\text{with}} = \frac{\sum_{i=1}^{100} \frac{\$414{,}000}{1.06^{i}}}{1.06^{(2015-2012)}} = \$5{,}776{,}279$$

- Under the without-project condition timing of culvert replacement is uncertain and the expected present value of annual benefits is therefore:

$$PV(\text{Fish})_{\text{without}} = \frac{\sum_{i=1}^{100} 0.1 \times 0.9^{i-1} \left[\sum_{j=i}^{100} \frac{\$414{,}000}{1.06^{j}}\right]}{1.06^{(2015-2012)}} = \$3{,}821{,}022$$

- The net benefit with the project is therefore $1,955,277.

[71] Olsen, D., J. Richards, and R. Scott. 1991. "Existence and Sport Values forDoubling the Size of Columbia River Basin Salmon and Steelhead Runs."Rivers 2(1): 44-56; Loomis, J. 1996. "Measuring the Economic Benefits of Removing Dams and Restoring the Elwha River: Results of a Contingent Valuation Survey." Water Resources Research 32(2): 441-447; Bell, K., D. Huppert, and R. Johnson. 2003. "Willingness to Pay for Local Coho Salmon Enhancement in Coastal Communities." Marine Resources Foundation 18: 15-31.
[72] This is the value per fish recommended by (EcoNorthwest, 2012).

Value of Reduced Sediment Deposition

- The Lagunitas Creek roads assessment has identified the crossings along the Cross Marin Trail as some of the largest potential sediment loads to Lagunitas Creek and some of the highest priority crossings to implement repairs on (Stetson Engineers, Inc., 2012).[73]
- The project is expected to reduce annual sediment deposition in Lagunitas Creek by 63%, from 7,270 tons to 2,658 tons.
- Reduced sediment deposition is valued at $5/ton based on values for water-based recreation reported in (EcoNorthwest, 2012).[74] Benefits to fisheries of reduced deposition of fine sediments are not counted to avoid double counting benefits.
- The annual benefit of sediment reduction is $23,060.
- Under the with-project condition, the present value of annual benefits is:

$$PV(\text{Sediment})_{\text{with}} = \frac{\sum_{i=1}^{100} \frac{\$23{,}060}{1.06^{i}}}{1.06^{(2015-2012)}} = \$321{,}743$$

- Under the without-project condition, timing of culvert replacement is uncertain and the expected present value of annual benefits is therefore:

$$PV(\text{Sediment})_{\text{without}} = \frac{\sum_{i=1}^{100} 0.1 \times 0.9^{i-1} \left[\sum_{j=i}^{100} \frac{\$23{,}060}{1.06^{j}}\right]}{1.06^{(2015-2012)}} = \$212{,}834$$

- The net benefit with the project is therefore $108,909.

[73] Stetson Engineers, Inc. (2012). *Lagunitas Creek Unpaved Roads Sediment Source Site Assessment (Draft).* Prepared for Marin Municipal Water District and California Department of Fish and Wildlife.
[74] EcoNorthwest. (2012). *Handbook for Estimating Economic Benefits of Environmental Projects.* North Bay Watershed Association.

Summary of Monetized Project Benefits

The value of monetized project benefits are summarized below and in PSP Table 15 for Project 3 and PSP Table 16 for Project 3.

Avoided Capital Cost	$572,500
Avoided Annual O&M	$116,985
Steelhead Spawning and Rearing Habitat	$1,955,277
Reduced Sediment Deposition	$108,909
Total	$2,753,671

PSP Table 15 – Annual Benefit **Project 3 – Lagunitas Creek Watershed Sediment Reduction and Management Project**									
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
Year	**Type of Benefit**	**Measure of Benefit (Units)[1]**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**	**Unit $ Value**	**Annual $ Value (f) x (g)**	**Present Value Coefficient**	**Discounted Benefits (h) x (i)**
100-Yrs, Starting 2016	Present Value of Expected Increase in Adult Fish Population	2012 Present Value Dollars	$0	$1,955,277	$1,955,277	$1.00	$1,955,277	1.000	**$1,955,277**
100-Yrs, Starting 2016	Present Value of Expected Reduction in Sediment Loading	2012 Present Value Dollars	$0	$108,909	$108,909	$1.00	$108,909	1.000	**$108,909**
Total Present Value of Discounted Benefits Based on Unit Value									**$2,064,186**
Comments: [1] Because project benefits are stochastic, expected present value is reported. See supporting analysis for benefit estimation methodology, assumptions, and data.									

PSP Table 16 – Annual Costs of Avoided Projects Project 3 – Lagunitas Creek Watershed Sediment Reduction and Management Project						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(f)	(g)	(h)
Year	Alternative (Avoided Project Name): Emergency NTL Repair and Culvert Replacement and Avoided Annual Maintenance Cost					
	Avoided Project Description: Without project, MMWD estimates 10% annual probability of catastrophic failure of one or more culverts. Failure will require emergency response to repair NTL (estimated cost $100,000) and replacement of culverts and other trail repairs (estimated cost of $960,000, excluding emergency response costs, is same as proposed project). MMWD will spend an estimated $15,000/yr maintaining and repairing existing culverts and $5,000/yr following culvert replacement.					
	2012 Expected Present Value Cost of Emergency Repairs, Water Loss, and Culvert Replacement[1]	2012 Expected Present Value Cost of O&M (without project)[1]	Avoided Replacement Costs	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)	Present Value Coefficient	Discounted Costs (e) x (f)
100-Yrs, Starting 2017	$572,500	$116,985		$689,485	1.000	**$689,485**
					Total Present Value of Discounted Costs	**$689,485**
					(%) Avoided Cost Claimed by Project	**100%**
					Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project	**$689,485**
Comments: [1] Because avoided project capital and O&M costs are stochastic, expected present value of avoided costs are reported in the table. See supporting analysis for benefit estimation methodology, assumptions, and data.						

Project Cost

Expenditures in 2012 are treated as sunk costs. The present value of annual culvert maintenance costs of $5,000 per year are calculated over the 100-year useful life of the culverts. The total present value economic cost of the project is $892,137. See PSP Table 19 for Project 3 below.

PSP Table 19—Annual Costs of Project
Project 3: Lagunitas Creek Watershed Sediment Reduction and Management Project

	Initial Costs Grand Total Cost from Table 7	Adjusted Grant Total Cost[1]	Annual Costs						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2012	$15,000	–$15,000						$0	1.000	**$0**
2013	$145,641							$145,641	0.943	**$137,397**
2014	$297,684							$297,684	0.890	**$264,938**
2015	$478,977							$478,977	0.840	**$402,158**
2016	$20,535							$20,535	0.792	**$16,266**
2017	$2,163							$2,163	0.747	**$1,616**
100-Yrs, Starting 2016					$5,000			$5,000	13.952	**$69,762**
Total Present Value of Discounted Costs (Sum of column (j))										**$892,137**

Comments:
[1] 2012 project expenditures for planning are treated as sunk costs.

Project Benefit-Cost Ratio

The present value of project benefits is $2,753,671. The present value of project economic costs is $892,137. The project net present value is $1,861,534, and the project benefit-cost ratio is 3.09.

Project 4 – Marin/Sonoma Conserving Our Watersheds: Agricultural BMP Projects

Project Benefits

With Project Condition: This project is an expansion of the Tomales Bay COW Program, which successfully implemented 40 BMPs in the last 5 years and has 20 additional planned in the next two years. The COW Program includes implementation of a total of 80 conservation practices (BMPs) (10 year effort), representing over 60,000 feet of exclusionary fencing, 8 lined waterways, 22 grade stabilizations, 4 road repairs, numerous troughs, tanks, solar pumps, and 15 acres of revegetated critical habitat areas within the Tomales Bay, San Antonio, and Novato Creek watersheds. This grant funding would support 20 stand-alone BMPs planned for application at 15 project sites (15 individual properties) in the next 2 years. These 20 BMPs (15 projects) would support the larger COW Program planning and construction efforts.

Without Project Condition: Under the without project condition, the BMPs would not be implemented and the environmental and grazing productivity benefits would not be realized.

D2 Non-Monetized Project Benefits

Non-monetizable project benefits, including community and social benefits, environmental stewardship benefits, and sustainability benefits are identified, as applicable to this project, in the PSP Table 12 "Non-Monetized Benefits Checklist" below.

PSP Table 12—Non-Monetized Benefits Checklist Project 4: Marin/Sonoma Conserving Our Watersheds: Agricultural BMP Projects			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
1	**Provide educational or technological benefits?**	Yes	D3 Monetized Benefit The project involves collaborating with and educating local ranchers about improving water quality, conserving water, and enhancing wildlife ecosystems. The project also involves cutting-edge carbon sequestration research. The Marin RCD is currently conducting carbon sequestration research associated with implementing agricultural management and restoration practices at 36 rangeland sites across Marin. This research is in collaboration with the Marin Agricultural Land Trust, University of CA Cooperative Extension Service, Marin Organic, USDA Natural Resources Conservation Service, and UC Berkeley. The project will extend monitoring research into riparian areas.

PSP Table 12—Non-Monetized Benefits Checklist Project 4: Marin/Sonoma Conserving Our Watersheds: Agricultural BMP Projects			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
2	**Provide social recreation or access benefits?**	No	
3	**Help avoid, reduce, or resolve various public water resource conflicts?**	Yes	The work conducted by the ranching community is part of a larger watershed enhancement effort involving many watershed stakeholders (residential septic, recreational users, etc.) who are actively implementing water quality improvements to meet TMDL requirements.
4	**Promote social health and safety?**	Yes	The water supply improvements will improve water quality to downstream beaches/estuaries located in or adjacent to public lands and two oyster-growing operations.
5	**Have other social benefits?**	Yes	The project will benefit a community of small, family-owned farms, 63% of which report no profit or marginal profit.
Environmental Stewardship Benefits: Will the proposal:			
6	**Benefit wildlife or habitat in ways that are not quantified?**	Yes	D3 Monetized Benefit The project will benefit instream flows and riparian habitats. It will promote the enhancement of riparian corridors and the removal of invasive and non-native species. The project is located within an area that includes a watershed that 1) is located in the Gulf of the Farallones National Marine Sanctuary, 2) is adjacent to one Area of Biological Significance, and 3) includes three critical coastal areas: Lagunitas Creek, Walker Creek, Tomales Bay. Past projects have been shown to benefit wildlife communities that rely heavily on the resources within the watersheds.

PSP Table 12—Non-Monetized Benefits Checklist Project 4: Marin/Sonoma Conserving Our Watersheds: Agricultural BMP Projects			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
7	**Improve water quality in ways that are not quantified?**	Yes	D3 Monetized Benefit The project will assist ranchers by implementing TMDL-required ranch water quality plans that specifically outline construction priorities and schedules. 20–30 management measures will be completed. The project will focus on reducing microbial contamination and sediment and associated nutrients. Projects will reduce pathogen loading of streams that drain into shellfish harvesting areas. These projects will address the pathogen TMDL established in the Tomales Bay Watershed.
8	**Reduce net emissions in ways that are not quantified?**	Neg	The project will increase miles traveled by construction equipment, which will result in more greenhouse gas emissions. 15 projects, each with a construction duration of 1–6 weeks (depending on the practices to be installed), may generate 174 CO_2 equivalent per year. This is equivalent to adding about 30 passenger vehicles to the road (EPA, 2010) during the time of construction.
9	**Provide other environmental stewardship benefits?**	Yes	Many of the projects will include new riparian vegetation. Carbon sequestered yearly by new tree canopy and willow plantings will likely be about 2.25 Tonnes CO_2 equivalent per year (or 0.15 Tonnes CO_2 equivalent per project per year). As emissions for each year's projects will last only a single year, it is anticipated that sequestration will continue for more than 100 years (Stadnyk, 2010; Kadyszewski, 2004).
Sustainability Benefits: Will the proposal:			
10	**Improve the overall, long-term management of California groundwater resources?**	Yes	Stormwater infiltration will contribute to the long-term recovery of groundwater overdraft conditions.
11	**Reduce demand for net diversions for the region from the Delta?**	No	
12	**Provide a long-term solution in place of a short-term one?**	Yes	The project will alleviate water quality concerns from increased sediment load throughout the entire project lifecycle. The project will alleviate air quality concerns through carbon sequestration, thereby reducing impacts associated with GHG emissions.

PSP Table 12—Non-Monetized Benefits Checklist Project 4: Marin/Sonoma Conserving Our Watersheds: Agricultural BMP Projects			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
13	**Promote energy savings or replace fossil-fuel-based energy sources with renewable energy and resources?**	No	
14	**Improve water supply reliability in ways not quantified?**	No	
15	**Other**		

D3 Monetized Project Benefits

Quantified Project Benefits:

- Reduction in sedimentation of local streams and Tomales Bay. Avoided discharge of approximately 120 tons/yr of sediment into local watershed
- Restoration of 75 acres of riparian habitat, providing critical habitat for federally listed species—such as coho salmon, steelhead trout, CA freshwater shrimp, and CA red-legged frog
- Increased livestock grazing productivity on 5,925 acres of ranchland in Marin and Sonoma Counties.

Stream Sedimentation Reduction Benefits

- BMP components related to erosion control are estimated to reduce sedimentation discharge into local streams feeding Tomales Bay by 1,800 cubic yards (1,942 tons) per year. The estimate is derived from data collected by NRCS, Prunuske Chatham, Erickson Engineering, MMWD, STRAW, and UCCE on streambank and gully erosion reduction from 276 ranchland management BMP projects implemented in Marin County since 1983, as reported by U.C. Cooperative Extension (University of California Cooperative Extension, 2011). Per Table 7 of the report, the average reduction in streambank, gully, and landslide sedimentation discharge was about 120 cubic yards per year per project.
- 15 BMPs x 120 cu yd/yr x 1.079 tons/cu yd = 1,942 tons/yr

- The value of sediment reduction is estimated at $9.30/ton, as reported in Handbook for Estimating Economic Benefits of Environmental Projects (EcoNorthwest, 2012).[75] Values for specific avoided costs are taken from the table on page 24 of the Handbook. Sediment reduction benefits for municipal and industrial water use, power plant cooling, navigation, and reservoir services (which are not expected to be realized by the project) are excluded from the calculation.
- Sedimentation reduction benefits are assumed to commence upon completion of the BMPs in 2016. The 2012 present value of annual expected sedimentation reduction benefits over an assumed project life of 30 years is $208,752.

Riparian Habitat Restoration

- This project will restore approximately 75 acres of coastal zone riparian and freshwater wetland habitat.
- Economic values for restored riparian and wetland habitat vary widely and depend on many factors. At the very low end of the value range, Chiabai et al. (2009) report a value of $128/acre/yr for restored riparian.[76] Woodward & Wui (2001) report values between $218 and $2,256/acre/yr for freshwater wetland, and Kazmierczak (2001) reports values between $289 and $524/acre/yr for coastal zone wetland.[77] In the Bay-Delta, the average cost for restoration of riparian and wetland habitat estimated by BDCP is $1,730/acre/yr.[78] Prices for riparian and wetland mitigation bank credits suggest much higher values. Riparian and wetland mitigation bank credit prices reported by ICF International for the US as a whole average $3,700/acre/yr, while in California the average price is $9,700/acre/yr.[79] In the Bay Area, mitigation credit prices for riparian and wetland habitat currently cost about $40,000/acre/yr.[80]
- For this analysis, a value of $2,000/acre is assumed. This is the midpoint between the BDCP average cost for riparian and wetland habitat restoration and the upper-end of the value range reported in Woodward and Wui (2001). Although credit bank prices indicate much greater values, particularly in the Bay Area, these prices include underlying market value of the land and may involve more comprehensive levels of critical habitat services than will be realized by riparian restoration brought about through rangeland management BMP implementation.

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[75] The sediment reduction benefits presented in the EcoNorthwest Handbook are derived from Hansen, L. and M. Ribaudo. 2008. Economic Measures of Soil Conservation Benefits: Regional Values for Policy Assessment. U.S. Department of Agriculture. Technical Bulletin No. 1922.

[76] Chiabai, A., C. Travisi, H. Ding, et al. 2009. *Economic Valuation of Forest Ecosystem Services' Methodology and Monetary Estimates*. Fondazione Eni Enrico Mattei Working Paper No. 2009. 12. All values reported in 2012 dollars.

[77] Woodward, W. and Y. Wui. 2001. "Economic Value of Wetland Services: A Meta-Analysis." Ecological Economics 37: 257-270; Kazmierczak, R.F. 2001. "Economic Linkages Between Coastal Wetlands and Habitat/Species Protection: A Review of Value Estimates Reported in the Published Literature." Louisiana State University Agricultural Center. Baton Rouge, Louisiana.

[78] Based on a capital cost of $27,300/acre (excluding land acquisition costs) annualized with a 6% discount rate and annual O&M of $45/acre.

[79] www.icf.com/insights/webinars/2012/12/recording-mitigation-banking-regulatory-ceqa-process. Annualized mitigation credit values based on a 6% discount rate.

[80] Based on current credit prices quoted for Springtown Natural Community Reserve, Newark Mitigation Bank, and San Francisco Bay Wetland District. Based on an average credit price of $700,000/acre annualized with a 6% discount rate.

- Riparian habitat benefits are assumed to commence upon completion of the BMPs in 2016. The 2012 present value of annual riparian habitat benefits over an assumed project life of 30 years is $1,733,583.

Livestock Grazing Productivity Benefits

- Rangeland management BMPs have been shown to result in consistently higher livestock weening weights and stocking rates (University of California Cooperative Extension, 2011; Macon, 2002; Kroeger, 2009).[81]
- Kroeger, et al. (2009) estimate an average gazing benefit of $3.53/acre/yr from implementation of riparian fencing and other rangeland management BMPs.
- Average ranch size in Marin and Sonoma County is 593 acres, approximately 2/3 of which is used from grazing. This project will implement rangeland management BMPs on 15 properties affecting a total of 5,925 grazed acres.
- Livestock grazing productivity benefits are estimated at $20,938/yr ($3.53 x 5,925).
- Livestock grazing productivity benefits are assumed to commence upon completion of the BMPs in 2016. The 2012 present value of annual grazing benefits over an assumed project life of 30 years is $241,987.

[81] Kroeger, T. F. 2009. *An Economic Analysis of the Benefits of Habitat Conservation on California Rangelands*. Washington, D.C.: Conservation Economics White Paper. Conservation Economics Program. Defenders of Wildlife; Macon, D. 2002. *Grazing for change: Range and watershed management success stories in California*. Sacramento, CA: California Cattleman's Association; University of California Cooperative Extension. 2011. *A Half Century of Stewardship: programmatic review of conservation by Marin RCD & partner organizations*. University of California, Davis.

Summary of Monetized Project Benefits

The present value of sediment reduction, riparian habitat restoration, and livestock grazing productivity benefits are summarized below and in PSP Table 15 for Project 4.

Benefit Category	Present Value (2012 Dollars)
Sediment Reduction	$208,752
Riparian Habitat Restoration	$1,733,583
Livestock Grazing Productivity	$241,987
Total	$2,184,322

Table 15 – Annual Benefit

Project 4 – Marin/Sonoma Conserving Our Watersheds: Agricultural BMP Projects

(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)**	**Present Value Coefficient**	**Discounted Benefits (h) x (i)**
2016-2045	Sediment Reduction	Tons	0	1,942	1942.2	$9.30	$18,062	11.56	**$208,752**
2016-2045	Riparian Habitat Restoration	Acres	0	75	75	$2,000	$150,000	11.56	**$1,733,583**
2016-2045	Livestock Grazing Productivity	Acres	0	5,925	5925	$3.53	$20,938	11.56	**$241,987**
Total Present Value of Discounted Benefits Based on Unit Value									**$2,184,321**

Project Cost

Project capital costs total $820,000 in 2012 dollars. Project implementation will start in 2013 and end in 2016. The present value of project implementation costs is based on the schedule of expenditures in the Annual Costs table of the project information sheet. The present value of project capital cost in 2012 is $695,624. The applicant estimates annual O&M costs of $5,000 per year for 10 years starting in 2016. The present value of annual O&M costs is $30,898. The applicant has not indicated that any project costs are sunk costs. The present value of project economic costs is therefore $726,522. See PSP Table 19 for Project 4 below.

PSP Table 19—Annual Costs of Project Project 4: Marin/Sonoma Conserving Our Watersheds: Agricultural BMP Projects										
	Initial Costs Grand Total Cost from Table 7	Adjusted Grant Total Cost	Annual Costs						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2012									1.000	
2013	$13,667							$13,667	0.943	**$12,893**
2014	$143,869							$143,869	0.890	**$128,043**
2015	$630,271							$630,271	0.840	**$529,188**
2016	$32,193							$32,193	0.792	**$25,500**
2016–2025					$5,000			$5,000	6.180	**$30,898**
Total Present Value of Discounted Costs (Sum of column (j))										**$726,522**

Project Benefit-Cost Ratio

The present value of benefits for the with-project condition is $2,184,321. The present value of project economic costs for the with-project condition is $726,522. The project net present value is $1,457,799, and the project benefit-cost ratio is 3.01.

Project 7 – Oakland Sausal Creek Restoration Project

Project Benefits

With Project Condition: The Sausal Creek Restoration project will occur on a 745 linear-foot stretch of the creek that runs through Dimond Park in Oakland. The project includes the removal of 180 linear-feet of buried creek culvert and 75 linear-feet of concrete spillway. The current culvert and concrete spillway create a barrier for fish passage as well as erosion problems. The project will recreate 1,600 linear feet of natural creek meander with pools and riffles, restore native vegetation, create 47,000 square feet of new habitat, stabilize creek banks, improve sight lines to the creek from Dimond Park, create an ADA-accessible walking path adjacent to the creek with interpretive features to raise awareness of the creek, reduce erosion and downstream sedimentation, create educational and recreational opportunities, and improve flood capacity, water quality, and fish habitat.

Without Project Condition: Creek bank erosion is threatening Canon Avenue, a public street, and other public and private assets. The right bank of the creek is primarily on private property, and its eroded and destabilized banks are threatening houses and structures. The left bank is also heavily eroded, undermining existing mature trees. Without the project, the City will need to construct a retaining wall and perform other actions to stabilize the creek bank and prevent further erosion and resultant damage to public infrastructure and private property and structures. As part of this project, the City will have to remove 52 mature trees and mitigate environmental impacts associated with installing hardscape structures in the creek channel. In addition, the City will incur annual maintenance and replacement costs associated with the retaining wall (e.g. graffiti removal) and a public restroom that would be removed in the with-project condition.

D2 Non-Monetized Project Benefits

Non-monetizable project benefits, including community and social benefits, environmental stewardship benefits, and sustainability benefits are identified, as applicable to this project, in the PSP Table 12 “Non-Monetized Benefits Checklist” below.

PSP Table 12—Non-Monetized Benefits Checklist Project 7: Oakland Sausal Creek Restoration Project			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
1	**Provide educational or technological benefits?**	Yes	Through the improvement of riparian habitat, the project offers increased opportunity for outdoor environmental education for local schools, non-profit environmental education programs, and community organizations. Groups will participate in stewardship activities in order to better understand creek ecosystem functions and benefits. Project partner The Friends of Sausal Creek (FOSC) currently leads educational programs throughout the watershed, and the project site will become an additional source of learning and volunteering opportunities. At the site, FOSC will engage local schools in learning about the watershed on an ongoing basis. This will foster in students a strong understanding of key watershed issues and encourage long-term support for the protection and preservation of natural resources.
2	**Provide social recreation or access benefits?**	Yes	The project involves improving sight lines to the creek from Diamond Park and creating an ADA-accessible walking path adjacent to the creek, which will have interpretive features to attract park users. The restored channel's improved integration with the park and distinct access points will improve recreation.
3	**Help avoid, reduce, or resolve various public water resource conflicts?**	No	
4	**Promote social health and safety?**	Yes	D3 Monetized Benefit Additionally, the project will improve public safety by incorporating CPTED (Crime Prevention Through Environmental Design) design principles, such as improved site lines and better site access. The project will also bring community-building activities to the site, such as regular volunteer and educational activities, to enhance community relations and promote the long-term social health of the community.

PSP Table 12—Non-Monetized Benefits Checklist Project 7: Oakland Sausal Creek Restoration Project			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
5	**Have other social benefits?**	Yes	The project is located adjacent to a disadvantaged community, and the picnic areas adjacent to the project area are heavily used year-round by the local community. The community may not have access to or strong linkages with other outdoor or recreational opportunities. The project will improve the aesthetics and environmental quality of the park. It will also improve the water quality flowing downstream of the project area, where the creek runs through primarily disadvantaged communities.
Environmental Stewardship Benefits: Will the proposal:			
6	**Benefit wildlife or habitat in ways that are not quantified?**	Yes	D3 Monetized Benefit
7	**Improve water quality in ways that are not quantified?**	Yes	D3 Monetized Benefit
8	**Reduce net emissions in ways that are not quantified?**	Neg	The project will involve construction vehicles and equipment, which will emit greenhouse gases during construction. This impact was evaluated in the project CEQA document, and required measures will be implemented to minimize the environmental impact of this activity to "less than significant."
9	**Provide other environmental stewardship benefits?**	No	
Sustainability Benefits: Will the proposal:			
10	**Improve the overall, long-term management of California groundwater resources?**	No	
11	**Reduce demand for net diversions for the region from the Delta?**	No	

PSP Table 12—Non-Monetized Benefits Checklist Project 7: Oakland Sausal Creek Restoration Project			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
12	**Provide a long-term solution in place of a short-term one?**	Yes	D3 Monetized Benefit
13	**Promote energy savings or replace fossil-fuel-based energy sources with renewable energy and resources?**	No	
14	**Improve water supply reliability in ways not quantified?**	No	
15	**Other**	No	

D3 Monetized Project Benefits

Quantified Project Benefits:

- Avoided costs of constructing retaining walls and performing other actions to stabilize the creek bank and prevent further erosion and resultant damage to public infrastructure and private property and structures[82]
- Restoration of 1.08 acres of riparian habitat
- Improved water quality via natural treatment of urban stormwater and dry weather nuisance runoff prior to discharge into the Bay

Avoided Cost of Retaining Wall and Tree Removal

- Without the project, the City will need to construct a retaining wall and perform other actions to stabilize the creek bank and prevent further erosion and resultant damage to public infrastructure and private property and structures. As part of this project, the City will have to remove 52 mature trees and mitigate environmental impacts associated with installing hardscape structures in

[82] We are assuming construction of the retaining wall and removal of the spillway under the without project condition will largely remove downstream sedimentation associated with creek bank erosion and streambed incising. Therefore, the avoided costs of stream sedimentation are not counted as a separate benefit to avoid double counting.

the creek channel. In addition, the City will incur annual maintenance and replacement costs associated with the retaining wall (e.g. graffiti removal) and a public restroom that would be removed in the with-project condition.

- Planning, engineering, and construction costs for the retaining wall project are documented in a memo from Restoration Design Group, LLC (RDG, 2013) to City of Oakland.[83] Total capital costs are $2,974,973. The schedule of expenditure for the alternative project is assumed to be the same as for the proposed project, but shifted out two years, starting in 2014.
- The alternative project installs 8,800 face feet of new concrete wall, which will require graffiti abatement. After 5 years of existence, it was assumed that the wall would require a fresh coat of paint. It was estimated that this cost would be $1.30 per square foot to remove graffiti and repaint. Costs for these repairs are assumed to occur in 2021.[84]
- Tree maintenance and/or removal in the without-project condition is expected to occur in 2015 and 2016. Removing a large redwood can cost between $3,000 to $7,000, depending on access and size.[85] Total maintenance and/or removal costs are $33,000 in 2017 and $17,300 in 2018.
- There are a number of site elements that are not being updated in the alternative project but are in the proposed project. These items include park upgrades around a Scout hut located in Dimond Park and the Wellington Ave Entry to Dimond Park, as well as replacement of the restroom. All of these items will need to be upgraded during the assumed project life of the Proposed Project. For purposes of cost estimation, these upgrades are assumed to occur in 2023 at a cost of $125,000 (2012 dollars).[86]
- The present value of avoided costs is $2,458,002.

Natural Treatment of Urban Stormwater and Dry Weather Runoff

- Restored riparian corridors in urban watersheds can improve water quality by removing nutrients, improving dissolved oxygen, storing sediment, and regulating temperatures, among other benefits (Riley, 2009).[87]
- Riley (2009) estimates that fully functioning riparian corridors in urbanized watersheds in the Bay Area can provide up to 0.064 MGD of treatment capacity for stormwater and dry weather nuisance runoff per 1,000 linear feet of riparian corridor. Restoration of 1,600 linear feet of Sausal Creek riparian corridor project could therefore provide up to 0.10 MGD of treatment capacity for stormwater and dry weather nuisance runoff.
- Stormwater treatment costs vary significantly. Riley (2009) estimated an average treatment cost of $0.009/gallon for a small-scale

[83] Restoration Design Group, LLC. Memo: IRWM - Basis of Cost of Avoided Projects, February 28, 2013. p. 1 & 2.
[84] Ibid. p. 3.
[85] Ibid. p. 3.
[86] Ibid, p. 3.
[87] Riley, A. (2009). *Putting A Price On Riparian Corridors As Water Treatment Facilities.* Oakland, CA: California Regional Water Quality Control Board, San Francisco Bay Region.

stormwater and dry weather runoff treatment facility recently constructed in Santa Monica. Weiss et al (2005) evaluated typical costs for a range of stormwater treatment technologies, including dry detention basins, wet detention basins, sand filters, constructed wetlands, bioretention filters, infiltration trenches, and swales. Costs ranged between $0.019 and $0.28/gallon with a midpoint cost of $0.13/gallon.[88]

- Using the low end of the treatment cost range, the alternative cost of treatment for 1,600 linear feet of fully functioning riparian corridor in urbanized watersheds is approximately $352,000/yr.
- Treatment efficacy of riparian corridors can vary significantly and depends on many factors (Riley, 2009). To account for the considerable uncertainty in the treatment effectiveness of restored riparian corridors, the estimated level of treatment capacity is reduced by half to 0.05 mgd. The annual value of stormwater treatment capacity provided by Sausal Creek restoration is reduced by an equivalent amount to $176,000/yr.
- It is assumed it will take up to 5 years following restoration of riparian habitat until treatment benefits are fully realized. Therefore, for the purposes of the economic analysis, treatment benefits are assumed to commence starting in 2020. Benefits are counted over a 50-year period.
- Given these assumptions, the present value of stormwater and dry weather nuisance flow treatment benefits is $1,844,927.

Riparian Habitat Restoration

- This project will restore approximately 1.08 acres (47,000 sq. ft) of riparian habitat.
- Economic values for restored riparian and wetland habitat vary widely and depend on many factors. At the very low end of the value range, Chiabai et al. (2009) report a value of $128/acre/yr for restored riparian.[89] Woodward & Wui (2001) report values between $218 and $2,256/acre/yr for freshwater wetland, and Kazmierczak (2001) reports values between $289 and $524/acre/yr for coastal zone wetland.[90] In the Bay-Delta, the average cost for restoration of riparian and wetland habitat estimated by BDCP is $1,730/acre/yr.[91] Prices for riparian and wetland mitigation bank credits suggest much higher values. Riparian and wetland mitigation bank credit prices reported by ICF International for the US as a whole average $3,700/acre/yr, while in California the

[88] Peter T. Weiss, John S. Gulliver, Andrew J. Erickson. 2005. *The Cost and Effectiveness of Stormwater Management Practices.* Department of Civil Engineering, University of Minnesota. MN/RC – 2005-23. http://www.lrrb.org/pdf/200523.pdf

[89] Chiabai, A., C. Travisi, H. Ding, et al. 2009. *Economic Valuation of Forest Ecosystem Services' Methodology and Monetary Estimates*. Fondazione Eni Enrico Mattei Working Paper No. 2009. 12. All values reported in 2012 dollars.

[90] Woodward, Richard and Yong-Suhk Wui. 2001. "The Economic Value of Wetland Services: A Meta-Analysis." *Ecological Economics* 37: 257-270; Kazmierczak, R.F. 2001. "Economic Linkages Between Coastal Wetlands and Habitat/Species Protection: A Review of Value Estimates Reported in the Published Literature." Louisiana State University Agricultural Center. Baton Rouge, Louisiana.

[91] Based on a capital cost of $27,300/acre (excluding land acquisition costs) annualized with a 6% discount rate and annual O&M of $45/acre.

average price is $9,700/acre/yr.[92] In the Bay Area, mitigation credit prices for riparian and wetland habitat currently cost more than $40,000/acre/yr.[93]

- For this analysis, a value of $2,000/acre/yr is assumed. This is the midpoint between the BDCP average cost for riparian and wetland habitat restoration and the upper-end of the value range reported in Woodward and Wui (2001). Although credit bank prices indicate much greater values, particularly in the Bay Area, these prices include underlying market value of the land and may involve more comprehensive levels of critical habitat services than will be realized by riparian restoration brought about by this project.
- Full riparian habitat benefits are assumed to commence in 2020 following a five-year establishment period. The 2012 present value of annual riparian habitat benefits is $22,642.

[92] www.icf.com/insights/webinars/2012/12/recording-mitigation-banking-regulatory-ceqa-process. Annualized mitigation credit values based on a 6% discount rate.

[93] Based on current credit prices quoted for Springtown Natural Community Reserve, Newark Mitigation Bank, and San Francisco Bay Wetland District. Based on an average credit price of $725,000/acre annualized with a 6% discount rate.

Summary of Monetized Project Benefits

The present values of stormwater and dry weather nuisance flow treatment and riparian habitat restoration are summarized below, and in PSP Table 15 and PSP Table 16 for Project 7.

Benefit Category	Present Value (2012 Dollars)
Avoided Retaining Wall Project Costs	$2,458,002
Stormwater Treatment Capacity	$1,844,927
Riparian Habitat Restoration	$22,642
Total	$4,325,570

PSP Table 15 – Annual Benefit Project 7 – Oakland Sausal Creek Restoration Project									
(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)**	**Present Value Coefficient**	**Discounted Benefits (h) x (i)**
2020-2069[1]	Stormwater and Dry Weather Nuisance Runoff Treatment Capacity	Gallons	0	18,688,000	18,688,000	$0.0094	$176,000	10.48	**$1,844,927**
2016-2065[1]	Riparian Habitat Restoration	Acres	0	1.08	1.08	$2,000	$2,160	10.48	**$22,642**
Total Present Value of Discounted Benefits Based on Unit Value									**$1,867,569**
Comments: [1] Benefits counted over 50-year period, starting in 2020.									

Table 16 – Annual Costs of Avoided Projects
Project 7 – Oakland Sausal Creek Restoration Project

	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
	Alternative (Avoided Project Name): Retaining walls, Channel Grading, tree removal and tree maintenance					
	Avoided Project Description: This alternative presents the minimum work that would have to be performed to provide bank stabilization to protect adjacent properties and roadway from collapse. It includes the cost of permitting and mitigation that would be paid in order to offset the environmental impact of installing hardscape structures in the channel. Costs based on a consultant estimate for retaining wall project including: demolition of the spillway, installation of concrete walls, earthen channel bottom grading and revegetation, and protective railing on walls.					
Year	**Avoided Capital Costs[1]**	**Avoided Replacement Costs[2]**	**Avoided Operations and Maintenance Costs[3]**	**Total Cost Avoided for Individual Alternatives (b) + (c) + (d)**	**Present Value Coefficient**	**Discounted Costs (e) x (f)**
2012				$0	1.000	$0
2013				$0	0.943	$0
2014	$53,780			$53,780	0.890	$47,864
2015	$44,989			$44,989	0.840	$37,774
2016	$2,638,330			$2,638,330	0.792	$2,089,804
2017	$177,888		$33,300	$211,188	0.747	$157,812
2018	$14,996		$17,300	$32,296	0.705	$22,768
2019	$14,996			$14,996	0.665	$9,973
2020	$14,996			$14,996	0.627	$9,409
2021	$14,996		$13,300	$28,296	0.592	$16,749
2022				$0	0.558	$0
2023		$125,000		$125,000	0.527	$65,848
					Total Present Value of Discounted Costs	**$2,458,002**
					(%) Avoided Cost Claimed by Project	**100%**
					Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project	**$2,458,002**

Comments:
[1] Schedule of expenditure for alternative project is assumed to be the same as the proposed project, but shifted out two years, starting in 2014.
[2] There are a number of site elements that are not being updated in the alternative project but are in the proposed project. These items include park upgrades around a Scout hut located in Dimond Park and the Wellington Ave Entry to Dimond Park, as well as replacement of the restroom. All of these items will need to be upgraded during the assumed project life of the Proposed Project. For purposes of cost estimation, these upgrades are assumed to occur in 2023.
[3] Costs for graffiti abatement and tree maintenance/removal that would be avoided by the proposed project. For purposes of cost estimation, these costs are assumed to occur in 2017 and 2018.

Project Cost

Costs for the proposed project are summarized in the following table. Project planning and design expenditures incurred in 2012 and $15,000 of expenditure incurred in 2013 are treated as sunk economic costs since they have no salvageable value outside the context of the proposed project. Costs in 2016-2019 are for site monitoring and adaptive management required by the City. See PSP Table 19 for Project 7 below.

PSP Table 19—Annual Costs of Project
Project 7: Oakland Sausal Creek Restoration Project

			Annual Costs						Discounting Calculations	
	Initial Costs Grand Total Cost from Table 7	Adjusted Grant Total Cost[1]	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2012	$52,000	-$52,000						$0	1.000	
2013	$43,500	-$15,000						$28,500	0.943	**$26,887**
2014	$2,551,000							$2,551,000	0.890	**$2,270,381**
2015	$172,000							$172,000	0.840	**$144,415**
2016	$14,500							$14,500	0.792	**$11,485**
2017	$14,500							$14,500	0.747	**$10,835**
2018	$14,500							$14,500	0.705	**$10,222**
2019	$14,500							$14,500	0.665	**$9,643**
Total Present Value of Discounted Costs (Sum of column (j))										**$2,483,868**

Comments:
[1] All costs incurred in 2012 and $15,000 of cost incurred in 2013 for planning the restoration project are sunk costs.

Project Benefit-Cost Ratio

The present value of benefits for the with-project condition is $4,325,570. The present value of project economic costs for the with-project condition is $2,483,868. The project net present value is $1,841,702, and the project benefit-cost ratio is 1.74.

Project 12 – Richmond Breuner Marsh Restoration Project

Project Benefits

With Project Condition: The project will restore approximately 68.4 acres of wetlands and 96 acres of coastal prairie upland habitat. Wetlands restoration will aid in reducing polluted run-off from surrounding urban industrial areas by providing a natural filtering system of marshland vegetation. Due to the combination of wetlands and upland areas, the project will provide a transitional area to mitigate the effects of extreme high-tide events caused by sea level rise due to climate change. To aid in public education regarding the fragile marsh habitat, public access improvements will include interpretive exhibits and provide for new naturalist-lead tours of the restored marsh and promote public health by increasing outdoor recreational opportunities for the adjacent under-served community of primarily low-income and minority residents.

Without Project Condition: Under the without project condition, Breuner Marsh will not be restored and will remain in its current condition or sold to private development interests.

D2 Non-Monetized Project Benefits

Non-monetizable project benefits, including community and social benefits, environmental stewardship benefits, and sustainability benefits are identified, as applicable to this project, in the PSP Table 12 "Non-Monetized Benefits Checklist" below.

PSP Table 12—Non-Monetized Benefits Checklist Project 12: Richmond Breuner Marsh Restoration Project			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
1	**Provide educational or technological benefits?**	Yes	The restoration plan will focus on establishing proper elevations and soil balance through a grading plan. The approach will not attempt to "engineer" a predetermined tidal marsh, but it will provide a setting for the natural evolution of wetland functions (including sea-level rise) and interplay of natural ecologic processes to restore the preexisting marsh. Goals are to create valuable habitat for special status species—by providing long-term, self-sustaining tidal wetlands, seasonal wetlands, and coastal prairie—and to provide public access to compatible, passive recreation and public education.
2	**Provide social recreation or access benefits?**	Yes	D3 Monetized Benefit

PSP Table 12—Non-Monetized Benefits Checklist Project 12: Richmond Breuner Marsh Restoration Project			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
3	**Help avoid, reduce, or resolve various public water resource conflicts?**	No	
4	**Promote social health and safety?**	No	
5	**Have other social benefits?**	Yes	Breuner Marsh is adjacent to the high-density, underserved neighborhoods of Parchester Village, Bayview-Montalvin, Tara Hills, Rollingwood, and the Iron Triangle in Richmond. The restoration project will provide water-resource-related recreational opportunities to lower-income residents in Richmond.
Environmental Stewardship Benefits: Will the proposal:			
6	**Benefit wildlife or habitat in ways that are not quantified?**	Yes	D3 Monetized Benefit
7	**Improve water quality in ways that are not quantified?**	Yes	Much of Richmond's historic shoreline has been lost to industrial uses and is a point source of pollution in the bay. Marshes have been filled, fragmented, polluted, and invaded by nonnative species. However, the seven-mile stretch of shoreline from Point San Pablo to Point Pinole represents one of the last remaining shorelines that is still largely intact. Wetlands restoration will reduce polluted runoff from surrounding urban industrial areas by providing a natural filtering system of marshland vegetation.

<table>
<tr><th colspan="4">PSP Table 12—Non-Monetized Benefits Checklist
Project 12: Richmond Breuner Marsh Restoration Project</th></tr>
<tr><th>No.</th><th>Question</th><th>“Yes,” “No,” or “Neg”</th><th>Explanation of Benefit</th></tr>
<tr><td>8</td><td>Reduce net emissions in ways that are not quantified?</td><td>Neg</td><td>The table below shows GHG emissions related to the project.
Draft EIR TABLE 4.6-3. PROJECT-RELATED GHG EMISSIONS
<table>
<tr><th>Category</th><th>GHG (MTons/Year)</th></tr>
<tr><td colspan="2">Construction</td></tr>
<tr><td>2013</td><td>242</td></tr>
<tr><td>2014</td><td>6</td></tr>
<tr><td>2015</td><td>29</td></tr>
<tr><td>Total</td><td>277</td></tr>
<tr><td colspan="2">Operation</td></tr>
<tr><td>Area Sources</td><td>0</td></tr>
<tr><td>Energy—Natural Gas and Purchased Electricity</td><td>0</td></tr>
<tr><td>Mobile Source</td><td>67</td></tr>
<tr><td>Waste</td><td>6</td></tr>
<tr><td>Water</td><td>7</td></tr>
<tr><td>Total</td><td>80</td></tr>
</table>
According to BAAQMD’s CEQA Guidelines, only a city park larger than 600 acres would need further analysis. As the project area is 150 acres, it is well below the BAAQMD screening threshold.
It should be noted that wetlands can sequester substantial amounts of carbon in vegetation and soil under favorable conditions, but they can also be a source of CH_4, which is a far more potent GHG on a pound-for-pound basis than CO_2. Protocols for accounting for carbon stock in wetlands are in their early stages. Wetlands associated with the project do not exceed BAAQMD’s screening criteria, so the project’s cumulative contribution to GHG emissions will be less than significant. (See the Draft EIR, p. 4.6-15.)</td></tr>
<tr><td>9</td><td>Provide other environmental stewardship benefits?</td><td>No</td><td></td></tr>
</table>

PSP Table 12—Non-Monetized Benefits Checklist Project 12: Richmond Breuner Marsh Restoration Project			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Sustainability Benefits: Will the proposal:			
10	**Improve the overall, long-term management of California groundwater resources?**	No	
11	**Reduce demand for net diversions for the region from the Delta?**	No	
12	**Provide a long-term solution in place of a short-term one?**	Yes	The primary goal of this wetland restoration project is to provide long-term, self-sustaining tidal wetlands, seasonal wetlands, and coastal prairie.
13	**Promote energy savings or replace fossil-fuel-based energy sources with renewable energy and resources?**	No	
14	**Improve water supply reliability in ways not quantified?**	No	
15	**Other**		

D3 Monetized Project Benefits

Quantified Project Benefits:

- Restoration of 6.7 acres and creation of 0.3 of seasonal wetland (total of 7 acres)
- Restoration of 35.5 acres and creation of 25.9 acres of tidal wetland (total of 61.4 acres)
- Recreation supported by public access to 164 acres of open space and recreational infrastructure

Restoration of 7 Acres of Seasonal Wetland

- The project will restore 7 acres of seasonal wetland.
- Restored seasonal wetland in the East Bay is valued at $725,000 per acre. This is the mid-point price for seasonal wetland mitigation

credits from a sample of East Bay mitigation credit banks.[94]

- The present value of 7 acres of seasonal wetland is $5,075,000 based on current East Bay mitigation bank credit prices.

Creation of 25.9 Acres of Tidal Wetland

- A wetland mitigation credit price of $725,000 per acre is also used to value the creation of 25.9 acres of tidal wetland.
- The valuation is consistent with current estimates and past forecasts of wetland mitigation values in the Bay Area (Cragg, Polek, & Polasky, 2011).[95] For example, the US Army Corps of Engineers estimated an average price of $400,000/acre for wetland mitigation credits in 2005, while Stratus Consulting estimated a mitigation credit price for the Springtown Natural Community Reserve of $250,000 in 2003 (US Army Corps of Engineers, 2006; Stratus Consulting, Inc., 2003).[96] Credit prices have grown at an annual rate of 9% between 1997 and 2005, and this growth is expected to continue (Cragg, Polek, & Polasky, 2011).[97] At this rate of growth, prices estimated by Stratus and the US Corps of Engineers would be roughly $600,000/acre and $800,000/acre, respectively, today. We note the current prices quoted by Springtown and San Francisco Bay Wetland District are $650,000/acre and $800,000/acre, matching the predicted values based on the historical rate of price increase.
- The present value of 25.9 acres of tidal wetland at a current unit value of $725,000/acre is $18,777,500.

[94] Quoted prices from San Francisco Bay Wetland District, Newark Mitigation Site currently being developed by Wildlands, Inc, and Springtown Natural Community Reserve were $800,000/acre, $650,000/acre, and $650,000/acre respectively. Since the Newark site is still under development and the Springtown bank does not yet have federal authorization, their prices are considered to be at the low end of price range. In the North Bay, the current price for seasonal wetland credits at the Burdell Ranch mitigation bank is $918,300/acre.

[95] Cragg, M., C. Polek, & S. Polasky. 2011. "Valuing Properties with Wetland Potential." *The Appraisal Journal*, 126-142.

[96] Stratus Consulting, Inc. 2003. *A Nationwide Survey of Conservation Banks, Final.* Prepared for Northwest Fisheries Science Center. Retrieved from www.st.nmfs.noaa.gov/st5/documents/Stratus%20Consulting_Conservation%20Banking_Final.pdf; U.S. Army Corps of Engineers. 2006. *Compensatory Mitigation Practices in the U.S. Army Corps of Engineers, U.S. Army Corps of Engineers Working Paper.* March. Washington, D.C.

[97] The economics of this type of scarcity have been extensively studied by economists starting with Hotelling. Hotelling's model of nonrenewable resources predicts that prices of nonrenewable resources will rise as the resource is used up. Furthermore, the rate of price increase is a function of expected demand and competition in meeting this demand. This effect has been seen in practice in many markets with nonrenewable resources.

Recreation Supported by Public Access to 164 Acres of Open Space and Recreational Infrastructure

- Visitation rates for recreation at Breuner Marsh were developed by EBRPD following the guidelines and tables in the Trip Generation Handbook (Institute of Transportation Engineers, 2nd Edition). This analysis estimated an annual visitation rate of 17,155 visits/yr, based on the daily trip rates shown below.[98]

Day of Week	Average Trips
Weekday	27
Saturday	148
Sunday	50
Average	47

- Substitution of Breuner Marsh for other recreation sites in the Bay Area is anticipated (Wetzstein, 1982).[99] The estimate of Breuner Marsh visitor days is therefore reduced by 40% to 10,000 visits/yr to account for these substitution effects.[100]
- Breuner Marsh will provide opportunities for hiking, biking, picnicking, and wildlife viewing and will connect to the Point Pinole Regional Park. Recreational features of the project include planned local trail connections, provision of exhibits and/or programs to inform visitors about natural and cultural resources on the site, picnicking areas, and other wildlife-compatible day use infrastructure.
- The composition of visitor-days is uncertain. For the economic analysis, it is assumed 60% of visitor-days would be classified as walking/hiking, 20% as picnicking, and 20% as wildlife viewing. Visitor-day values for these activities are taken from Loomis (2005).[101] The weighted-average consumer surplus value per visitor day is $54.04 (2012 dollars) and the annual recreation value is $540,400/yr. Annual recreation benefits are assumed to start in 2016.
- The present value of annual recreation benefits is $7,134,124.

[98] Annual visitation at the adjacent Point Pinole Regional Park is approximately 200,000 visits/yr.
[99] Wetzstein, M. 1982. "An Economic Evaluation of a Multi-Area Recreation System." *Southern Journal of Agricultural Economics*, 51-55.
[100] Wetzstein estimated visitation to new wilderness areas in California would reduce visitation to existing ones by 15 to 20 percent on average. Because of the proximity of many potential outdoor recreation sites in the Bay Area and to be conservative, we have doubled the upper end of the range estimated by Wetzstein to estimate the visitor substitution effects at Breuner Marsh.
[101] Loomis, J. 2005. *Updated Outdoor Recreation Use Values on National Forests and Other Public Lands*. Pacific Northwest Research Station. General Technical Report PNW-GTR-658. United States Department of Agriculture.

Summary of Monetized Project Benefits

The present values of monetized benefits are summarized below, and in PSP Table 15 and PSP Table 16 for Project 12.

Restoration of 7 acres of seasonal wetland	$5,075,000
Creation of 25.9 acres of tidal wetland	$18,777,500
Recreation supported by public access to 164 acres of open space and recreational infrastructure	$7,134,124
Total	$30,986,624

Table 15 – Annual Benefit
Project 12 – Richmond Breuner Marsh Restoration Project

(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[1]**	**Annual $ Value (f) x (g)**	**Present Value Coefficient[2]**	**Discounted Benefits (h) x (i)**
In Perpetuity, starting 2016	Outdoor Recreation	Visitor Days	0	10,000	10,000	$54.04	$540,400	13.20	**$7,134,124**
In Perpetuity, starting 2016	Seasonal Wetland	Acres	0.0	7.0	7.0	$54,918	$384,424	13.20	**$5,075,000**
In Perpetuity, starting 2016	Tidal Wetland	Acres	0.0	25.9	25.9	$54,918	$1,422,370	13.20	**$18,777,500**
Total Present Value of Discounted Benefits Based on Unit Value									**$30,986,624**

Comments:
[1] Unit value has been set to the annualized asset value of the restored habitat based on a current market price of $725,000 for wetland mitigation credits in the East Bay. The estimated market values are $725,000/acre and $79,400/acre for seasonal wetland and supporting upland habitat, respectively.
[2] Present value coefficient set to recover the present value of a perpetual annuity (starting in 2016) equal to the annualized asset value using a real discount rate of 6%.

Project Cost

Project planning costs incurred in 2012 are treated as sunk costs. Because EBRPD has ownership interest in the 164 acre Breuner Marsh property, project costs in 2013 are adjusted by the estimated market value of the 164 acre property. Market value is estimated at $56,667/acre, the purchase cost of the property. The valuation is at the high-end of the range of valuations of Bay Area properties with wetland potential reported in Cragg, M., Polek, C., & Polasky, S. (2011). See PSP Table 19 for Project 12 below.

PSP Table 19—Annual Costs of Project
Project 12: Richmond Bruener Marsh Restoration Project

			Annual Costs						Discounting Calculations	
	Initial Costs Grand Total Cost from Table 7	Adjusted Grant Total Cost[1], [2]	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2012	$954,800	−$954,800							1.000	
2013	$1,000,000	$8,500,000						$9,500,000	0.943	**$8,962,264**
2014	$3,430,000							$3,430,000	0.890	**$3,052,688**
2015	$3,520,000							$3,520,000	0.840	**$2,955,460**
2016								$0	0.792	**$0**
In Perpetuity, starting 2016				$52,231				$52,231	13.20	**$689,531**
Total Present Value of Discounted Costs (Sum of column (j))										**$15,659,943**

Comments:
[1] Project planning costs incurred in 2012 are treated as sunk costs.
[2] EBRPD has ownership interest in the 150 acre Breuner Marsh property. Project costs in 2013 are adjusted by the estimated market value of the 150 acre property. Market value is estimated at $56,667/acre, the purchase cost of the property. The valuation is at the high-end of the range of valuations of Bay Area properties with wetland potential reported in Cragg, M., Polek, C., & Polasky, S. (2011) "Valuing Properties with Wetland Potential," *The Appraisal Journal*, 126-142.

Project Benefit-Cost Ratio

The present value of benefits for the with-project condition is $30,986,624. The present value of project economic costs for the with-project condition is $15,659,943. The project net present value is $15,326,681, and the project benefit-cost ratio is 1.98.

Project 17 – San Pablo Rheem Creek Wetlands Restoration Project

Project Benefits

With Project Condition: Under the with-project condition, 4.82 acres of seasonal wetland and 5.2 acres of supporting upland habitat will be constructed adjacent to Rheem Creek in Richmond, California, near San Pablo Bay. 3.11 acres of the seasonal wetland will provide mitigation for impacts from CCWD's Shortcut Pipeline Improvement Project (SCPL) to satisfy mitigation requirements issued by the San Francisco District Army Corps of Engineers (SF Corps) and San Francisco Bay Regional Water Quality Control Board (RWQCB). The SCPL is located in the City of Martinez and provides water supply to the City of Martinez, as well as the Shell and Tesoro oil refineries.

Without Project Condition: Under the without project condition, the SCPL will need to purchase 3.11 acres of seasonal wetland mitigation credits from an accredited mitigation bank located in the Bay Area and approved by SF Corps and RWQCB.

D2 Non-Monetized Project Benefits

Non-monetizable project benefits, including community and social benefits, environmental stewardship benefits, and sustainability benefits are identified, as applicable to this project, in the PSP Table 12 "Non-Monetized Benefits Checklist" below.

PSP Table 12—Non-Monetized Benefits Checklist Project 17: San Pablo Rheem Creek Wetlands Restoration Project			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
1	**Provide educational or technological benefits?**	No	
2	**Provide social recreation or access benefits?**	Yes	The project will include community open space along Rheem Creek, which is located adjacent to East Bay Regional Park's Bruner Marsh property. The project is located in a highly urbanized location of Richmond and San Pablo that currently lacks opens space area. Public access to the site will be determined as part of the Mitigation Monitoring and Reporting Plan.
3	**Help avoid, reduce, or resolve various public water resource conflicts?**	Yes	This project is associated with regulatory mitigation for impacts related to a water supply pipeline. The Contra Costa Water District is in the process of making improvements to the Shortcut Pipeline located between the Contra Costa Canal near Clyde and the Shell Oil Refinery in Martinez. The SCPL provides untreated water service to the City of Martinez.

PSP Table 12—Non-Monetized Benefits Checklist Project 17: San Pablo Rheem Creek Wetlands Restoration Project			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
4	**Promote social health and safety?**	Yes	This project will create wetlands to buffer the effects of sea level rise, improve stormwater water quality into San Pablo Bay, and reduce flooding along the creek channel within the cities of Richmond and San Pablo.
5	**Have other social benefits?**	Yes	The project is adjacent to DAC areas, and maintaining open space should provide benefits for local residents in this area.
Environmental Stewardship Benefits: Will the proposal:			
6	**Benefit wildlife or habitat in ways that are not quantified?**	Yes	D3 Monetized Benefit
7	**Improve water quality in ways that are not quantified?**	Yes	The project will improve water quality by filtering pollutants from stormwater through wetland vegetation prior to entering the Bay, which is located immediately downstream.
8	**Reduce net emissions in ways that are not quantified?**	Yes	Construction equipment used for the project will emit greenhouse gases. However, implementation of the project will more than offset any construction emissions by preventing construction of a commercial building. This should also lower the importation of greenhouse gases into this area and reduce net emissions of other harmful chemicals into the air and the water.
9	**Provide other environmental stewardship benefits?**	Yes	Restoration of wetlands on the project site will return historic functions and values lost through years of grading, grazing, and manipulation of the property. Protection of this segment of Rheem Creek will occur directly upstream of the Breuner Marsh property and will increase the size of protected wildlife resources being restored in this urbanized setting.
Sustainability Benefits: Will the proposal:			
10	**Improve the overall, long-term management of California groundwater resources?**	No	The project will minimally influence groundwater resources.
11	**Reduce demand for net diversions for the region from the Delta?**	No	

PSP Table 12—Non-Monetized Benefits Checklist Project 17: San Pablo Rheem Creek Wetlands Restoration Project			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
12	**Provide a long-term solution in place of a short-term one?**	Yes	This project will create wetlands to buffer the effects of sea level rise, improve stormwater water quality into San Pablo Bay, and reduce flooding within the cities of San Pablo and Richmond.
13	**Promote energy savings or replace fossil-fuel-based energy sources with renewable energy and resources?**	No	
14	**Improve water supply reliability in ways not quantified?**	No	
15	**Other**	No	

D3 Monetized Project Benefits

Quantified Project Benefits:

- Avoided purchase cost for 3.11 acres of seasonal wetland mitigation credits
- Restoration of an additional 1.69 acres of seasonal wetland and 5.2 acres of supporting upland habitat, including expansion of habitat for the federally listed salt marsh harvest mouse known to inhabit the adjacent Breuner Marsh

Avoided Purchase of Mitigation Credits for 3.11 Acres of Seasonal Wetland

- Mitigation requirements for SCPL have not been finalized. However, the best estimate at this time is a mitigation requirement of 3.11 acres of seasonal wetland.
- Seasonal wetland mitigation credits in the Bay Area are in short supply and prices are high. The primary options available to the SCPL project are purchasing credits from the San Francisco Bay Wetland District or from the Newark Mitigation Site currently being developed by Wildlands, Inc. The price quoted for wetland credits by the San Francisco Bay Wetland District is $800,000 per acre. The price quoted for wetland credits from the Newark Mitigation Site is $650,000 per acre. Springtown Natural Community Reserve also offers state credits for $650,000 per acre for seasonal wetland impacts in Alameda and Contra Costa counties. This site does not have federal authorization yet. Since the Newark site is still under development and the Springtown bank does not yet have federal

authorization, they likely constitute a lower-bound for the price CCWD would have to pay for seasonal wetland mitigation credits. In the North Bay, the current price for seasonal wetland credits at the Burdell Ranch mitigation bank is $918,300 per acre.

- For this analysis, the mid-point price of $725,000 per acre for the San Francisco Bay Wetland District and Newark Mitigation Site price quotes is used to estimate the current market value for seasonal wetland mitigation credits in the East Bay.
- Using the mid-point price, the present value of avoiding the purchase of mitigation credits for 3.11 acres of seasonal wetland is $2,254,750.

Restoration of an Additional 1.69 Acres of Seasonal Wetland

- In addition to mitigating for the SCPL pipeline project, the project will restore an additional 1.69 acres of seasonal wetland.
- The district will have the option to use the residual wetland acres (those not needed to mitigate the SCPL project) for mitigation of other projects down the road or as credits they could sell to another party seeking wetland mitigation.
- This acreage therefore is valued at $725,000 per acre, the current estimated market value for seasonal wetland mitigation credits in the East Bay.
- The present value of 1.69 acres of seasonal wetland, which can be used or sold as mitigation credits in the future, is $1,225,250.

Restoration of 5.2 Acres of Upland Habitat

- The project will restore 5.2 acres of supporting upland habitat, including expansion of habitat for the federally listed salt marsh harvest mouse known to inhabit the adjacent Breuner Marsh.
- Mitigation credit prices for upland habitat could not be obtained. However, the Bay Delta Conservation Plan includes the restoration of 2,100 acres of upland habitat supporting tidal and freshwater wetland habitat at an estimated cost of $4,400 per acre, excluding land acquisition.
- This cost could be used as a proxy for social willingness to pay for upland habitat restoration. Adding the underlying market value of $75,000 per acre for the Rheem Creek property results in a present value of $79,400 per acre for restoration of upland habitat.
- This calculates to a present value of $412,880 for restoration of 5.2 acres of supporting upland habitat.

Summary of Monetized Project Benefits

The present values of monetized benefits are summarized below, and in PSP Table 15 and PSP Table 16 for Project 17.

Avoided purchase of 3.11 acres of seasonal wetland mitigation credits	$2,254,750
Restoration of 1.69 acres of seasonal wetland	$1,225,250
Restoration of 5.2 acres of supporting upland habitat	$412,880
Total	$3,892,880

Table 15 – Annual Benefit
Project 17 – San Pablo Rheem Creek Wetlands Restoration Project

(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[1]**	**Annual $ Value (f) x (g)**	**Present Value Coefficient[2]**	**Discounted Benefits (h) x (i)**
In Perpetuity	Restored Seasonal Wetland	Acres	0	1.69	1.69	$43,500	$73,515	16.67	**$1,225,250**
In Perpetuity	Supporting Upland Habitat	Acres	0	5.2	5.2	$4,764	$24,773	16.67	**$412,880**
								Total Present Value of Discounted Benefits Based on Unit Value	**$1,638,130**

Comments:
[1] Unit value has been set to the annualized asset value of the restored habitat based on current market prices for mitigation credits. The estimated market values are $725,000/acre and $79,400/acre for seasonal wetland and supporting updland habitat, respectively.
[2] Present value coefficient set to recover the present value of a perpetual annuity equal to the annualized asset value using a real discount rate of 6%.

PSP Table 16 – Annual Costs of Avoided Projects Project 17 – San Pablo Rheem Creek Wetlands Restoration Project						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
	Alternative (Avoided Project Name): Seasonal Wetland Mitigation Credit Purchase					
	Avoided Project Description: Purchase 3.11 acres of seasonal wetland mitigation credits at an expected present value cost of $725,000 per acre to mitigate wetland impacts of CCWD's SCPL pipeline project.					
Year	**Avoided Capital Costs**	**Avoided Replacement Costs**	**Avoided Operations and Maintenance Costs**	**Total Cost Avoided for Individual Alternatives (b) + (c) + (d)**	**Discount Factor**	**Discounted Costs (e) x (f)**
Present Value[1]	$2,254,750			$2,254,750	1.000	**$2,254,750**
					Total Present Value of Discounted Costs	**$2,254,750**
					(%) Avoided Cost Claimed by Project	**100%**
					Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project	**$2,254,750**
Comments: [1] Credit purchase would likely have to occur in the next several years. Timing is uncertain. The avoided purchase cost is the present value of future credit purchases based on current market prices.						

Project Cost

Project economic costs include site administration and maintenance during a five-year establishment period from 2016 to 2020, following completion of the project in 2015. Following the establishment period, costs of long-term site management will be paid from a $250,000 capital endowment. The endowment cost is included in the project's 2015 initial capital cost. See PSP Table 19 for Project 17 below.

PSP Table 19—Annual Costs of Project
Project 17: San Pablo Rheem Creek Wetlands Restoration Project

	Initial Costs Grand Total Cost from Table 7	Adjusted Grant Total Cost	Annual Costs						Discounting Calculations	
			Admin	Operations	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2012									1.000	
2013	$173,978							$173,978	0.943	**$164,131**
2014	$173,978							$173,978	0.890	**$154,840**
2015	$1,402,061							$1,402,061	0.840	**$1,177,198**
2016			$10,000		$20,000			$30,000	0.792	**$23,763**
2017			$10,000		$20,000			$30,000	0.747	**$22,418**
2018			$10,000		$20,000			$30,000	0.705	**$21,149**
2019			$5,000		$20,000			$25,000	0.665	**$16,626**
2020			$5,000		$20,000			$25,000	0.627	**$15,685**
Total Present Value of Discounted Costs (Sum of column (j))										**$1,595,810**

Comments: Site management and maintenance costs will be paid by the project during the five-year establishment and monitoring period from 2016 to 2020. Capital costs in 2015 include $250,000 endowment to fund site management costs after 2020.

Project Benefit-Cost Ratio

The present value of benefits for the with-project condition is $3,892,880. The present value of project economic costs for the with-project condition is $1,595,810. The project net present value is $2,297,070, and the project benefit-cost ratio is 2.44.

Project 18 – St. Helena Upper York Creek Dam Removal and Ecosystem Restoration Project

Project Benefits

With Project Condition: Eliminate fish passage barrier for federally listed steelhead by removing Upper York Creek Dam. Provide access to an additional 1.7 miles of fish spawning and rearing habitat for federally listed steelhead. Restore approximately 2 acres of riparian corridor along York Creek, resulting in shaded aquatic and riparian habitat, improved water quality, and restored gravel yield to channels downstream of the dam.

Without Project Condition: Do not remove Upper York Creek Dam. Do not create access to an additional 1.7 miles of fish spawning and rearing habitat for anadromous fish species native to the York Creek watershed. Do not restore 2 acres of riparian habitat that will provide future carbon sequestration. Do not re-establish hydraulic connectivity between the upper and lower portions of York Creek. Continue annual maintenance and assessment from NMFS associated with the existing obsolete dam embankment and reservoir.

D2 Non-Monetized Project Benefits

- Value of restoring coarse sediment and gravel transport to lower York Creek and Napa River. Disruption of sediment transport by dams has been shown to have significant geomorphic, ecological, and economic impacts (Kondolf, 1997).[102] Negative impacts caused by disruption of sediment transport include channel erosion and incision, which result in undermining of bridge foundations, streambed coarsening and armoring, loss of spawning gravel, and loss of beach sand. The Upper York Creek Dam traps most of the annual supply of gravel produced by the upper watershed. Sediment accumulates in the reservoir at a rate of 1,000 to 5,000 cubic yards per year depending on the magnitude of winter storm events. With total sediment storage potential of 28,000 cubic yards of material, the reservoir pool area is filled every 15–20 years. Sediment trapping is reasoned to be a contributing factor to bed incision and armoring that has occurred in the Napa River over the last century (Stillwater Sciences, 2002).[103]
- Non-monetizable project benefits, including community and social benefits, environmental stewardship benefits, and sustainability benefits are identified, as applicable to this project, in the PSP Table 12 “Non-Monetized Benefits Checklist” below.

[102] Kondolf, G. 1997. “Hungry Water: Effects of Dams and Gravel Mining on River Channels.” *Environmental Management* Vol. 21, No. 4, pp. 533–551
[103] Stillwater Sciences and William Dietrich. 2002. *Napa River Basin Limiting Factors Analysis Final Technical Report*. June 14, 2002.

PSP Table 12—Non-Monetized Benefits Checklist Project 18: St. Helena Upper York Creek Dam Removal and Ecosystem Restoration Project			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
1	**Provide educational or technological benefits?**	Yes	The project will provide the restoration community with a local example of dam removal and subsequent revegetation with a variety of native riparian species and channel restoration in our high-gradient, coarse-bedded coastal streams.
2	**Provide social recreation or access benefits?**	Yes	The project will create a newly constructed public pathway with interpretive signage.
3	**Help avoid, reduce, or resolve various public water resource conflicts?**	No	
4	**Promote social health and safety?**	No	
5	**Have other social benefits?**	No	
Environmental Stewardship Benefits: Will the proposal:			
6	**Benefit wildlife or habitat in ways that are not quantified?**	Yes	D3 Monetized Benefit Additionally, the project will create and enhance habitat by restoring delivery of coarse sediment to downstream reaches of York Creek and the Napa River, which are starved of beneficial coarse sediment. Renewed sediment delivery will improve spawning gravels and macroinvertebrate substrate.
Environmental Stewardship Benefits: Will the proposal:			

PSP Table 12—Non-Monetized Benefits Checklist Project 18: St. Helena Upper York Creek Dam Removal and Ecosystem Restoration Project			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
7	**Improve water quality in ways that are not quantified?**	Yes	The project will improve downstream water quality by ▪ removing the chance of accidental fine sediment releases; ▪ restoring the natural proportion of coarse to fine gravel moving downstream; and ▪ removing the chance of hydrogen sulfide releases that could be toxic to aquatic organisms. Hydrogen sulfide concentrates in the eutrophic conditions of the reservoir sediment deposits. Storm events can mobilize these sediments and water through the reservoir's drop inlet.
8	**Reduce net emissions in ways that are not quantified?**	Yes	The project removes the need for ongoing City vehicle and equipment usage for annual maintenance activities at the project site. This reduces vehicle emissions of air pollutants and greenhouse gases.
9	**Protect sensitive resources existing at the project site?**	Yes	D3 Monetized Benefit
Sustainability Benefits: Will the proposal:			
10	**Improve the overall, long-term management of California groundwater resources?**	No	
11	**Reduce demand for net diversions for the region from the Delta?**	No	
12	**Provide a long-term solution in place of a short-term one?**	Yes	D3 Monetized Benefit
13	**Promote energy savings or replace fossil-fuel-based energy sources with renewable energy and resources?**	No	
14	**Improve water supply reliability in ways not quantified?**	No	
15	**Others?**	No	

D3 Monetized Project Benefits

Quantifiable Project Benefits:

- Avoided annual maintenance costs incurred by City of St. Helena to remove debris and periodically dredge the abandoned reservoir and assessments by NMFS for blocked fish passage
- Value of fish spawning and rearing habitat capable of supporting 825–1,811 juvenile steelhead annually[104]
- Value of restored riparian habitat
- Value of carbon sequestration

Present Values: Future benefits and costs under both the with- and without-project conditions are assumed to start in 2016. In the calculations below, future benefits and costs are discounted back to 2012 to conform to PSP requirements.

Avoided Annual Maintenance Costs

- Regular maintenance of the dam is required, including annual debris removal from the drop-inlet and spillway to maintain stormwater passage and periodic removal of accumulated sediment. Downstream release of fine sediments trapped behind Upper York Creek Dam pose significant risk to aquatic species. Prior to 1993 when annual maintenance and periodic dredging were begun, there were four recorded sediment releases (1965, 1973, 1975, 1992), resulting in significant downstream fish kills (CDFG, 1992).[105]
- Dam maintenance costs average $125,783 per year (Prunuske Chatham, Inc. 2013).[106]
- In addition to annual maintenance costs, NMFS assesses the City $20,000 per year for interference with salmonid migration (St. Helena, 2002).[107] This annual assessment is expected to continue until Upper York Creek Dam has been removed and fish passage is restored.
- These annual costs would be avoided upon project completion in 2016. The present value of avoiding annual payments of $145,783 starting in 2016 is $2,034,025.

Value of Steelhead Spawning and Rearing Habitat

- York Creek is one of the most significant spawning and rearing streams for federally listed Central California Coast steelhead within

[104] U.S. Army Corps of Engineers (Corps). 2006. *Draft Detailed Project Report: Upper York Creek Ecosystem Restoration Project, Napa County, California* (DPR). San Francisco District, South Pacific Division. December 15, 2006. Appendix L p. 10.
[105] Hunter, Brian. 1992. California Department of Fish and Game Letter to City of St. Helena, dated July 30, 1992.
[106] Prunuske Chatham, Inc. 2013. Memo to File: Upper York Creek Dam Annual No Project Alternative Costs. January 24, 2013.
[107] City of St. Helena. 2002. *Initial Study/Proposed Mitigated Negative Declaration For the York Creek Dam Removal and Stream Restoration Project*, Napa County, California.

the Napa Basin (CDFG, 2005).[108]

- Removal of Upper York Creek Dam will provide access to an additional 1.7 miles of fish spawning and rearing habitat for federally listed steelhead (City of St. Helena, 2007).[109]
- Steelhead are documented using York Creek immediately below the dam and rainbow trout using the upstream habitat. Since the efficacy of barrier removal in providing fish passage is well-documented, the likelihood of fish passing through the restored project area to the upper watershed is very high. Further, previous site assessments have concluded the area above the dam is highly likely to be used by anadromous fish (City of St. Helena, 2007).[110]
- The restored spawning and rearing habitat in upper York Creek has an estimated carrying capacity of 825–1,811 juvenile steelhead annually (U.S. Army Corps of Engineers, 2006).[111] The mid-point estimate is 1,318 juvenile steelhead.
- Ocean survival rates of Napa River steelhead smolt are estimated to range between 15–25% (Koehler & Blank, 2012).[112] The mid-point survival rate is 20%.
- The expected increase in the adult steelhead population is calculated as the product of the mid-point carrying capacity and ocean survival rate estimates. The expected increase is 264 fish.
- Studies of household willingness-to-pay (WTP) to preserve and increase anadromous fish populations have estimated a range of values. When stated in terms of aggregate annual WTP per fish, estimates range from a low of $500 to a high of $9,300, with higher values associated with more recent WTP studies (Olsen, Richards, and Scott 1991; Loomis 1996; Bell, Huppert, and Johnson 2003).[113]
- To avoid overestimating potential benefits and to account for inherent uncertainty in both the expected increase in the adult salmonid population and WTP estimates, a value of $2,000 per fish is used to value the restoration of fish spawning and rearing habitat above Upper York Creek Dam.[114] The annual benefit is, therefore, $538,000.
- The present value of annual benefits is $7,355,712.

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[108] California Department of Fish and Game. 2005. *Central Napa River Watershed Project, Salmonid Habitat Form and Function*. Prepared by Napa County Resource Conservation District.

[109] City of St. Helena. 2007. *Draft Environmental Impact Report, Upper York Creek Ecosystem Restoration Project, Napa County, California.* Prepared by Prunuske Chatham, Inc. April 20, 2007.

[110] Ibid.

[111] U.S. Army Corps of Engineers. 2006. Rev. 2007. *Draft Detailed Project Report: Upper York Creek Ecosystem Restoration Project*, Napa County, California (DPR). U.S. Army Corps of Engineers, San Francisco District, South Pacific Division. December 15, 2006. Appendix L- Plan Formulation, Pg. 10.

[112] Koehler, J., & Blank, P. 2012. *Napa River Steelhead and Salmon Monitoring Program: 2011-2012 Season.* Napa, California: Napa County Resource Conservation District.

[113] Olsen, D., J. Richards, and R. Scott. 1991. "Existence and Sport Values for Doubling the Size of Columbia River Basin Salmon and Steelhead Runs." *Rivers* 2(1): 44-56; Loomis, J. 1996. "Measuring the Economic Benefits of Removing Dams and Restoring the Elwha River: Results of a Contingent Valuation Survey." *Water Resources Research* 32(2): 441-447; Bell, K., D. Huppert, and R. Johnson. 2003. "Willingness to Pay for Local Coho Salmon Enhancement in Coastal Communities." *Marine Resources Foundation* 18: 15-31.

[114] This is the value per fish recommended by (EcoNorthwest, 2012).

Value of Restored Riparian Habitat

- This project will restore approximately 2 acres of riparian habitat.
- Economic values for restored riparian habitat vary widely and depend on many factors. At the very low end of the value range, Chiabai et al. (2009) report a value of $128/acre/yr for restored riparian. [115] Woodward & Wui (2001) report values between $218 and $2,256/acre/yr for freshwater wetland, and Kazmierczak (2001) reports values between $289 and $524/acre/yr for coastal zone wetland.[116] In the Bay-Delta, the average cost for restoration of riparian and wetland habitat estimated by the Bay Delta Conservation Plan (BDCP) is $1,730/acre/yr.[117] Prices for riparian and wetland mitigation bank credits suggest much higher values. Riparian and wetland mitigation bank credit prices reported by ICF International for the U.S. as a whole average $3,700/acre/yr, while in California the average price is $9,700/acre/yr.[118] In the Bay Area, mitigation credit prices for riparian and wetland habitat currently average $40,000/acre/yr.[119]
- For this analysis, a value of $2,000/acre/yr is assumed. This is the midpoint between the BDCP average cost for riparian and wetland habitat restoration and the upper-end of the value range reported in Woodward and Wui (2001). Although credit bank prices indicate much greater values, particularly in the Bay Area, these prices include underlying market value of the land and may involve more comprehensive levels of critical habitat services.
- The present value of riparian habitat restoration is $55,810.

Value of Carbon Sequestration

- Annual dam maintenance and periodic sediment removal activities have prevented development of substantive woody plants that sequester large amounts of carbon. In addition, the build-up of soil carbon that occurs in stable forest systems has been retarded. The end of regular maintenance activities and planting of substantial riparian trees and shrubs in the restoration area will begin the process of storing carbon.
- Estimates of potential carbon sequestration were developed using tables for Northwest, West Alder/Maple forests from Smith et al.

[115] Chiabai, A., C. Travisi, H. Ding, et al. 2009. *Economic Valuation of Forest Ecosystem Services' Methodology and Monetary Estimates*. Fondazione Eni Enrico Mattei Working Paper No. 2009. 12. All values reported in 2012 dollars.

[116] Woodward, Richard and Yong-Suhk Wui. 2001. "The Economic Value of Wetland Services: A Meta-Analysis." *Ecological Economics* 37: 257-270; Kazmierczak, R.F. 2001. "Economic Linkages Between Coastal Wetlands and Habitat/Species Protection: A Review of Value Estimates Reported in the Published Literature." Louisiana State University Agricultural Center. Baton Rouge, Louisiana.

[117] Based on a capital cost of $27,300/acre (excluding land acquisition costs) annualized with a 6% discount rate and annual O&M of $45/acre.

[118] www.icf.com/insights/webinars/2012/12/recording-mitigation-banking-regulatory-ceqa-process. Annualized mitigation credit values based on a 6% discount rate.

[119] Based on current credit prices quoted for Springtown Natural Community Reserve, Newark Mitigation Bank, and San Francisco Bay Wetland District. Based on an average credit price of $700,000/acre annualized with a 6% discount rate.

2006.[120] Only live tree carbon sequestration is included in the estimates. Carbon sequestration, in metric tons, is estimated to increase from 6.4 tons in 2016 to 313 tons in 2115, which is equivalent to an annual growth rate of about 4%.

- The current social value of carbon sequestration in California is estimated at $13 per ton (Shaw, 2009), increasing at a real rate of 2.5% per year (Nordhaus, 2008).[121]
- Given these initial values and real growth rates, the present value of 100 years of carbon sequestration starting in 2016 is $9,793.

Summary of Monetized Project Benefits

The present values of monetized benefits are summarized below, and in the following PSP Table 15 and PSP Table 16 for Project 18.

Avoided annual maintenance costs	$2,034,025
Steelhead spawning and rearing habitat	$7,355,712
Restored riparian habitat	$55,810
Carbon sequestration	$9,793
Total	$9,455,340

[120] Smith, James E., Linda S. Heath, Kenneth E. Skog, Richard A. Birdsey. 2006. *Methods for Calculating Forest Ecosystem and Harvested Carbon with Standard Estimates for Forest Types of the United States.* United States Department of Agriculture, Forest Service, Northeastern Research Station. General Technical Report NE-343.

[121] Shaw, M., L. Pendleton, D. Cameron, et al. 2009. *The Impact of Climate Change on California's Ecosystem Services.* California Climate Change Center. CEC-500-2009-025-F; Nordhaus, W. 2008. *A Question of Balance: Weighing the Options on Global Warming Policies*. New Haven: Yale University Press.

Table 15 – Annual Benefit Project 18 – St. Helena Upper York Creek Dam Removal and Ecosystem Restoration Project									
(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)**	**Present Value Coefficient**	**Discounted Benefits (h) x (i)**
100-Yrs, Starting 2016	Steelhead Spawning and Rearing Habitat	Adult Returning Fish	0	264	263.6	$2,000	$527,200	13.952	**$7,355,712**
100-Yrs, Starting 2016	Restored Riparian Habitat	Acres	0	2	2	$2,000	$4,000	13.952	**$55,810**
100-Yrs, Starting 2016	Carbon Sequestration[1]	Dollars	0	$702	$702	$1.00	$702	13.952	**$9,793**
Total Present Value of Discounted Benefits Based on Unit Value									**$7,421,314**

Comments: [1] The amount and value of carbon sequestration vary through time. To fit within the format of the table and economize on space, rather than show the annual quantity and unit value for each year in the forecast period, the value of carbon sequestration is shown in terms of annualized value.

Table 16 – Annual Costs of Avoided Projects Project 18 – St. Helena Upper York Creek Dam Removal and Ecosystem Restoration Project						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(f)	(g)	(h)
	Alternative (Avoided Project Name): Upper York Creek Dam Annual O&M and NOAA Assessment					
	Avoided Project Description: Annual costs incurred by City of St. Helena for regular maintenance of the dam, including annual debris removal from the drop-inlet and spillway to maintain storm water passage and periodic removal of accumulated sediment plus annual NOAA assessment for interference with salmonid migration.					
Year	**Avoided Capital Costs**	**Avoided NOAA Assessment**	**Avoided Operations and Maintenance Costs**	**Total Cost Avoided for Individual Alternatives (b) + (c) + (d)**	**Present Value Coefficient**	**Discounted Costs (e) x (f)**
100-yrs, Starting 2016		$20,000	$125,783	$145,783	13.952	**$2,034,025**
Total Present Value of Discounted Costs						**$2,034,025**
(%) Avoided Cost Claimed by Project						**100%**
Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project						**$2,034,025**

Project Cost

Project economic costs are shown in PSP Table 19 for Project 18.

PSP Table 19—Annual Costs of Project Project 18: St. Helena Upper York Creek Dam Removal and Ecosystem Restoration Project										
	Initial Costs Grand Total Cost from Table 7	Adjusted Grant Total Cost	Annual Costs						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2012								$0	1.000	**$0**
2013	$172,267							$172,267	0.943	**$162,516**
2014	$131,733							$131,733	0.890	**$117,242**
2015	$4,256,002							$4,256,002	0.840	**$3,573,421**
2016	$19,760							$19,760	0.792	**$15,652**
2017	$19,760							$19,760	0.747	**$14,766**
2018	$19,760							$19,760	0.705	**$13,930**
Total Present Value of Discounted Costs (Sum of column (j))										**$3,897,527**

Project Benefit-Cost Ratio

The present value of project benefits is $9,455,340. The present value of project economic costs is $3,897,527. The project net present value is $5,557,813, and the project benefit-cost ratio is 2.43.

Flood Damage Reduction Projects

The projects included in this section provide primarily flood damage reduction benefits along with significant habitat protection/restoration benefits. The goal of these projects is to resolve threats to public health and safety and property by improving hydrologic functioning of stream courses and flood control structures. Each of these projects includes habitat restoration efforts as an integrated component of flood protection improvements. The projects range from removal of dam (Project 5), restoration of creek floodplain (Project 9), and improved stormwater drainage (Project 10). The Flood Protection projects collectively will provide increased flood protection for over 250 residences, improve fish passage, and support bay tidal pond and marsh habitat restoration. Combined, the benefit-cost ratio for the flood protection projects included in this Proposal is 1.89.

Project 5: Napa Milliken Creek Flood Damage Reduction and Fish Passage Barrier Removal 158

Project 9: Petaluma Flood Reduction, Water & Habitat Quality, and Recreation Project for Capri Creek 165

Project 10: Redwood City Bayfront Canal and Atherton Channel Flood Improvement and Habitat Restoration Project 174

Project 5: Napa Milliken Creek Flood Damage Reduction and Fish Passage Barrier Removal

Project Benefits

With Project Condition: The Project involves three integrated elements along Milliken Creek: 1) removal of a dam and restoration of the stream; 2) construction of a flood bypass/weir to ensure a flood detention area does not overflow into neighboring homes; and 3) grading/landscape improvements to ensure adjacent low lying properties receive a comparable level of flood protection. The project will prevent against flooding of a neighborhood of over 50 homes. The dam is currently a passage barrier for steelhead.

Without Project Condition: Without the project periodic flooding of residential structures and streets will continue and the passage barrier for steelhead will remain in place.

D2 Non-Monetized Project Benefits

Non-monetizable project benefits, including community and social benefits, environmental stewardship benefits, and sustainability benefits are identified, as applicable to this project, in the PSP Table 12 "Non-Monetized Benefits Checklist" below.

PSP Table 12—Non-Monetized Benefits Checklist Project 5: Napa Milliken Creek Flood Damage Reduction and Fish Passage Barrier Removal			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
1	**Provide educational or technological benefits?**	No	
2	**Provide social recreation or access benefits?**	No	
3	**Help avoid, reduce, or resolve various public water resource conflicts?**	No	
4	**Promote social health and safety?**	Yes	Flood damage reduction is a D4 quantified benefit for the project.
5	**Have other social benefits?**	No	

PSP Table 12—Non-Monetized Benefits Checklist Project 5: Napa Milliken Creek Flood Damage Reduction and Fish Passage Barrier Removal			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Environmental Stewardship Benefits: Will the proposal:			
6	**Benefit wildlife or habitat in ways that are not quantified?**	Yes	The habitat restoration elements of the project include removing a steelhead fish passage barrier and increasing the amount of available spawning and rearing habitat. Streambank restoration will increase and improve riparian habitat.
7	**Improve water quality in ways that are not quantified?**	No	
8	**Reduce net emissions in ways that are not quantified?**	No	
9	**Provide other environmental stewardship benefits?**	Yes	Removal of instream dam and instream impoundment will restore natural stream functions. This will also initiate an improved water diversion approach for the landowner's existing riparian water rights usage.
Sustainability Benefits: Will the proposal:			
10	**Improve the overall, long-term management of California groundwater resources?**	No	
11	**Reduce demand for net diversions for the region from the Delta?**	No	
12	**Provide a long-term solution in place of a short-term one?**	Yes	D4 Flood Damage Reduction Benefit
13	**Promote energy savings or replace fossil-fuel-based energy sources with renewable energy and resources?**	No	
14	**Improve water supply reliability in ways not quantified?**	No	
15	**Other**	No	

D4 Flood Damage Reduction Project Benefits

Quantified Project Benefits: Flood damage reduction benefits from reduced frequency and depth of flooding in project area.

Flood Expected Annual Damage (EAD) Estimation

Expected annual flood damage for the without- and with-project conditions were estimated with DWR's F-RAM model. F-RAM calculates EAD in 2007 dollars. An update factor for 2007 was requested from DWR, however, DWR did not respond to the request. Therefore, F-RAM results are updated from 2007 to 2012 dollars using an update factor of 1.11 from the BLS CPI inflation calculator (Bureau of Labor Statistics, 2013).

Flood Damage Categories

Flood damages were estimated for the without- and with-project conditions for the following categories.

- Residential structures and contents
- Roads and highways
- Indirect costs, including emergency response, and disruption to employment, commerce, transportation, and communications

F-RAM Model Inputs

Hydrology: An unsteady state HEC-RAS model was used to estimate Water Surface Elevations (WSELs) for 25-, 50-, and 100-year storms. The resulting WSEL was compared with finished floor elevations (FFEs) and ground surface elevations to determine which houses and roads would be affected in the without- and with-project scenarios. Estimated average flood depth (in feet above ground level) for the without- and with-project conditions are summarized in **Project 5-Table A**.

Residential Structure Inventory: An unsteady state HEC-RAS model was used to estimate Water Surface Elevations (WSELs) for 25-, 50-, and 100-year storms. The resulting WSEL was compared with finished floor elevations (FFEs) and ground surface elevations to determine which houses and roads would be affected in the without- and with-project scenarios. F-RAM's residential structure damage estimates are based on a ratio of depreciated to replacement value for residential structures of 80%. Project 5-Table A provides the residential structure inventory for the without- and with-project conditions input into the F-RAM model.

Impacted Roads: Length of inundated roads in miles for the without- and with-project conditions is summarized in Project 5-Table A. An unsteady state HEC-RAS model was used to estimate Water Surface Elevations (WSELs) for 25-, 50-, and 100-year storms. The resulting WSEL and ground surface elevations were compared to determine which would be affected in the without- and with-project scenarios.

Indirect Costs: Indirect costs include costs for emergency response and costs associated with disruption to employment, commerce, transportation, and communications. These costs are calculated by F-RAM to equal 25% of direct damages to residential and industrial

structures and contents and direct damages to roads.

Project 5-Table A: F-RAM Model Inputs			
Hydrologic Event	**25-Yr**	**50-Yr**	**100-Yr**
Exceedance Probability	0.04	0.02	0.01
Average Flood depth above ground level (ft)			
Without Project	0.78	0.88	1.75
With Project	0.39	0.59	0.75
Impacted Residential Structures			
Without Project	13	24	52
With Project	1	1	7
Impacted Roadways – Minor Roads (miles)			
Without Project	0.49	0.49	0.49
With Project	0.00	0.00	0.20

F-RAM Flood Damage Estimate

Flood damages for each damage category for the without- and with- project conditions are summarized in **Project 5-Table B**.

Project 5-Table B: F-RAM Model Flood Damage Estimates (2012 Dollars)			
Hydrologic Event	**25-Yr**	**50-Yr**	**100-Yr**
Exceedance Probability	0.04	0.02	0.01
Damages to Residential Property[1]			
Without Project	$576,123	$1,063,612	$4,129,680
With Project	$45,025	$44,317	$310,220
Damages to Roads			
Without Project	$16,317	$16,317	$16,317

With Project	$0	$0	$6,660
Indirect Costs[3]			
Without Project	$148,110	$269,982	$1,036,499
With Project	$11,256	$11,079	$79,220
Total Estimated Damages			
Without Project	$740,550	$1,349,911	$5,182,497
With Project	$56,282	$55,396	$396,100

Notes:
[1] Includes F-RAM estimated damages to structure and contents, out buildings and landscape, plus cleanup costs.
[2] Includes F-RAM estimated damages to structures and contents, plus cleanup costs.
[3] Includes F-RAM estimated costs for emergency response, costs associated with disruption to employment, commerce, transportation, and communications.

Present Value of EAD

Expected annual damages (EAD) calculated by F-RAM for the without- and with project conditions are summarized in PSP Table 18 for Project 5, shown below. EAD for the without-project condition is $124,555. EAD for the with-project condition is $9,039. The annual flood damage reduction benefit is therefore $115,516.

Flood damage reduction benefits are assumed to start in 2016. The present value of future annual flood damage reduction benefits over the 50-year useful project life at a discount rate of 6% is $1,620,455.

PSP Table 18—Present Value of Expected Annual Damage Reduction Benefits Project 5: Napa Milliken Creek Flood Damage Reduction and Fish Passage Barrier Removal			
(a)	Expected Annual Damage Without Project (1)		**$124,555**
(b)	Expected Annual Damage With Project (1)		**$9,039**
(c)	Expected Annual Benefit	(a) – (b)	**$115,516**
(d)	Present Value Coefficient (2)		**13.23**
(e)	Present Value of Future Benefits	(c) x (d)	**$1,528,731**

(1) This project assumes no land use changes in the floodplain. So, EAD was constant over the analysis period.
(2) Present value in 2012 given 6% real discount rate; 50-year analysis period (useful project life), benefits commence in 2016.

Project Cost

The economic project costs are shown in PSP Table 19 for Project 5 below. The County would not be responsible for maintaining the project site once completed since the site is on private property.

PSP Table 19—Annual Costs of Project Project 5: Napa Milliken Creek Flood Damage Reduction and Fish Passage Barrier Removal										
	Initial Costs Grand Total Cost from Table 7	Adjusted Grant Total Cost	Annual Costs						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012									1.000	
2013	$132,240							$132,240	0.943	**$124,755**
2014	$174,060							$174,060	0.890	**$154,913**
2015	$1,083,960							$1,083,960	0.840	**$910,114**
2016	$15,280							$15,280	0.792	**$12,103**
2017	$7,000							$7,000	0.747	**$5,231**
2018	$6,000							$6,000	0.705	**$4,230**
Total Present Value of Discounted Costs (Sum of column (j))										**$1,211,345**

Project Benefit-Cost Ratio

Present value of benefits for the with-project condition is $1,528,731. Present value of project economic costs for the with-project condition is $1,211,345. Project net present value is $317,386 and the project benefit-cost ratio is 1.26.

Project 9: Petaluma Flood Reduction, Water & Habitat Quality, and Recreation Project for Capri Creek

Project Benefits

With Project Condition: The Project implements improvements to an existing engineering drainage swale to mitigate chronic flooding in a residential neighborhood. The goals of the project are to achieve flood reduction, habitat enhancement, groundwater recharge, recreation, and water quality improvements. The project will include the design and construction of a reconfigured channel section, flood terraces, trails to connect to existing pathways and reduce flood elevations, provide water quality improvements, increased groundwater recharge opportunity, and riparian habitat enhancement.

Without Project Condition: Without the project chronic flooding of residential structures and streets in the project area will remain unmitigated.

D2 Non-Monetized Project Benefits

Non-monetizable project benefits, including community and social benefits, environmental stewardship benefits, and sustainability benefits are identified, as applicable to this project, in the PSP Table 12 "Non-Monetized Benefits Checklist" below.

PSP Table 12—Non-Monetized Benefits Checklist Project 9: Petaluma Flood Reduction, Water & Habitat Quality, and Recreation Project for Capri Creek			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
1	**Provide educational or technological benefits?**	Yes	The project will include educational kiosks to inform visitors and residents of the benefits of watershed preservation and enhancement.
2	**Provide social recreation or access benefits?**	Yes	The project will provide substantially improved outdoor passive recreational opportunities, information on the riparian corridor enhancement project, and the opportunity to participate in the stewardship and maintenance of the restored corridor. The project will also create 5 acres of riparian corridor which currently exists as an engineered swale. Public access will primarily be along existing trails in the upland area, but the flood terrace will also be accessible (weather permitting).

PSP Table 12—Non-Monetized Benefits Checklist Project 9: Petaluma Flood Reduction, Water & Habitat Quality, and Recreation Project for Capri Creek			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
3	**Help avoid, reduce, or resolve various public water resource conflicts?**	Yes	Water supply benefits will be achieved primarily through passive groundwater recharge as a result of channel recontouring, and construction of a flood terrace, thereby slowing the surface flow, spreading it across the flood terrace and allowing percolation of the storm water. Providing longer water retention on site will reduce the need for landscape irrigation. Percolation of substantial water volume is not anticipated.
4	**Promote social health and safety?**	Yes	D4 Flood Damage Reduction Benefit
5	**Have other social benefits?**	Yes	The project site is adjacent to several affordable housing projects and a City-sponsored community garden. Access to the riparian corridor will inform all residents and visitors of the benefits of riparian restoration and watershed preservation. The multi-benefit project includes habitat protection and restoration and will create opportunities for recreation, education, and stewardship along this Petaluma River tributary.
Environmental Stewardship Benefits: Will the proposal:			
6	**Benefit wildlife or habitat in ways that are not quantified?**	Yes	The environmental restoration elements of the project will increase and improve upland, riparian, and instream habitat for listed and non-listed species.
7	**Improve water quality in ways that are not quantified?**	Yes	In this section of creek corridor, water travels the 1400 linear feet of the open drainage swale, and no testing has been done of pollutant loads from upstream rural and agricultural activities. Allowing the flows to slow across the newly created flood terrace will allow pollutants to settle out of the water before it reaches the River, which continues to the Bay. Water quality benefits will be realized through the reduction of deposition of sediment and other pollutants in the newly constructed flood terrace, capture of sediment by a proposed sediment basin near the downstream outfall structure, and channel stabilization and filtration capabilities of installed riparian vegetation.
8	**Reduce net emissions in ways that are not quantified?**	Yes	While not a primary goal of the project, carbon dioxide emissions will be captured by riparian and upland habitat vegetation growth.

PSP Table 12—Non-Monetized Benefits Checklist Project 9: Petaluma Flood Reduction, Water & Habitat Quality, and Recreation Project for Capri Creek			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
9	**Provide other environmental stewardship benefits?**	Yes	A Creek Stewardship Program for this reach is planned, and outreach efforts will be undertaken in concert with project implementation. Surrounding neighborhoods' sense of ownership is limited to the community garden and the corridor as a dog run; enhancing the corridor will allow the residents and visitors to see the site as a natural amenity to be treasured, maintained, and monitored for years to come.
Sustainability Benefits: Will the proposal:			
10	**Improve the overall, long-term management of California groundwater resources?**	Yes	While not a primary goal of the project, slowing the flow of the creek and allowing it to sink into the soil within the flood terrace may enhance the groundwater aquifers in the area. Agricultural uses upstream and east of the site may benefit from this recharge potential. The project will maximize passive infiltration to the groundwater basin by providing opportunities for storm flow to access and fan out over the floodplain at more frequent storm intervals and connect with constructed bioswales and other potential design features.
11	**Reduce demand for net diversions for the region from the Delta?**	No	
12	**Provide a long-term solution in place of a short-term one?**	Yes	There is no short-term solution to riparian corridor enhancement and flood reduction. Recontouring the channel and constructing a floodplain terrace will provide a long-term solution to reduce flooding impacts, provide a more holistic stormwater management component along this urban creek, and offer opportunity to improve surface water quality.
13	**Promote energy savings or replace fossil-fuel-based energy sources with renewable energy and resources?**	No	

PSP Table 12—Non-Monetized Benefits Checklist Project 9: Petaluma Flood Reduction, Water & Habitat Quality, and Recreation Project for Capri Creek			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
14	**Improve water supply reliability in ways not quantified?**	No	The project will have no benefits to urban water, but a minor passive benefit for agricultural water sources may be achieved for upstream users. Water supply benefits will be achieved primarily through passive groundwater recharge as a result of channel recontouring and construction of a flood terrace to improve function during peak storm flows.
15	**Other**		

D4 Flood Damage Reduction Project Benefits

Quantified Project Benefits: Flood damage reduction benefits from reduced frequency and depth of flooding in project area.

Flood EAD Estimation

Expected annual flood damage for the without- and with-project conditions are estimated with DWR's F-RAM model. F-RAM calculates EAD in 2007 dollars. An update factor for 2007 was requested from DWR, however, DWR did not respond to the request. Therefore, F-RAM results are updated from 2007 to 2012 dollars using an update factor of 1.11 from the BLS CPI inflation calculator (www.bls.gov/data/inflation_calculator.htm).

Flood Damage Categories

Flood damages were estimated for the without- and with-project conditions for the following categories.

- Residential structures and contents
- Roads and highways
- Indirect costs, including emergency response, and disruption to employment, commerce, transportation, and communications

F-RAM Model Inputs

Hydrology: A HEC-RAS model was used to estimate Water Surface Elevations (WSELs) for 10-, 25-, 50-, and 100-year storm events. The resulting WSEL was compared with finished floor elevations (FFEs) and ground surface elevations to determine which houses and roads would be affected in the without- and with-project scenarios. Hydraulic modeling results are presented in (Hammond, 2011). Estimated average flood depth (in feet above ground level) for the without- and with-project conditions used with F-RAM are summarized in **Project 9-Table A**.

Residential Structure Inventory: A HEC-RAS model was used to estimate Water Surface Elevations (WSELs) for 10-, 25-, 50-, and 100-year storms. The resulting WSEL was compared with finished floor elevations (FFEs) and ground surface elevations to determine which houses and roads would be affected in the without- and with-project scenarios. F-RAM's residential structure damage estimates are based on a ratio of depreciated to replacement value for residential structures of 80%. Project 9-Table A provides the residential structure inventory for the without- and with-project conditions input into the F-RAM model.

Impacted Roads: Length of inundated roads in miles for the without- and with-project conditions is summarized in Project 9-Table A. HEC-RAS model results were used to estimate Water Surface Elevations (WSELs) for 10-, 25-, 50-, and 100-year storms. The resulting WSEL and ground surface elevations were compared to determine which roads would be affected in the without- and with-project scenarios.

Indirect Costs: Indirect costs include costs for emergency response and costs associated with disruption to employment, commerce, transportation, and communications. These costs are calculated by F-RAM to equal 25% of direct damages to residential and industrial structures and contents and direct damages to roads.

Project 9-Table A: F-RAM Model Inputs

Hydrologic Event	10-Yr	25-Yr	50-Yr	100-Yr
Exceedance Probability	0.10	0.04	0.02	0.01
Average Flood depth above ground level (ft)				
Without Project	0.50	0.90	1.00	1.10
With Project	0.00	0.20	0.60	0.90
Impacted 2-Story Residential Structures				
Without Project	0	39	39	39
With Project	0	0	0	39

Impacted Mobile Homes				
Without Project	0	63	63	63
With Project	0	0	31	63
Impacted Roadways (miles)				
Arterial				
Without Project	0.00	0.00	0.00	0.14
With Project	0.00	0.00	0.00	0.00
Major				
Without Project	0.00	0.00	0.00	0.13
With Project	0.00	0.00	0.00	0.00
Minor				
Without Project	0.18	0.48	0.53	0.66
With Project	0.00	0.18	0.50	0.55

F-RAM Flood Damage Estimates

Flood damages for each damage category for the without- and with- project conditions are summarized in **Project 9-Table B**.

Project 9-Table A: F-RAM Model Flood Damage Estimates (2012 Dollars)				
Hydrologic Event	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Exceedance Probability	0.10	0.04	0.02	0.01
Damages to Residential Property[1]				
Without Project	$0	$1,467,741	$1,467,741	$2,589,645
With Project	$0	$0	$309,690	$1,467,741
Damages to Roads				
Without Project	$5,994	$15,984	$17,649	$75,258
With Project	$0	$5,994	$16,650	$18,315
Indirect Costs[2]				
Without Project	$1,499	$370,931	$371,348	$656,513
With Project	$0	$1,499	$81,585	$371,514
Total Estimated Damages				
Without Project	$7,493	$1,854,657	$1,856,738	$3,321,416
With Project	$0	$7,493	$407,925	$1,857,571

Notes:
[1]Includes F-RAM estimated damages to structure and contents, out buildings and landscape, plus cleanup costs.
[2]Includes F-RAM estimated costs for emergency response, costs associated with disruption to employment, commerce, transportation, and communications.

Present Value of EAD

Expected annual damages (EAD) calculated by F-RAM for the without- and with project conditions are summarized in PSP Table 18 for Project 9, below. EAD for the without-project condition is $238,788. EAD for the with-project condition is $135,676. The annual flood damage reduction benefit is $103,111.

Flood damage reduction benefits are assumed to commence with completion of the project in 2015. The present value of future annual flood damage reduction benefits over the 50-year useful project life at a discount rate of 6% is $1,446,447.

PSP Table 18—Present Value of Expected Annual Damage Reduction Benefits Project 9: Petaluma Flood Reduction, Water & Habitat Quality, and Recreation Project for Capri Creek			
(a)	Expected Annual Damage Without Project (1)		**$238,788**
(b)	Expected Annual Damage With Project (1)		**$135,676**
(c)	Expected Annual Benefit	(a) – (b)	**$103,111**
(d)	Present Value Coefficient (2)		**14.03**
(e)	Present Value of Future Benefits	(c) x (d)	**$1,446,447**

(1) This program assumes no land use changes in the floodplain. So, EAD will be constant over analysis period.
(2) 6% discount rate; 50-year analysis period, benefits commence in 2015.

Project Cost

The economic project costs are shown in PSP Table 19 for Project 9, below. The administrative costs reflect annual adjustments for cost of living raises for staff. Maintenance and other costs are associated with maintaining the project site once constructed.

PSP Table 19—Annual Costs of Project Project 9: Petaluma Flood Reduction, Water & Habitat Quality, and Recreation Project for Capri Creek										
	Initial Costs Grand Total Cost from Table 7	Adjusted Grant Total Cost	Annual Costs						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012									1.000	
2013								$0	0.943	**$0**
2014	$1,100,002							$1,100,002	0.890	**$978,998**
2015-2064			$314		$1,205		$250	$1,769	14.028	**$24,816**
Total Present Value of Discounted Costs (Sum of column (j))										**$1,003,813**

Project Benefit-Cost Ratio

Present value of benefits for the with-project condition is $1,446,447. Present value of project economic costs for the with-project condition is $1,003,813. Project net present value is $442,634 and the project benefit-cost ratio is 1.44.

Project 10: Redwood City Bayfront Canal and Atherton Channel Flood Improvement and Habitat Restoration Project

Project Benefits

With Project Condition: This project proposes to route flood flows from the Bayfront Canal and Atherton Channel into managed ponds that are part of the Ravenswood Pond Complex and the South Bay Salt Ponds Restoration project. With the project, flood flows from the Bayfront Canal will bypass around the Flood Slough tide gate and be routed into Ponds S5 and R5 of the Ravenswood pond complex. Stormwater flows will enable the development of seasonal freshwater wetlands habitat in Ponds S5 and R5 and support the restoration goals of the South Bay Salt Ponds project. The project will mitigate chronic and widespread flooding in the Bayfront Canal (Redwood City) and Atherton Channel (Menlo Park) neighborhoods.

Without Project Condition: If the project is not implemented the neighborhoods in Redwood City, Menlo Park, and unincorporated San Mateo County will continue to experience chronic and widespread flooding. In addition, the Ravenswood salt ponds will not have a source of fresh water to enhance wetland habitat, which can potentially hinder habitat restoration goals.

D2 Non-Monetized Project Benefits

Non-monetizable project benefits, including community and social benefits, environmental stewardship benefits, and sustainability benefits are identified, as applicable to this project, in the PSP Table 12 "Non-Monetized Benefits Checklist" below.

PSP Table 12—Non-Monetized Benefits Checklist Project 10: Redwood City Bayfront Canal and Atherton Channel Flood Improvement and Habitat Restoration Project			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
Community/Social Benefits: Will the proposal:			
1	**Provide educational or technological benefits?**	No	
2	**Provide social recreation or access benefits?**	Yes	Trails provide public access in relation to the South Bay Salt Ponds Project. See: Opportunities and Constraints for Ravenswood Complex, South Bay Salt Ponds Restoration, Phase II (URS, 2012).
3	**Help avoid, reduce, or resolve various public water resource conflicts?**	No	
4	**Promote social health and safety?**	Yes	D4 Flood Damage Reduction Benefit

PSP Table 12—Non-Monetized Benefits Checklist Project 10: Redwood City Bayfront Canal and Atherton Channel Flood Improvement and Habitat Restoration Project			
No.	**Question**	**"Yes," "No," or "Neg"**	**Explanation of Benefit**
5	**Have other social benefits?**	No	
Environmental Stewardship Benefits: Will the proposal:			
6	**Benefit wildlife or habitat in ways that are not quantified?**	Yes	The environmental restoration elements of the project will increase the amount of seasonal wetland habitat in the managed ponds S5 & R5 of the Ravenswood pond complex.
7	**Improve water quality in ways that are not quantified?**	Yes	The project will improve water quality by detaining and treating stormwater prior to its release to the Bay.
8	**Reduce net emissions in ways that are not quantified?**	No	
9	**Provide other environmental stewardship benefits?**	Yes	The project will foster bird habitat. See Opportunities and Constraints for Ravenswood Complex, South Bay Salt Ponds Restoration, Phase II (URS, 2012).
Sustainability Benefits: Will the proposal:			
10	**Improve the overall, long-term management of California groundwater resources?**	No	
11	**Reduce demand for net diversions for the region from the Delta?**	No	
12	**Provide a long-term solution in place of a short-term one?**	Yes	D4 Flood Damage Reduction Benefit
13	**Promote energy savings or replace fossil-fuel-based energy sources with renewable energy and resources?**	No	
14	**Improve water supply reliability in ways not quantified?**	No	
15	**Other**	No	

D4 Flood Damage Reduction Project Benefits

Quantified Project Benefits: Flood damage reduction benefits from reduced frequency and depth of flooding in project area.

Flood EAD Estimation

Expected annual flood damage for the without- and with-project conditions are estimated with DWR's F-RAM model. F-RAM calculates EAD in 2007 dollars. An update factor for 2007 was requested from DWR, however, DWR did not respond to the request. Therefore, F-RAM results are updated from 2007 to 2012 dollars using an update factor of 1.11 from the BLS CPI inflation calculator (www.bls.gov/data/inflation_calculator.htm).

Flood Damage Categories

Flood damages were estimated for the without- and with-project conditions for the following categories.

- Residential structures and contents
- Commercial structures and contents
- Roads and highways
- Indirect costs, including emergency response, and disruption to employment, commerce, transportation, and communications

F-RAM Model Inputs

Hydrology: A combination of flood routing modeling and steady-state flood modeling using HEC-RAS for the without- and with-project conditions was completed to determine flood durations and depths by storm return interval. Historical flood frequency data, hydrologic modeling approach, and modeling results are summarized in (Goettel, 2011).[122] Estimated average flood depth (in feet above ground level) for the without- and with-project conditions are summarized in **Project 10-Table A**.

Residential Structure Inventory: The residential structure inventory was developed from the County Assessor's Database and onsite inspections. County assessor data includes information on structure type (e.g. single family, multi-family, mobile home), building footprint (in square feet), number of stories, and other data. Onsite inspections were used to supplement the assessor's data and to estimate first floor elevations. A detailed description of the residential structure inventory is provided in (Goettel, 2011). F-RAM's residential structure damage estimates are based on a ratio of depreciated to replacement value for residential structures of 80%. Project 10-Table A provides the residential structure inventory for the without- and with-project conditions input into the F-RAM model.

[122] Goettel, K. (2011). *5th Avenue Stormwater Pump Station Upgrade Project: Benefit Cost Analysis Report.* Redwood City, CA: City of Redwood City.

Industrial Structure Inventory: Average flood depths are based on the hydrologic modeling summarized in (Goettel, 2011). The industrial structure inventory was developed by City of Redwood City with FEMA flood maps and onsite inspections. Industrial structure damages are based on F-RAM's medium value for industrial structures and a ratio of depreciated to replacement value for industrial structures of 80%. Project 10-Table A provides the industrial structure inventory for the without- and with-project conditions input into the F-RAM model.

Impacted Roads: Length of inundated roads in miles for the without- and with-project conditions is summarized in Project 10-Table A. The road inventory was developed by City of Redwood City using FEMA flood maps for the project area.

Impacted Roads: Length of inundated roads in miles for the without- and with-project conditions is summarized in Project 10-Table A. The road inventory was developed by City of Redwood City using FEMA flood maps for the project area.

Project 10-Table A: F-RAM Model Inputs				
Hydrologic Event	**1.0-Yr**	**5-Yr**	**50-Yr**	**100-Yr**
Exceedance Probability	1.00	0.20	0.04	0.01
Average Flood depth above ground level (ft)				
Without Project	0.90	0.94	0.72	1.08
With Project	0.66	0.83	0.58	1.01
Impacted Single-Story Residential Structures				
Without Project	0	0	326	530
With Project	0	0	326	533
Impacted Mobile Homes				
Without Project	110	136	394	418
With Project	87	111	136	148
Impacted Industrial Structures (sq ft)				
Without Project	126	10,222	97,452	340,782
With Project	37	140	77,362	329,806
Impacted Roads (miles)				
Arterial				
Without Project	0.00	0.00	0.18	0.86
With Project	0.00	0.00	0.09	0.83
Major				
Without Project	0.00	0.18	4.15	6.25
With Project	0.00	0.03	3.21	5.36
Minor				
Without Project	0.00	0.07	1.92	2.78
With Project	0.00	0.00	1.38	2.58

Project 10-Table A: F-RAM Model Inputs				
Hydrologic Event	**1.0-Yr**	**5-Yr**	**50-Yr**	**100-Yr**
Unsealed				
Without Project	0.00	0.00	0.98	1.03
With Project	0.00	0.00	0.01	0.02

F-RAM Flood Damage Estimates

Flood damages for each damage category for the without- and with- project conditions are summarized in **Project 10-Table B**.

Project 10-Table B: F-RAM Model Flood Damage Estimates (2012 Dollars)				
Hydrologic Event	**1.0-Yr**	**5-Yr**	**50-Yr**	**100-Yr**
Exceedance Probability	1.00	0.20	0.04	0.01
Damages to Residential Property[1]				
Without Project	$1,098,900	$1,358,640	$18,152,576	$27,288,561
With Project	$869,130	$1,108,890	$15,575,156	$24,722,088
Damages to Commercial Property[2]				
Without Project	$826	$67,026	$638,992	$2,234,505
With Project	$243	$918	$507,262	$2,162,535
Damages to Roads				
Without Project	$0	$22,311	$585,414	$1,036,407
With Project	$0	$3,330	$427,350	$911,421
Indirect Costs[3]				
Without Project	$274,932	$361,994	$4,844,245	$7,639,868
With Project	$217,343	$278,284	$4,127,442	$6,949,011
Total Estimated Damages				
Without Project	$1,374,658	$1,809,971	$24,221,227	$38,199,341
With Project	$1,086,716	$1,391,422	$20,637,210	$34,745,055

Notes:
[1]Includes F-RAM estimated damages to structure and contents, out buildings and landscape, plus cleanup costs.
[2]Includes F-RAM estimated damages to structures and contents, plus cleanup costs.
[3]Includes F-RAM estimated costs for emergency response, costs associated with disruption to employment, commerce, transportation, and communications.

Present Value of EAD

Expected annual damages (EAD) calculated by F-RAM for the without- and with project conditions are summarized in PSP Table 18 for Project 10, below. EAD for the without-project condition is $4,100,828. EAD for the with-project condition is $3,490,593. The annual flood damage reduction benefit is therefore $610,236. The F-RAM estimate of annual flood damage reduction benefit is within 10% of annual flood damage reduction benefits reported in (Goettel, 2011) that were calculated using FEMA Version 4.5.5 Damage-Frequency Benefit-Cost software. The F-RAM model results are therefore deemed to provide an accurate estimate of project flood damage reduction benefits.

Project benefits are assumed to start in 2015. The present value of future annual flood damage reduction benefits over the 50-year useful project life at a discount rate of 6% is $8,560,385.

PSP Table 18—Present Value of Expected Annual Damage Reduction Benefits **Project10: Redwood City Bayfront Canal and Atherton Channel Flood Improvement and Habitat Restoration Project**			
(a)	Expected Annual Damage Without Project (1)		**$4,100,828**
(b)	Expected Annual Damage With Project (1)		**$3,490,593**
(c)	Expected Annual Benefit	(a) – (b)	**$610,236**
(d)	Present Value Coefficient (2)		**14.03**
(e)	Present Value of Future Benefits	(c) x (d)	**$8,560,385**

(1) This program assumes no land use changes in the floodplain. So, EAD will be constant over analysis period.
(2) 6% discount rate; 50-year analysis period, benefits commence in 2015.

Project Cost

Project capital costs total $4,209,840 in 2012 dollars. Project is assumed to be constructed in 2014 and online in 2015. Present value of project capital cost in 2012 is $3,746,743. There are no sunk economic costs for this project. Annual project O&M is expected to average $11,200 per year. The present value cost of annual O&M over the 50-year project life is $157,114.

PSP Table 19—Annual Costs of Project Project 10: Redwood City Bayfront Canal and Atherton Channel Flood Improvement and Habitat Restoration Project										
	Initial Costs Grand Total Cost from Table 7	Adjusted Grant Total Cost	Annual Costs						Discounting Calculations	
			Admin	Operation [1]	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2012									1.000	
2013									0.943	
2014	$4,209,840							$4,209,840	0.890	**$3,746,743**
2015-2064				$11,200				$11,200	14.028	**$157,114**
Total Present Value of Discounted Costs (Sum of column (j))										**$3,903,856**
Comments: [1] Annual O&M costs of project.										

Project Benefit-Cost Ratio

Present value of benefits for the with-project condition is $8,560,385. Present value of project economic costs for the with-project condition is $3,903,856. Project net present value is $4,656,529 and the project benefit-cost ratio is 2.19.