Attachment 8

Benefits and Cost Analysis

Attachment

8

San Diego Integrated Regional Water Management

Implementation Grant Proposal – Round 2

Benefits and Cost Analysis

Attachment 8 consists of the following items:

- ✓ **Project Costs and Benefits**. The body of this attachment provides an overview of the costs and benefits of this proposed funding package, as well as the benefits associated with each individual project.
- ✓ **Appendix 8-1.** Appendix 8-1 provides a detailed discussion of the estimated avoided future imported water costs from developing local supplies in the San Diego region.
- ✓ **Appendix 8-2.** Appendix 8-2 of this attachment contains detailed information and background regarding the qualitative and quantitative costs and benefits of each individual project contained within this proposal.

This attachment contains estimations of thecosts and benefits of each project contained within this *San Diego IRWM Round 2 Implementation Grant Proposal – Round 2*. A narrative description of the expected benefits and costs that may be incurred to implement and operate each project is provided for each project. Where possible, each benefit was quantified and presented in physical or economic terms. In cases where quantitative analyses were not feasible, this attachment provides complementary qualitative analyses. In addition, this attachment provides a description of economic factors that may affect or qualify the amount of economic benefits to be realized..

Proposal Benefits and Costs Summary

Because several projects are being proposed with multiple benefits, Table 8-1 below contains a summary of the costs and benefits for all projects. This summary shows the benefit-cost ratio of the overall Proposal is 10.3, and that as a whole, the benefits well exceed the costs.

Table 8-1: Proposal Benefits and Costs Summary (PSP Table 20)

Proposal: San Diego IRWM Implementation Grant, Round 2						
Agency: San Diego County Water Authority						
Project	Project Proponent	Total Present Value Project Costs (1)	Total Present Value Project Benefits			Section D2 – Briefly Describe the Main Non-monetized Benefits*
			Section D3 Monetized (2)	Section D4 Flood Damage Reduction (3)	Total	
(a)	(b)	I	(d)	(e)	(f) = (d) + (e)	(h)
1. North San Diego County Regional Recycled Water Project – Phase II	Olivenhain Municipal Water District	$22,603,039	$178,127,244	--	$178,127,244	*B. Avoided loss of agricultural production* – recycled water is cheaper for users than the potable imported water currently used for irrigation. Water costs are the greatest single expense for farmers, and current rates are likely to force farm closures. *E. Improve water quality* – imported water is high in TDS and may require additional groundwater pumping for dilution. Reducing imported water will reduce TDS imported to the Region. *F-Reduce net diversions from Bay-Delta* and *D-Benefit Wildlife or Habitat* – because imported supplies are from the Delta, reducing imported water purchases will improve aquatic habitat conditions in the Delta *H. Long-term solution*and *I. Improve water supply reliability* – maximizing recycled water use helps diversify the area's water portfolio and reduce water waste. This improves reliability in the face of drought or water restrictions. *L. Avoid costs of discharge or upgrading outfalls* – excess treated waste water are contributing to meeting outfall capacity. Maximizing recycled water use in North County will reduce the pressures on outfall capacity and associated costs with upgrades and O&M
2. Turf Replacement and Agricultural Irrigation Efficiency Program	San Diego County Water Authority	$1,385,598	$7,348,499	--	$7,348,499	*A. Water conservation*– 45 AFY of water will be conserved through turf replacement with water-wise landscaping *C. Reduced green waste* – 66% reduction in green waste is expected for every lawn replaced with water-wise landscaping. This benefit is associated with reduced trash removal costs *E. Increased recycled water use* – 250 AFY of recycled water use is anticipated through the Agricultural Irrigation Program component, which will reduce imported water demand and the associated energy use and TDS imports *D. Educational benefits*– program participants take online tutorials about water use and water-wise landscaping. Additional educational materials are available on project websites.

Proposal: San Diego IRWM Implementation Grant, Round 2						
Agency: San Diego County Water Authority						
Project	Project Proponent	Total Present Value Project Costs (1)	Total Present Value Project Benefits			Section D2 – Briefly Describe the Main Non-monetized Benefits*
			Section D3 Monetized (2)	Section D4 Flood Damage Reduction (3)	Total	
(a)	(b)	I	(d)	(e)	(f) = (d) + (e)	(h)
						N. Improve water quality – lawn care is often accompanied by high use of fertilizers and pesticides, and require frequent watering. Conversion to water-wise landscaping will reduce increased runoff, which carried nutrients and pesticides into local water systems. *M. Long-term solution* – conservation and use of recycled water reduce potable water demand and help contribute to water independence. Additionally, turf conversion and conversion to recycled water for irrigation provide benefits over the long-run.
3. Rural DAC Partnership Program	Rural Community Assistance Corporation	$4,631,384	$21,832,082	-	$21,832,082	*B. Address critical water quality and water supply needs of DACs* – this program will fund projects that address critical water supply or water quality needs for rural DACs. These communities lack the funds and expertise necessary to implement water projects. *D. Increase water availability for fire protection* – fire is a common concern in the Region, and many of the rural DACs lack sufficient water supplies to meet domestic demand, much less provide surplus water to assist in firefighting efforts. A history of fires in the Region makes this a critical concern. *C. Long-term solutions* – the project partner will assist in providing training for water resources employees to empower communities to provide for their water needs in the future *E. Improve water supply reliability* – many of the rural DACs that could be helped by this program suffer from inadequate or unreliable water supplies marked by a lack of storage and frequent water outages. This program will fund projects to address these problems through infrastructure improvements.
4. Failsafe Potable Reuse at the Advanced Water Purification Facility	WateReuse Research Foundation	$2,697,016	$5,692,561	-	$5,692,561	*C. Expand scientific foundation for potable reuse* – failsafe potable reuse represents a significant opportunity for water recycling and meeting potable demand. As a newer technology, additional information is necessary in order to assess the benefits, risks, and overall feasibility of a full-scale system. *F. Leverage existing research efforts* – this project builds on existing research efforts at the Advanced Water Purification Facility, and utilizes these data to guide design of failsafe treatment trains. It also

Proposal: San Diego IRWM Implementation Grant, Round 2						
Agency: San Diego County Water Authority						
Project	Project Proponent	Total Present Value Project Costs (1)	Total Present Value Project Benefits			Section D2 – Briefly Describe the Main Non-monetized Benefits*
			Section D3 Monetized (2)	Section D4 Flood Damage Reduction (3)	Total	
(a)	(b)	I	(d)	(e)	(f) = (d) + (e)	(h)
						takes advantage of the educational program at the Facility to conduct community outreach and gain community support. *G. Additional statewide water supply* – data from this project will be used to inform State agencies on the safety and feasibility of direct potable reuse. This technology has the potential to address water supply demand throughout the state, and increase water independence throughout the state.
5. Sustaining Healthy Tributaries to the Upper San Diego River and Protecting Local Water Resources	San Diego River Park Foundation	$597,340	$2,875	-	$2,875	*A. Restoration of native habitat* – 4.4 acres will be restored to native habitat following degradation from fire and invasive species. This restoration is expected to provide water quality and habitat benefits in the stream and riparian zone. *F. Scientific knowledge* – data collected through this project can be used to create a baseline for stream health in the watershed, and to assess water quality objectives relevant to similar streams. *G. Community and tribal engagement* – tribes are important local land managers in the project area, and will be worked with closely to monitor water quality and invasive species. Many of the data collection and restoration activities will be conducted by trained volunteers.
6. Chollas Creek Integration Project – Phase II	Jacobs Center for Neighborhood Innovation	$591,454	$38,864	7,953	$46,817	*B. Reduced stormwater runoff* – restoration activities will convert impermeable surfaces to permeable surfaces, reducing runoff through increased infiltration. This leads to a host of benefits including reduced pollutant loading and improved habitat. *H. Community involvement* – This project implements restoration activity identified as meeting community needs and priorities. The design of this project has been community driven, and implementation will further increase community involvement through outreach, education, and volunteer opportunities. *D. Protection of public health* – Arundo removal and homeless encampment clean-ups will reduce risks to public health from sanitation problems, flood, and fire. These activities will also contribute to a safer environment by lowering risks of crime associated with transient access to the creek.

Proposal: San Diego IRWM Implementation Grant, Round 2						
Agency: San Diego County Water Authority						
Project	Project Proponent	Total Present Value Project Costs (1)	Total Present Value Project Benefits			Section D2 – Briefly Describe the Main Non-monetized Benefits*
			Section D3 Monetized (2)	Section D4 Flood Damage Reduction (3)	Total	
(a)	(b)	I	(d)	(e)	(f) = (d) + (e)	(h)
						F. Recreation opportunities – the areas restored through this project will be connected with previously restored areas to create public parkland along the creek. Trails will allow the public to safely experience the creek and its native habitat and provide open space in a disadvantaged neighborhood sorely lacking parkland.
7. Implementing Nutrient Management in the Santa Margarita River Watershed – Phase II	County of San Diego	$1,408,396	$135,008,438	-	$135,008,438	*B. Improved scientific knowledge of the SMR watershed* – data gaps exist to adequately determine appropriate site-specific water quality objectives for the SMR watershed. This project will fill these gaps and provide a complete analysis of water quality and beneficial uses in the watershed, furthering our scientific understanding. *E. Improved water quality and nutrient management* – there is potential that recommended water quality objectives that result from this project will provide for alternate management strategies for nutrient loading management. Improved nutrient management will reduce eutrophication in the water bodies and improve water quality.
Totals		**$33,914,227**	**$348,050,563**	**$7,953**	**$348,058,516**	
Benefit: Cost Ratio					**10.3:1**	
**These are only a selection of the non-monetized benefits. For a full description of all benefits, see each project's benefits in the following section*						

Benefit and Cost Analysis

For each project, a project abstract and project benefit-cost summary table are followed by sections outlined in the PSP: Non-Monetized Benefits Analysis (Section D2), Monetized Benefit Analysis (Section D3), Flood Damage Reduction Benefits Analysis (Section D4) (where applicable), and Project Benefits and Costs Summary (Section D5).

A number of studies and documents have been used to support the projects included in this proposal. These studies and documents have been referenced as footnotes in this attachment, including specific references to the page locations and sections of the studies or documents that support the claims made in this attachment. **Please note that in accordance with guidance from DWR found on Page 11 of the *Proposal Solicitation Package*, the documents referenced in this section have been provided in an electronic format only (on the supporting CD), and are not included within the printed hard copies that have been mailed to DWR.**

Project 1: North San Diego County Regional Recycled Water Project – Phase II

Project Abstract

NSDCRRWP-Phase II represents a coordinated effort between several North San Diego County water and wastewater agencies to maximize recycled water use within the North San Diego County region. The proposed project includes 10 components designed to regionalize recycled water facilities so that agencies with the ability to generate recycled water in excess of local demand (i.e., within their service area) can provide recycled water to areas where additional supplies are needed. Together, the pipelines, pump stations, storage tanks, and interties constructed in this project will produce an estimated 6,790acre-feet per year (AFY) of recycled water. This will directly offset the use of potable supplies imported through the State Water Project (SWP) and the Colorado River Authority (CRA) via the San Diego County Water Authority (Water Authority) and the Metropolitan Water District (MWD).

The water and wastewater agencies participating in this effort include:

- Leucadia Wastewater District (LWD)
- Vallecitos Water District (VWD)
- Vista Irrigation District (VID)
- Rincon del Diablo Municipal Water District (RMWD)
- Olivenhain Municipal Water District (OMWD)
- Santa Fe Irrigation District (SFID)
- Carlsbad Municipal Water District (Carlsbad MWD),
- City of Escondido
- City of Oceanside
- San Elijo Joint Powers Authority (SEJPA)

Table 8-1 provides a summary of the ten project components incorporated into this grant application. For each component, the table shows the primary project proponent and partner agencies, a brief summary of project activities, and the acre-feet per year (AFY) of recycled water that the project will provide. Across all components, primary activities include construction of recycled water transmission pipelines, connection to and extension of existing distribution systems, and upgrades to recycled water facilities to promote additional recycled water production (e.g., upgrade of pumps and storage tanks).

Table 8-2: Summary of NSDCRRWP-Phase II Project Components
North San Diego County Regional Recycled Water Project – Phase II

Project Component	Project Proponents and Partner Agencies[a]	Project Description	AFY
1-1: LWD Regional System Connection	• LWD • OMWD, Carlsbad MWD (will receive recycled water from LWD)	• Construction of 1,200 feet of recycled water pipeline that will connect to existing OMWD pipeline. Installation of a new high pressure pump station at the existing LWD Gafner WRP to facilitate additional recycled water production	250
1-2: VWD Lift Station No. 1 Pump Improvements	• VWD	• Installation of new wastewater pump at VWD Lift Station No. 1 to increase wastewater flows to VWD's Meadowlark Water Reclamation Facility for treatment to tertiary standards • Overhaul of the lift station's electrical package and discharge pipeline to meet increased flow.	300
1-3: VIDGolf Course Recycled Water Project	• VID • Carlsbad MWD (wholesale provider of recycled water)	• Metered connection from a Carlsbad MWD recycled water main to VID's Shadowridge Water Reclamation Facility (SWRF) failsafe pipeline. • Installation of approximately 400 ft of pipeline from the terminus of the failsafe pipe at the SWRF to an existing VID pipeline. • Installation of a 4-inch potable water meter at golf course irrigation pond for supplemental water and blending.	200
1-4: RMWD Northwest Recycled Water Expansion	• RMWD • City of Escondido (source of recycled water).	• Construction of 3,500 feet of recycled water pipeline to serve customers in the northern portion of the District's service area, and open space areas located westerly near Escondido Country Club. • Installation of 1400 feet of recycled water pipeline to connect to a future filling station for construction water use near the Rockhoff Pump Station	16
1-5: OMWD Conversion of Distribution Facilities to Recycled Water	• OMWD • SEJPA, Carlsbad MWD, and LWD (potential sources of recycled water supply).	Construction of up to 26.500 feet of pipeline and a pump station to facilitate conversion of HOA common areas and schools in the Village Park community of Encinitas (in OMWD's Northwest Quadrant recycled water service area) to recycled water.	350
1-6: SFID Onsite Recycled Water Irrigation System Improvements	• SFID • SEJPA (wholesale recycled water supplier).	Final design and construction of onsite recycled water irrigation improvements (retrofits and/or new systems) to connect SFID customers to SEJPA's existing recycled water distribution system.	50

Project Component	Project Proponents and Partner Agencies[a]	Project Description	AFY
1-7: Carlsbad MWD Recycled Water Pipeline Expansion	• Carlsbad MWD • City of Oceanside (will receive recycled water and retrofit conversion of El Camino Country Club golf course and any location within their boundary)	Extend Carlsbad MWD's existing recycled water system north to the El Camino Country Club located in the City of Oceanside. Construction includes 43,300 feet of pipeline. Water would be used for irrigation of two HOAs, two City parks, the Plaza Camino Real, an elementary school, a private golf course driving range, median landscaping, and El Camino Country Club.	454
1-8: Escondido Recycled Water Easterly Main Extension	• City of Escondido	Construction of approximately 5.1 miles of recycled water transmission main to connect agricultural connections to the existing recycled water system.	4,570
1-9: Oceanside Reclaimed Water Main Extension	• City of Oceanside • VID • Carlsbad MWD (provider of recycled water)	Construction of 14,440 ft. of pipeline to extend existing recycled water distribution system. This includes pipeline extension from Faraday (in Carlsbad MWD service area) to Melrose (in VID service area) to serve the Shadowridge Golf Course and two schools, and an extension to the west to serve the Ocean Hills golf course and greenbelt areas in Oceanside service area.	600
1-10: SEJPA Conversion of Existing Tanks to Recycled Water Storage	• SEJPA • OMWD, SDWD (partnering agencies in conversion of the 3MG tank)	Evaluation of two tanks for conversion to recycled water storage, with ultimate conversion of one tank. The first is a 3 MG potable water tank owned by OMWD and San Dieguito Water District. SEJPA provides both districts recycled water and has existing distribution pipelines near the tank. Conversion of this tank would allow expansion of recycled water use to the eastern portions of the City of Encinitas. The second tank is a 1 MG wastewater equalization tank located at the San Elijo Water Reclamation Facility, and would provide recycled water storage for SEJPA's four water purveyors.	*
a. Primary project proponent is listed as the first partner agency			
** Storage for component 1-5*			

Summary Project Benefits and Costs

A summary of all benefits and costs of the project are provided in Table 8-3. A description of the monetized benefits and non-monetized benefits are presented in the following sections, while physically quantified (but not monetized) benefits are described in Attachment 7.

As shown in Table 8-3, the present value (PV) of monetized benefits outweighs the PV costs by a considerable margin. Benefits are lettered for cross-reference with Attachment 7, and are therefore not represented in order in the following sections.

Table 8-3. Benefit-Cost Analysis Overview
North San Diego County Regional Recycled Water Project – Phase II

	Present Value
Costs – Total Capital and O&M	**$22,603,039**
Monetizable Benefits	
A-Avoid Imported Water Supply Purchases	$174,893,215
J-Avoid Fertilizer Costs due to Recycled Water Use	$995,100
C-Reduce Net Production of Greenhouse Gases	$2,238,929
Total Monetizable Benefits	**$178,127,244**
Physically Quantified Benefits	**Project Life Total**
F-Reduce Demand for Net Diversions from the Bay-Delta	407,400 AF
Qualitative Benefit or Cost	**Qualitative Indicator***
B-Avoid Economic Losses Due to Reduced Agricultural Production	+
G-Provide Social Recreation or Access Benefits	+
K-Help Avoid, Reduce or Resolve Various Public Water Resources Conflicts	+
D-Benefit Wildlife or Habitat in Bay-Delta Through Reduced Imports	+
E-Improve Water Quality Through Reduced Imports	+
H-Provide a Long-Term Solution in Place of a Short-Term One	+
I-Improve Water Supply Reliability Due to Use of Local Sources	++
M-Avoid O&M Costs Associated with Ocean Outfall Discharge	+
L-Avoid Costs Associated with Upsizing Escondido Land Outfall	+

* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease net benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Non-Monetized Benefits Analysis (Section D2)

Narrative descriptions of the benefit categories marked "Yes" in DWR's *Proposal Solicitation Package* Table 12 are provided below.

G-Provide Social Recreation or Access Benefits

By switching to recycled water, customers participating in the project will be much less likely to be subject to watering restrictions during times of drought. Thus, open space areas, golf courses, parks, and other recycled water customers that provide recreational or aesthetic services can continue to irrigate their landscape/turf areas regardless of drought conditions (thus remaining green during dry periods). This will improve the aesthetics and enjoyment of these areas and, in extreme cases, may avoid closures that would otherwise be necessary to prevent further turf damage (e.g., on playing fields, parks, and golf courses).

K-Help Avoid, Reduce or Resolve Various Public Water Resources Conflicts

This project helps to meet requirements set forth in California Senate Bill X7-7 (2009), which sets an overall goal for urban water suppliers of reducing per capita water use by 20% by December 31, 2020 (and by at least 10% by December 31, 2015). Under this legislation, the use of recycled water in lieu of potable supplies can be counted as a reduction in per capita use. With the *NSDCRRWP-Phase II*, an additional 6,790 AFY of recycled water will be made available, contributing to the Region's SBx7-7 goal.

This project also helps to meet statewide goals to increase use of recycled wastewater by at least 1 million AFY by 2020 and by at least 2 million AFY by 2030.[1]

B-Avoided Economic Losses Due to Reduced Agricultural Production

C*omponent 1-8: Escondido Recycled Water Easterly Main Extension* will supply a total of 4,570 AF of recycled water to farmers in San Diego County. This water will be used to irrigate up to 870 acres of agricultural land within the Escondido service area (no other components involve the use of recycled water for agricultural irrigation).[2]

Agriculture is a primary component of economic activity in Escondido and San Diego County. Agriculture supports more than $5.1 billion of economic activity in the County[3], with crop value (sales) totaling more than $1.68 billion.[4] The County has the 12th largest farm economy among more than 3000 farm counties in the United States and is the top producer of avocados and nursery crops in the nation.[5]

Within the Escondido component area (870 acres), avocado is the primary crop grown, along with small patches of citrus. In recent years, farmers in the area have been subject to water rate increases on imported water. In 2012, the City of Escondido raised agricultural water rates by 12% in order to cover rising MWD rates and fixed costs associated with their water infrastructure and delivery system. As described in Attachment 7, avocado growers provided figures on average annual irrigation demands for avocados, amounting to 5 AF per acre.[6]

In Escondido, farmers currently pay between $1,200 and $1,300 per acre foot for imported water supplies (their primary source of water).[7] Based on the current cost of imported water and a demand of 5 AF per acre, water costs for avocados can range from $6,000 to $6,500/acre per year.[8] Given an average production of 5,000 lbs of avocados per acre (the average yield in CA for the last 5 years), and a price of $1 per pound, avocado crops are currently valued at approximately $5,000 per acre.[9] Thus, farmers can barely cover their water costs, much less costs associated with labor, supplies, and other inputs.[10] Avocado and other farmers in the region have indicated that further price increases may force them to shut down their operations.[11]

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[1]State Water Resources Control Board. 2009. Recycled Water Policy. Available: http://www.waterboards.ca.gov/water_issues/programs/water_recycling_policy/docs/recycledwaterpolicy_approved.pdf. Accessed March 2013

[2]City of Escondido. *2012. Easterly Recycled Water Main Extension Preliminary Design Report*. August 2012. Page 2-1.

[3] San Diego County Farm Bureau, website: http://sdfarmbureau.org/SD-Ag/Ag-Facts.php, accessed March 14, 2013.

[4]Department of Agriculture, Weights and Measures, County of San Diego. 2012. *2011 Crop Statistics and Annual Report*. Pg. 1.

[5] San Diego County Farm Bureau, website: http://sdfarmbureau.org/SD-Ag/Ag-Facts.php, accessed March 14, 2013.

[6]City of Escondido. *2012. Easterly Recycled Water Main Extension Preliminary Design Report*. August 2012. Page 2-1.

[7]Bender, G. 2012.Avocado Farming with High-Priced Water. Can It Remain Profitable? Tropics in Subtropics – ANR Blogs.

[8]Bender, G. 2012.Avocado Farming with High-Priced Water. Can It Remain Profitable? Tropics in Subtropics – ANR Blogs.

[9]Bender, G. 2012.Avocado Farming with High-Priced Water. Can It Remain Profitable? Tropics in Subtropics – ANR Blogs.

[10]Bender, G. 2012.Avocado Farming with High-Priced Water. Can It Remain Profitable? Tropics in Subtropics – ANR Blogs.

[11]Escondido City Council Meeting minutes, December 14, 2011

Given the high value of avocado and agriculture in general to the San Diego County economy, this would potentially result in substantial economic impacts. Loss of the 870 acres of farmland intended for recycled water service in the Eastern Block would result in $4,350,000 in annual lost crop productivity should those farmers fallow or abandon their crops. The proposed project will help to avoid these losses by providing a much less expensive and more reliable source of water supply for farmers within the Escondido region.

Although this is a substantial benefit for the region, it is not included in benefit cost tables because it is not known how many farmers would go out of business if they do not receive recycled water. It is also not clear how market forces willaffect profitability (i.e., as some farmers leave the market, supply will decrease, and prices may increase for the remaining farmers).

D-Benefit Wildlife or Habitat in Bay-Delta Through Reduced Imports

As members of the Water Authority, the water supply agencies participating in this project receive imported water supplies. Although the Water Authority and its member agencies use a mix of imported water and local sources to supply their customers, imported water is more expensive to provide and is the marginal water source. Thus, reduced overall potable water demand due to increased use of recycled water will be used to reduce reliance on imported water supplies exclusively. Consistent with the mix of Water Authority imported supplies, it is assumed that two-thirds of the recycled water (about 4,700 AF) generated by the proposed project will offset SWP supplies. The remaining one-third (2,350 AF) will offset the use of imported water from the CRA.

By reducing the use of imported SWP water, the *NSDCRRWP – Phase II* will augment in-stream flows in Sacramento-San Joaquin River Delta (which provides the means by which the SWP delivers water from Northern California tothe south) or will offset other diversions that may otherwise reduce flows. Reduced demands on Delta supplies also will help reduce the overall salinity of the Delta and improve Delta habitat.

E-Improve Water Quality Through Reduced Imports

SWP water has a number of water quality constituents that affect its suitability as a drinking water source. SWP water contains relatively high levels of bromide and total organic carbon (TOC), two elements that are of particular concern to drinking water agencies. Bromide and TOC combine with chemicals used in the water treatment process to form disinfection byproducts (DBPs) such as trihalomethanes (THMs) and bromate. Currently, there are no standards for bromide or TOC in drinking water. However, current levels of bromide and TOC are significantly higher than target levels identified by an expert panel hired by the California Urban Water Agencies. These levels are 50 parts per billion (ppb) for bromide and 3 parts per million (ppm) for TOC. Average SWP levels are significantly higher: up to 600% above the target level for bromide and 10% above the target level for TOC.[12]

Water agencies treat all water to meet stringent state and federal drinking water standards before delivering it to their customers. However, poor-quality source water makes it increasingly expensive and difficult to meet such standards. Increased levels of constituents that aid in the formation of THMs, bromate, and other DBPs of public health concern can mean more time spent monitoring finished water in the distribution system, and the need to increase the use of expensive water treatment and disinfection processes. Increased levels of these constituents may also lead to the use of increased proportions of groundwater in the blend of water supplies in order to control THMs. However, reduced imports of SWP water will reduce the need for such preventative measures.

F-Reduce Demand for Net Diversions from the Bay-Delta

As members of the Water Authority, the water supply agencies participating in this project receive imported water supplies. SDCWA purchases this water from MWD, which obtains its water from two sources: the CRA, which it owns and operates, and the SWP, with which MWD has a water supply

[12]Owen, D.M., P.A. Daniel, and R.S. Summers. 1998. Bay-Delta Water Quality Evaluation Draft Final Report. California Urban Water Agencies.D.M. Owen, Malcolm Pirnie, Inc.; P.A. Daniel, Camp, Dresser and McKee; and R.S. Summers, University of Cincinnati (Expert Panel).Prepared by California Urban Water Agencies. June.

contract through the state of California. Imported water purchases from MWD account for about 80% of SDCWA supplies. About two-thirds of this water is imported through the SWP, while the remainder comes from the CRA.[13]

The Water Authority and its member agencies use a mix of imported water and local sources to supply their customers. Reduced overall potable water demand due to increased use of recycled water will be used to reduce reliance on imported water supplies. Consistent with the mix of Water Authority imported supplies, it is assumed that two-thirds of the recycled water (about 4,700 AFY) generated by the proposed project will offset SWP supplies. This will augment in-stream flows in the Delta or will offset other diversions that may otherwise reduce flows.

H-Provide a Long-Term Solution in Place of a Short-Term One

The availability of imported water is subject to a number of natural and human forces, ranging from increased population growth (and accompanying increased demands), to drought, changes in snowpack and earthquakes, to environmental regulations, water rights determinations, and associated legal challenges and Court rulings. Local groundwater is also limited in some areas of North San Diego County, highlighting the need for additional reliable sources of water to meet current and future demands under all hydrologic conditions. The proposed project offers a drought-resistant water supply source and long-term solution that will reduce continued reliance on unsustainable water supply sources.

I-Improve Water Supply Reliability Due to Use of Local Sources

The reliability of a water supply refers to its ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. The proposed project will help address reliability issues for Northern San Diego County water supply agencies by offsetting the use of imported water delivered by the Water Authority. As noted above, the reliability of imported water is subject to a number of natural and human forces, ranging from increased population growth (and accompanying increased demands), to drought and earthquakes, to environmental regulations and water rights determinations.

Although interest in water supply reliability is increasing (e.g., due to increasing water demands and concerns over climate-related events), only a few studies have directly attempted to quantify its value (i.e., through nonmarket valuation studies). The results from these studies indicate that residential and industrial (i.e., urban) customers seem to value supply reliability quite highly. Stated preference studies find that water customers are willing to pay $100 to more than $500 per household per year for total reliability (i.e., a 0% probability of their water supply being interrupted in times of drought).

The challenge in applying these values to determine a value of increased reliability as a result of *NSDCRRWP-Phase II* is recognizing how to reasonably interpret these survey-based household monetary values. The values noted above reflect a willingness to pay per household to ensure complete reliability (zero drought-related use restrictions in the future), whereas *NSDCRRWP-Phase II* only enhances overall reliability and does not guarantee 100% reliability. Thus, if applied directly to the number of households within the Water Authority service area, the dollar values from the studies would overstate the reliability value provided by the project.

A simple way to roughly adjust for this “whole versus part” problem is to attribute a portion of the total value of reliability to the portion of the problem that is solved by the project. To adjust for the partial improvement in reliability from *NSDCRRWP-Phase II*, it is assumed that household willingness to pay for improved reliability is directly proportional to the amount of recycled water that will offset imported water, as a percentage of the total potable water supply. This represents the percentage of total supply that has been improved in terms of overall reliability (i.e., by offsetting imported water demand with local sources).

For example, the project will offset more than 6,790 AFY of imported water. The Water Authority’s *2010 Urban Water Management Plan* reports that total imported water demand in 2010 for the ten agencies in this project was approximately 107,552 AF, which is projected to increase to 132,520 AF by 2020.[14]

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[13]Equinox Report. 2010.*San Diego’s Water Sources: Assessing the Options*, July 2010.

[14]San Diego County Water Authority. 2011. *2010Urban Water Management Plan*. Page 2-14.

Therefore, in 2020, about 5.1% of total imported water demand will be met by recycled water made available by this project. To obtain a lower bound estimate for the value of improved reliability associated with this water, it is assumed that households within the collective service areas are willing to pay about $5.10 per year for improved reliability of supplies ($100 multiplied by 5.1%). Applying this per household dollar value to the approximately 280,457 households within the collective service areas in 2020[15] would result in $1,430,330 of benefits. Taking into account increasing population and changing demands, this calculation could be completed for each year of the project's useful life.

Due to the uncertainty involved in applying these numbers to this situation, this benefit estimate is not included in the tables. However, it is provided here to give an idea of the potential magnitude of this benefit.

L-Avoid Costs Associated with Upsizing Escondido Land Outfall

The City of Escondido owns and operates its own treatment and disposal facility. The City's Hale Avenue Resource Recovery Facility (HARRF) treats influent from Escondido and the City of San Diego's Rancho Bernardo Community. Wastewater effluent from the plant is discharged to the Escondido Land Outfall, which ultimately connects to the San Elijo JPA ocean outfall.[16]

Based on the City's 2009 *Indirect Potable Reuse Feasibility Study*[17], projected wet weather flow through the Escondido Land Outfall is expected to be 49.0 mgd in 2030. Current capacity at the outfall is about 23.7 mgd. Thus, in order to avoid exceeding the Escondido Land Outfall capacity, at least 25.3 mgd of HARRF effluent will need to be diverted to another method of disposal (e.g., recycled water use) during wet weather months (January through March). During dry weather months (April through December), it is estimated that 3.8 mgd will need to be diverted to another method of disposal or used as recycled water in order to avoid expanding the capacity of the outfall. Thus, an average of 9.18 mgd, or 10,277 AFY, will need to be produced throughout the year in order to avoid expanding capacity.

The Escondido component (*Component 1-8: Escondido Recycled Water Easterly Main Extension*) will generate 4,570 AFY of recycled water, or about 44% of the total 10,277 AFY needed to avoid expanding the land outfall[18]. The City estimates that expanding the outfall will cost about $400 million. Attributing 44% of this cost to the Escondido component would result in total avoided costs associated with the project of about $178 million.

This benefit is included as a non-monetized benefit because the $400 million estimate is a rough estimate that was calculated for the purposes of a grant application for indirect potable reuse. No specific source for this estimate can be found. In addition, it is not known exactly when the outfall would need to be built. Therefore, the present value of this benefit was not calculated.

M-Avoid O&M Costs Associated with Ocean Outfall Discharge

Without the project, North San Diego County water and wastewater agencies would continue to discharge 6,790 AFY of wastewater effluent (treated to secondary standards) through various local outfalls, including three ocean outfalls (Oceanside, Encina, and SEJPA ocean outfalls) and 1 land outfall (the Escondido land outfall, which ultimately connects to the SEJPA ocean outfall). With the project, the effluent is treated to tertiary standards and used as recycled water. Discharge of 6,790 AFY through the outfalls, and associated costs, are therefore avoided as a result of the project.

The O&M costs associated with pumping treated wastewater (if it were not recycled) through the Escondido Land Outfall and/or one of the three ocean outfalls would be avoided with the project. Recycled water customers are generally within close proximity of treatment plants. Pumping costs associated with recycled water are therefore typically lower than pumping costs associated with

[15] Estimate calculated based on the projected 2020 population documented in the 2010 UWMP for each agency. Population was divided by 2.79 persons per household (based on Census data for San Diego County) to obtain household estimate.

[16] City of Escondido.2011, *2010 Urban Water Management Plan*.

[17] Brown and Caldwell. 2009. *Indirect Potable Reuse Feasibility Study.* July 22, 2009.

[18] This analysis assumes that recycled water can be stored during the winter months in order to accommodate daily flows at the outfall.

discharging to the ocean outfalls due to far shorter pumping/transport distances. However, these distances and associated pumping requirements have not been accurately quantified. This benefit is therefore included as a non-monetized benefit for this analysis.

Monetized Benefit Analysis (Section D3)

A-Avoid Imported Water Supply Purchases

By expanding the use of recycled water within Northern San Diego County, this project will directly offset the use of 6,790 AFY of imported water provided to the participating agenciesby Water Authority. The Water Authority is the water wholesaler to water agencies in San Diego County, and purchases water through the Metropolitan Water District (MWD). MWD obtains its water from two sources: the Colorado River Aqueduct, which it owns and operates, and the SWP, with which MWD has a water supply contract through the state of California. Currently, imported water purchases from MWD account for about 59% (331,825 AF) of Water Authority supplies.[19]

Although SDCWA and its member agencies use a mix of imported water and local sources to supply their customers, imported water is more expensive to provide than most sources, and it is not considered to be a very reliable source of supply (see I-Improve Water Supply Reliability Due to Use of Local Sources). For this analysis, imported water is therefore considered the marginal water source for North San Diego County water supply agencies. Thus, reduced overall water demand due to increased use of recycled water will be used to reduce reliance on imported water supplies exclusively.

To calculate the avoided costs of imported water over time, the amount of imported water avoided each year is multiplied by the projected cost of imported water. For this analysis, it is assumed that the project will avoid Tier 1 treated MWD water supplies because this is the primary source of water obtained by the participating agencies and the extent of Tier 2 versus Tier 1 future usage is unknown. In 2012 and 2013, the cost of Tier 1 treated water for SDCWA retail customers amounted to $1,148 and $1,259 per AF of water delivered, respectively.

In recent years, annual MWD rate increases have averaged about 6% in nominal terms (i.e., including inflation). For this analysis, we assume that the cost of imported supplies will continue to increase at this rate through 2020 based on MWD's current and planned financial commitments. After adjusting for annual inflation of about 2.5%[20], the cost of imported water is therefore expected to increase annually by 3.5% in real terms over this time period. Beginning in 2021, a 1.5% annual real increase in water rates is assumed through the end of the project life. Appendix X provides additional documentation on the avoided imported water costs and escalation rates assumed for this analysis.

Given the construction schedule for the ten components incorporated into *NSDCRRWP-Phase II*, the overall project will avoid a total of 407,400 AF of imported water over the expected 60-year project life. Based on the assumptions described above and applying a discount rate of 6% (per DWR's PSP Guidelines), total present value benefits associated with the avoided purchase of this water amounts to $174,893,215 a 60-year project life.

J-Avoid Fertilizer Costs Due to Recycled Water Use

Fertilizing compounds commonly present in recycled water (e.g., nitrogen, phosphorus, potassium) are typically not found in potable water at levels of significance. Thus, the use of recycled water for landscape irrigation will reduce fertilizer costs associated with the properties that will be serviced by the project.

The exact offset of fertilizer use from using recycled water is difficult to predict due to daily and seasonal nutrient variations in the recycled water. However, the amount of nutrients (i.e., pounds of fertilizer) per AF of recycled water can be calculated from average (tertiary-treated) effluent values for the City of Escondido's HARRF which will produce a majority of the project supply. The HARRF permit limitation for

[19] San Diego County Water Authority. 2011. *2010Urban Water Management Plan*. Page 6-1, Section 6, Metropolitan Water District of Southern California.

[20] Based on long-range Consumer Price Index (CPI) projections from the Federal Reserve Bank of Philadelphia of 2.3% per year, for 2013 through 2022.

nitrate ($N0_3$ as N) is 10 mg/L and the reported 12-month average is 8.66 mg/L.[21] Thus, for every AF of recycled water used in lieu of potable water, recycled water customers will avoid the use of a total of 23.6 lbs of fertilizer (8.66 mg/L divide by 453,592 mg/pound times 1,233,481.84 Liter/AF = 23.6 lbs/AF). The weighted average commercial value of this fertilizer is $0.46/lb.[22]

For the 6,790 AF of recycled water applied each year in lieu of imported water, recycled water customers serviced by the project will avoid the use of 160,244 lbs/year of fertilizer. This will result in avoided costs of $73,712 annually (undiscounted)[23]. Over the 60-year lifetime of the project, total present value avoided fertilizer costs will amount to $995,100. Additional benefits would be expected for avoided fertilizer costs due to increased levels of phosphorus and potassium in recycled water compared to potable supplies.

C-Reduce Net Production of Greenhouse Gases

As described in Attachment 7, reduced reliance on imported water will avoid the extensive energy requirements associated with transporting water from Northern California and the Colorado River to San Diego County. This in turn will result in avoided CO2 emissions (a GHG) associated with the production of this energy.

To calculate avoided CO2 emissions with the project, we multiplied the amount of energy required to treat and convey 6,790 AF of water (2.65 MWh/AF[24]) by the average carbon emissions rate associated with energy production in California (0.354 MT/MWh). We performed the same calculation for recycled water (using an average energy use of 0.800 MWh/AF[25]). This provided us with the annual net reduction in CO2 emissions resulting from the project. By avoiding 6,790 AFY of imported water (at full implementation), the project will result in a net reduction in CO2 emissions of 4,447 MT per year. Given the schedule for project construction (with some benefits beginning to accrue in 2014), total net CO2 emissions reductions amount to 266,833 MT over the 60-year project life.

To monetize this benefit, we applied the dollar value assigned to greenhouse gas (GHG) emissions, measured in carbon dioxide equivalent (CO2e). The social cost of carbon is estimated as the aggregate net economic value of damages from climate change across the globe, and is expressed in terms of future net benefits and costs that are discounted to the present.[26] In February 2010, the U.S. Government's Interagency Working Group on Social Cost of Carbon issued guidance[27] on recommend values for the social cost of carbon for use in regulatory benefit-cost analysis. The recommended mean estimate of the social cost of reducing one metric ton (MT) of CO2 in 2012 is $22.53/MT(updated from 2010 values using CPI), with a range of values from $4.95 to $68.33 per MT. The recommended mean estimate of the social cost of carbon reflects the worldwide net benefits of reducing CO2 emissions. Estimates of the portions of the net benefits occurring in the United States range from 7% to 23% of the worldwide social cost of carbon.

For this analysis, the average value of $22.53/MT was used when calculating social benefits and costs, which produces conservative estimates for the benefits and costs associated with GHG emissions. To determine total costs over the 60-year project period, we escalate the social cost of carbon by 2.4% per

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[21]City of Escondido. 2011. *City of Escondido Recycled Water Master Plan*. June. Appendix A, page D-4 and D-6.

[22] This represents the average weighted cost of nitrogen and phosphorus. Source: Asano, 1981, updated to 2006 using the national fertilizer price index. Updated from 2006 to 2012 based on the Consumer Price Index (CPI).

[23] Numbers do not add exactly due to rounding.

[24]Equinox Center. 2010. *San Diego's Water Sources: Assessing the Options*, July 2010. pg. 10

[25]Equinox Center. 2010. *San Diego's Water Sources: Assessing the Options*, July 2010. pg. 10

[26]IPCC. 2007. Summary for policymakers. In *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change,* M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden, and C.E. Hanson (eds.). Cambridge University Press, Cambridge, UK. pp. 7–22.

[27]Interagency Working Group. 2010. Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866. Interagency Working Group on Social Cost of Carbon, United States Government.February. Available: www.epa.gov/oms/climate/regulations/scc-tsd.pdf. Accessed 7/13/2011.

year, which is above the general rate of inflation. The social cost of carbon will increase in future years because CO2 will produce larger incremental damages as physical and economic systems become more stressed in responding to greater climate change.

Over the 60-year project life, total present value benefits associated with avoided social costs of carbon amount to $2,238,929.

Summary of Monetized Benefits

Table 8-4 summarizes the annual benefits from the project, including: avoided imported water supply costs, avoided fertilizer costs, and reduced social costs associated with CO_2 emissions.

Table 8-4: Annual Benefits (PSP Table 15)
North San Diego County Regional Recycled Water Project – Phase II

Annual Benefit (All benefits should be in 2012 dollars)									
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**	**Unit $ Value (1)**	**Annual $ Value (1) (f) x (g)**	**Discount Factor (1)**	**Discounted Benefits (1) (h) x (i)**
2014	Imported water supply	AF	36	0	36	$1,303	$46,911	0.890	**$41,750**
	Fertilizer use	lbs	842	0	842	$0.46	$387	0.890	**$345**
	Reduction in GHG production	MT	23	0	23	$23.62	$553	0.890	**$492**
2015	Imported water supply	AF	912	0	912	$1,349	$1,229,994	0.840	**$1,032,727**
	Fertilizer use	lbs	21,519	0	21,519	$0.46	$9,899	0.840	**$8,311**
	Reduction in GHG production	MT	597	0	597	$24.19	$14,447	0.840	**$ 12,130**
2016	Imported water supply	AF	5,364	0	5,364	$1,396	$7,487,507	0.792	**$5,930,806**
	Fertilizer use	lbs	126,594	0	126,594	$0.46	$58,233	0.792	**$46,126**
	Reduction in GHG production	MT	3,513	0	3,513	$24.77	$87,031	0.792	**$68,937**
2017	Imported water supply	AF	6,582	0	6,582	$1,445	$9,509,259	0.747	**$7,105,871**
	Fertilizer use	lbs	155,327	0	155,327	$0.46	$71,450	0.747	**$53,392**
	Reduction in GHG production	MT	4,311	0	4,311	$25.37	$109,350	0.747	**$81,713**
2018 - 2073	Imported water supply	AF	6,790	0	6,790	Variable	Variable	Variable	**$159,442,478**
	Fertilizer use	lbs	160,244	0	160,244	$0.46	$73,712	Variable	**$882,900**
	Reduction in GHG production	MT	4,447	0	4,447	Variable	Variable	Variable	**$2,051,490**
2074	Imported water supply	AF	6754	0	6,754	$3,579	$24,173,369	0.027	**$652,189**
	Fertilizer use	lbs	159402	0	159,402	$0.46	$73,325	0.027	**$1,978**
	Reduction in GHG production	MT	4423.85	0	4,424	$98.03	$433,670	0.027	**$11,700**
2075	Imported water supply	AF	5878	0	5,878	$3,633	$21,353,632	0.025	**$543,503**
	Fertilizer use	lbs	138725	0	138,725	$0.46	$63,814	0.025	**$1,624**
	Reduction in GHG production	MT	3849.99	0	3,850	$100.38	$386,472	0.025	**$9,837**
2076	Imported water supply	AF	1426	0	1,426	$3,687	$5,258,087	0.024	**$126,256**

Annual Benefit (All benefits should be in 2012 dollars)									
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**	**Unit $ Value (1)**	**Annual $ Value (1) (f) x (g)**	**Discount Factor (1)**	**Discounted Benefits (1) (h) x (i)**
	Fertilizer use	lbs	33650	0	33,650	$0.46	$15,479	0.024	**$372**
	Reduction in GHG production	MT	933.87	0	934	$102.79	$95,994	0.024	**$2,305**
2077	Imported water supply	AF	208	0	208	$3,743	$778,462.31	0.023	**$17,634**
	Fertilizer use	lbs	4917	0	4,917	$0.46	$2,262	0.023	**$51**
	Reduction in GHG production	MT	136.45	0	136	$105.26	$14,363	0.023	**$325**
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$178,127,244**

Project Benefits and Costs Summary (Section D5)

Project Economic Costs

Total capital costs for the project amount to $19,150,228. Direct construction and implementation costs account for $18,849,668 (about 98%) of total project costs. Project administration, planning, design, environmental documentation and compliance, and mitigation costs account for the remainder of the capital budget. In addition to the project capital costs borne by the project proponents, agricultural customers receiving recycled water from the Escondido subproject will pay to connect to the recycled water system. The project proponent estimates that these costs will amount to $2,160,000 based on assumed pipe size of 8-inch (main lines from tank) and 4-inch (lines to extent of agricultural properties). This is included as an additional project cost for the purposes of this analysis and assumes the agricultural connections are constructed immediately after completion of the recycled water main extension to take advantage of lower recycled water rates.

O&M costs associated with the various subprojects will total about $281,758 per year. Based on the planning criteria included in the *North San Diego County Regional Recycled Water Project Facilities Plan*, annual O&M costs for pipeline and pressure reducing stations are assumed to equal 1% of capital costs and O&M costs for pump stations are assumed to equal 5% of capital costs.[28] O&M would include staff costs for operation (e.g., exercising valves) and maintenance, including both staff costs and purchase of materials (e.g., grease or oils for motors, floats for PRVs). In addition, the VWD and OMWD components will both require periodic replacement costs associated with the pumps being installed as part of these projects. These costs will amount to $451,023 and $748,500, respectively, and will be incurred every 15 years.

Table 8-5 shows the capital and O&M costs associated with each component of the overall *NSDCRRWP-Phase II* project.

[28]RMC Water & Environment.2012. *North San Diego County Regional Recycled Water Project Facilities Plan*.May.Appendix B.

Table 8-5: Total Costs for NSDCRRWP-Phase II
North San Diego County Regional Recycled Water Project – Phase II

Component	Facility	Total Capital Cost	Total O&M (annual)	Replacement Costs (every 15 yrs)
1-1: LWD Regional System Connection	Pipe	2,000,000	20,000	-
1-2: VWD Lift Station No. 1 Pump Improvements	Pump	451,023	22,551	451,023
1-3: VID Golf Course Recycled Water Project	Pipe	799,000	7,990	-
1-4: RMWD Northwest Recycled Water Expansion	Pipe	572,806	5,728	-
1-5: OMWD Conversion of Distribution Facilities to Recycled Water	Pipe	3,569,300	35,693	-
	Pump	748,500	37,425	748,500
1-6: SFID Onsite Recycled Water Irrigation System Improvements	Pipe	347,500	3,475	-
1-7: Carlsbad MWD Recycled Water Pipeline Expansion	Pipe	3,283,871	32,839	-
1-8: Escondido Recycled Water Easterly Main Extension	Pipe	4,489,200	44,892	
1-9: Oceanside Reclaimed Water Main Extension	Pipe	2,116,527	21,165	-
1-10: SEJPA Conversion of Existing Tanks to Recycled Water Storage	Tank	471,941	50,000	-
Subtotal		**18,849,668**	**281,758**	**1,199,523**
Design and Administration		**300,560**		
Total Project Costs		**19,150,228**		

In total, the present value capital and O&M costs associated with the project amount to $22,603,039 over the 60-year project life. Table 8-6 summarizes the economic project costs for the project

Table 8-6: Total Project Cost Schedule
North San Diego County Regional Recycled Water Project – Phase II

Year	NSDCRRWP-Phase I	NSDCRRWP-Phase II (this work plan)	Agricultural Connections
2011	$500,000		
2012	$500,000		
2013	$500,000	$766,009	
2014	$500,000	$5,745,068	
2015		$8,617,603	
2016		$3,830,046	
2017		$191,502	
2018			$1,080,000
2019			$1,080,000
Total	**$2,000,000**	**$19,150,228**	**$2,160,000**

Table 8-7: Annual Costs (PSP Table 19)

North San Diego County Regional Recycled Water Project – Phase II

Table 19 – Annual Costs of Project										
(All costs should be in 2012 Dollars)										
	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost[1]	Annual Costs [2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2013	$766,009			$1,909				$767,918	0.943	$724,451.28
2014	$5,745,068			$33,458				$5,778,526	0.890	$5,142,867.38
2015	$8,617,603	$1,440,000		$152,870				$10,210,473	0.840	$8,572,910.41
2016	$3,830,046	$720,000		$263,038				$4,813,084	0.792	$3,812,413.50
2017	$191,502			$279,705				$471,207	0.747	$352,113.18
2018-2030				$283,038				$283,038	Variable	$1,872,366
2031				$283,038		$451,023		$734,061	0.331	$242,616.78
2032				$283,038		$748,500		$1,031,538	0.312	$321,638.49
2033-2046				$283,038				$283,038	Variable	$820,307
2047				$283,038		$451,023		$734,061	0.130	$95,505.19
2048				$283,038		$748,500		$1,031,538	0.123	$126,611.80
2049-2062				$283,038				$283,038	Variable	$322,911
2063				$283,038		$451,023		$734,061	0.051	$37,595.26
2064				$283,038		$748,500		$1,031,538	0.048	$49,840.26
2065-2073				$283,038				$283,038	Variable	$93,016
2074				$279,697				$279,697	0.027	$7,546.12
2075				$236,654				$236,654	0.025	$6,023.43
2076				$78,767				$78,767	0.024	$1,891.33
2077				$18,333				$18,333	0.023	$415.30
Total Present Value of Discounted Costs (Sum of Column (j)) Transfer to Table 17, column (c), Proposal Benefits and Costs Summaries										**$22,603,039**

Benefits and Costs Summary

As shown in Table 8-4 above, the total present value benefits associated with the *NSDCRRWP – Phase II* amount to $178,127,244 over the expected 60-year lives of the various project components. The total present value cost of the project (including capital and O&M costs) is $22,603,039. The proposed project will therefore result in total present value net benefits of $155,524,205.

Total monetized benefits include avoided imported water supply costs, avoided fertilizer costs, and reduced social costs associated with CO2 emissions. In addition to monetized benefits and costs, the proposed project will also result in the non-monetized benefits associated with avoided economic losses due to agricultural production, social recreation/access benefits due to recycled water customers being able to irrigate during times of drought, helping to meet state mandates associated with water recycling, reduce demand for net diversions and associated benefits to wildlife or habitat by reducing stress on the Bay-Delta ecosystem, avoided costs associated with upsizing Escondido Land Outfall, and avoided O&M costs associated with ocean outfall discharge.

Omissions, Biases, and Uncertainties

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biasesassociated with monetizing these benefits. In this analysis, the main uncertainties are associated with avoided imported water supply purchases, avoided fertilizer costs, and reduced social costs associated with CO2 emissions. These issues are listed in Table 8-8

Table 8-8. Omissions, Biases, and Uncertainties, and Their Effect on the Project
North San Diego County Regional Recycled Water Project – Phase II

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
A-Avoid Imported Water Supply Purchases	-	Benefits associated with avoided imported water are dependent on full use of the 6,790 AF made available by the project. If less recycled water is used, benefits will decrease proportionately.
A-Avoid Imported Water Supply Purchases	U	The calculation of avoided imported water costs assumes that MWD water rates will increase annually (in real terms) by 3.5% through 2020. Beyond 2020, a 1.5% real increase in water rates is assumed. These projections are based on existing and planned MWD financial commitments and recent increases in MWD rates. It is uncertain whether actual future rate increases will be above or below these assumed rate increases.
C-Avoid Fertilizer Costs due to Recycled Water Use	-	This benefit is dependent on the knowledge and behavior of the landscape manager, as well as the use of the recycled water provided by this project exclusively for irrigation. If the landscape manager does not reduce fertilizer use on a 1:1 ratio with the increased nutrients in the recycled water, then this benefit will be reduced. In addition, if less recycled water is used for irrigation than the full 6,790, then less fertilizer use will be avoided.
Avoided Social Costs of CO2 Emissions	U	The estimate used to calculate the value of reduced carbon emissions represents the mid-point of estimates from the literature. The true social cost of carbon may be higher or lower than the estimate used here.

*Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
— = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Project 2: Turf Replacement and Agricultural Irrigation Efficiency Program

Project Abstract

The *Turf Replacement and Agricultural Irrigation Efficiency Program* will provide financial incentives, technical assistance, on-site support and guidance, training, and resource lists to encourage and support projects that improve irrigation efficiency and reduce water use in urban landscapes and agricultural lands. There are two components of this program:

1. *Turf Replacement Program*: Turf replacement s will be incentivized through cash rebates once projects are completed according to program guidelines. The San Diego County Water Authority (Water Authority) will manage the overall grant and administer the incentive program for customers participating throughout its service area, except for those customers located within the City of San Diego's (City's) service area. The City of San Diego Public Utilities Department (Water Conservation Program) will administer the incentive program for customers within its own service area and service areas for which it supplies wholesale water such as Coronado and Imperial Beach, and the City of San Diego Transportation & Storm Water Department (Think Blue/Storm Water Pollution Prevention Program) will provide education and outreach regarding the incentive program with an emphasis on dry weather runoff prevention and water quality protection that are achieved with improvements to irrigation efficiency within the City. This program component has been implemented by the Water Authority and the City for several years, and is ready for continued implementation.

2. *Agricultural Irrigation Efficiency Program*: The Water Authority will also administer a program component that provides incentives for agricultural customers to retrofit on-site potable irrigation systems to increase water use efficiency. This program will provide incentives to retrofit potable water irrigation systems to recycled water irrigation systems. This program component has been designed, and is ready for implementation.

The financial incentives, training, and education that are the main components of this program will encourage customers to replace turf grass and upgrade irrigation systems in urban landscapes and increase water use efficiency in the agricultural sector. This program is designed to reduce regional water demands, reduce energy consumption via reduced water demands (considering the energy required for water use), reduce green waste production, and improve surface water quality. Reducing outdoor water use and increasing irrigation efficiency in both agricultural and urban sectors also helps to minimize dry weather runoff that flows into storm drains and receiving waters, and reduces pollutants that contribute to the impairment of watersheds.

Summary Project Benefits and Costs

A summary of all benefits and costs of the project are provided in Table 8-19. Monetized benefits and non-monetized benefits are presented in this attachment, while physically quantified (but not monetized) benefits are described in Attachment 7.Benefits are lettered for cross-reference with Attachment 7. Benefits are lettered for cross-reference with Attachment 7, and are therefore not represented in order in the following sections.

Table 8-9. Benefit-Cost Analysis Overview
Turf Replacement and Agricultural Irrigation Efficiency Program

	Present Value
Costs – Total Capital and O&M	**$1,385,598**
Monetizable Benefits	
F. Avoid Imported Water Supply Purchases	$7,076,469
B. Avoid Surface Water Treatment	$57,783
I. Reduce Net Production of Greenhouse Gases	$89,901
L. Avoid Fertilizer Costs	$105,385
Total Monetizable Benefits	**$7,348,499**
Physically Quantified Benefit or Cost	**Project Life Total**
A. Water Conservation	900 Acre-Feet
C. Reduced Trash Removal Cost Through Reduction in Green Waste	9% reduction in solid waste
J. Reduce Net Diversions from the Bay-Delta	8,978 Acre-Feet
E. Increase Recycled Water Use	12,500 Acre-Feet
H. Helps Meet Existing State Mandates	295 AFY
Qualitative Benefit or Cost	**Qualitative Indicator***
D. Provides Education or Technology Benefits	+
K. Benefits Wildlife and Habitat	+
N. Improve Water Quality	++
M. Provide a Long-Term Solution in Place of a Short-Term One	+
G. Improved Water Supply Reliability	

* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease net benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Non-Monetized Benefits Analysis (Section D2)

Narrative descriptions of the benefit categories marked "Yes" in DWR's *Proposal Solicitation Package* Table 12 are provided below.

D. Provides Education or Technology Benefits

City of San Diego Transportation & Storm Water Department (Think Blue/Storm Water Pollution Prevention Program) will provide education and outreach regarding the *Turf Replacement and Agricultural Irrigation Efficiency Program* with an emphasis on dry weather runoff prevention and water quality protection that are achieved with improvements to irrigation efficiency within the City. There is an additional online turf replacement study guide for those who wish to view the information, regardless of whether or not they are participating in these rebate programs. In addition to providing water savings quantified in Attachment 7, this educational outreach program can educate water customers on a variety of water use efficiency measures and lead them to other water conservation initiatives.

H. Helps Meet Existing State Mandate

Both program components help the Water Authority to achieve potable water demand reduction goals set out in SBX7-7. Numerous factors causing water scarcity in the region have forced water resource planners to set a target of a 20% reduction in potable water consumption by 2020. Water conservation stemming from these programs directly helps that goal, in addition to a goal of 10% reduction by 2015. The Water Authority's 2010 *Urban Water Management Plan* determines that its member agencies must

reduce potable water demands by -15,386 AF by 2015 and -76,705 AF by 2020.[29] The *Turf Replacement and Agricultural Irrigation Efficiency Program*savings comprise 1.92% of the 2015 target and 0.38% of the 2020 target.

Water conserved through the *Turf Replacement and Agricultural Irrigation Efficiency Program* directly offsets imported water supplied by MWD from SWP and CRA sources. While reliance on MWD supplies has been replaced by IIDand canal lining transfers, as well as local sources, MWD imports still comprise over half of all water supply and are the marginal source of water for the Water Authority's service area. Since both the SWP and CRA water sources (the Bay-Delta and Colorado River, respectively) are major sources of many water-related activities in addition to water supply, offsetting imports from them will help to decrease regional water-demand stress on scarce water resources.

K. Benefits Wildlife or Habitat

Reductions in over-irrigation have additional habitat benefits due to reduced pollution. Estuarial and other aquatic habitat may be protected by decreasing the irrigation water that brings pesticides, organic waste and other elements into the waterways via the storm drain system. By decreasing the amount of irrigation water that enters the storm drain system (bringing with it pesticides, organic waste and other elements into our waterways) a reduction in harmful chemicals emitted into waterbodies is anticipated. Since the Water Authority's service area is highly populated with residential units, especially within the City of San Diego itself, local bodies of water and the plants and animals that depend upon them are especially vulnerable to fertilizers and other highly-used chemicals. By replacing turf and upgrading urban irrigation systems, there will be reduced levels of applied fertilizers and pesticides, and less use of water required to irrigate and then produce runoff from these areas.

This project will provide additional habitat benefits by promoting native species. By replacing turf in urban areas, customers are removing a non-native species and planting water-wise varieties that are native to the area and the climate.

The SWP relies on diversions from the Bay-Delta to provide water to numerous agricultural, residential, and commercial customers, including those served by the Water Authority. By reducing the use of imported SWP water, the *Turf Replacement and Agricultural Irrigation Efficiency Program* will augment in-stream flows in the Delta (which provides the means by which the SWP delivers water from Northern California tothe south) or will offset other diversions that may otherwise reduce flows. Reduced demands on Delta supplies also will help reduce the overall salinity of the Delta and improve Delta habitat.

N. Improves Water Quality

Water conservation directly inhibits watershed pollution by reducing urban runoff. Urban irrigation runoff can include pollutants such as chemicals and bacteria, which can flow from urban landscapes into existing water bodies. The San Diego Regional Water Quality Control Board (RWQCB), in collaboration with the U.S. Environmental Protection Agency (USEPA), identified the San Diego Region water bodies on the 2010 California 303(d) List of Water Quality Limited Segments.[30] The 303(d) list includes approximately 440 water bodies within the San Diego RWQCB (Region 9) jurisdiction. The *Water Quality Control Plan for the San Diego Basin* (Basin Plan) notes that highways, agricultural fields and orchards, residential and urban areas, and septic tank disposal systems contribute non-point source pollution, including nutrients, as a result of storm water runoff, irrigation return flows, and ground water contributions.[31]Estuarial and other aquatic habitat may be protected by decreasing the irrigation water that brings pesticides, organic waste and other elements into the waterways via the storm drain system. By decreasing the amount of irrigation water that enters the storm drain system (bringing with it pesticides, organic waste and other elements into our waterways), the Region's surface water quality will be improved.

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[29]San Diego County Water Authority. 2011. *2010 Urban Water Management Plan*. Table 2-3: Member Agency Water Use Efficiency Targets (AF), Page 2-8.

[30] California EPA, State Water Resources Control Board (SWRCB). *2010 Integrated Report*. Available http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml?wbid=CAR30981177200 20319112226 (Accessed 14 March 2013).

[31]RWQCB. 2011. *Water Quality Control Plan for the San Diego Basin*. Chapter 7, TMDLs, page 7-16.

M. Provides a Long-Term Solution in Place of a Short-Term One

Both turf replacement and conversion to recycled water have extended benefits lifetimes. While we quantify water savings benefits from the programs to be 20 and 50 years, respectively, it is possible that benefits can accrue over an even longer period of time, or lead customers to upgrade their irrigation systems and landscapes in the future. Similar programs in other cities have seen participation in turf conversion programs as a result of conversations with existing participants, leading to shifts in customer attitudes and behaviors.[32] This shift can lead to long-term changes in water use behavior. The benefits lifetimes of the individual programs also allow customers to plan water use over a long period of time. The availability of imported water is subject to a number of natural and human forces, ranging from increased population growth (and accompanying increased demands), to drought, changes in snowpack and earthquakes, to environmental regulations, water rights determinations, and associated legal challenges and Court rulings. This project offers a drought-resistant water supply source and long-term solution that will reduce continued reliance on unsustainable water supply sources.

G. Improve Water Supply Reliability

The reliability of a water supply refers to its ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. The *Turf Replacement and Agricultural Irrigation Efficiency Program* will help address reliability issues for the Water Authority by offsetting the use of imported water delivered by MWD. As noted above, the reliability of imported water is subject to a number of natural and human forces, ranging from increased population growth (and accompanying increased demands), to drought and earthquakes, to environmental regulations, Court rulings, and water rights determinations.

Although interest in water supply reliability is increasing (e.g., due to increasing water demands and concerns over climate-related events), only a few studies have directly attempted to quantify its value (i.e., through nonmarket valuation studies).[33] The results from these studies indicate that residential and industrial (i.e., urban) customers seem to value supply reliability quite highly. Stated preference studies find that water customers are willing to pay approximately $100 to more than $500 per household per year in 2012 dollars for total reliability (i.e., a 0% probability of their water supply being interrupted in times of drought).

The challenge in applying these values to determine a value of increased reliability as a result of the Turf Replacement and Agricultural Irrigation Efficiency Project is recognizing how to reasonably interpret these survey-based household monetary values. The values noted above reflect a willingness to pay per household to ensure complete reliability (zero drought-related use restrictions in the future), whereas the Turf Replacement and Agricultural Irrigation Efficiency Project only enhances overall reliability and does not guarantee 100% reliability. Thus, if applied directly to the number of households within the SDCWA service area, the dollar values from the studies would overstate the reliability value provided by the project.

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[32] Grenoble, Penelope B. 2012. Thinking Long-Term: Water resource management and public outreach help water utilities deal with climate variability and water scarcity.*Water Efficiency*. 22 October 2012.

[33]Carson, R.T.; Mitchell, R.C. *Economic Value of Reliable Water Supplies for Residential Water Users in the State Water Project Service Area*; SWC Exhibit Number 54; the Metropolitan Water District of Southern California, Los Angeles, 1987.

CUWA.*The Value of Water Supply Reliability: Results of a Contingent Valuation Survey of Residential Customers*, California Urban Water Agencies, Sacramento, CA. [Online] **1994**, http://www.cuwa.org/library/TheValueofWaterSupplyReliabilityAug94.pdf (accessed October 1, 2009).

Griffin, R.C.; Mjelde, J.W. Valuing Water Supply Reliability.*American Journal of Agricultural Economics* **2000**, *82*, 414–426

Howe, C.W.; Smith, M.G.The Value of Water Supply Reliability in Urban Water Systems.*Journal of Environmental Economics and Management* **1994**,*26*, 19–30.

Raucher, R., J. Clements, and others. 2013. *The Value of Water Supply Reliability in the Residential Sector.* WateReuse Research Foundation. Project WRF-08-09.

Due to the uncertainty involved in applying these numbers to this situation, no benefit estimate is included in the monetized benefits tables. However, we provide a description here to give an idea of the potential magnitude of this benefit.

J. Reduce Demand for Net Diversions from the Bay-Delta

As described above, the Water Authority and its member agencies use a mix of imported water and local sources to supply their customers. Reduced overall potable water demand due to water conservation and increased use of recycled water will be used to reduce reliance on imported water supplies exclusively. Consistent with the mix of Water Authority imported supplies, it is assumed that two-thirds of the offset imported water (about 168 AFY for 50 years from the Agricultural Irrigation Efficiency Program, and 30 AFY for 20 years from the Turf Replacement Program) generated by the proposed project will offset SWP supplies. This will augment in-stream flows in the Delta or will offset other diversions that may otherwise reduce flows.

A. Water Conservation

Estimates for the amount of water conversion from turf to water-efficient landscaping were made using a combination of expertise and scientific studies. Using water meter records, the MWD*Evaluation of the Synthetic Turf Pilot Program*that showed water savings achieved when converting a natural grass field to a synthetic turf of 0.00014 AFY per square foot.[34]This program plans to provide incentives for conversion of approximately 320,000 square feet of turf to water-efficient landscaping. At a savings of 0.00014 AFY per square foot, this would result in water savings of approximately 45 AFY.

C. Reduced Trash Removal Cost Through a Reduction in Green Waste

Turf removal provides more benefits than just reduced water demand. It also reduces the amount of green waste produced from landscaping care. The Sustainable Site Initiative's *The Case for Sustainable Landscapes* profiles a series of case studies that document the benefit of conversion to sustainable landscaping. The Santa Monica Garden case documented a 66% reduction in green waste between the lawn and the native plant garden.[35]

Green waste is currently collected by local solid waste companies, and who collect all municipal solid waste for a fee. Reducing the amount of green waste generated by water-wise landscapes will reduce the amount that must be collected, saving costs for municipalities and potentially for customers. Given that the USEPA reports that approximately 13.7% of total municipal solid waste is yard trimmings[36], turf conversion can result in a 9% reduction of municipal solid waste.With an average waste collection cost of $18.50 to $14.50 per residence (for incorporated and unincorporated areas, respectively), it can be assumed that turf conversion will reduce waste collection costs to approximately $15.01 per residence on average (from $16.50), or an average saving of $1.49 per residence per month by conversion to water-efficient landscaping.[37]

This benefit was not monetized further because the potential number of residences and business that could participate in the Turf Replacement program is unknown. The Turf Replacement program is designed on a square-foot basis, rather than a number of lots. There is a wide range of lot sizes and set-backs across the county, depending on location and age of neighborhoods. Because these costs can only be monetized at the residence level, and the number of potential residences is unknown, we were unable to monetize this benefit.

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[35]The Sustainable Sites Initiative. 2009. The Case for Sustainable Landscapes. Available http://www.sustainablesites.org/report/The%20Case%20for%20Sustainable%20Landscapes_2009.pdf.Pg. 37.

[36]U.S. EPA. 2009. Municipal Solid Waste Generation, Recycled, and Disposal in the United States: Facts and Figures for 2009.

[37] These values were calculated using: Average collection costs – (13.7% x Average collection costs x 66%). 13.7% is the amount of total waste that is green waste, 66% represents the reduction in green waste from conversion to water-efficient landscaping.

E. Increase in Recycled Water Use

The Agricultural Irrigation Efficiency Component is expected to convert 50 acres of agricultural land on a minimum of two sites to recycled water with efficient irrigation systems. With irrigation demand estimated at 5 AFY per acre, per the City of Escondido's *Easter Recycled Water Main Extension Preliminary Design Report,*this result in 250 AFY in recycled water use. This recycled water use will offset potable water, which is currently used to irrigate avocado and citrus crops.

Monetized Benefit Analysis (Section D3)

Several monetized benefits are expected to accrue over the expected 52 year life of the project. Those include avoided cost of imported water, avoided wastewater treatment costs, and reduced net greenhouse gas production associated with the energy used in importing water.

F. Avoid Imported Water Supply Purchases

Although the Water Authorityuses a mix of imported water and local sources to supply their customers, imported water is the most expensive source to provide and it is not considered to be a very reliable source of supply (see G-Improve Water Supply Reliability discussion above). For this analysis, imported water is therefore considered to be the marginal water source for the Water Authority's service area. Thus, reduced overall water demand due to increased use of recycled water and increased water use efficiency will reduce reliance on MWD water supplies.

The *Turf Replacement and Agricultural Irrigation Efficiency Program* will directly offset 295 AFY of imported water provided by MWD. Approximately 45 AFY will be offset by turf replacement over approximately 320,000 square feet of residential and commercial turf. Approximately 250 AFY will be offset by converting 50 acres of agricultural land to a recycled water irrigation system. Any conservation or recycled water supplies from this project will be used to directly offset imported water in a 1:1 ratio.

Since turf replacement benefits are only estimated over a 20-year benefit lifetime, total benefits are conservative since water conservation will likely continue beyond this 20-year span. Furthermore, imports offset by recycled water conversion are considered over a 50-year span, while farmers will likely continue to use recycled water for irrigation well beyond that. Approximately 900 AF of imported water will be avoided over the 20-year lifespan of the turf conversions, and approximately 12,500 AF of imported water will be avoided over the 50-year lifespan of the agricultural conversions, which totals 13,400 AF over the entire program.

To calculate the present value of offset imports, we multiply the amount of avoided imported water by the total cost of Water Authority melded "all in" Tier 1 water in each year. MWD supplies imported water to the Water Authority, who in turn supplies water to 24 member agencies including the City of San Diego. MWD provides water using two major sources: SWP water from the Sacramento-San Joaquin Delta and Colorado River water pumped through MWD's Colorado River Aqueduct. For the purposes of this analysis we consider the marginal supply of water to be the Water Authority melded M&I Tier 1 (including fixed charges) (see Appendix 8-1).

Based on Water Authority charges as of February, 2013, Tier 1 Full Treated water cost of $1,259 in 2013, we estimate that offsetting 295 AF/year of imported water will provide an estimated benefit of $411,783 in 2016, the first year in which full project benefits are realized. Accounting for the price escalation of imported water and a standard discount rate of 6%, we estimate the present value of future avoided water imports to amount to $7,076,469 over the 50-year project life.

B. Avoid Surface Water Treatment

Water conservation directly inhibits watershed pollution by reducing urban runoff. Urban irrigation runoff can include pollutants such as chemicals and bacteria, which can flow from urban landscapes into existing water bodies. Given that San Diego County and the City of San Diego in particular are densely populated areas with high usage of chemicals such as fertilizers and pesticides for residential and commercial landscaping, these substances can easily infiltrate local water bodies, as well as protected areas adjacent to the Pacific Ocean. The *Water Quality Control Plan for the San Diego Basin* (Basin Plan)

notes that highways, agricultural fields and orchards, residential and urban areas, and septic tank disposal systems contribute non-point source pollution, including nutrients, as a result of storm water runoff, irrigation return flows, and ground water contributions.[38]

In this benefit, we are assuming that the conservation activities achieved through residential and commercial turf replacement and micro irrigation improvements will reduce non-point source runoff, and therefore the amount of storm water entering municipal systems and requiring wastewater treatment. Since this benefit is exclusive to turf replacement (and acknowledging that residential landscapes can change following property sales), benefits are assumed to last for 20 years and not the full lifetime of the project (50 years).

To calculate avoided surface water treatment costs, we multiply the amount of turf that will be replaced each year by the annual cost per acre of wastewater treatment. Based on estimates in the *Sun Valley Watershed Management Plan Environmental Impact Report* for project alternatives to treat pollutants from runoff, the cost to collect and treat urban runoff is estimated at $46.96 million per square mile over the 50-year timeframe, while the cost to conserve water is estimated at $39 million per square mile.[39] The difference between the two is $7.96 million per square mile (discounted 4% over a 50 year period), or $12,440 per acre ($7.96 million per square mile x 1 square mile per 640 acres) in 2002 dollars. Converting this to 2012 dollars gets a 50-year project life savings of $15,876.74 per acre to conserve water versus full conveyance with BMPs. Converting this to annual costs for a 20-year project provides an annual per acre savings of $739.07 (present value of 50 year total per acre/present value of $1 in 50 years with a 4% discount rate). This results in approximately $0.0169 per square foot of land area wherein runoff will be reduced. Over the 20-year span of benefits from the conversion of approximately 320,000 ft^2 (or 7.3 acres) of turf to water-wise landscaping, avoided surface water treatment from reduced urban irrigation runoff will yield a present value benefit of $57,783.

I. Reduce Net Production of Greenhouse Gases

As described in Attachment 7, reduced reliance on imported water will avoid the extensive energy requirements associated with transporting water from Northern California and the Colorado River to San Diego County. This in turn will result in avoided CO2 emissions (a greenhouse gas (GHG)) associated with the production of this energy.

To calculate avoided CO2 emissions with the project, we multiplied the amount of energy required to treat and convey 295 AFY of water (2.65 MWh/AF for imported water and 0.8 MWh/year for recycled water[40]) by the average carbon emissions rate associated with energy production in California (0.354 MT/MWh[41]). Approximately 45 AFY of water will be directly conserved by this project, and 250 AFY of recycled water will be used in lieu of imported water. This provided us with the annual net reduction in CO2 emissions of approximately 206 MT/year for the first 20 years of project implementation, and approximately 164 MT/year for the 30 years after that. Given the schedule for project construction (with some benefits beginning to accrue in 2016), total net CO2 emissions reductions amount to 9,030 MT over the 50-year project life.

To monetize this benefit, we applied the dollar value assigned to GHG emissions, measured in carbon dioxide equivalent (CO2e). The social cost of carbon is estimated as the aggregate net economic value of damages from climate change across the globe, and is expressed in terms of future net benefits and costs that are discounted to the present.[42] In February 2010, the U.S. Government's Interagency Working

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[38]RWQCB. 2011. *Water Quality Control Plan for the San Diego Basin*. Chapter 7, TMDLs, page 7-16.

[39]County of Los Angeles Department of Public Works. 2004. *Environmental Impact Report for the Sun Valley Watershed Management Plan*. Available http://www.sunvalleywatershed.org/ceqa_docs/plan.asp. Pg. 4-6.

[40]Equinox Center. 2010. *San Diego's Water Sources: Assessing the Options*, July 2010. pg. 10

[41]U.S. EPA. 2009. Emissions & Generation Resource Integrated Database. eGRID Summary Table, pg. 3 eGRID2012 Version 1.0 Year 2009 Summary Tables. Available: http://www.epa.gov/cleanenergy/documents/e.g.ridzips/eGRID2012V1_0_year09_SummaryTables.pdf. Accessed March 2013.

[42]IPCC, 2007.Summary for policymakers. In *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on*

Group on Social Cost of Carbon issued guidance on recommend values for the social cost of carbon for use in regulatory benefit-cost analysis.[43] The recommended mean estimate of the social cost of reducing one metric ton (MT) of CO2 in 2012 is $22.53/MT (updated from 2010 values using CPI), with a range of values from $4.95 to $68.33 per MT. The recommended mean estimate of the social cost of carbon reflects the worldwide net benefits of reducing CO2 emissions. Estimates of the portions of the net benefits occurring in the United States range from 7% to 23% of the worldwide social cost of carbon.

For this analysis, the average value of $22.53/MT was used when calculating social benefits and costs, which produces conservative estimates for the benefits and costs associated with GHG emissions. To determine total costs over the 50-year project period, we escalate the social cost of carbon by 2.4% per year, which is above the general rate of inflation. The social cost of carbon will increase in future years because CO2 will produce larger incremental damages as physical and economic systems become more stressed in responding to greater climate change.

Over the 50-year project life, total present value benefits associated with avoided social costs of carbon amount to $89,901.

L. Avoided Fertilizer Costs

Fertilizing compounds commonly present in recycled water are typically not found in potable water (e.g., nitrogen, phosphorus, potassium). Thus, the use of recycled water for landscape irrigation will reduce fertilizer costs associated with the properties that will be serviced by the project.

The exact offset of fertilizer use from using recycled water is difficult to predict due to daily and seasonal nutrient variations in the recycled water. However, the amount of nutrients (i.e., pounds of fertilizer) per AF of recycled water can be calculated from average (tertiary-treated) effluent values for the City of Escondido's Hale Avenue Resource Recovery Facility (HARRF). The recycled water fromHARRF contains 8.66 mg/L of nitrogen.[44]Thus, for every AF of recycled water used in lieu of potable water, therecycled water customers will avoid the use of a total of 23.6 lbs. ofnitrogen. The weighted average commercial value of this fertilizer is $0.46/lb.[45].

For the 250 AF of recycled water applied each year in lieu of imported water, recycled water customers serviced by the project will avoid the use of 5,900 lbs/year of fertilizer. This will result in avoided costs of $2,714 annually (undiscounted)[46]. Over the lifetime of the project, total present value avoided fertilizer costs will amount to $36,994. Additional benefits would be expected for avoided fertilizer costs due to increased levels of potassium in recycled water compared to potable supplies.

Additional fertilizer savings can be realized through the turf conversion program. The USEPA says homeowners use 10 times more fertilizer per acre than farmers.[47] Conversion to native plants and those better suited to local conditions will reduce the need for fertilizers in residential areas. Assuming homeowners typically use 0.044 lbs/square foot and this project converts approximately 320,000 square feet of turf, this would result in a saving of 14,066lbs of nitrogen per year. The results in $6,470 annually (undiscounted) of avoided fertilizer costs. The present value of all future avoided fertilizer costs through turf replacement is $68,931. Over the 50-year project lifetime, fertilizer costs avoided through conversion to recycled water irrigation systems and urban turf replacement has a present value of $105,925.

Table 8-10 summarizes the annual benefits from the project.

Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden, and C.E. Hanson (eds.). Cambridge University Press, Cambridge, UK. pp. 7–22.

[43]Interagency Working Group, 2010. Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866. Interagency Working Group on Social Cost of Carbon, United States Government.February. Available: www.epa.gov/oms/climate/regulations/scc-tsd.pdf

[44]City of Escondido. 2011. *City of Escondido Recycled Water Master Plan*. June. Appendix A, page D-4 and D-6.

[45] This represents the average weighted cost of nitrogen and phosphorus. Source: Asano, 1981, updated to 2006 using the national fertilizer price index. Updated from 2006 to 2012 based on the Consumer Price Index (CPI).

[46] Numbers do not add exactly due to rounding.

[47]US EPA. 2003. Sustainable Landscaping. Available http://www.epa.gov/glnpo/greenacres/smithsonian.pdf. Pp. 6-7.

Table 8-10: Annual Benefits (PSP Table 15)
Turf Replacement and Agricultural Irrigation Efficiency Program

Annual Benefit (All benefits should be in 2012 dollars)									
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**	**Unit $ Value (1)**	**Annual $ Value (1) (f) x (g)**	**Discount Factor (1)**	**Discounted Benefits (1) (h) x (i)**
2013	Avoided Imported Water Supply Purchases	Acre-Feet	0	5	5	$1,259	$5,666	0.943	**$5,345**
	Avoided Surface Water Treatment Costs	Square Feet	0	38,361	38,361	$0.02	$651	0.943	**$614**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	4	4	$22.53	$95	0.943	**$90**
	Avoided Fertilizer Costs	Lbs.	0	1,688	1,688	$0.54	$911	0.943	**$860**
2014	Avoided Imported Water Supply Purchases	Acre-Feet	0	27	27	$1,303	$35,183	0.890	**$31,313**
	Avoided Surface Water Treatment Costs	Square Feet	0	191,804	191,804	$0.02	$3,254	0.890	**$2,896**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	25	25	$23.07	$584	0.890	**$520**
	Avoided Fertilizer Costs	Lbs.	0	8,439	8,439	$0.54	$4,557	0.890	**$4,056**
2015	Avoided Imported Water Supply Purchases	Acre-Feet	0	170	170	$1,349	$229,274	0.840	**$192,503**
	Avoided Surface Water Treatment Costs	Square Feet	0	319,673	319,673	$0.02	$5,424	0.840	**$4,554**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	124	124	$23.62	$2,931	0.840	**$2,461**
	Avoided Fertilizer Costs	Lbs.	0	17,016	17,016	$0.54	$9,188	0.840	**$7,715**
2016-2032	Avoided Imported Water Supply Purchases	Acre-Feet	0	295	295	$1,396	$411,783	Variable	**$4,269,436**
	Avoided Surface Water Treatment Costs	Square Feet	0	319,673	319,673	$0.02	$5,424	Variable	**$47,712**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	206	206	$24.19	$4,982	Variable	**$51,616**
	Avoided Fertilizer Costs	Lbs.	0	19,966	19,966	$0.54	$10,781	Variable	**$94,843**
2033	Avoided Imported Water Supply Purchases	Acre-Feet	0	291	291	$1,944	$564,694	0.294	**$166,108**
	Avoided Surface Water Treatment Costs	Square Feet	0	281,312	281,312	$0.02	$4,773	0.294	**$1,404**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	202	202	$36.20	$7,303	0.294	**$2,148**
	Avoided Fertilizer Costs	Lbs.	0	18,278	18,278	$0.54	$9,870	0.294	**$2,903**
2034	Avoided Imported Water Supply Purchases	Acre-Feet	0	268	268	$1,973	$528,771	0.278	**$146,737**
	Avoided Surface Water Treatment Costs	Square Feet	0	127,869	127,869	$0.02	$2,170	0.278	**$602**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	181	181	$37.07	$6,696	0.278	**$1,858**
	Avoided Fertilizer Costs	Lbs.	0	11,526	11,526	$0.54	$6,224	0.278	**$1,727**
2035 - 2064	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$2,003	$500,655	Variable	**$2,247,193**
	Avoided Surface Water Treatment Costs	Square Feet	0	-	-	$0.02	$-	Variable	**-**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$37.96	$6,215	Variable	**$30.919**

Annual Benefit (All benefits should be in 2012 dollars)									
(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value (1)	(h) Annual $ Value (1) (f) x (g)	(i) Discount Factor (1)	(j) Discounted Benefits (1) (h) x (i)
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$0.54	$3,186	Variable	**$12,170**
2065	Avoided Imported Water Supply Purchases	Acre-Feet	0	125	125	$3,130	$391,282	0.046	**$17,835**
	Avoided Surface Water Treatment Costs	Square Feet	0	-	-	$0.02	$-	0.046	**-**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	82	82	$77.33	$6,331	0.046	**$289**
	Avoided Fertilizer Costs	Lbs.	0	2,950	2,950	$0.54	$1,593	0.046	**$73**
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$7,348,499**

Project Benefits and Costs Summary (Section D5)

Project Economic Costs

Table 8-4 summarizes the cost schedule for the *Turf Replacement and Agricultural Irrigation Efficiency Program* and Table 8-5 summarizes the economic project costs for the project.

Administration costs of the project total $15,347 and are made up entirely of Water Authority grant administration labor costs. The remainder of the project costs borne by project proponents is comprised of construction and implementation costs totaling $751,979, and a grant administration cost of $17,265.

In addition to the $784,591 outlined in Attachment 4, there are costs borne by end-users in order to complete turf replacement and agricultural irrigation retrofits. Residential and Commercial customers will pay an average of $2.18/ft^2 to complete turf replacement, for a total end-user cost of $696,887 for the Turf Replacement Program. Agricultural customers will pay approximately $25,000 per site to convert their irrigation system from potable water to recycled water, for a total agricultural end-user cost of $50,000 over two sites.

The Water Authority's website, which will provide education and public outreach for the Turf Replacement Program, will incur operation and maintenance costs for the first five years after project implementation begins. This includes $125/year for software licensing and $80/year for technical support, for a total of $605 of O&M costs per year over a five year period (2013 – 2017).

The present value of administration, construction and implementation, end-user, and O&M costs for the Turf Replacement and Agricultural Irrigation Efficiency Project is $1,385,598.

Table 8-11: Total Project Cost Schedule
Turf Replacement and Agricultural Irrigation Efficiency Program

Year	Program Implementation (this work plan)	Residential and Commercial Property-Owner Contributions	Agricultural Property-Owner Contributions	Microsite O&M
2013	78,459	69,689		605
2014	392,296	348,444	50,000	605
2015	313,836	278,755	50,000	605
2016	-			605
2017	-			605
Total	**784,591**	**696,887**	**100,000**	**3,025**

Table 8-12: Annual costs (PSP Table 19)

Turf Replacement and Agricultural Irrigation Efficiency Program

Project Annual Costs (2012 Dollars)										
			Annual Costs						Discounting Calculations	
	Initial Costs Grand Total Cost from Table 6 (row (i), column (d))	Adjusted Grand Total Cost	Admin	Operation	Maintenance	Replace-ment	Other	Total Costs (a) +…+ (g)	Discount Factor (Capital) Present Value Coeff (O&M)	Discounted Project Costs (h) x (i)
Year			(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012										
2013	78,459	69,689		$605				$148,753	0.943	$140,333
2014	392,296	398,444		$605				$791,345	0.890	$704,294
2015	313,836	328,755		$605				$643,196	0.840	$540,040
2016				$605				$605	0.792	$479
2017				$605				$605	0.747	$452
Total Present Value of Discounted Costs (Sum of Column (j)) Transfer to Table 17, column (c), Proposal Benefits and Costs Summaries										**$1,385,598**

Benefits and Costs Summary

The present value of avoided imported water costs, avoided wastewater treatment costs, reduced GHG emissions, and avoided fertilizer costs totals $7,348,499.

Water savings achieved through the project will prevent 8,978 AF of water from being diverted from the Sacramento-San Joaquin Delta. Replacing residential and commercial turf will conserve 45 AFY, and retrofitting potable irrigation systems to use recycled water at agricultural sites will allow for new distribution of 250 AFY of recycled water. This project also will provide education benefits, will reduce water resource conflicts, benefit native habitat, improve water quality through reduced runoff, provide a local long-term water planning solution, and improve water supply reliability.

The present value of all project costs, including end-user and O&M expenditure, equals $1,385,598. With a present value of project benefits totaling $7,348,499, the present value of monetized *net* benefits is approximately $5,962,901.

Omissions, Biases, and Uncertainties

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainties are associated with avoided imported water supply costs. These issues are listed in Table 8-13.

Table 8-13. Omissions, Biases, and Uncertainties, and Their Effect on the Project
Turf Replacement and Agricultural Irrigation Efficiency Program

Benefit or Cost Category	Likely Impact on Net Benefits*	*Comment*
Avoid Imported Water Supply Purchases	+	Benefits associated with turf replacement and conversion to recycled water irrigation systems are based on 20- and 50-year lifetimes, respectively. Since water savings, and therefore avoided imported water costs, will likely continue beyond the assumed lifetimes for both project components, actual benefits will likely be higher than the estimate provided here.
Avoid Imported Water Supply Purchases	U	The calculation of avoided imported water costs assumes that MWD water rates will increase annually (in real terms) by 3.5% through 2020. Beyond 2020, a 1.5% real increase in water rates is assumed. These projections are based on existing and planned MWD financial commitments and recent increases in MWD rates. It is uncertain whether actual future rate increases will be above or below these assumed rate increases.
Reduce Net GHG Emissions	U	The estimate used to calculate the value of reduced carbon emissions represents the mid-point of estimates from the literature. The true social cost of carbon may be higher or lower than the estimate used here.

*Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
— = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Project 3: Rural Disadvantaged Community (DAC) Partnership Program

Project Abstract

The *Rural DAC Partnership Program*, administered by the Rural Community Assistance Corporation (RCAC), will fund critical water supply and water quality projects in rural DACs in San Diego County. Water supply infrastructure deficiencies will be identified and prioritized by the Rural DAC Stakeholder Committee and then funding will be provided via grant reimbursements to resolve those deficiencies. This program helps meet the critical DAC need for safe, healthy, potable, supplies of water that are adequate to meet basic household and fire protection demands, while at the same time recognizing and responding to DACs' needs for technical and managerial support to even request funding for these basic water needs.

RCAC will manage the *Rural DAC Partnership Program* to address inadequate water supply and water quality in rural DACs, including tribal communities, with populations less than 10,000. DACs will be selected using 2010 Census data.

Projects will be selected based on need and priorities established by the Rural DAC Stakeholder Committee with an emphasis on critical water supply and water quality issues. The Rural DAC Stakeholder Committee designated the following criteria for DAC selection:

Primary Criteria

- Disadvantaged community per 2010 Census data
- Construction project
- Addresses public health issue
- Critical water projects (quantity/quality/reliability)
- Adequate TMF capacity (likely to be successful)
- Shovel ready or ability to complete within project time frame

Secondary Criteria

- Project ability to leverage other funding
- Capital cost per connection
- Multiple benefits
- Green technology
- Environmental justice concerns

Opportunities to merge related projects will be evaluated. Projects will be selected from both tribal and non-tribal rural DACs. In every case, RCAC will look at other available funding resources to leverage Prop 84 grant dollars.

All projects will address inadequate, unsafe, or unreliable water supply and water quality in rural DACs based on priorities already identified by the Rural DAC Stakeholder Committee. The proposed *Rural DAC Partnership Program* will select and implement four or more projects similar to the example projects described below. Three example projects described below have been identified as likely to be, or similar to projects likely to be selected for inclusion in this program by the Rural DAC Stakeholder Committee.

Example 3-1: Phoenix House School – The Phoenix House Foundation owns and operates a small PWS serving 75 students and staff in Descanso, CA. The only well that serves this system is located adjacent to a creek, approximately 25 feet from a sewer line that crosses the creek and about 100 feet down gradient from the septic leach field. Due to the location of this well, it is susceptible to exposure from fecal coliform, and has a history of bacteriological failures at the wellhead.[48] The proposed project is construction of a replacement well and two new 10,000 gallon storage tanks. The project will protect the drinking water source from bacteriological contamination and provide sufficient storage to provide the

[48]Phoenix House Foundation. 2006. *Preliminary Engineering Report* (System #3701478). Page 1.

community with water in the event of power outages or routine maintenance procedures on the well pump and motor.[49]

Example 3-2: Rancho Estates MWC – The Rancho Estates Mutual Water Company (MWC) serves an agricultural community of approximately 180 residents in Pauma Valley, CA. The water system is served by 7 active wells and two shallow open cut reservoirs that are approximately 3 million gallons and 1.5 million gallons. Since the community is agricultural, the bulk of the water demands (average of 680 gpm) are used for irrigation of crops. Because the reservoirs are subject to contamination, the County of San Diego has issued Compliance Orders to cover and/or replace them.[50] The water system is also plagued with nitrate and bacterial problems which are violations of the Title 22 California Code of Regulations for drinking water.[51]The water system currently blends water from YMWD through the distribution system as a control measure for nitrates which has kept them under the nitrate MCL.[52]The proposed project would improve the connection with YMWD, construct a covered finished water storage tank, and replace the existing distribution system piping. This project will separate the distribution system into one for domestic supply (supplied exclusively by YMWD water) and one for agricultural irrigation supply (supplied by existing Rancho Estates well system). This would protect public health by eliminating potential contamination due to the environmental exposure and provide the Rancho Estates community with adequate storage capacity.

Example 3-3: San Pasqual District B Water System – San Pasqual District B (Western) is a community PWS located near Valley Center, CA, on the San Pasqual Reservation. The water system has 90 residential connections and 12 transient connections. The PWS consists of a consecutive connection to Valley Center Municipal Water District (VCMWD), a booster pump station, a storage tank, and a distribution system.[53] The primary existing tank was constructed in 1992 and has a storage capacity of 100,000 gallons. A small 38,000 gallon corrugated steel tank also exists at the same site. Both USEPA[54] and IHS[55]have concluded that the tank exterior is showing oxidation and significant corrosion, as well as leaking in the base and joints. In addition, the system does not have an adequate amount of storage capacity to meet the County regulation requiring 2 days of storage for fire protection.[56] Due to the age and leaking of the tank and the need for additional storage, replacement of the tank was deemed the most reasonable option for addressing these issues. The proposed project will abandon the aging and leaking 100,000 gallon tank in place, and replace an adjacent 38,000 gallon tank with a new 250,000 gallon welded steel tank to provide greater water storage to the entire distribution system.[57] This would protect public health by eliminating potential contamination due to the leakage, eliminate wasted water supplies, and provide the District B community with adequate storage capacity.

Summary Project Benefits and Costs

A summary of the benefits and costs for the program described above are provided in Table 8-14. Monetized benefits and non-monetized benefits are presented in this attachment, while physically quantified (but not monetized) benefits are described in Attachment 7. Note that it is not possible to develop a complete analysis for the monetized and physically quantified benefits for this Program as the individual projects have yet to be selected. However, example projects that have been identified as priorities by the Rural DAC Stakeholder Committee are provided although they only represent the

[49]Phoenix House Foundation. 2006. *Preliminary Engineering Report* (System #3701478). Page 2.
[50]County of San Diego. 2010. *Compliance Order, Rancho Estates Mutual Water Company*.
County of San Diego. 2007. *Compliance Order, Rancho Estates Mutual Water Company*.
[51]Rancho Estates MWC. 2009. *Engineering Report Executive Summary*. Page 1-6.
[52]Rancho Estates MWC. 2009. *Engineering Report Executive Summary*. Page 2-6.
[53]USEPA. 2012. Sanitary Survey of San Pasqual District B (Western) (PWSID #0605080). Prepared by Sleeping Giants Environmental Consultants, LLC.Page 1.
[54]USEPA. 2012. Sanitary Survey of San Pasqual District B (Western) (PWSID #0605080). Prepared by Sleeping Giants Environmental Consultants, LLC.Page 5.
[55]IHS. 2012. *Technical Memorandum No. 2, San Pasqual District B Tank Replacement*. Page 2.
[56]IHS. 2012. *Technical Memorandum No. 2, San Pasqual District B Tank Replacement*. Page 2.
[57]IHS. 2012. *Technical Memorandum No. 2, San Pasqual District B Tank Replacement*. Page 1.

monetized and physically quantifiable benefits attributable to one likely project. The Program will fund a minimum of four projects – making the example of physically quantifiable and monetized benefits significantly smaller than expected. Benefits are lettered for cross-reference with Attachment 7, and are therefore not represented in order in the following sections.

Table 8-14. Benefit-Cost Analysis Overview
Rural DAC Partnership Program

	Present Value
Costs – Total Capital and O&M	**$4,631,384**
Monetizable Benefits	
K. Avoid Bottled Drinking Water Supply Purchases	$1,372,157
F. Avoid Imported Water Supply Purchases	$20,107,667
G. Reduce Net Production of Greenhouse Gases	$352,268
Total Monetized Benefits	**$21,832,082**
Qualitative Benefit or Cost	**Qualitative Indicator***
J. Provide Safe Drinking Water	++
B. Benefit DACs by Addressing Critical Water Supply or Water Quality Needs	++
A. Increase Stakeholder Involvement and Stewardship	+
D. Increase Water Available for Fire Protection	+
H. Benefit Wildlife or Habitat in Bay-Delta Through Reduced Imports	+
L. Improve Water Quality	+
C. Long-Term Solutions to Critical Water Quality or Water Supply Needs of DACs	+
I. Reduce Demand for Net Diversions from the Bay-Delta	+
E. Improve Water Supply Reliability	+

* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease net benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Non-Monetized Benefits Analysis (Section D2)

Narrative descriptions of the benefit categories marked "Yes" in DWR's *Proposal Solicitation Package* Table 12 are provided below.

A. Increase Stakeholder Involvement and Stewardship

Maximizing stakeholder/community involvement is one of the primary objectives of this Program. Selection of DAC projects for funding will be decided by a Rural DAC Stakeholder Committee with representatives from RCAC, the California Department of Public Health (CDPH), County DEH, Indian Health Service (IHS), and the Regional Water Management Group (RWMG). Additionally, project solicitation outreach meetings will be conducted to inform citizens of the importance of environmental stewardship, emphasizing conservation, regulatory (drinking water quality) compliance, and utility efficiency.

The *Rural DAC Partnership Program* also supports the following State, federal programs to address critical water supply and water quality issues in PWS:

- USEPA Region 9 primary regulatory responsibilities for Indian Tribes.
- CDPH State Revolving Fund Priority Project List and primary regulatory responsibilities.
- SWRCB's Small Community Wastewater Strategy which promotes strategies to assist small and/or disadvantaged communities with wastewater needs.

- USDA Rural Development and Health and Human Services' targeted low income projects.
- IHS support for Indian Tribes and public health goals.
- County DEH list of Community Water Systems' compliance orders.

RCAC partners with these agencies to help them achieve their goals of assisting rural DACs with infrastructure improvements and protection of public health.

J. Provide Safe Drinking Water

The goal of the *Rural DAC Partnership Program* is to provide funding and technical support to address inadequate water supply and water quality affecting rural DACs, including tribal communities. The program will help rural water systems to provide a safe water quality source that is not contaminated with nitrates, bacteria, or other contaminants. The program reduces potential for high public health risks in water and/or wastewater systems through infrastructure improvements and helps small water systems to provide sufficient quantities of safe drinking water to the residents served by their systems.[58]

Rural communities within the San Diego IRWM Region unincorporated areas that are not served directly by the Water Authority's member agencies have water supply and quality issues exacerbated by climate change, poor economies, and lack of community expertise. Inadequate water supply to support existing communities poses a public health risk. The majority of drinking water maximum containment level (MCL) violations occur with small public water systems.[59] Further, inadequate wastewater treatment results in unplanned discharge events that pose risks to human health and the environment.

Drinking water systems that serve disadvantaged communities often lack both access to much needed infrastructure financing and the resources to adequately operate and maintain existing system facilities. As a result, these systems face significant challenges in complying with long standing and new drinking water rules. All of the example projects identified by the Rural DAC Stakeholder Committee for priority implementation will address a current water supply or storage system that either has been, is currently, or has significant potential to be the source of a waterborne disease outbreak.

Three major problems that impede the safety of DACs served by small community water systems, and which will be addressed by this program, include:

- Contamination of drinking water source water from wastewater intrusion, agricultural influences, and/or contaminant spills from industrial activities;
- Seasonal weather changes resulting in floods or droughts, which require design options to bypass treatment during rain and storm events and identification of alternative water supplies (including water reuse sources) to increase capacity during droughts; and
- Deteriorating collection and distribution systems that compromise source water quality and increase the cost of water treatment.[60]

The California Department of Public Health (CDPH) has 41 small (less than 10,000 population) systems located in San Diego County on its 2013 State Revolving Fund (SRF) Priority Project List (PPL)[61], with many listed more than once. The Rancho Estates MWC project, identified as an example project by the Rural DAC Stakeholder Committee, is listed in the CDPH PPL with a funding target of $500,000. The State Water Resources Control Board (SWRCB) has a similarly lengthy list of communities requesting funding from the Clean Water SRF for wastewater improvements.

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[58] Work Plan, Attachment 3, Project purpose

[59] U.S. EPA. 2007. *Small Drinking Water Systems: State of the Industry and Drinking Water Technologies to Meet the Safe Drinking Water Act Requirements*. EPA/600/R-07/110. Pp. 2-5 to 2-6, and Figure 2-10.

[60] Work Plan, Attachment 3, pg. 3-X. (Project Need); and U.S. EPA 2007.*Small Drinking Water Systems: State of the Industry and Drinking Water Technologies to Meet the Safe Drinking Water Act Requirements*. EPA/600/R-07/110.Pg. 4-4.

[61] Sean Sterchi, CDPH. 2013. *State Revolving Fund Priority Project List*. Email dated March 5, 2013.

Rural DACs in the San Diego IRWM Region are faced with water supply systems that are inadequate to support existing connections. It is costly to provide supplemental treatment processes to improve the water quality of contaminated drinking water sources.[62] It is difficult for small DAC drinking water and wastewater systems to afford improvements because they have fewer ratepayers to share the costs. Further, rural DACs lack technical expertise and financial stability to access and comprehend funding programs. All of the example projects identified by the Rural DAC Stakeholder Committee for priority implementation (see Project Abstract above) will provide safe drinking water to economically disadvantaged communities in the backcountry, and will be offered TMF support from RCAC to operate the PWS safely.

D. Increase Water Available for Fire Protection

Fire protection is a major issue for tribes and surrounding communities, and increased water storage improves water supplies for firefighting and other emergency conditions. The San Diego backcountry is prone to 'Santa Ana' winds and associated wildfires. CalFire has documented 55 wildfire incidents in San Diego County between 2003 and 2012.[63]

Public safety will be improved by providing adequate storage necessary for fire-fighting and emergency conditions. The increased water storage from these types of projects will help ensure adequate water supplies for firefighting efforts on these rural and tribal lands.

B. Benefit Disadvantaged Communities by Addressing Critical Water Supply or Water Quality Needs

Rural communities within the San Diego IRWM Region unincorporated areas that are not served directly by the Water Authority's member agencies have water supply and quality issues exacerbated by climate change, poor economies, and lack of community expertise. Inadequate water supply to support existing communities poses a public health risk. The majority of drinking water maximum containment level (MCL) violations occur with small public water systems.[64]Further, inadequate wastewater treatment results in unplanned discharge events that pose risks to human health and the environment.

This series of small DAC projects is designed to provide safe, reliable water that is adequate to meet community needs and regulatory standards in areas that have neither the technical nor the funding capability to provide safe drinking water. In every one of these projects, the primary objective is to ensure the community has access to reliable water supplies that meet water quality standards in sufficient quantities to meet basic community and fire protection needs.

This benefit to DACs will be obtained by implementing the *Rural DAC Partnership Program*, and is not affected by which projects are selected. Per the work plan in Attachment 3, all projects considered as part of the program will meet the definition of a DAC project as defined in the 2012 Guidelines and described in Attachment 10.[65]

This program is the second phase of RCAC's *Rural DAC Partnership Program*. The projects selected for inclusion in this round will be selected by the Rural DAC Project Selection Committee. Phase II will continue partnerships established in the Phase I portion of this project (funded in Proposition 84-Round 1), and creates linkages and continued support with previous IRWM DAC projects.

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[62]U.S. EPA. 2007. *Small Drinking Water Systems: State of the Industry and Drinking Water Technologies to Meet the Safe Drinking Water Act Requirements*. EPA/600/R-07/110.Pg. 3-6 and 4-3.

[63]CalFire. Incident Information. Available http://cdfdata.fire.ca.gov/incidents/incidents_search_results?search=Search&search=San+Diego (Accessed 15 March 2013).

[64]U.S. EPA. 2007. *Small Drinking Water Systems: State of the Industry and Drinking Water Technologies to Meet the Safe Drinking Water Act Requirements*. EPA/600/R-07/110. Pp. 2-5 to 2-6, and Figure 2-10.

[65]DWR. 2012. Guidelines: Integrated Regional Water Management, Proposition 84 and 1E. Appendix G, pg. 85. For description of DACs in San Diego IRWM Region, refer to Attachment 8 of this application. Work Plan is available in Attachment 3 of this application.

H. Benefit Wildlife or Habitat in Bay-Delta through Reduced Imports

Some of the projects that will be considered for funding as part of this *Rural DAC Partnership Program* receive water directly from the Water Authority. The Water Authority purchases this water from MWD, which obtains its water from two sources: the Colorado River Aqueduct (CRA), which it owns and operates, and the SWP, with which MWD has a water supply contract through the state of California. Currently, imported water purchases from MWD account for about 59% (331,825 AF) of Water Authority supplies.[66]Although the Water Authority and its member agencies use a mix of imported water and local sources to supply their customers, imported water is more expensive to provide and is the marginal water source.[67] Thus, reduced overall potable water demand due to increased use of local water resources (such as through leak repair) will be used to reduce reliance on imported water supplies. Where these proposed DAC projects reduce demands for Water Authority-provided waters, the project will reduce the use of imported SWP water. This means that the program will help augment in-stream flows in the Bay-Delta (which provides the means by which the SWP delivers water from Northern California to the south) or will offset other diversions that may otherwise reduce flows. Reduced demands on Delta supplies also will help reduce the overall salinity of the Delta and improve Delta habitat.

L. Improve Water Quality

Water agencies treat all water to meet stringent state and federal drinking water standards before delivering it to their customers. However, poor-quality source water and/or contamination during storage make it increasingly expensive and difficult to meet such standards. Increased levels of constituents, including fecal coliform, bacteria, nitrates, and TOCs that aid in the formation of THMs and other public health concerns can mean more time spent monitoring finished water in the distribution system, and the need to increase the use of expensive water treatment and disinfection processes. Increased levels of these constituents may also lead to the use of increased proportions of groundwater in the blend of water supplies in order to control them.

The objective of the *Rural DAC Partnership Program* is to provide both funding and technical support for implementing projects that will solve critical water or wastewater system issues in the Region's rural DACs. The program will improve drinking water quality through some of the projects that may be selected.

I. Reduce Demand for Net Diversions from the Bay-Delta

As described in Attachment 7, this project will reduce Water Authority member agency demand for imported water. Reduced overall potable water demand will reduce overall imported water demand and reduce net diversions from the Bay-Delta.

C. Long-term Solutions for Water Quality and Water Supply Needs of DACs

The projects that will be selected as part of this *Rural DAC Partnership Program* will improve water infrastructure in rural DACs, and reduce the amount of water wasted through inefficient systems. This will reduce the need to purchase water in excess of demand, and therefore help to reduce groundwater pumping and imported water demand. In turn, this will serve to protect groundwater supplies and increase water reliability for rural DACs, both of which are long term goals for the Region.

The *Rural DAC Partnership Program* will address three major problems identified by USEPA that impede the sustainability of a small community water system, including:

- Contamination of drinking water source water from wastewater intrusion, agricultural influences, and/or contaminant spills from industrial activities;

[66]San Diego County Water Authority. 2011. *2010Urban Water Management Plan*. Page 6-1, Section 6, Metropolitan Water District of Southern California.

[67]Equinox Center. 2010. *San Diego's Water Sources: Assessing the Options,* July 2010. Pg. 10. Note that despite desalinated water's high cost, the San Diego IRWM region's priority is to reduce dependence on imported water (IRWM Plan, 2007).

- Seasonal weather changes resulting in floods or droughts that require design options to bypass treatment during rain and storm events and identification of alternative water supplies (including water reuse sources) to increase capacity during droughts; and
- Deteriorating collection and distribution systems that compromise source water quality and increase the cost of water treatment.

Additionally, system sustainability will be a priority in the development of DAC funded projects. RCAC will provide appropriate training and technical assistance, and will assist when needed with tasks like selecting the right engineer for infrastructure improvements. It will also help to reduce safety risk to operators by providing adequate training. A well-maintained system run by experienced, well-trained operators will reduce risks of contamination, prolong the life of the equipment, and provide a system that is likely better able to withstand weather impacts. RCAC will also leverage sustainability activities with other RCAC state, federal and local contracts. This will serve to provide long-term solutions to critical water supply and water quality needs of DACs.

E. Improve Water Supply Reliability

The reliability of a water supply refers to its ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. The proposed *Rural DAC Partnership Program* will help address reliability issues by ensuring the PWS operator in rural, disadvantaged areas are able to maintain the reliability of their systems. The reliability of local groundwater is subject to a number of natural and human forces, ranging from increased population growth (and accompanying increased demands), to drought and earthquakes, to water rights determinations. The program will also increase supply reliability by increasing access to groundwater supplies, decreasing leaks and water loss, increasing storage facilities, and decreasing O&M constraints (for example, pumping and distribution deficiencies).

Monetized Benefit Analysis (Section D3)

The individual projects that will be funded as part of this Program will be selected based on benefit criteria established by the RCAC Steering Committee. However, in order to provide an example of the types and magnitude of monetized benefits that are likely to occur, an example of monetized benefits is developed based on the physical benefits example developed in Attachment 7.

K. Avoid Bottled Drinking Water Supply Costs

The objective of the *Rural DAC Partnership Program* is to provide both funding and technical support for implementing projects that will solve critical water or wastewater system issues in the Region's rural DACs. In ***Example 3-2: Rancho Estates MWC***, the *Engineering Report* states that residents served by Rancho Estates MWC currently purchase bottled water for their drinking needs.[68] Assuming that each person requires one gallon of drinking water per day, and that 80% of the Rancho Estates MWD's 180 residents currently purchase bottled water, this results in 52,560 gallons of bottled water purchased each year. With project implementation, this would lead to a savings of 52,560 gallons per year of bottled water purchases. This estimate is conservative because some residents may also choose to use bottled water for other cooking and washing activities, in addition to drinking.

Assuming that the cost of a gallon of water is estimated to average $1.75 per gallon, the Rancho Estates MWC project would result in a water supply benefit totaling $1,372,157 over the 50-year lifetime of the *Rural DAC Partnership Program*.

F. Avoid Imported Water Supply Purchases

For rural PWS that have interconnections with Water Authority member agencies to purchase imported water supplies on an as-needed basis, the improved storage infrastructure that will be constructed

[68] Engineering Report, Pg. 2-6

through the *Rural DAC Partnership Program* will allow the rural PWS to operate their water systems to balance supply availability with demand.

In ***Example 3-2: Rancho Estates MWC***, the Rancho Estates MWC project would construct covered water storage to replace uncovered reservoirs and construct a separate domestic water supply distribution system. Rancho Estates MWC blends its water with Yuima Municipal Water District (YMWD) water in a 1:3 ratio, as explained in Attachment 7[69], in order to meet water quality standards.

This project would eliminate agricultural use of YMWD water, and meet all domestic demands with YMWD supplies. Therefore, this project would lead to a 792 AFY decreased in YMWD water demand for agriculture uses, and increase domestic demand for YWMD water by 10 AFY. The new system installed for domestic water supply would prevent loss of water through leakage, estimated at 10% of use.[70]Though the new system will reduce leakage, it will not eliminate it entirely, so no water savings from reduced leakage is included in this analysis. Net reduction in YMWD water demand by Rancho Estates MWC would be 782 AFY (-792 AFY from agriculture + 10 AFY from domestic).

These improvements would begin in 2018 following construction of the Rancho Estates MWC project and extend over the 50-year lifetime of the project.

Applying the avoided imported water rates described in detail in Appendix 8-1, this results in a monetized benefit, discounted over the 50 year project life, of $20,107,667. Although not all projects funded as part of the *Rural DAC Partnership Program* will provide exactly the same kinds of monetized benefits, this type of project, or a similar type of project, is extremely likely to occur and has thus been included in this economic analysis.

There are several empirical and conceptual challenges to forecasting the future avoided cost of import water. Appendix 8-1 discusses these issues and how they were addressed to develop the avoided water supply cost of $1,259 per acre foot (for 2013), and escalation rates for future years, that are used to evaluate the benefits of those projects that result in a reduction in imported waters in the San Diego region.

This example for the type of project likely to be funded as part of the Program results in a monetized benefit from imported water savings, discounted over the 50 year project life, of $20,107,667. Although not all projects funded as part of this Rural DAC Partnership will provide exactly the same kinds of monetized benefits this type of project, or a similar type of project, is extremely likely to occur as part of this Program.

Table 8-15 summarizes the annual benefits from the project and Table 8-16 summarizes the avoided costs from the project.

[69]Attachment 7
[70]Rancho Estates MWC. 2008. *Engineering Report Executive Summary*. Pg. 2-6.

Table 8-15: Annual Benefit (PSP Table 15)
Rural DAC Partnership Program

Annual Benefit									
(All benefits should be in 2012 dollars)									
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit (Units)	Without Project	With Project	Change Resulting from Project (e) – (d)	Unit $ Value (1)	Annual $ Value (1) (f) x (g)	Discount Factor (1)	Discounted Benefits (1) (h) x (i)
2014	Avoided Imported water	Acre Feet	782	0	782	$1,303.07	$1,018,997	0.890	$906,904
	Reduced CO2e emissions	MT	0	0	0	$23.07	-	0.890	-
2015 - 2063	Avoided Imported water	Acre Feet	782	0	782	$1,348.67	$1,054,662	Variable	$19,991,143
	Reduced CO2e emissions	MT	733.5	0	733.5	$23.62	$17,328	Variable	$349,581
2064	Avoided Imported water	Acre Feet	0	0	0	$3,084.00	-	0.048	-
	Reduced CO2e emissions	MT	733.5	0	733.5	$75.52	$55,392	0.048	$2,676
Total Present Value of Discounted Benefits for Avoided Imported Water Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$20,107,667**
Total Present Value of Discounted Benefits for Reduced CO2 Emissions Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$352,268**

Table 8-16: Annual Cost of Avoided Purchase of Bottled Water (PSP Table 16)
Rural DAC Partnership Program

Annual Costs of Avoided Project						
(All costs should be in 2012 Dollars)						
Alternative: Purchase of Bottled Water						
					Discounting Calculations	
	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance costs	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)	Discount Factor	Discounted Project Costs (h) x (i)
(a) Year	(b)	(c)	(d)	(e)	(i)	(j)
2014 - 2064		$ 91,980		$91,980	Variable	$81,862
Total Present Value of Discounted Costs (Sum of Column (g))						**$1,372,157**
(%) Avoided Cost Claimed by Project						**100 %**
Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project (Total Present Value of Discounted Costs x % Avoided Cost Claimed by Project)						**$1,372,157**
Comments: By having the YMWC provide drinking water residents will no longer purchase bottled water. The purchase of bottled water represents an avoided cost for this project.						

G-Reduce Net Production of Greenhouse Gases

As described in Attachment 7, reduced reliance on imported water will avoid the extensive energy requirements associated with transporting water from Northern California and the Colorado River to San Diego County. This in turn will result in avoided CO2 emissions (a GHG) associated with the production of this energy.

To calculate avoided CO2 emissions with the project, we multiplied the amount of energy required to treat and convey 782AF of water (2.65 MWh/AF[71]) by the average carbon emissions rate associated with energy production in California (0.354 MT/MWh). This provided us with the annual net reduction in CO2 emissions resulting from the project. These calculations are described in detail in Attachment 7.

By avoiding 782AFY of imported water (at full implementation), the project will result in a net reduction in CO2 emissions of 733.5 MT per year. Given the schedule for project construction (with some benefits beginning to accrue in 2014), total net CO2 emissions reductions amount to 36,675 MT over the 50-year project life.

To monetize this benefit, we applied the dollar value assigned to greenhouse gas (GHG) emissions, measured in carbon dioxide equivalent (CO2e). The social cost of carbon is estimated as the aggregate net economic value of damages from climate change across the globe, and is expressed in terms of future net benefits and costs that are discounted to the present.[72] In February 2010, the U.S. Government's Interagency Working Group on Social Cost of Carbon issued guidance[73] on recommend values for the social cost of carbon for use in regulatory benefit-cost analysis. The recommended mean estimate of the social cost of reducing one metric ton (MT) of CO2 in 2012 is $22.53/MT(updated from 2010 values using CPI), with a range of values from $4.95 to $68.33 per MT. The recommended mean estimate of the social cost of carbon reflects the worldwide net benefits of reducing CO2 emissions. Estimates of the portions of the net benefits occurring in the United States range from 7% to 23% of the worldwide social cost of carbon.

For this analysis, the average value of $22.53/MT was used when calculating social benefits and costs, which produces conservative estimates for the benefits and costs associated with GHG emissions. To determine total costs over the 50-year project period, we escalate the social cost of carbon by 2.4% per year, which is above the general rate of inflation. The social cost of carbon will increase in future years because CO2 will produce larger incremental damages as physical and economic systems become more stressed in responding to greater climate change.

Over the 50-year project life, total present value benefits associated with avoided social costs of carbon amount to $352,268.

Project Benefits and Costs Summary (Section D5)

Project Economic Costs

The total present value cost of this program is $4,631,384. A summary of the discounted costs is provided in Table 8.17. Approximately $5,701,077 of the total project cost is allocated to construction/ implementation components of the *Rural DAC Partnership Program*, approximately 99% of which will go directly to infrastructure reimbursements for the Region's rural DAC water systems.

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[71] Equinox Center. 2010. *San Diego's Water Sources: Assessing the Options*, July 2010. pg. 10

[72] IPCC. 2007. Summary for policymakers. In *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change,* M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden, and C.E. Hanson (eds.). Cambridge University Press, Cambridge, UK. pp. 7–22.

[73] Interagency Working Group. 2010. Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866. Interagency Working Group on Social Cost of Carbon, United States Government.February. Available: www.epa.gov/oms/climate/regulations/scc-tsd.pdf. Accessed 7/13/2011.

Examples of projects described in Attachment 4 illustrate the range of potential project costs. For example, ***Example 3-1 Phoenix House School*** has a total project cost, not discounted, of $444,093. Of this, $69,600 is directed to design and environmental compliance and the remaining $374,793 is allocated to construction of a new well that is not susceptible to bacteriological contamination.

Example 3-2: Rancho Estates MWC has a total undiscounted project cost of $1,636,800. This includes installation of 3,000 feet of 4" pipe, 13,500 feed of 6" pipe, 41 new hydrants, a 50,000 water storage tank, a 500 gallon hydropnuematic tank, 60 household connections and meters, design, contingency, labor, and profit. Of this, $420,400 of the total cost is allocated to design and environmental compliance with the remainder, $2,442,424 allocated to construction and performance testing. The cost of this project, updated to 2012$, is $1,745,445.

The monetized discounted benefits for this project include $3,774,117 in reduced imported water costs, $64,260 in reduced social cost of carbon and $4,699 in avoided bottle water purchases for a total project benefit of $3,843,076 in present value 2012$. For this example project, the present value benefits exceed the costs by nearly $2.1 million, at a benefit-to-cost ratio of approximately 2.2 to 1.0.

In ***Example 3-3: San Pasqual District B Water System***, the total undiscounted project cost is $940,452. Design and Environmental needs account for $110,817 of total costs with the remainder, $829,635 allocated to construction and testing of a new tank that will reduce water waste and not be susceptible to contamination due to leaking

Table 8-167: Annual Costs (PSP Table 19)
Rural DAC Partnership Program

Table 8-69 – Annual Costs of Project										
(All costs should be in 2012 Dollars)										
	Initial Costs		Annual Costs (2)						Discounting Calculations	
	Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost(1)	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2014	$290,964							$290,964	0.890	$258,957
2015	$1,454,822							$1,454,822	0.840	$1,221,497
2016	$2,385,908							$2,385,908	0.792	$1,889,863
2017	$1,687,593							$1,687,593	0.747	$1,261,068
Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries										**$4,631,384**

Benefits and Costs Summary

This project will provide multiple qualitative benefits to disadvantaged communities in rural San Diego county including: providing safe drinking water, addressing critical water supply or water quality needs of DACs, increasing stakeholder involvement and stewardship, increasing water available for fire protection, benefiting wildlife or habitat in Bay-Delta through reduced imports, improving water quality, and improving water supply reliability.

Because individual projects that will be funded as part of this *Rural DAC Partnership Program* have yet to be selected, it is not possible to provide a true estimate of physically quantifiable or monetized benefits. An example of the type of physically quantifiable and monetized benefits is provided for one of the four or five likely projects. Discounted program costs are calculated to be $4,631,384. For the example project illustrated above, the PV of monetizable benefits outweighed the costs by a conservable margin (about 2.2 to 1.0). If a similar ratio of benefits to costs were obtained from other projects to be pursued under this program, then the benefits associated with the program would equal about $10 million (2.2 * $4.55 million PV program costs). The primary benefit of this *Rural DAC Partnership Program* is the supply of safe drinking water to disadvantaged communities in the San Diego IRWM region.

Omissions, Biases, and Uncertainties

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainties are associated with inability to quantify or monetize the benefit of reducing the incidence of Water Borne Disease Outbreaks. These issues are listed in Table 8-18.

Table 8-17. Omissions, Biases, and Uncertainties, and Their Effect on the Project
Rural DAC Partnership Program

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Provide Safe Drinking Water	++	Safe Drinking water reduces the potential for transmission of Water Borne Disease Outbreaks and associated morbidity and mortality.
Benefit DAC	++	DACs require additional resources to ensure environmental justice.
Avoid Imported Water Purchases	U	The calculation of avoided imported water costs assumes that MWD water rates will increase annually (in real terms) by 3.5% through 2020. Beyond 2020, a 1.5% real increase in water rates is assumed. These projections are based on existing and planned MWD financial commitments and recent increases in MWD rates. It is uncertain whether actual future rate increases will be above or below these assumed rate increases.

*Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
— = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Project 4: Failsafe Potable Reuse at the Advanced Water Purification Demonstration Facility

Project Abstract

The *Failsafe Potable Reuse at the Advanced Water Purification Demonstration Facility* project will provide comprehensive testing, evaluation, and demonstration of sequential failsafe treatment steps (treatment trains) for potable reuse without an environmental buffer. To accomplish this, the project will draw upon active potable reuse research projects in the United States, Singapore, South Africa, and Australia in addition to worldwide potable reuse applications and practices used and researched in these same countries. Highlighted by a workshop on hazard analysis, critical control points, and redundancy requirements, this project will convene national and international health, treatment, and water quality experts to establish an appropriate framework for demonstration of failsafe potable reuse at the City of San Diego's existing advanced water purification demonstration facility (demonstration facility).

This project consists of four distinct phases activities as described below:

Phase 1 – Develop expert panel guidelines on hazard analysis, redundancy, reliability and monitoring requirements for potable reuse without an environmental buffer: This task will identify an expert panel to participate in an international workshop that will develop the necessary guidelines to address hazard analysis, redundancy requirements, and appropriate water quality monitoring techniques for implementing potable reuse without an environmental buffer. A two-day workshop will be held in San Diego with the California Department of Public Health (CDPH) and municipalities pursuing potable reuse invited to attend. The expert panel will produce failsafe guidelines that will provide needed guidance for the potable reuse demonstration testing that will be performed as a part of this project.

Phase 2 - Develop a comprehensive test plan for a failsafe potable reuse system that incorporates failsafe guidelines from previous WRRF studies: This task will devise a test plan that incorporates the failsafe guidelines developed by the expert panel in this project along with the potable reuse treatment guidelines (developed in WRRF 11-02) and any other salient guidance from on-line monitoring (WRRF 11-01) and/or engineered storage buffer (WRRF 12-06). The test plan will be comprehensive and will include bench-scale work to better develop surrogate and indicator concepts, pilot-scale testing to demonstrate alternative disinfection and oxidation technology performance, as well as demonstration-scale testing to provide proof of failsafe system concept.

Phase 3 – Perform bench-scale, pilot-scale and demonstration-scale testing at the City of San Diego's water purification demonstration plant: This task will operate the City's demonstration facility for 52 weeks to develop long-term information that will evaluate the failsafe concepts developed in the test plan. The demonstration testing will involve microbial challenges, evaluations of intentional system failures, demonstration of on-line monitoring equipment's response, and redundancy treatment response. In addition to the demonstration testing, pilot-scale testing of alternative disinfection and oxidation processes will also be routinely operated and challenge tested. The combination of demonstration and pilot-scale testing will cover a wide range of treatment alternatives, monitoring, system response, and system reliability concepts.

Phase 4 – Prepare Final report on complete strategy for failsafe potable reuse: A final report will be compiled to provide a comprehensive pathway to failsafe potable reuse. The report will summarize expert panel guidelines and all the data gathered for on-line monitoring applications, redundancy and reliability performance, and relevant surrogate and indicators for various treatment processes. The report will be provided along with a workshop to develop a common understanding of project outcomes prior to finalizing the report with any specific comments.

The WateReuse Research Foundation is actively funding nearly $3 million in research to better develop potable reuse as a supplemental water supply. This project leverages the expertise from those investments and combines them to demonstrate failsafe potable reuse at the City of San Diego's demonstration facility.

Although this project will have important implications for the future of potable reuse in San Diego and throughout the State of California, however, it will not in itself result in immediate monetizable benefits. The true value of this project is that it will help to facilitate future implementation of failsafe potable reuse. This could potentially result in significant financial, environmental, and social benefits for water supply agencies (and their customers) throughout the State.

Summary Project Benefits and Costs

To demonstrate the magnitude of potential benefits that could ultimately result from this project, this attachment describes the benefits associated with wide-scale implementation of failsafe potable reuse in the City of San Diego. This is compared to a baseline implementation of indirect potable reuse that involves the use of a local reservoir as an environmental buffer (San Diego has planned for implementation of indirect potable reuse through reservoir augmentation but would like to explore failsafe potable reuse, which could potentially result in even greater benefits for the City). The direct benefits of the demonstration project itself are also qualitatively described.

A summary of all benefits and costs of the project are provided in Table 8-19. A description of the monetized benefits and non-monetized benefits are presented in the following sections, while physically quantified (but not monetized) benefits are described in Attachment 7. Benefits are lettered for cross-reference with Attachment 7, and are therefore not represented in order in the following sections.

Table 8-18. Benefit-Cost Analysis Overview
Failsafe Potable Reuse at the Advanced Water Purification Demonstration Facility Project

	Present Value
Costs – Total Capital and O&M	**$2,697,016**
Monetizable Benefits	
A-Avoid Construction of Pipeline to San Vicente Reservoir	$5,618,559
B-Reduce Net Generation of Greenhouse Gases	$74,002
Total Monetizable Benefits	**$5,692,561**
Quantitative Benefits	
G-Additional Statewide Water Supply Derived From Potable Reuse	0.9 million AFY
I-Reduce Ocean Discharges	0.9 million AFY
Qualitative Benefit or Cost	**Qualitative Indicator***
C-Expand Scientific and Technical Foundation for Potable Reuse	++
D-Help Avoid, Reduce or Resolve Various Public Water Resources Conflicts	+
F- Leverage Existing Research Efforts	
H-Improve Water Supply Reliability	+

* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease net benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Non-Monetized Benefits Analysis (Section D2)

Narrative descriptions of the benefit categories marked “Yes” in the *Proposal Solicitation Package* Table 12 are provided below.

C-Expand Scientific and Technical Foundation for Potable Reuse

Through comprehensive testing, evaluation, and demonstration of failsafe treatment trains, the *Failsafe Potable Reuse at the Advanced Treatment Demonstration Facility* project will expand industry knowledge related to the implementation of potable reuse without environmental buffers.

As described in Attachment 7, a challenge in establishing regulations for all types of potable reuse is a lack of industry knowledge regarding specific treatment objectives required to protect public health, the myriad of alternative treatment processes available to enhance water quality, treatment train redundancy requirements, system reliability requirements and real-time water quality monitoring techniques. This project seeks to fill this gap and ultimately support wider implementation of potable reuse by increasing industry understanding and easing the burden on regulators to address the complex issues associated with the variations of possible potable reuse scenarios.

In addition, the City's Advanced Water Purification Demonstration Facility will continue to be open for public tours throughout implementation of the demonstration project. This will provide for additional public education regarding San Diego's water supply challenges and the role that full advanced water treatment technology and potable reuse can have in addressing those challenges.

D-Help Avoid, Reduce or Resolve Various Public Water Resources Conflicts

Senate Bill 918 (SB 918) requires the California Department of Public Health (CDPH) to finalize regulations for indirect potable reuse through groundwater recharge and reservoir augmentation by the end of 2013 and 2016,respectively. CDPH must also report on the feasibility of direct potable reuse, which would not require an environmental buffer and could increase the viability of potable reuse for water agencies throughout the State. The proposed demonstration project will provide guidelines and scientific assessment that will help CDPH to make a determination regarding direct potable reuse for the State of California.

Senate Bill X7-7 mandates a 20% reduction in per capita urban water use by December 31, 2020(and by at least 10% by December 31, 2015).[74]Under this legislation, the use of recycled water in lieu of potable supplies can be counted towards SBX7-7 compliance.The *Failsafe Potable Reuse at the Advanced Treatment Demonstration Facility* project could help to facilitate up to 100,000 AFY of failsafe potable reuse in the San Diego region. Implementation of direct potable reuse will help to meet requirements set forth in Senate Bill X7-7.

This project also helps to meet statewide goals established through the State Water Resources Control Board (SWRCB) Recycled Water Policy to increase use of recycled wastewater by at least 1 million AFY by 2020 and by at least 2 million AFY by 2030.[75]

E-Improve Water Quality by Reducing Salt Loading

The*San Diego Recycled Water Study* notes that when blended with imported water, water produced at the AWPF has the potential to reduce salinity in reservoirs by up to 50% due to its purity.[76] Imported water entering San Vicente Reservoir averages 500mg/L of total dissolved solids (TDS), while water from Orange County's Groundwater Replenishment System – an operating advanced water treatment plant – averages 35-50 mg/L.[77]On land, the reservoirs that receive the advanced purified water, theresidents that use the water, and the soil that is irrigated with the water would all benefit from having waterwith up to half the current salinity levels. Residents would benefit from softer water and extended lives ofhousehold appliances such as water heaters, dishwashers, clothes washers and faucets.

In order to estimate the magnitude of potential Statewide water quality improvement that could accrue from failsafe potable reuse, Attachment 7 calculated the amount of salt import that is avoided by using purified water in lieu of imported water supplies. Using the estimated quantity of 0.9 million AFY Statewide failsafe supply (see G- Additional Statewide Water Supply Derived from Potable Reuse), the estimated salt content (50 mg/l) of failsafe supply, and an assumption that failsafe potable reuse could offset 50% of MWD's imports, this results in 320 million lbs/year of salt import avoided.

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[74]San Diego County Water Authority. 2011. *2010Urban Water Management Plan*. Page 1-4, Section 1.2.
[75]State Water Resources Control Board. 2009. Recycled Water Policy. Available: http://www.waterboards.ca.gov/water_issues/programs/water_recycling_policy/docs/recycledwaterpolicy_approved.pdf. Accessed March 2013
[76]City of San Diego. 2012. *San Diego Recycled Water Study* (Final Draft). May 10. Page ES-1.
[77]City of San Diego. 2012. *San Diego Recycled Water Study* (Final Draft). May 10. Section 6.1, page 6-1.

F-Leverage Existing Research Efforts

This project will build upon research developed as part of the WRRF's Potable Reuse Development Program. This program has funded close to $3 million in research efforts to investigate on-line monitoring technologies for evaluating system performance (WRRF 11-01), as well as alternative potable reuse treatment trains and public health criteria for direct potable reuse (WRRF 11-02).

Failsafe Potable Reuse at the Advanced Water Purification Facility will demonstrate the treatment and monitoring methods developed in these WRRF projects, which is necessary for regulatory approval of the failsafe potable reuse concept.

G-Additional Statewide Water Supply Derived from Potable Reuse

Although the most important benefit of the *Failsafe Potable Reuse at the Advanced Water Purification Facility* project is to demonstrate the feasibility of failsafe treatment trains, the development of potable reuse in general (whether it involves an environmental buffer or not) will provide important benefits for the City of San Diego, as well as throughout the State of California. For San Diego, a key benefit of increased potable reuse includes the development of a local, drought-resistant source of high-quality drinking water that will reduce reliance on unsustainable water supply sources.

In Southern California many water supply agencies receive imported water supplies from MWD. The availability of imported water (from both the Colorado River and the SWP) is subject to a number of natural and human forces, ranging from increased population growth (and accompanying increased demands), to drought, changes in snowpack and earthquakes, to environmental regulations, water rights determinations, and associated legal challenges and Court rulings. Local groundwater is also limited in many areas, highlighting the need for additional reliable sources of water to meet current and future demands under all hydrologic conditions.

In addition, by reducing the need for imported SWP water, wide-scale implementation of potable reusewill augment in-stream flows in Sacramento-San Joaquin River Delta (which provides the means by which the SWP delivers water from Northern California to the south) or will offset other diversions that may otherwise reduce flows. Reduced demands on Delta supplies also will help reduce the overall salinity of the Delta and improve Delta habitat.

Further, if failsafe approaches to potable reuse without an environmental buffer can be demonstrated to be safe and reliable – as this proposed project is intended to help demonstrate – then there will be many additional opportunities to expand reuse throughout the State. In most communities this would also likely provide significant financial cost savings and environmental benefits (e.g., from reduced piping and pumping in most locations) compared to the alternatives of more limited and often more costly forms of potable and non-potable reuse.

As described in Attachment 7, the magnitude of potential Statewide benefit that could accrue from failsafe potable reuse was estimated using two different methods and then averaging them. Noting that approximately 3.5 million AFY offresh water is currently discharged to the ocean as wastewater,[78] our analysis equates to 0.9 million AFY of purified water produced through failsafe potable reuse.

H-Improve Water Supply Reliability

The reliability of a water supply refers to its ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. The *Failsafe Potable Reuse at the Advanced Water Purification Facility* project will help address reliability issues for the City of San Diego by providing a drought proof-supply. As noted above, the reliability of imported water – which is the region's primary current supply – is subject to a number of natural and human forces, ranging from increased population growth (and accompanying increased demands), to drought and earthquakes, to environmental regulations and water rights determinations.

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[78]WateReuse California. 2009. Potable Reuse Program Position Statement. Available: http://www.watereuse.org/sites/default/files/u8/PR%20position%20statement%20v3a.pdf
SWRCB.2009 Survey.

Though the increase in local water supply (equivalent to the total purified water produced by the AWPF, or 100,000 AFY) can be quantified, reliability is more challenging because it is subject to a number of natural and human forces (e.g., drought, earthquakes, population growth, legal agreements). This project contributes towards water supply reliability, but it does not guarantee a reliable water supply. However, failsafe potable reuse provides high quality water that is of equal or better quality than untreated imported water. It is a locally developed sustainable water supply that is uninterruptible and is not affected by outside influences, and as such would increase water supply reliability if implemented at full scale in the region.

I-Reduce Ocean Discharges

In 2010, the U.S. Environmental Protection Agency (USEPA) allowed the City of San Diego to continue to operate the Point Loma Wastewater Treatment Plant (PLWWTP) as a chemically enhanced primary treatment facility under a modification to its National Pollutant Discharge Elimination System (NPDES) Permit.[79] During the 2008-2010 permit modification process, two environmental organizations entered into a Cooperative Agreement with the City to conduct the *Recycled Water Study*which sought to identify alternatives to large-scale wastewater system upgrades, including a water reuse program. Water reuse programs provide valuable water supplies by using resources that otherwise are sent to the ocean.[80]

The supply of purified water that would be reused by the City of San Diego AWPF totals 100,000 AFY.[81] The calculated supply for failsafe potable reuse Statewide (0.9 million AF)includes wastewater that would be otherwise discharged to the ocean. This reduction in ocean discharges would have a substantial impact on coastal ecosystems directly adjacent to ocean outfalls.

Monetized Benefit Analysis (Section D3)

As described above, the demonstration project itself will not result in immediate monetizable benefits. However, this project would potentially facilitate wide-scale implementation of direct potable reuse in the City of San Diego (up to 100,000 AFY). To demonstrate the magnitude of potential benefits that could ultimately result from this project; this attachment describes the benefits associated with failsafe potable reuse in San Diego compared to a “without project” baseline of IPR/RA that involves the use of San Vicente Reservoir as an environmental buffer.

In San Diego, failsafe potable reuse would result in the following benefits compared to IPR/RA:

- Avoided costs associated with construction of a 22 mile pipeline to San Vicente Reservoir
- Reduced social costs ofGHG (CO_2) emissions associated with the pipeline

A-Avoid Construction of Pipeline to San Vicente Reservoir

Due to increasing concerns over the reliability of imported water in Southern California, the City of San Diego has developed extensive plans for expanding potable reuse within its service area. Currently, the City is evaluating the potential for an IPR/RA program that would ultimately recycle 100,000 AFY of wastewater using advanced treatment technologies. Following treatment, this water would be pumped to San Vicente Reservoir (which effectively serves as the environmental buffer), blended with water from other sources, and ultimately treated again at the potable water treatment plant. The pipeline from the City’s Advanced Water Purification Facility (AWPF) to San Vicente Reservoir would be 22 miles long.

Although IPR/RA (i.e., using the San Vicente Reservoir as an environmental buffer) would provide important benefits to the City, potable reuse without the use of an environmental buffer has the potential to save the City significant amounts of money. With this option, recycled water would also be developed at the City’s AWPF but would be delivered directly to the Water Authority’s regional raw aqueduct system (which serves the City of San Diego and other local communities). Similar to IPR/RA, this water would be

[79]City of San Diego. 2012. *San Diego Recycled Water Study* (Final Draft). May 10. Page ES-1.
[80]City of San Diego. 2012. *San Diego Recycled Water Study* (Final Draft). May 10. Page ES-1.
[81]City of San Diego. 2012. *San Diego Recycled Water Study* (Final Draft). May 10. Page ES-6.

treated again at a potable water treatment plant. The pipeline from the City's AWPF to the raw aqueduct system would be 10 miles long.

Due to the much shorter pipeline and the less difficult terrain that the pipeline would traverse, failsafe potable reuse would result in significant cost savings for the City compared to the IPR/RA alternative. Table 8-20 presents the estimated capital costs associated with construction of the pipelines and associated pumping facilities required for direct and indirect potable reuse in San Diego. By eliminating the need for an environmental buffer, failsafe potable reuse would save the City about $127 million in initial construction costs for the pipe and pumping facilities alone.

Table 8-20: Construction Costs Associated with IPR/RA and DPR Facilities in San Diego
Failsafe Potable Reuse at the Advanced Water Purification Facility

Indirect Potable Reuse Through Reservoir Augmentation	
Pipeline to San Vicente (22 miles)	$132,666,112
Tunneling for pipeline	$37,755,000
Pump Stations (2)	$33,536,502
Total costs	**$203,957,614**
Failsafe Potable Reuse	
Pipeline to Water Authority Aqueduct (10 miles) – assumed proportional $/mile cost as IPR/RA minus tunneling	$60,302,778
Pump station (1) – assumed 50% of IPR/RA cost	$16,768,251
Total costs	**$77,071,029**
Cost Difference	**$126,886,585**

Source: Appendix F, City of San Diego Recycled Water Study, 2012

Although the capital costs associated with failsafe potable reuse are significantly lower than those for IPR/RA, there may be additional savings or costs associated with the O&M requirements of operating the failsafe potable reuse approach compared to the IPR/RA approach. Unfortunately, O&M costs for each approach are not currently available, hence the analysis here is confined to the capital costs only.

In general, it is likely that in most applications, direct potable reuse will require less piping and pumping in order to deliver the recycled water supplies to the potable water treatment and distribution facilities as compared to the pipe and pumping distances typically associated with delivering recycled water to an environmental buffer such as the SVR. Thus, it is likely to be the case that DPR approaches will typically have lower energy needs and lower related O&M costs for water transport. This will vary be location, depending on site-specific circumstances (for example, in the San Diego setting, the failsafe approach would have a far shorter pumping distance, but would need to pump to slightly higher elevation becausethe water would be piped to the raw water aqueduct system at a higher elevation than the reservoir, so the net difference in pumping-related energy use across the options is not clear). For the purposes of this illustration, we assume the total O&M costs across the failsafe and IPR/RA options are roughly equal (and thus net out to a zero difference between the two options).Hence, O&M costs are not included in the calculations or results.

To calculate the present value cost savings associated with the failsafe project compared to IPR/RA option, this analysis assumes that construction would begin in 2025 and take three years to complete. Thus, failsafe potable reuse would result in a present value cost savings of 56,185,593 in terms of initial costs for pipeline and pump station requirements alone.

We estimate that the proposed demonstration project will be partly responsible for facilitating the implementation of failsafe potable reuse within the City of San Diego. We therefore attribute 10% of the present value cost savings associated with direct potable reuse directly to this project ($5,618,559).

B-Reduce Net Generation of Greenhouse Gases

As described above, failsafe potable reuse in this site-specific illustration will require slightly more energy than indirect potable reuse for treated water conveyance (on a per AF basis) because the raw aqueduct system is located at a higher elevation than San Vicente Reservoir. This will result in slightly higher CO_2 emissions associated with conveyance of treated water under the failsafe potable reuse alternative.

However, the slightly higher energy requirements (and related CO2 emissions) associated with failsafe potable reuse will be offset by the energy requirements associated with construction of the 22 mile pipeline to San Vicente under the IPR/RA alternative. Recent research has revealed that there is a considerable carbon footprint associated with pipelines. As described in Attachment 7, much of this footprint is associated with the production phase (i.e., manufacturing the pipe accounts for between 70% to 99% of the total carbon footprint), with the balance attributed to transport of the pipe to the installation site, and actual installation activities.

For the San Diego illustration, the pipe is anticipated to be cement mortar lined steel and 36 inches in diameter, for either the 22 mile IPR/RA or the 10 mile failsafe pipelines. Based on the research described in Attachment 7, the avoidance of 12 miles of pipeline under the failsafe alternative would save approximately 53,280 MT of CO2e emissions. To calculate the net CO2 emissions associated with IPR/RA and failsafe potable reuse, we multiplied the amount of energy required to convey 100,000 AF of treated water under each alternative, as well as the energy use associated with construction of the pipelines required under each alternative, by the average carbon emissions rate associated with energy production in California (0.354 MT/MWh). This analysis showed that over an expected project life of 50-years, failsafe potable reuse would result in a net reduction in CO2 emissions of 53,280 MT compared to IPR/RA.

To monetize this benefit, we applied the dollar value assigned to greenhouse gas (GHG) emissions, measured in carbon dioxide equivalent (CO2e). The social cost of carbon is estimated as the aggregate net economic value of damages from climate change across the globe, and is expressed in terms of future net benefits and costs that are discounted to the present.[82] In February 2010, the U.S. Government's Interagency Working Group on Social Cost of Carbon issued guidance[83] on recommend values for the social cost of carbon for use in regulatory benefit-cost analysis. The recommended mean estimate of the social cost of reducing one metric ton (MT) of CO2 in 2012 is $22.53/MT(updated from 2010 values using CPI), with a range of values from $4.95 to $68.33 per MT. The recommended mean estimate of the social cost of carbon reflects the worldwide net benefits of reducing CO2 emissions. Estimates of the portions of the net benefits occurring in the United States range from 7% to 23% of the worldwide social cost of carbon.

For this analysis, the average value of $22.53/MT was used when calculating social benefits and costs, which produces conservative estimates for the benefits and costs associated with GHG emissions. To determine total costs over the 60-year project period, we escalate the social cost of carbon by 2.4% per year, which is above the general rate of inflation. The social cost of carbon will increase in future years because CO2 will produce larger incremental damages as physical and economic systems become more stressed in responding to greater climate change.

Assuming the pipeline would be manufactured in 2026 (the second of the three-year anticipated project construction timeline, assumed to begin in 2025), then the present value benefits associated with the net reduction in carbon emissions with failsafe potable reuse (compared to IPR/RA) amount to $740,019.Again, because the proposed demonstration project will be partly responsible for facilitating the

[82]IPCC. 2007. Summary for policymakers. In *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change,* M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden, and C.E. Hanson (eds.). Cambridge University Press, Cambridge, UK. pp. 7–22.

[83]Interagency Working Group. 2010. Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866. Interagency Working Group on Social Cost of Carbon, United States Government.February. Available: www.epa.gov/oms/climate/regulations/scc-tsd.pdf. Accessed 7/13/2011.

implementation of direct potable reuse within the City of San Diego, we attribute 10% of this present value benefit directly to this project ($74,002).

Summary of Monetized Benefits

Table 8-20 shows the cost savings associated with failsafe potable reuse resulting from avoided construction of a 22 mile pipeline from the AWPF to San Vicente Reservoir. This table also summarizes the annual benefits associated with reduced social costs of CO_2 emissions with failsafe potable reuse (with 10% of the total benefits directly attributed to this project).

Table 8-20: Annual Cost of the Avoided Pipeline To San Vicente Reservoir (PSP Table 16)
Failsafe Potable Reuse at the Advanced Water Purification Facility

Annual Costs of Avoided Project						
(All costs should be in 2012 Dollars)						
Pipeline and pump station construction costs saved, including GHG emissions avoided						
					Discounting Calculations	
	Avoided Capital Costs	Avoided GHG Emissions Value in Pipeline	Avoided Operations and Maintenance costs	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)	Discount Factor	Discounted Project Costs (h) x (i)
(a) Year	(b)	(c)	(d)	(e)	(i)	(j)
2025	$42,295,528			$42,295,528	0.469	$19,829,794
2026	$42,295,528	$1,673,111		$43,968,640	0.442	$19,447,372
2027	$42,295,528			$42,295,528	0.417	$17,648,446
Total Present Value of Discounted Costs (Sum of Column (g))						**$56,925,612**
(%) Avoided Cost Claimed by Project						**10%**
Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project (Total Present Value of Discounted Costs x % Avoided Cost Claimed by Project)						**$5,692,561**

Project Benefits and Costs Summary (Section D5)

Project Economic Costs

Total costs for the proposed demonstration project total $3,151,703 (in $2012). Direct construction and implementation costs account for $1,466,460 (about 46%) of total capital costs, while grant administration, planning, design, engineering, and environmental documentation and compliance costs account for the remainder of the budget.

Because this project is a demonstration project that will be implemented over 5 years, all costs are considered to be implementation costs. There are therefore no O&M costs associated with this project.

Over the 5-year implementation period, the present value costs of the project amount to $2,697,016. Table 8-22 summarizes the economic project costs for the project.

Table 8-21: Annual Costs (PSP Table 19)

Failsafe Potable Reuse at the Advanced Water Purification Facility

Annual Costs of Project										
(All costs should be in 2012 Dollars)										
	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost[1]	Annual Costs [2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012	$63,034							$63,034	1.000	$63,034
2013	$315,170							$315,170	0.943	$297,330
2014	$693,375							$693,375	0.890	$617,101
2015	$1,512,817							$1,512,817	0.840	$1,270,190
2016	$567,307							$567,307	0.792	$449,360
2017								$0	0.747	$0
Total Present Value of Discounted Costs (Sum of Column (j)) Transfer to Table 17, column (c), Proposal Benefits and Costs Summaries										**$2,697,016**

Benefits and Costs Summary

As shown in the Table 8-20 above, the total present value benefits associated with the *Failsafe Potable Reuse at the Advanced Treatment Demonstration Facility* project amount to $5,692,561 (assuming a 60-year life for failsafe potable reuse in San Diego, and assuming that this demonstration project will increase the probability of failsafe potable reuse acceptance for the San Diego application by 10%). The total present value cost of the project is $2,697,016. The proposed project will therefore result in total present value net benefits (benefits exceeding costs) of $2,978,430.

Total monetized benefits of the project include avoided construction of a 22-mile pipeline from the AWPF to San Vicente Reservoir, and reduced social costs of GHG emissions compared to the implementation of IPR/RA. In addition to monetized benefits and costs, the proposed project will also result in the following non-monetized benefits: provide education and technology benefits for the water industry, provide CDPH with a scientific assessment of failsafe potable reuse, help to meet state mandates associated with water recycling, and leverage existing research efforts related to failsafe potable reuse.

Omissions, Biases, and Uncertainties

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainties are associated with the level of import savings potentially made feasible state-wide, and the cost savings reflectedin the illustration developed for San Diego.. These issues are listed in Table 8-23

Table 8-23. Omissions, Biases, and Uncertainties, and Their Effect on the Project
Failsafe Potable Reuse at the Advanced Water Purification Facility

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Additional Statewide Water Supply Derived from Potable Reuse	U	The calculation presented herein for potential state-wide opportunities to reduce water imports is considered a first approximation of the benefit. No comprehensive study of statewide failsafe potable reuse opportunities has been conducted.
Cost savings from Failsafe project compared to San Diego IPR/RA	U	Cost savings based here on available data for capital costs differential for an illustrative DPR to IPR comparison. O&M costs were not available and are thus not included in the calculation. In addition, an assumed 10% was used to attribute the contribution of the study to the ability to successfully pursue DPR in the San Diego illustration.

*Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
— = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Project 5: Sustaining Healthy Tributaries to the Upper San Diego River

Project Abstract

The Upper San Diego River Watershed contains water bodies that provide source water for the City of San Diego's El Capitan Reservoir, the largest local water supply source in San Diego County, which is impaired by water quality concerns and is on the 303(d) list of impaired water bodies. The streams and creeks that drain into El Capitan Reservoir are relatively healthy, but are under continued threat of degradation from both natural and man-made sources. This project seeks to develop a means of engaging local community members in assessing and monitoring the health of this important watershed and using the information collected to identify emerging threats and changing conditions.

This project will restore and maintain a portion of Boulder Creek, an important tributary to the El Capitan Reservoir in the San Diego River Watershed that captures rain, snow melt, and spring water and drains into El Capitan Reservoir. Areas of the Boulder Creek catchment, including Cuyamaca Peak, average more than 40 inches of rain a year. Boulder Creek is of unique significance because it is used to transfer water between Helix Water District's Lake Cuyamaca and the City of San Diego's El Capitan Reservoir where water is stored until treated for potable use.As part of this project, the community will be engaged in restoring approximately 4.4 acres of degraded riparian and associated buffer habitat on Boulder Creek. The project will also include monitoring of Boulder Creek and surrounding creeks to increase knowledge of the creeks and provide baseline information that will allow for early actions to be taken in the event that the creek begins to degrade. With a relatively small investment now, the creek and watershed can remain healthy, improving the health of the environment, maintaining carrying capacity in the reservoir, and reducing potential water treatment costs.

Boulder Creek is one of two known creeks in the San Diego River Watershed that supports wild rainbow trout. The presence of trout indicates a high quality stream with cold water. These unique conditions offer an exciting potential to use Boulder Creek and nearby creeks as baselines for monitoring the overall health of the 440 square mile San Diego River Watershed. Identifying a suitable creek to use as a baseline for "healthy" conditions and creating a robust monitoring program is a primary goal of the overall watershed water quality monitoring program for the San Diego River Watershed.

Preliminary studies have shown that Boulder Creek is threatened by rural development, legacy mines, erosion and sedimentation from wildfires, and invasive plants and animals. Some hydromodifications have occurred on Boulder Creek, most of which is in public ownership. Recently, the San Diego River Park Foundation (SDRPF) purchased a privately owned 3,000-foot section of the Creek. This project will also include work to restore this section, which has been damaged by private development and wildfire.

Through integration with partners and to bring a more holistic approach to assessing baseline conditions for Boulder Creek, this project includes field surveys of other creeks that drain into the El Capitan Reservoir. Monitoring will include real-time monitoring stations, biological assessments, and invasive animal and plant surveys. Education elements will provide information to private land owners in the area on how to reduce pollutant loading and activities that result in erosion and sedimentation. Another important component is outreach to three Native American Tribes in the area to provide training to empower their members to survey their tribal lands.

Summary Project Benefits and Costs

A summary of all benefits and costs of the project are provided in Table 8-24. Monetized benefits and non-monetized benefits are presented in this attachment, while physically quantified (but not monetized) benefits are described in Attachment 7. Benefits are lettered for cross-reference with Attachment 7, and are therefore not represented in order in the following sections.

Table 8-24. Benefit-Cost Analysis Overview
Sustaining Healthy Tributaries to the Upper San Diego River

	Present Value
Costs – Total Capital and O&M	**$597,340**
Monetizable Benefits	
B. Reduce Net Greenhouse Gas Emissions via Habitat Restoration	$2,875
Total Monetizable Benefits	**$2,875**
Physically Quantified Benefits	**Project Life Total**
A. Restore Native Habitat and Benefits to Wildlife	4.4 acres
I. Provide Access to Restored Lands	13.35 acres available
Qualitative Benefits	**Qualitative Indicator***
F. Scientific and Technical Foundation of Water Management	++
E. Source Water Protection for El Capitan Reservoir	+
G. Community and Tribal Engagement	+
C. Prevent Water Quality Degradation	+
D. Improve water supply reliability	+
H. Provide Education or Technology Benefits	+

* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease net benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Non-Monetized Benefits Analysis (Section D2)

Narrative descriptions of the benefit categories marked "Yes" in DWR's *Proposal Solicitation Package* Table 12 are provided below.

H. Provide Education or Technology Benefits

Education and technology benefits are a key part of the *Sustaining Healthy Tributaries to the Upper San Diego River* project. This project will engage many community members, and educate them on native ecosystems, the benefits of native ecosystems, the importance of Boulder Creek, and the role riparian ecosystems play in river health. This project also involves informing and updating the public about the progress of the project, as well as educating landowners about actions they can take to improve water quality by reducing nutrient and sediment loads. The focus on involvement is expected to result in a more active and educated community, as well as real improvements in environmental quality. Further, this project will open 11.35 acres to the public for recreation, and install educational signage along trails.

In addition to the educational efforts at the site itself, this project will engage with local Tribes to conduct ecosystem monitoring. In particular, trainings will be held with Tribe members on water quality assessments and invasive species monitoring – especially feral pigs.[84]

The ongoing monitoring component has inherent education and technology benefits. It involves a partnership between the SDRPF and San Diego State University to set up and operate a monitoring station in Boulder Creek. The station is customizable, and researchers will be able to swap out various sensors and parts to get the inputs they need in real-time. The data will be made publically available and explicitly shared with land managers. Data on Boulder Creek is especially valuable because it is a relatively healthy cold water stream, which allows it to serve as a baseline (or attainable goal) for other, more impaired creeks. This should make it easier for researchers and water managers to evaluate and improve water bodies throughout the watershed.

[84] Work Plan, Attachment 3, Subtask 9.3.

I. Provide Access to Restored Land

A major component of this project involves providing access to 13.35 acres of restored SDRPF land through signage, fencing and a public information web portal. As one of two known creeks in the watershed supporting wild rainbow trout, public access to Boulder creek is very valuable to anglers. The SDRPF is collaborating with San Diego Fly Fishers to develop a monitoring program that will ensure recreation benefits for years to come. The area is also used by hikers and birders, and provides scenic views. Value is enhanced through the restoration component, where 4.4 acres will be newly restored and cleared of invasives.

G. Community and Tribal Engagement

The *Sustaining Healthy Tributaries to the Upper San Diego River* project relies heavily on the contribution of volunteers. Volunteers will collect data and participate in restoration activities.[85] Through this process, volunteers will receive training on native species, monitoring techniques, and the importance of healthy ecosystems. Educational materials will be installed along trails in the 11.35 acres of this project, which will further engage the community when they arrive to recreate.

There are 18 Native American tribes in San Diego County, and the San Diego River and its adjacent lands are the ancestral home of the Barona and Viejas tribes. These tribes have a unique and important history with the watershed, and all project staff working on the initial multi-creek assessment are trained to recognize culturally significant objects, including arrowheads, pounding stones, clay potsherds etc.

The SDRPF recognizes these tribes continue to play an important role in protecting the watershed today. This project involves a concerted effort to work with these local tribes. The SDRPF has partnered with the Kumeyaay Digueno Land Conservancy, which is affiliated with several tribes, and on-site workshops are planned for the Viejas, Barona, and Inaja Reservations. Many face similar issues, and the Viejas and Barona tribes jointly administer Capitan Grande, which is another reservation also located in the watershed.

A. Restoration of Native Habitat and Benefits to Wildlife or Habitat

One the primary goals of *Sustaining Healthy Tributaries to the Upper San Diego River* is to restore 4.4 acres of riparian habitat along Boulder Creek. This restoration activity will include invasive species removal (e.g., tamarisk, palms) and planting of native species. In addition to enhancing and protecting native plant ecosystems, this will increase available habitat for native species by removing invasive plants and planting in burned areas that have not recovered. Water quality improvements related to riparian restoration – reduced sedimentation, reduced pollutant concentration, decreased stream temperatures, and reduced water loss from increased shading – will provide a high quality cold water stream for wild rainbow trout and other cold-water species.

The real-time monitoring component of the project benefits wildlife and habitat by allowing for early warning of any anomalies. This is particularly important for Boulder Creek's wild rainbow trout population. The project's focus on invasives also provides a significant benefit to both wildlife and habitat. In addition to the 4.4 acres of riparian habitat restored, one of the most valuable ways the project addresses invasives is by partnering with local Native American tribes to monitor for and control feral pig populations. These pigs can be disastrous for important native plant species – the Nature Conservancy and the National Park Service spent $5 million to eradicate wild pigs from Santa Cruz Island, CA in 2007 – and there is worry that feral pigs may serve as a disease vector.[86] Monitoring for feral pigs will enable implementation of control measures early, which will reduce feral pig control costs, and help protect the newly restored habitat before it is damaged.

F. Scientific and Technical Foundation of Water Management

The *Sustaining Healthy Tributaries to the Upper San Diego River pr*oject will collect real-time monitoring data, field assessments of three tributaries to the Upper San Diego River, and implement a field

[85] Work Plan, Attachment 3, Task 9.2 and 9.6.
[86] Kreith, M. 2007. *Wild Pigs in California: The Issues*. University of California – Agricultural Issues Center. December 2007. Available: http://aic.ucdavis.edu/pub/briefs/brief33_v3.pdf

monitoring program. Knowledge of invasives and additional hydromodifications (there are at least two known modifications) are helpful in planning and prioritizing future removal efforts. In addition, an initial, comprehensive assessment also gives researchers an idea of the effectiveness of the project by allowing them to gauge how habitat quality changes as the project progresses. This helps guide future research efforts, both in the Upper San Diego River Watershed and elsewhere.

C. Prevent Water Quality Degradation

The *San Diego River Watershed Management Plan* notes that the water quality in the undeveloped upper watershed is much higher than that found in the lower watershed.[87] The Plan notes that source water and reservoir monitoring in the El Capitan Watershed management Area showed the primary constituents of concern to water quality are excessive nutrients, total organic carbon (TOC), and total dissolved solids (TDS).[88]As described in Attachment 3, this project will restore 4.4 acres along Boulder Creek. A portion of this restoration involves replanting an area along the creek that was damaged by fire, which will reduce loadings of sediment and other nonpoint source pollutants from these fire-damaged areas.

In addition, a portion of the project involves two hydromodification removal studies, which will involve analyzing the costs, benefits and feasibility of removing two separate creek modifications. If these modifications do end up being removed it will likely be because of benefits associated with lowered flow velocities, mainly a reduction in erosion and sedimentation.

It is important to note this project does *not* involve any actual modification removal, just studies to determine whether removal is a good idea. This does not preclude benefits from these studies, however, which are similar to an option value. Currently, the net gain for each of these removal studies can be expressed as the probability that removal is pursued, times the benefits of removal minus the cost of removal. In addition, there is knowledge gained benefits in terms of developing more precise estimates on what these costs and benefits will be. In the worst case scenario, the costs will outweigh the benefits of removal, and the modifications will remain in place. The downside, in other words, is bounded at the cost of the studies.[89] Importantly, the upside has no such bound. The benefits may outweigh the costs by a substantial amount, in which case the modifications will be removed, and the citizens of the San Diego region will gain. For these reasons, it is likely the hydro-modification removal studies have a positive expected value.

E. Source Water Protection for El Capitan Reservoir

The *San Diego River Watershed Management Plan* notes that surface water from the El Capitan Watershed Management Area (including Boulder Creek) is an important source of water supply. The 2003 Cedar Fire burned this entiremanagement area, and the *San Diego River Watershed Management Plan* concludes that water quality issues associated with sediment loading and nutrientcycling will persist for many years. This will require additional effort and expense by the City of San Diego and they will incur additional near-term water treatment costs due to post-fireinputs of sediment, ash, and nutrients.[90]

Boulder Creek directly flows into the El Capitan Reservoir, and water quality in the creek and Reservoir will benefit from the 4.4 acres of riparian habitat restoration. It is anticipated that the greatest water quality benefits that the reservoir will experience are reduced sediment loads (which settle in the reservoir and eventually reduce capacity) and reduced nutrient loading from runoff.

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[87] San Diego River Watershed Working Group. 2005. *San Diego River Watershed Management Plan*.Prepared by Anchor Environmental, et al. Section 2.3 Surface Water Quality, page 15.

[88] San Diego River Watershed Working Group. 2005. *San Diego River Watershed Management Plan*.Prepared by Anchor Environmental, et al. Section 3.2 Surface Water Quality, page 40.

[89]Even this may be too low, as information about the benefits and costs of removal is likely valuable regardless of whether the modifications get removed.

[90] San Diego River Watershed Working Group. 2005. *San Diego River Watershed Management Plan*.Prepared by Anchor Environmental, et al. Section 3.2 Surface Water Quality, page 40.

D. Improve Water Supply Reliability

A portion of the project involves canopy restoration along the bank of the upper San Diego River. Studies have shown canopy shade can reduce evaporative water loss by more than 50%.[91]Invasives removal, including tamarisk, will also yield some water supply enhancements. These activities will provide some additional (but unquantifiable) water supply yields and, because this is a local resource, will contribute to water supply reliability (by enabling a small offset of less reliable import water).

Monetized Benefit Analysis (Section D3)

This project will provide a range of important benefits. However, only one can be reliably estimated in monetary terms – the reduction in net greenhouse gas emissions. Table 8-25 summarizes the annual benefits from the project.

B. Reduce Net Greenhouse Gas Emissions

The *Sustaining Healthy Tributaries to the Upper San Diego River* project will restore 4.4 acres of riparian habitat along Boulder Creek. This land was previously burned in the Cedar fire, and the land has not yet recovered. Restoration activities would involve replanting the area with native riparian species, which will act as a carbon sink, because it will replace either currently unvegetated land or will replace non-native grassland, which is essentially carbon-neutral.[92] Part of *this* restoration project however, involves replanting an area that was damaged by fire and currently lacks vegetation. As a result, the restoration is offsetting greenhouse gas (GHGs) emissions through carbon sequestration.

Assuming a 50 year project life time, we can calculate the total amount of carbon dioxide the 4.4 acres of restored habitat will sequester. As described in Attachment 7, this project anticipates restoring 4.4 acres of riparian habitat for a project lifetime sequestration of 230 MT of CO_2.

To monetize this benefit, we applied the dollar value assigned to greenhouse gas (GHG) emissions, measured in carbon dioxide equivalent (CO2e). The social cost of carbon is estimated as the aggregate net economic value of damages from climate change across the globe, and is expressed in terms of future net benefits and costs that are discounted to the present.[93] In February 2010, the U.S. Government's Interagency Working Group on Social Cost of Carbon issued guidance[94] on recommend values for the social cost of carbon for use in regulatory benefit-cost analysis. The recommended mean estimate of the social cost of reducing one metric ton (MT) of CO2 in 2012 is $22.53/MT (updated from 2010 values using CPI), with a range of values from $4.95 to $68.33 per MT. The recommended mean estimate of the social cost of carbon reflects the worldwide net benefits of reducing CO2 emissions. Estimates of the portions of the net benefits occurring in the United States range from 7% to 23% of the worldwide social cost of carbon.

For this analysis, the average value of $22.53/MT was used when calculating social benefits and costs, which produces conservative estimates for the benefits and costs associated with GHG emissions. To determine total costs over the 50-year project period, we escalate the social cost of carbon by 2.4% per year, which is above the general rate of inflation. The social cost of carbon will increase in future years

[91]Stormont, J., Farfan, E., and Coonrod, J. (2009). "Total Soil Water Evaporation in a Riparian Environment: Model Development and Application." J. Hydrol. Eng., 14(9), 904–912. Available: http://ascelibrary.org/doi/abs/10.1061/%28ASCE%29HE.1943-5584.0000069

[92]Defenders of Wildlife. 2010. *An Economic Analysis of the Benefits of Habitat Conservation on California Rangelands*. Pg. 28.

[93]IPCC. 2007. Summary for policymakers. In *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change,* M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden, and C.E. Hanson (eds.). Cambridge University Press, Cambridge, UK. pp. 7–22.

[94]Interagency Working Group. 2010. Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866. Interagency Working Group on Social Cost of Carbon, United States Government.February. Available: www.epa.gov/oms/climate/regulations/scc-tsd.pdf. Accessed 7/13/2011.

because CO2 will produce larger incremental damages as physical and economic systems become more stressed in responding to greater climate change.

Over the 50-year project life, total present value benefits associated with avoided social costs of carbon amount to $2,875.

Benefit Summary

Only one of the project benefits was monetized – A-Reduce Net Greenhouse Gas Emissions – and, discounted over the 50 year project life, is $2,875. Though the other benefits for this project were not monetized, they do hold value and remain important.

Table 8-25: Annual Benefit of Reduction in Greenhouse Gas Emissions
Sustaining Healthy Tributaries to the Upper San Diego River

Annual Benefit (All benefits should be in 2012 dollars)									
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit (Units)	Without Project	With Project	Change Resulting from Project (e) – (d)	Unit $ Value (1)	Annual $ Value (1) (f) x (g)	Discount Factor (1)	Discounted Benefits (1) (h) x (i)
2017-2036	Reduction in CO2	MT	0	9.179852	9.179852	Variable	Variable	Variable	$2,556.39
2037-2056	Reduction in CO2	MT	0	2.195182	2.195182	Variable	Variable	Variable	$306.30
2057-2066	Reduction in CO2	MT	0	0.299343	0.299343	Variable	Variable	Variable	$12.25
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$2,875**

Project Benefits and Costs Summary (Section D5)

Project Economic Costs

The main costs associated with this project the involve the restoration of 4.4 acres of riparian habitat ($272,223), conducting the initial in-field assessment and developing and implementing the monitoring program ($149,391) and purchasing and installing the real time monitoring station and establishing the web portal ($117,367). Note much of the in-field assessment work will be done by volunteers. There are opportunity costs to volunteering—and estimates of this opportunity cost *have* been included in the budget—but these are not explicit monetary expenditures per say. Other costs include designing and implementing the education plan ($48,261) and conducting the two hydro-modification removal studies ($60,000). Total present value costs are $597,340. Table 8-26 summarizes the economic project costs for the project.

Benefits and Costs Summary

While the type of benefits associated with this project—public access and education, ongoing monitoring, habitat restoration etc—are traditionally difficult to monetize, this does not mean they are unimportant. The present value costs of the Sustaining Healthy Tributaries Project are $597,340, and mostly consist of the restoration project, the initial assessment, and ongoing monitoring and web data portal.

Table 8-26: Annual Costs (PSP Table 19)

Sustaining Healthy Tributaries to the Upper San Diego River

Annual Costs of Project (All costs should be in 2012 Dollars)										
			Annual Costs						Discounting Calculations	
	Initial Costs Grand Total Cost from Table 6 (row (i), column (d))	Adjusted Grand Total Cost	Admin	Operation	Maintenance	Replace-ment	Other	Total Costs (a) +…+ (g)	Discount Factor (Capital) Present Value Coeff (O&M)	Discounted Project Costs (h) x (i)
Year			(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012										
2013	$71,185							$71,185	0.943	$67,156
2014	$128,134							$128,134	0.890	$114,039
2015	$220,675							$220,675	0.840	$185,283
2016	$284,742							$284,742	0.792	$225,542
2017	$7,119							$7,119	0.747	$5,320
2018										
Total Present Value of Discounted Costs (Sum of Column (j)) Transfer to Table 17, column (c), Proposal Benefits and Costs Summaries										**$597,340**

Project 6: Chollas Creek Integration Project – Phase II

Project Abstract

The *Chollas Creek Integration Project - Phase II* aims to improve water and habitat quality in a Chollas Creek segment at Northwest Village, and engage members of the surrounding DAC in water quality monitoring along Chollas Creek. The project will reduce flood damage and improve water quality at Northwest Village Chollas Creek through creek realignment, headwall installation, and drop structures; improve habitat through invasives removal and native riparian revegetation; and conduct pre/post water quality monitoring.

A. Northwest Village Creek Restoration: Construction will accomplish flood damage reduction and water quality improvement through 1) creek re-alignment 2) construction of inlets 3) drop structure installation 4) non-native removal/restoration..Specifically, two 3-foot drop structures (rip-rap) will be developed along the northwest and southwest segments of this creek section to slow the creek flow at these points. Plants removed during construction will be replaced with native riparian species to restore habitat disturbed during this phase.

B. Habitat Improvement Through Invasive Removal: Invasives removal and restoration will improve water quality through erosion control and pollution uptake, and will contribute to improved habitat values for wildlife. Recreational and public access benefits will also be achieved. This Phase II project will support a comprehensive invasives removal effort at Northwest Village Creek (Euclid Avenue and Market Street), as well as 47th Street and Castana. Building upon *Chollas Creek Integration Project - Phase I*, biological site assessment data (delineation of vegetation communities/wetland resources and identification of sensitive plant and animal species) will inform the Phase II invasives removal efforts, reflecting community removal priorities where the greatest water quality, recreation, wildlife conservation, and stakeholder benefits can be achieved. The project design is 90% complete with CEQA compliance approval pending in mid-2013.

C. Water Pollution Source Tracking, Citizen Monitoring, Pollution/Conservation Education, and Community Engagement: Phase II will build upon *Chollas Creek Integration Project - Phase I*'s engagement of institutional stakeholders in the determination of water quality, natural resource, and environmental justice opportunities/constraints. Phase II will expand stakeholder outreach to include residentsin water quality monitoring, and conduct targeted educational messaging. Thirty (30) area youth will be trained and employed as water quality monitors. Water quality monitoring will utilize existing City of San Diego Stormwater data for pollution source tracking, and will expand upon the San Diego Coastkeeper's Citizen Science Monitoring and Pollution/Conservation Education programs. The project will also partner with Groundwork's Green Team Community Service Project for engagement of student volunteers, and a coalition of institutional stakeholders in the determination of water quality, natural resource, and environmental justice opportunities/constraints.

A summary of all benefits and costs of the project are provided in Table 8-1. Monetized benefits and non-monetized benefits are presented in this attachment, while physically quantified (but not monetized) benefits are described in Attachment 7.

Summary Project Benefits and Costs

A summary of all benefits and costs of the project are provided in Table 8-27. Monetized benefits and non-monetized benefits are presented in this attachment, while physically quantified (but not monetized) benefits are described in Attachment 7. Benefits are lettered for cross-reference with Attachment 7, and are therefore not represented in order in the following sections.

Table 8-27. Benefit-Cost Analysis Overview
Chollas Creek Integration Project - Phase II

	Present Value
Costs – Total Capital and O&M	**$591,454**
Monetizable Benefits	
A. Avoid Flood Damage	$7,953
C. Improve Water Quality and AvoidMore Costly BMPs	$38,864
Total Monetizable Benefits	**$46,817**
Physically Quantified Benefits	**Project Life Total**
B. Reduce Stormwater Runoff	0.12 acre feet/year
E. Benefits to Wildlife and Habitat	6.3 acres
F. Provide Recreation Opportunities	6.3 acres
I. Increase Scientific Knowledge of Creek	300 WQ samples
Qualitative Benefits	**Qualitative Indicator***
G. Educational Benefits	+
H. Stakeholder and Community Involvement, Including DACs	
F. Improved Water Quality	+
D. Reduce Public Health Hazards	+

* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease net benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Non-Monetized Benefits Analysis (Section D2)

Narrative descriptions of the benefit categories marked "Yes" in DWR's *Proposal Solicitation Package* Table 12 are provided below.

B. Reduce Stormwater Runoff

Runoff from properties near Chollas Creek currently sheet flows towards the creek from surrounding paved surfaces and is discharged over creek bank. Other properties discharge storm water runoff onto Market Street viasurface flow or via public catch basinsthe collect runoff via private grated inlets and discharge into the public 42"-RCP storm drain pipe in MarketStreet.The public 42"-RCP storm drain pipe discharges into Chollas Creek at the Market Street culvert.[95]

Rick Engineering has estimated runoff reduction benefits for the restoration project by comparing the % rainfall runoff (runoff coefficient) before the restoration project (0.95) and after the restoration project (0.45). Based on this comparison, there is approximately a 52% decrease in the anticipated runoff volume from the Phase II restoration site, which includes 2.3 acres of construction/restoration within the channel and installation of stormwater BMPs for an additional 2.9-acre catchment area.[96] This equates to a 0.12 acre-ft per year reduction in runoff based on an average annual rainfall of 9.8 inches over the 5.2 acre site.

[95] Rick Engineering. 2011. *Water Quality Technical Report for Northwest Village Creek*. January 2011 (with revisions through June 2012).Page 3.
[96] Rick Engineering. 2013. Personal Communication with Joe Hammond. 21 March 2013.

G. Provide Education or Technology Benefits

This qualitative benefit of the *Chollas Creek Integration Project – Phase II*results from the community-based water quality sampling program that will be implemented by Coastkeeper and Groundworks. Sampling will be conducted by 30 student volunteers who will receive training as water quality monitors. This training will educate them on water issues in the area and what affects factors affect water quality. This project then goes further to incorporate the results of the water quality sampling effort into the City of San Diego's stormwater data, Coastkeeper's Citizen Science Monitoring data, and Groundwork's watershed assessment data, as well as the City's Think Blue outreach materials for the community. .

H. Stakeholder and Community Involvement, Including DACs

The work plan for the *Chollas Creek Integration Project – Phase II* calls for a high level of community engagement in all three components of the project. This project will continue the community involvement efforts of Phase I by implementing a restoration and invasives control plan that reflects community priorities. This project will utilize citizen scientists for water quality monitoring through Coastkeeper and Groundworks programs. Groundworks will also continue facilitating a coalition of watershed stakeholders to determine water quality natural resource, and environmental justice opportunities and constraints.

The 30 student water quality monitors that would be employed by this project would not have this opportunity to develop important environmental stewardship and work ethic values without this project. These activities do more than just monitoring the water quality of Chollas Creek – they encourage and inspire local DAC residents to feel a sense of stewardship and ownership over their local waterways. This benefit is invaluable.

E. Benefits to Wildlife or Habitat

One the primary goals of the *Chollas Creek Integration Project – Phase II* are to restore 6.3 acres of riparian habitat along Chollas Creek. This will involve removal of invasives, channel improvements, and native plant revegetation. Total restored area for the proposed project will include the channel and banks restored during the Northwest Village Creek Restoration (Component A, 2.3 acres) or as part of the Habitat Improvement Through Invasives Removal (Component B, 4 acres).Restoration efforts will improve water quality through erosion control and pollution uptake. Invasive colonies threaten native riparian habitats by monopolizing water resources, altering flood regimes, and reducing habitat quality. This has an effect on animals as well as plants. The *Chollas Creek Integration Project – Phase II*will improve riparian and aquatic habitats that serve as nesting and foraging grounds for native wildlife.

F. Provide Recreation Opportunities

Parkland and open space are currently lacking in the Encanto neighborhood, where Chollas Creek is located. While the City of San Diego seeks to provide 2.8 acres of parkland per 1,000 residents, there are only 1.2 acres of parkland per 1,000 residents in the Encanto neighborhood.[97] The *Chollas Creek Integration Project – Phase II* helps remedy that by restoring an additional 6.3 acres of riparian habitat. An open space easement will encompass the creek, revegetation areas, and the existing coastal sage scrub habitat that is being left in place.[98]

D. Reduce in Public Health Hazards

The *Chollas Creek Integration Project – Phase II* promotes social health and safety through invasive removal and native restoration. Thick colonies of giant reed (arundo) at the site are associated with homeless populations. Giant reed grows in large, dense clumps that homeless people have found may provide some measure of privacy and safety.While on the surface this seems as if it could be a successful social adaptation, it has inherent problems in that it makes residents extremely vulnerable to both flood and fire dangers. It also creates critical pollution problems due to the lack of sanitary facilities. As documented in Attachment 7, there are higher concentrations of crime occurrences at streets and

[97]City of San Diego. 2007. Draft General Plan Final PEIR. Pg. 2-12.
[98]City of San Diego. 2012. Draft Mitigated Negative Declaration, Project No. 230777. November 2012. Page 16.

intersections that provide transient access to the creek.[99] Note the cluster of crime occurrences along 47th Street (Segment 4) and Euclid Street (Segment 2) where invasives removal activities are proposed.

I. Increase Scientific Knowledge of Creek

The USEPA has identified increased scientific knowledge as a key component to motivating environmental stewardship in its 2005 *Everyday Choices: Opportunities for Environmental Stewardship*.[100] This project seeks to improve its scientific understanding of Chollas Creek, its nonpoint pollutant sources, and the effectiveness of creek restoration in pollution update and erosion control through collection of 300 pre- and post-project water quality samples.[101]These water quality samples will be analyzed and results shared with other agencies, such as the City of San Diego, which allows for the discussion of restoration successes to be broadcast throughout the region.

Monetized Benefit Analysis (Section D3)

A monetizable benefit in the form of avoidance of more costly BMPs is expected to accrue over the expected 50 year life of the project.

C. Improve Water Quality and Avoid More Costly BMPs

The *Chollas Creek Integration Project – Phase II* will restore 6.3 acres of land to native habitat, and remove invasive species along a reach of Chollas Creek. Restored native habitat will act as a filter for runoff, reducing the amount of pollutants entering the creek following a storm event or through other sources of runoff. The creek realignment, culvert widening, and installation of drop structures and headwalls will reduce erosion and sedimentation within the channel, while removal of invasives can also improve water quality. Invasive species, namely arundo and tamarisk, are associated with water quality indicators such as low dissolved oxygen and associated eutrophication.

As described in C- Reduce Stormwater Runoff, this project is anticipated to generate a 0.12 AFY reduction in runoff due to Phase II restoration activities. This represents a 52% reduction in stormwater runoff and associated nonpoint source pollutant loading to the creek. Although stormwater runoff discharging to Chollas Creek from the Northwest Village properties will comply with the City of San Diego's Storm Water Standards[102], this site-specific reduction in runoff will help ensure that the City does not have to implement costly treatment BMPs in the future to address TMDL mandates.

To calculate avoided BMP costs, we multiply the amount of turf that will be replaced each year by the annual cost per acre of wastewater treatment. The *Sun Valley Watershed Management Plan Environmental Impact Report* provides project lifetime costs of four alternatives to treat pollutants from runoff.[103] Two of the four alternatives are of interest in the context of this project: Alternative 2 (Water Conservation) and Alternative 4 (Full Conveyance with Regional BMPs). These alternatives represent our with-project and without-project scenarios, respectively. Over a 50-year project lifetime, Alternative 2 (our with-project scenario) costs $171.58 million over a 4.4 mi^2 area (2002 dollars, discounted). Alternative 4 (our without-project scenario), would cost $206.61 million over a 4.4 mi^2 area (2002 dollars, discounted). If this section of Chollas Creek is not restored, it will continue to produce urban runoff that will need to be treated prior to being discharged from the municipal separate stormwater system (MS4) which is located in Market Street. The cost to collect and treat urban runoff is estimated at $46.96 million per square mile, while the cost to conserve water is estimated at $39 million per square mile (2002 dollars).[104] The

[99]Groundworks San Diego-Chollas Creek. Map from Leslie Reynolds via email, February 26, 2013.
[100]U.S. EPA. 2005. *Everyday Choices: Opportunities for Environmental Stewardship*, EPA Innovation Action Council. Pg. 2
[101] Work Plan. Attachment 3. Task 4 and Task 9.3
[102] Rick Engineering. 2012. Water Quality Technical Report. Pg 1.
[103]County of Los Angeles Department of Public Works. 2004. *Environmental Impact Report for the Sun Valley Watershed Management Plan*. Available http://www.sunvalleywatershed.org/ceqa_docs/plan.asp. Pg. 4-16.
[104]County of Los Angeles Department of Public Works. 2004. *Environmental Impact Report for the Sun Valley Watershed Management Plan*. Available http://www.sunvalleywatershed.org/ceqa_docs/plan.asp. Pg. 4-16.

difference between the two is $7.96 million per square mile, or $12,439.63 per acre, in 2002 dollars ($7.96 million per square mile x 1 square mile per 640 acres). Converting this to 2012 dollars, we get a benefit of $15,876.74 per acre. This project will reduce stormwater runoff by 52% (effectively conserving it); therefore, over the 50 year period from 2017-2066, it is estimated that restoration of 6.3 acres to native riparian habitat would save $52,012.20 cumulatively in avoided BMP costs (savings per acre x total acres x 0.52). Assuming that the combined restoration areas only contribute 52% to the future avoided cost of surface water treatment BMPs, this results in a PV avoided project cost of $38,867. Please note that because this analysis has been explained here, the calculation figures are not provided in the appendices to this attachment.

Reduced runoff will also result in a reduction of pollutants entering the creek. Native plants in the restored riparian habitat will be able to act as filters for pollutants carried by runoff, further reducing the amount of pollutants entering and transported by the creek. However, it is not possible to quantify the amount of pollutant reduction that will be attained by this component of the project.

Table 8-28: Annual Costs of Avoided BMPs (PSP Table 16)
Chollas Creek Integration Project – Phase II

Annual Costs of Avoided Projects (2012 Dollars)						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
Year	Avoided Surface Water Treatment BMPs					
	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Costs Avoided for Individual Alternatives (b) + (C) + (d)	Discount Factor	Discounted Costs (e) x (f)
2017 - 2066			$52,012	$52,012	Already included from source	$52,012
Total Present Value of Discounted Costs (Sum of column (g))						**$52,012**
(%) Avoided Cost Claimed by Project						**52%**
Total Present Value Discounted Avoided Project Costs Claimed by Alternative Project (Total Present Value of Discounted Costs x % Avoided Cost Claimed by Project)						**$38,867**

Flood Damage Reduction Benefit Analysis (Section D4)

According to the *Water Quality Technical Report for Northwest Village Creek*, runoff from properties near Chollas Creek currently sheet flows towards the creek from surrounding paved surfaces and is discharged over creek bank.[105]Other properties discharge storm water runoff onto Market Street viasurface flow or via public catch basinsthe collect runoff via private grated inlets and discharge into the public 42”-RCP storm drain pipe in MarketStreet.The public 42”-RCP storm drain pipe discharges into Chollas Creek at the Market Street culvert.

[105]Rick Engineering. 2011. *Water Quality Technical Report for Northwest Village Creek*. January 2011 (with revisions through June 2012).Page 3.

A- Avoid Flood Damage

According to the *Water Quality Technical Report for Northwest Village Creek*, runoff from properties near Chollas Creek currently sheet flows towards the creek from surrounding paved surfaces and is discharged over the creek bank.[106]

Figure 7-1 in Attachment 7 shows floodplains for the 50-year, 100-year, 200-year, and 500-year floods at the Northwest Village Creek restoration site. Currently, flooding will occur for each of these flood events, with the majority of flooding occurring to the east of the creek. The hydromodifications included as part of the Chollas Creek Integration Project - Phase II are expected to have flood damage avoidance benefits, mainly by reducing expected damage to two commercial buildings located near the creek. According to flood analyses by Rick Engineering, the proposed hydromodifications will reduce the commercial building area affected by the 200-year flood by 1,704 square feet.

The reduction in flood risk because of this project will also benefit the planned Village at Market Creek community development. This development will convert 60 acres of blighted land into productive properties including recreational, commercial, and residential properties.[107] In total, the *Chollas Creek Integration Project - Phase II* will protect 1.7 million square feet of future development at the Village at Market Creek.

It is assumed commercial property has a value of $151.41per square foot, clean-up costs are 30% of structural damages[108] and the buildings have an 80% depreciated value to replacement value ratio. Running these estimates through the F-RAM model gives a discounted value of $10,040 in avoided costs over the 50 year life of the project (2017 – 2067). Discounting this from 2016values to present, 2012 values gives $7,953.

The present value of flood damage reduction benefits are summarized in Table 8-29 (which corresponds to PSP Table 18). Benefits are assumed to commence in 2016 and have useful life of 50 years. Future benefits are discounted using a 6% discount rate.

Project Benefits and Costs Summary (Section D5)

Project Economic Costs

Table 8-30 summarizes the economic project costs for the project. The primary budgeted costs associated with the project are the installation of stream structures and habitat restoration ($562,126). Additional costs include training and employing student monitors ($52,162) and permitting ($17,380). Total present value costs are $591,454.

[106]Rick Engineering. 2011. *Water Quality Technical Report for Northwest Village Creek*. January 2011 (with revisions through June 2012).Page 3.
[107]The Village at Market Creek. Available: http://thevillageatmarketcreek.com/index.html (Accessed 18 March 2013).
[108]CA Department of Water Resources, Division of Flood Management. 2008. *Flood Rapid Assessment Model (F-RAM) Development*

Table 8-29: Value of Flood Reduction Benefit
Chollas Creek Integration Project – Phase II

Present Value of Expected Annual Damage Reduction Benefits (All values in 2012 Dollars)			
(a)	Expected Annual Damage Without Project (1)		$1,038
(b)	Expected Annual Damage With Project (1)		$401
(c)	Expected Annual Benefit	(a) – (b)	$637
(d)	Present Value Coefficient (2)		15.76
(e)	**Present Value of Future Benefits Transfer to Table 20, column (e). (3)**	**(c) x (d)**	**$7,953**
(1)This program assumes no land use changes in the floodplain. So, EAD will be constant over analysis period. Note it is assumed annual damages begin accruing upon project completion in 2017.			
(2)6% discount rate; 50-year analysis period (2017-2067) discounted to 2012.			
(3) Note: this is the 10,040 output from FRAM discounted to 2012 dollars (because value FRAM gives is value over 2017-2067).			

Benefits and Costs Summary

Present value monetized benefits, mainly avoided BMP costs and flood damage reduction, total $46,817. Present value costs are higher at $591,454, although the project also contains many valuable non-monetized benefits. These include educational, community and social benefits, as well as qualitative improvements to wildlife and habitat, water quality and public access.

Omissions, Biases, and Uncertainties

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainties are associated with avoided water import costs and flood damage. These issues are listed in Table 8-31

Table 8-31. Omissions, Biases, and Uncertainties, and Their Effect on the Project
Chollas Creek Integration Project – Phase II

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Value of commercial real-estate	U	Flood analysis involves FRAM assumptions about the value each commercial square foot, which assumes it is the same across all buildings.

*Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
— = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Table 8-30: Annual Costs
Chollas Creek Integration Project – Phase II

Annual Costs of Project (All costs should be in 2012 Dollars)										
			Annual Costs						Discounting Calculations	
	Initial Costs Grand Total Cost from Table 6 (row (i), column (d))	Adjusted Grand Total Cost	Admin	Operation	Maintenance	Replace-ment	Other	Total Costs (a) +…+ (g)	Discount Factor (Capital) Present Value Coeff (O&M)	Discounted Project Costs (h) x (i)
Year			(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2011								$3,793	1.000	$3,793
2012	$33,936							$18,088	1.000	$18,088
2013	$33,936		$625					$60,924	0.943	$57,475
2014	$305,425		$2,500					$434,264	0.890	$386,493
2015	$237,553		$625					$149,598	0.840	$125,605
2016	$67,872									
Total Present Value of Discounted Costs (Sum of Column (j)) Transfer to Table 17, column (c), Proposal Benefits and Costs Summaries										**$591,454**

Project 7: Implementing Nutrient Management in the Santa Margarita River Watershed – Phase II

Project Abstract

Nitrogen and phosphorous loading from the Santa Margarita River (SMR) Watershed can result in low dissolved oxygen (DO) and increased algal blooms in the estuary and stream segments, several of which have been 303(d)-listed for nitrogen, phosphorus, or eutrophication. Total Maximum Daily Loads (TMDLs) are not currently in place in most of the SMR Watershed segments which are listed for nutrient impairment. However, TMDLs are likely to be instituted in the near future. As there is little scientific knowledge about the appropriate level of nutrients that the SMR can sustainably assimilate, the TMDLs would be based on a generalized approach if no actions are taken.

Thisproject aims to establish the science and seek stakeholder consensus to develop nutrient water quality goals that are protective of beneficial uses and could be employed in the development of alternative nutrient water quality objectives (WQOs) forthe SMR Watershed in response to the *Water Quality Control Plan for the San Diego Basin* (Basin Plan) Triennial Update. This is the second phase of work, which consists of continued stakeholder facilitation and continued monitoring, modeling, and data analyses to determine nutrient water quality goals. The project leverages an investment of over $2 million in data collection and other resources contributed by watershed stakeholders and partners in Phase I. The project aims to:

(1) Maximize community involvement in the SMR watershed through ongoing stakeholder group facilitation (established in Phase I),
(2) Continue work with the group to obtain feedback and critical review of technical work products to achieve consensus on the nutrient water quality goals,
(3) Continue core monitoring and special studies to address data gaps required to develop the nutrient water quality goals for the river,
(4) Further refine proposed nutrient water quality goals developed as part of Phase I for the SMR Estuary, if deemed necessary by the Stakeholder Group, and
(5) Develop nutrient water quality goals for the SMR River as needed based on the Nutrient Numeric Endpoints (NNE) approach and local data that are protective of beneficial uses

The project benefits the SMR watershed and the region by providing scientifically–based nutrient water quality goals that will control eutrophication. Stakeholders believe that since the estuary through which the SMR flows is open to the ocean during the winter (the wet season), nutrients in the river only have a short residence time before they enter the ocean. This effort will counteract hydromodifications. Within the region, the project will further the technical foundation of water management by demonstrating a science-based approach to establishing nutrient water quality goals that can be developed jointly with the regulatory agencies. If warranted by the results, the scientific studies will provide the underpinnings necessary to support Nutrient Site-Specific Objectives (SSOs) that require a Basin Plan amendment. This effort will serve as a template for similar efforts within the region.

This analysis concerns itself with the second phase of a three phase project. Phases I and III are not directly connected to this phase, and so are not included in the analysis.

Summary Project Benefits and Costs

A summary of all benefits and costs of the project are provided in Table 8-32. Monetized benefits and non-monetized benefits are presented in this attachment. Benefits are lettered for cross-reference with Attachment 7, and are therefore not represented in order in the following sections.

Table 8-32. Benefit-Cost Analysis Overview
Implementing Nutrient Management in the Santa Margarita River Watershed – Phase II

	Present Value
Costs – Total Capital and O&M	**$1,408,396**
Monetizable Benefits	
C. Avoid Municipal Stormwater Treatment Facility	$135,008,438
Total Monetizable Benefits	**$135,008,438**
Quantifiable Benefits	
A. Stakeholder Involvement in Nutrient Assessment	15 meetings
Qualitative Benefit or Cost	**Qualitative Indicator***
B. Improve Scientific Knowledge of the Santa Margarita River Watershed	+
D. Avoid Third Party Litigation Related to TMDL Compliance	+
E. Improve Water Quality and ReduceEutrophication Due to Nutrient Management	+

* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease net benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Non-Monetized Benefits Analysis (Section D2)

Narrative descriptions of the benefit categories marked "Yes" in DWR's *Proposal Solicitation Package* Table 12 are provided below.

B. Improve Scientific Knowledge of the Santa Margarita River Watershed

A qualitative benefit of this project is improved scientific knowledge of the SMR.Increased knowledge is nearly impossible to quantify. However, it is possible to consider the number of studies that are produced as a result of this project as an increase in scientific knowledge relating to the SMR watershed. Thisproject aims to establish the science and seek stakeholder consensus to develop nutrient water quality goals that are protective of beneficial uses and could be employed in the development of alternative nutrient WQOs forthe SMR Watershed in response to the Basin Plan Triennial Update.

Implementing Nutrient Management in the Santa Margarita River Watershed – Phase II will conduct field and special studies during task 4B of this project, from which they will develop nutrient water quality goals for the SMR in Task 4C. Results will be reported in *The Technical Studies Supporting Proposed Nutrient Water Quality Goals for Santa Margarita River Report*. In addition to the reports, the knowledge gained in Tasks 4B and 4C will be shared during the Stakeholder Advisory Group meetings that constitute Task 4A.

Within the region, the project will further the technical foundation of water management by demonstrating a science-based approach to establishing nutrient water quality goals that can be developed jointly with the regulatory agencies. If warranted by the results, the scientific studies will provide the underpinnings necessary to support Nutrient Site-Specific Objectives (SSOs) that require a Basin Plan amendment. This effort will serve as a template for similar efforts within the region.

D. Avoid Third Party Litigation Related to TMDL Compliance

A qualitative benefit of this project is potential avoidance of third party litigation related to TMDLs set under a generalized approach. In the absence of the project, TMDLs that are neither site-specific nor season-specific are likely to be set for the SMR in the near future. If the County of San Diego does not meet the TMDL targets, the County may face pressure from third parties demanding that the TMDLs be

met. If the third parties are not satisfied with the county's response, they could bring litigation, resulting in additional costs to the County.[109]

Litigation may occur over a number of issues related to water quality standards, such as violating current standards or the current standards violating beneficial uses. A scientifically-sound site-specific set of nutrient standards is likely to reduce litigation over violations of beneficial uses. Additionally, if stakeholders are involved in developing the recommendations for new standards, there will be increased understanding by all stakeholders (including dischargers) on how their activities impact the watershed, increased knowledge over the source of potential violations, increased dialogue between stakeholders, and an understanding of how best to address water quality concerns. All of these activities are likely to reduce potential litigation and instead promote a collaborative solution, though without knowing what the recommended standards and management practices may be, it is not possible to quantify this benefit.

E. Improve Water Quality and Reduce Eutrophication Due to Nutrient Management

If the project is undertaken, project proponents think that nutrient loading to the SMR Watershed would be managed to achieve maximum benefit for all beneficial uses. Using an NNE approach, rather than a numerical approach for establishing water quality standards, may allow for variable nutrient loading based on seasonality, wet/dry weather, and other conditions which may affect nutrient assimilation in the watershed. The NNE approach allows for this flexibility because it is designed to reduce the risk of impairment, regardless of actual measured levels of contaminants.[110] As such, nutrient loading may be heavier during wet weather when the assimilative capacity of the watershed is great and lower during dry weather when the potential for eutrophication is greatest. By adjusting nutrient loading for seasonality, dry weather nutrient concentrations may be reduced and eutrophication controlled.

Without the project, should stringent TMDLs and a treatment facility be constructed to address stream water quality, nutrient loading and algal blooms may still persist. Establishing the NNE and new WQOs/SSOs with stakeholder support will make it more likely that those stakeholders implement changes that would reduce loading during the dry season consistent with watershed management goals.

A. Stakeholder Involvement in Nutrient Assessment

A qualitative benefit of this project is the engagement of the different SMR stakeholders. These stakeholders, representing many different viewpoints, will collectively determine how to manage the watershed to its maximum benefit.

The work plan for *Project 7: Implementing Nutrient Management in the Santa Margarita River Watershed – Phase II*, calls for continued facilitation of the Stakeholder Advisory Group (Subtask 4A) established during Phase I. Subtask 4A, the "Facilitate Stakeholder Advisory Group", calls for 15 meetings to take place over the four years of the project. During these meetings, stakeholders will:

- Guide project activities and reviews,
- Provide feedback on technical and policy elements of the project,
- Identify key questions and a conceptual approach,
- Determine specific technical activities and information required to carry out that approach,
- Evaluate existing data, and
- Identify any current data gaps.

After data are collected, models run, and results interpreted, the Stakeholder Advisory Group will determine the appropriate nutrient water quality goals for the SMR. Maximizing stakeholder involvement in all aspects of the project would foster a sense of stewardship and consensus to further watershed management goals.

[109] In the 1990s, the Natural Resources Defense Council brought litigation against the County of San Diego for violating a Consent Decree.

[110] USBR. 2010. Hydrological and Biological Support to Lower Santa margarita River Watershed Monitoring Program Water Years 2008-2009. Pg. 5-9.

Monetized Benefit Analysis (Section D3)

One monetized benefit is expected to accrue over the expected 15 year life of the project: the avoided project costs associated with building and operating a municipal stormwater treatment facility.

C. Avoid Municipal Stormwater Treatment Facility

Project proponents think that nutrient loading to the SMR Watershed could be managed to achieve maximum benefit. Nutrient loading may be adjusted for seasonality by those sources that have flexible operations. By adjusting nutrient loading for seasonality, dry weather nutrient concentrations may be reduced thereby leading to de-listing of the SMR Estuary and stream segments from the 303(d) list and/or establishment of watershed management strategies in lieu of a formal TMDL. However, without the project, TMDLs may be set such that the County of San Diego may need to build one or more municipal stormwater treatment facilities in order to treat stormwater that is discharged from the municipal separate storm sewer system (MS4) into the SMR, particularly after storm events. This would result in costs to the County of San Diego if the project does not occur.

In particular, the County of San Diego has determined the percentage of nitrogen and phosphorus reductions (75% and 50%, respectively) expected to be set for the SMR under the generalized TMDLs (that is, if the project does not occur). Using these percentage reductions with the current annual loading of these nutrients in the SMR, the County of San Diego has determined that the municipal stormwater treatment facility(ies) would need to remove about 745,000 pounds of nitrogen per year and about 25,000 pounds of phosphorous per year. The capital and operations and maintenance costs associated with the facility(ies) needed has also been determined from costs of other treatment facilities that are in operation for nutrient loadings in the San Luis Rey River Watershed, located just south of the SMR.

Costs for the municipal stormwater treatment facility are based on BMPs sized to conditions in the San Luis Rey River. Capital and O&M costs were estimated from the *San Luis Rey River Watershed Comprehensive Load Reduction Plan*.[111] A description of how these costs were derived are in Section 4.3.2 and state, "Capital and O&M cost opinions were based on SBPAT default unit costs for BMPs, which were based on very preliminary order-of-magnitude opinions of construction costs derived from regression equations found in literature and from construction estimates derived from RS Means.[112]" The San Luis Rey BMP groupings (and their related efficiencies) were then scaled to meet the estimated load reduction described in Attachment 7. Since nitrogen has the largest scalar, it was used to calculate the total capital and operations & maintenance costs needed to reduce loading and meet the current Basin Plan WQO. Finally, the analysis assumes that the plant would be operational from 2018 to 2032.

Over the 15 year expected useful life of municipal stormwater treatment facility(ies), the present value cost associated with building and operating the facility(ies) that can remove the designated amounts of nitrogen and phosphorus is$1,350,084,385.($2012).However, this analysis assumes that only 10% of this cost, or $135,008,438, is the benefit from undertaking the project. That is, if thereis only a 10% chance that the municipal stormwater treatment facility(ies) would actually be built in the absence of the project, the expected benefit is $135,008,438.

Table 8-33 shows the avoided costs from the project.

[111] County of San Diego, City of Oceanside, City of Vista, and Caltrans.2012. *San Luis Rey River Watershed Comprehensive Load Reduction Plan*. June 2012. Available: http://www.projectcleanwater.org/index.php?option=com_content&view=article&id=44&Itemid=34.Section 4.3.2.

[112] RS Means is a unit cost database that is updated annually (http://meanscostworks.com/). When costs from literature are not available, a project's design criteria and unit costs from the database were used to estimate the project's cost

Table 8-33: Annual Costs of Avoided Projects (PSP Table 16)
Implementing Nutrient Management in the Santa Margarita River Watershed – Phase II

Annual Costs of Avoided Projects Avoided Municipal Stormwater Treatment Facility (2012 dollars)						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
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	$0	$0	$0	$0	1.000	$0
2013 - 2017	$311,635,546	$0	$0	$311,635,546	Variable	$1,312,722,289
2018-2032	$0	$0	$5,148,026	$5,148,026	Variable	$37,362,096
Total Present Value of Discounted Costs (Sum of Column (g))						**$1,350,084,385**
(%) Avoided Cost Claimed by Project						**10%**
Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project (Total Present Value of Discounted Costs x % Avoided Cost Claimed by Project)						**$135,008,438**
Comments: Costs for the Municipal Stormwater Treatment Facility (an avoided project) are shown in the table. Capital costs occur in years 2013 through 2017; O&M costs occur in years 2018 through 2032. Once construction is finished in 2017, the Municipal Stormwater Treatment Facility has an expected life of 15 years, from 2018 to 2032.						

Project Benefits and Costs Summary (Section D5)

Project Economic Costs

Project costs for *Implementing Nutrient Management in the Santa Margarita River Watershed – Phase II* total $1,596,159 (non-discounted). Direct assessment costs account for $1,510,062 (about 95%) of the total project costs. Phase I costs totaled $618,000 and were funded through the San Diego IRWM Region under a Proposition 84-Round 1 grant. Phase III costs are roughly estimated to total $1,000,000, however they are so uncertain that they were not included in the following table. There are no annual costs (administration, operation, maintenance, replacement, or other) for this project.

Table 8-35 summarizes the economic costs for the project. The total present value cost for *Implementing Nutrient Management in the Santa Margarita River Watershed – Phase II* is $1,782,722.

Benefits and Costs Summary

As shown in Table 8-3 above, the total present value benefits associated with the *Implementing Nutrient Management in the Santa Margarita River Watershed – Phase II* project amount to $135,008,438.The total present value cost of the project is $1,408,396. The proposed project will therefore result in total present value net benefits of$133,600,042 ($135,008,438 minus $1,408,396).

Total monetized benefits include 10% of the avoided cost of a municipal stormwater treatment facility. (This can be thought of as the expected benefit if the municipal stormwater treatment facility only has a 10% probability of being constructed without the project.) If the project did not occur, the County of San Diego may need to install and operate a municipal stormwater treatment facility (or a series of facilities), which would cost $1,350,084,385 in present value capital and O&M costs over 15 years of operation (or $135,008,438 if 10% of the total is taken). The cost of undertaking the project, $1,408,396, is extremely small compared to the benefit.

Table 8-35: Annual Project Costs (PSP Table 19)
Implementing Nutrient Management in the Santa Margarita River Watershed – Phase II

Annual Project Costs										
(All costs should be in 2012 Dollars)										
	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost[1]	Annual Costs [2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2010	-		-	-	-	-	-	-	1.000	-
2011	$238,580		-	-	-	-	-	$238,580	1.000	$238,580
2012	-		-	-	-	-	-	-	1.000	-
2013	$381,728		-	-	-	-	-	$381,728	0.943	$360,121
2014	$318,106		-	-	-	-	-	$318,106	0.890	$283,113
2015	$286,297		-	-	-	-	-	$286,297	0.840	$240,380
2016	$286,297		-	-	-	-	-	$286,297	0.792	$226,774
2017	$79,527		-	-	-	-	-	$79,527	0.747	$59,427
Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries										**$1,408,396**
There are no annual costs (administration, operation, maintenance, replacement, or other) for this project.										

In addition to monetized benefits and costs, the proposed project will also achieve the following non-monetized benefits: improve scientific knowledge of the SMR, avoid third party litigation related to TMDL compliance, improve water quality and reduce eutrophication due to nutrient management, and stakeholder involvement in nutrient assessment. All four of these will likely yield modest benefits; however, avoiding third party litigation related to TMDL compliance would yield larger benefits if in the without-project scenario it was not assumed that a municipal stormwater treatment facility would be constructed to remove nitrogen and phosphorous from the SMR.

Omissions, Biases, and Uncertainties

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainties are associated with the avoided project costs of the municipal stormwater treatment facility. These issues are listed in Table 8-36.

Table 8-36. Omissions, Biases, and Uncertainties, and Their Effect on the Project
Implementing Nutrient Management in the Santa Margarita River Watershed – Phase II

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Avoided project costs (municipal stormwater treatment facility)	U	Both with and without the project, it is uncertain at what nutrient concentrations will be established for the SMR Watershed either through Basin Plan WQOs, TMDLs, and other in-lieu management strategies. The levels that would be set (in both with- and without-project scenarios) would have a significant impact on the benefits of undertaking the project. Even if the project is carried out, it is possible that a municipal stormwater treatment facility may eventually be needed. The studies undertaken with this project will illuminate how nutrient loading in the SMR affects the river's beneficial uses.
Avoided project costs (municipal stormwater treatment facility)	U	There is variation in the amount of annual and seasonable loading of nitrogen and phosphorous into the SMR. More (less) loading will increase (decrease) the benefits associated with undertaking the project.
Avoided project costs (municipal stormwater treatment facility)	U	Capital and operations and maintenance costs are estimates from ten other municipal stormwater treatment facilities in the area; costs associated with treatment facilities built in the without-project scenario are likely to be similar to these ten other facilities, but not exactly so.
Avoided project costs (municipal stormwater treatment facility)	U	Without the project, it is uncertain whether a municipal stormwater treatment facility would be built. However, even so, without the project, there would need to be less than a 1% probability that the municipal stormwater treatment facility would need to be built for the expected monetized benefit to exceed the cost of the project.

*Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
— = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Appendix 8-1: Estimating the Avoided Future Imported Water Supply Costs from Developing Local Supplies in the San Diego Region

Introduction

Water produced by conservation, recycling, groundwater extraction, and other "local sources" will offset the need to use imported water supply. Imported water supply in the San Diego region is derived from the State Water Project (SWP) and/or Colorado River Aqueduct (CRA) from the Metropolitan Water District of Southern California (MWD),water transfers with Imperial Irrigation District (IID), and the All-American and Coachella Canal lining projects. The value of adding new local supplies can thus be estimated based on the costs avoided by reducing local demands for imported water.

The cost savings arising from reducing demands for imported water should be estimated based on the projected future cost of imports, at the margin. This in turn requires a projection of the cost of providing additional imported water, at the levels needed in the future if local resources are not expanded in accordance with the *San Diego IRWM Implementation Grant Proposal – Round 2*. The key empirical question for valuation is thus, "What is the future cost, at the margin, of acquiring another acre-foot (AF) of imported water, and having it delivered (and treated, where applicable) to the users of the local supply alternatives?"[113]

There are several empirical and conceptual challenges to forecasting the future avoided cost of import water.This appendixdiscusses these issues and how they were addressed to develop the avoided water supply costs that are used to evaluate the benefits of those projects that provide local water (or conserve water) in the San Diego region.

Wholesale Water Supplies

San Diego County Water Agency (Water Authority) wholesales water to 24 member agencies within its service area. The two uses for water within the service area are municipal and industrial (M&I), which accounts for 91% of total consumption; and agricultural, which accounts for the remaining 9% of the total.[114]

Since experiencing severe shortages during the 1987-1992 drought, the Water Authority has diversified its sources to enhance overall reliability.[115]Today, water supplies within the Water Authority service area include imports from MWD, water transfers from IID, conservation savings from the canal lining projects, and local supplies of member agencies. Historically, imports have accounted for the single largest proportion of total supplies, followed by Water Authority (transfer and canal lining) supplies and local supplies. Imports from MWD are wholesaled to the Water Authority from both SWP and CRA supplies. One of 26 MWD member agencies, the Water Authority is the largest agency in terms of deliveries, purchasing 331,825 AF or about 21 percent of all the water MWD delivered in FY 10.[116]SWP supplies have been restricted since 2006, due to drought and regulatory restrictions. In the past, MWD had relied on surplus supplies on the Colorado River to fill the aqueduct but are now limited to their entitlement. However, additional supplies have been implemented through the long-term transfer agreement with IID and conserved water from projects lining the All-American and Coachella Canals. The Water Authority

[113] Cost of treatment and delivery need to be included in the avoided import water costs, to provide a suitable "apples-to-apples" comparison of import water costs to the local supplies.This is because the costs used in these analyses for local supplies are generally inclusive of treatment and delivery.

[114]San Diego County Water Authority. 2011. 2010 Urban Water Management Plan.

[115]San Diego County Water Authority. 2008. Long-Range Financing Plan 2008

[116]San Diego County Water Authority. 2011. *2010 Urban Water Management Plan*.

entered into a Water Conservation and Transfer Agreement with IID, an agricultural district in neighboring Imperial County, to receive an annually increasing volume of water from 30,000 AFY in 2005 to 200,000 AFY in 2021. Additionally, the Quantification Settlement Agreement (QSA) on the Colorado River assigned the Water Authority rights to 77,700 AFY of conserved water from projects to line the All-American and Coachella Canals. The Water Authority had also acquired short-term dry-year water transfers from agencies in Northern California during the last drought. Local water sources within the Water Authority service area include surface water, groundwater, recycled water, and desalinated seawater (under construction).[117]In 1991, local member agency supplies comprised only 5% of the Water Authority's total requirements and MWD imported supplies comprised the remaining 95%. By 2010, the Water Authority had decreased reliance on MWD imports to 59% (331,825 AF), with increased use of IID transfers (13% or 70,000 AF), canal lining transfers (14% or 80,200 AF), and member agency local sources (14% or 76,100 AF) (derived from Water Authority 2011). The local supply goal for 2020 is 36% made up of 13% from conservation, 7% from seawater desalination, 6% from recycled water, 6% from local surface water, and 4% from groundwater.[118]

Water Prices

The Water Authority sells both untreated and treated water to its member agencies. As the name suggests, untreated water is raw and has not been processed to meet minimum standards acceptable for human consumption.Treated water has been treated and meets federal drinking water standards.Because treated water is subject to processing more than the untreated resource, treated water is more expensive. The current melded supply rate for treated water for the Water Authority (effective January 1, 2013) is $256 per AF. Treatment costs have increased to that level from $125 per AF in calendar year 2006.[119]

MWD has established a two-tiered rate structure. Including both Tier 1 and Tier 2 classes, the Water Authority's water rate schedule parallels that of MWD.[120]

For this analysis, only Water Authority Tier 1 prices are projected, as the extent of Tier 2 versus Tier 1 future usage is unknown. The projected future water costs used to calculate the avoided costs of imported water reflect the total "all in" treated water rate described below.The Water Authority's current melded supply rate is set to recover the costs of purchasing Tier 1 water from MWD, water purchases from IID, payments in connection with the All-American and Coachella Canal lining projects, payments to MWD under the 2003 Exchange Agreement for conveyance of IID and canal lining water, and other costs associated with acquisition of the IID supply source. For CY 2013, the melded Municipal and Industrial (M&I) supply rate for untreated water is $714 per AF. The corresponding melded supply rate for treated water is $970 per AF. The transportation charges on both treated and untreated water are $93 per AF.

Water Authority water prices include both fixed and variable charges. The variable rates, described above, include the untreated and treated melded supply rates plus transportation charges on a per AF basis. Fixed charges are those which are primarily invariant with water volume and include, across all Water Authority water sources, MWD capacity and readiness-to serve charges, and Water Authority customer service, emergency storage, infrastructure access, and property taxes/in-lieu charges.

Current Prices

With transportation charges, the CY 2013 Water Authority rate for untreated water is $807 per AF and $1,063 per AF for treated water. The estimated unit rate for storage is calculated on a regional average

[117]San Diego County Water Authority. 2011. *2010 Urban Water Management Plan.*

[118]San Diego County Water Authority. 2011. *2010 Urban Water Management Plan.*

[119]San Diego County Water Authority (Water Authority). 2010. Historical Rates and Charges. Website http://www.sdcwa.org/historical-rates-and-charges, accessed December 13, 2010.

[120]Metropolitan Water District of Southern California (MWD). 2010. Water Rates and Charges Effective 1/1/2013, and 1/1/2014.Website:http://www.mwdh2o.com/mwdh2o/pages/finance/finance_03.html, accessed February 20, 2013.

and does vary by agency, but for the purpose of the funding application a regional average will be used. This is estimated by taking the fixed charge of $60.2 million divided by the projected sales forecast for 2013 to derive $139 per AF. The same approach is used to derive the projected customer service charge by taking the fixed charge of $26.4 million divided by the projected sales to net a unit cost of $57 per AF.

With fixed charges for storage and customer service included, the Water Authority charged its member agencies an "all in" rate of $1,003 per AF for untreated water and $1,259 per AF for treated water. The Water Authority's "all in" rates for CY 2013 are shown in Table 8-A below. The difference is the treatment surcharge of $256 per AF.[121]

Table 8-A: Water Authority Water Rates Effective January 1, 2013 ($2013)

	Untreated ($/AF)	Treated ($/AF)
Volumetric Charges		
Melded Supply Rate	$714	$970
Transportation	$93	$93
Melded Tier 1	$807	$1,063
Fixed Charges (in Volumetric Terms)		
Storage	$139	$139
Customer Service	$57	$57
Total Fixed Charges	$196	$196
Total "All In" Costs for M&I Water	$1,003	$1,259
Source: Water Authority 2013		

Real Price Escalation for Imported Water

Several proposed projects enhance local water supplies and, thus, reduce the Region's reliance on waters imported from the Bay-Delta and the Colorado River. The avoided cost of imported water is thus an important monetized benefit for projects that enhance local supplies.

An important aspect in monetizing the value of avoided imports entails predicting the future cost of imported water. The economic analyses in this funding application was developed in real terms (based on $2012), meaning that the future stream of benefits and costs typically are not adjusted for general inflation. This is because most outcomes are expected to see price changes that generally align with broader measures of inflation, such as the Consumer Price Index (CPI), which is measured and reported by the federal Bureau of Labor Statistics.[122]

The price of imported water is an important exception, because various factors have led to rate increases that have considerably outpaced general inflation over the past two decades (as detailed below).This trend of real price increases for imported water (i.e., above the projected CPI) is likely to continue in the future as well, because the same factors that have driven these prices upward will remain relevant for several years to come.These factors principally include limitations on overall supply, due to a variety of factors primarily linked to the declining health of the Bay-Delta system from which these waters are extracted.

The supply-constraining factors for the Bay-Delta include Court rulings and environmental regulations related to the severe adverse impacts that declining water levels and the associated alterations in water quality (e.g., salinity) have imposed on this important ecosystem. Fish populations have declined dramatically in recent decades (including threatened and endangered species such as salmon and the delta smelt, for which the Bay Delta provides critical habitat). The levee system is aging, and vulnerability

121San Diego County Water Authority (Water Authority). 2013. CY 2012 and CY2013 Rates and Charges. Website: http://www.sdcwa.org/rates-charges, accessed February 19, 2013.

[122] Bureau of Labor Statistics data can be accessed at: ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt

of the Delta to flooding, sea level rise, or a major earthquake has contributed to concerns about possible levee collapse which could have devastating and far-reaching consequences. In addition, water quality problems continue, with impacts not only on fisheries and natural systems, but also on water treatment needs to meet drinking water standards for protecting human health and aesthetics.

These factors – and the associated investments that MWD and other water agencies have needed to make in infrastructure and potable water treatment – have resulted in dramatic increases in the cost of water that MWD wholesales throughout southern California. Large investments in new infrastructure made over the past ten to twenty years include the Diamond Valley Lake and Inland Feeder. In the coming years, additional large-scale costs are likely to be incurred for the Delta Conveyance, which may cost around $20 billion in its current formulation, with MWD likely to bear a large portion (e.g., one-third to one-half) of the cost.

Tables 8-B and 8-C reveal the extent to which MWD water rates have increased over the past 10 to 20 years, relative to general inflation as reflected by the federal CPI. Table 8-B shows the change in MWD "Tier 1 treated" supply rates, and Table 8-C provides the same information for MWD's "Tier 2 treated" water rates.[123] In both instances, it is evident that over both the recent short-term (5-year period) and longer-term periods (10-year and 20-year), imported water costs have increased at rates well above inflation.For example, Tier 1 rates in the 2008 through 2012 period increased by over 56%, which is 8.5 times greater than the CPI over the same period. A very similar result is evident for Tier 2 rates. This indicates that the real rate of price increase (above general inflation) for MWD water has been between 9.4% and 10.2% over the past five years (as shown in the right-most column in Tables 8-B and 8-C).

Over a longer timeframe, similar escalations are evident as well. Over the last decade, the 10-year average annual cost increase for MWD water has been from 4.8% to 5.2% per year above inflation, for Tier 2 and Tier 1, respectively.The 20-year price trend indicates a real annual increase in imported water costs of nearly 2% above inflation.

Table 8--B: MWD Tier 1 Treated Rates compared to CPI

		cumulative change			average annual change		
time interval	**# years**	**Tier 1**	**CPI**	**ratio**	**Tier 1**	**CPI**	**Real Tier 1**
2008 - 2012	5 years	56.3%	6.6%	8.5	11.8%	1.6%	10.2%
2003 - 2012	10 years	94.6%	24.8%	3.8	7.7%	2.5%	5.2%

Table 8-C: MWD Tier 2 Treated Rates compared to CPI

		cumulative change			average annual change		
time interval	**# years**	**Tier 2**	**CPI**	**ratio**	**Tier 2**	**CPI**	**Real Tier 2**
2008 - 2012	5 years	51.8%	6.6%	7.8	11.0%	1.6%	9.4%
2003 - 2012	10 years	88.1%	24.8%	3.6	7.3%	2.5%	4.8%
1993 - 2012	20 years	123.3%	58.9%	2.1	4.3%	2.5%	1.9%

Based on these data, it is appropriate for the economic analyses to reflect how imported water costs in southern California are likely to continue to increase at rates considerable above general inflation. To reflect real prices of imported water in the future, we have adopted the following conservative assumptions:

[123] MWD rates derived from http://www.mwdh2o.com/mwdh2o/pages/finance/finance_03.html

1. For water imported from 2012 and 2013, we use rates published by the Water Authority as of February 2013.[124]
2. For water imported between 2014 and 2020 (inclusive), we derive a 2012 real cost by escalating by 3.5%.This escalation of 3.5% above CPI is fairly conservative (i.e., low end), given the documented trends over the past 5 to 10 years for which real increases have ranged from 4.8% to 10.2% per year.
3. For water imported in 2021 and years thereafter, we escalate at a rate of 1.5% per year to obtain real prices. This is also a conservative, given that observed 10 to 20 year escalation rates have been in the 1.9% to 5.2% range.

Another benchmark for considering these real price adjustments is provided by the long-term forecast for CPI for the upcoming 10-year period, 2013 through 2022. The Federal Reserve Bank of Philadelphia indicates an anticipated annual average CPI of 2.3% over the next ten years.[125]

Combining the CPI forecast with the real escalation rates we propose above for MWD imports, this suggests an average *nominal* increase in imported water costs of only 5.8% per year through 2020 (2.3% + 3.5%), and 3.8% from 2021 onwards (2.3% + 1.5%). Both of these nominal price increases are well below the average nominal price increases observed for MWD over the relevant comparable time periods:

- The MWD 5- and 10-year average nominal rate increase has ranged from 7.3% to 11.8% (as shown in Tables 8-B and 8-C), compared to our use of 5.8% over the 6-year period 2015 – 2020; and
- The 10- and 20-year MWD history shows nominal increases of 4.3% to 7.7%, contrasted to our use of a 3.8% nominal increase starting in 2012, eight years in the future.

Projected Prices for Water Authority Supplies

Based on the escalation methodology presented above, Table 8-1-D projects the cost of the melded supply rate for treated Water Authority supplies through year 2072.These “all in” water rates are used in this funding application to estimate the avoided costs of purchasing treated imported water for M&I uses (generally landscape irrigation)within the Water Authority’s service area.

Table 8-1-D: Water Authority Water Rates: Melded Treated Supply ($/AF, in real prices, $2012)

Year	Cost	% Change
2012		
2013	$1,259.00	
2014	$1,303.07	3.5%
2015	$1,348.67	3.5%
2016	$1,395.88	3.5%
2017	$1,444.73	3.5%
2018	$1,495.30	3.5%
2019	$1,547.63	3.5%
2020	$1,601.80	3.5%
2021	$1,625.83	1.5%
2022	$1,650.21	1.5%
2023	$1,674.97	1.5%
2024	$1,700.09	1.5%

[124] Water Authority CY2012 and CY2013 rates from http://www.sdcwa.org/rates-charges, accessed February 19, 2013

[125] Survey of Professional Forecasters, http://www.phil.frb.org/research-and-data/real-time-center/survey-of-professional-forecasters/2013/survq113.cfm, accessed February 28, 2013

Year	Cost	% Change
2025	$1,725.59	1.5%
2026	$1,751.48	1.5%
2027	$1,777.75	1.5%
2028	$1,804.42	1.5%
2029	$1,831.48	1.5%
2030	$1,858.95	1.5%
2031	$1,886.84	1.5%
2032	$1,915.14	1.5%
2033	$1,943.87	1.5%
2034	$1,973.03	1.5%
2035	$2,002.62	1.5%
2036	$2,032.66	1.5%
2037	$2,063.15	1.5%
2038	$2,094.10	1.5%
2039	$2,125.51	1.5%
2040	$2,157.39	1.5%
2041	$2,189.75	1.5%
2042	$2,222.60	1.5%
2043	$2,255.94	1.5%
2044	$2,289.78	1.5%
2045	$2,324.12	1.5%
2046	$2,358.99	1.5%
2047	$2,394.37	1.5%
2048	$2,430.29	1.5%
2049	$2,466.74	1.5%
2050	$2,503.74	1.5%
2051	$2,541.30	1.5%
2052	$2,579.42	1.5%
2053	$2,618.11	1.5%
2054	$2,657.38	1.5%
2055	$2,697.24	1.5%
2056	$2,737.70	1.5%
2057	$2,778.76	1.5%
2058	$2,820.45	1.5%
2059	$2,862.75	1.5%
2060	$2,905.69	1.5%
2061	$2,949.28	1.5%
2062	$2,993.52	1.5%
2063	$3,038.42	1.5%
2064	$3,084.00	1.5%
2065	$3,130.26	1.5%
2066	$3,177.21	1.5%
2067	$3,224.87	1.5%
2068	$3,273.24	1.5%
2069	$3,322.34	1.5%
2070	$3,372.18	1.5%
2071	$3,422.76	1.5%
2072	$3,474.10	1.5%

Conclusions

The water supply benefits of local water supply development and conservation projects are typically characterized according to the avoided costs of obtaining the added yields from the most expensive of the other viable supply options.For the San Diego region, such projects avoid the “all in” water supply costs for imported water, as furnished to the region by MWD and blended with other sources. Treatment and distribution costs also need to be factored into the cost of avoided import water, because the local options typically include the cost of delivering treated water to the relevant users.

The Water Authority’s projected “all in” supply rates – which include the MWD Tier 1 full service volumetric rate, Canal lining water rate, IID supply cost, and various fixed charges – provide a sound basis for beginning the exercise of estimating the avoided cost of imported water. We believe that the avoided costs developed here are generally conservative projections because at the margin, and especially in dry years (but also conceivably in normal ones), offset supplies may need to reflect Tier 2 water rather than Tier 1 water, which are generally more expensive. Further, if import waters become as scarce as is conceivable (e.g., due to climate change and/or other events that may impact extractable yields from the Bay-Delta), then prices will escalate faster than projected and local desalination (which according to the Water Purchase Agreement will be on the order of between $1,849 to $2,064 per AF in $2012, depending on how much water is purchased annually) may not become the most expensive alternative.

Appendix 8-2: Economic Analysis Tables

✓ Project 1: North County Regional Recycled Water Project – Phase II

Table 15 – Annual Benefits ..... Attached
Table 16 – Annual Costs of Avoided Projects ..... Not Applicable
Table 17 – Expected Annual Damage ..... Not Applicable
Table 18 – Expected Annual Demand Reduction Benefits ..... Not Applicable
Table 19 – Annual Costs of Project ..... Attached

✓ Project 2: Turf Replacement and Agricultural Irrigation Efficiency Program

Table 15 – Annual Benefits ..... Attached
Table 16 – Annual Costs of Avoided Projects ..... Not Applicable
Table 17 – Expected Annual Damage ..... Not Applicable
Table 18 – Expected Annual Demand Reduction Benefits ..... Not Applicable
Table 19 – Annual Costs of Project ..... Attached

✓ Project 3: Rural Disadvantaged Community (DAC) Partnership Program

Table 15 – Annual Benefits ..... Attached
Table 16 – Annual Costs of Avoided Projects ..... Attached
Table 17 – Expected Annual Damage ..... Not Applicable
Table 18 – Expected Annual Demand Reduction Benefits ..... Not Applicable
Table 19 – Annual Costs of Project ..... Attached

✓ Project 4: Failsafe Potable Reuse at the Advanced Water Purification Facility

Table 15 – Annual Benefits ..... Not Applicable
Table 16 – Annual Costs of Avoided Projects ..... Attached
Table 17 – Expected Annual Damage ..... Not Applicable
Table 18 – Expected Annual Demand Reduction Benefits ..... Not Applicable
Table 19 – Annual Costs of Project ..... Attached

✓ Project 5: Sustaining Healthy Tributaries to the Upper San Diego River and Protecting Local Water Supplies

Table 15 – Annual Benefits ..... Attached
Table 16 – Annual Costs of Avoided Projects ..... Not Applicable
Table 17 – Expected Annual Damage ..... Not Applicable
Table 18 – Expected Annual Demand Reduction Benefits ..... Not Applicable
Table 19 – Annual Costs of Project ..... Attached

✓ Project 6: Chollas Creek Integration Project – Phase II

FRAM model output ..... Attached

✓ Project 7: Implementing Nutrient Management in the Santa Margarita River Watershed – Phase II

Table 15 – Annual Benefits ..... Not Applicable
Table 16 – Annual Costs of Avoided Projects ..... Attached
Table 17 – Expected Annual Damage ..... Not Applicable
Table 18 – Expected Annual Demand Reduction Benefits ..... Not Applicable
Table 19 – Annual Costs of Project ..... Attached

Table 15 – Annual Benefit
(All benefits should be in 2012 dollars)
Project: NSDCRRWP - Phase II

(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 (1) (f) x (g)	Discount Factor (1)	Discounted Benefits (1) (h) x (i)
2012	Imported water supply	AF						1.000	
	Fertilizer use	lbs						1.000	
	Social costs of CO_2 emissions	MT						1.000	
2013	Imported water supply	AF						0.943	
	Fertilizer use	lbs						0.943	
	Social costs of CO_2 emissions	MT						0.943	
2014	Imported water supply	AF	36	0	36	$ 1,303	$ 46,911	0.890	**$ 41,750**
	Fertilizer use	lbs	842	0	842	$ 0.46	$ 387	0.890	**$ 345**
	Social costs of CO_2 emissions	MT	23	0	23	$ 23.62	$ 553	0.890	**$ 492**
2015	Imported water supply	AF	912	0	912	$ 1,349	$ 1,229,994	0.840	**$ 1,032,727**
	Fertilizer use	lbs	21,519	0	21,519	$ 0.46	$ 9,899	0.840	**$ 8,311**
	Social costs of CO_2 emissions	MT	597	0	597	$ 24.19	$ 14,447	0.840	**$ 12,130**
2016	Imported water supply	AF	5,364	0	5,364	$ 1,396	$ 7,487,507	0.792	**$ 5,930,806**
	Fertilizer use	lbs	126,594	0	126,594	$ 0.46	$ 58,233	0.792	**$ 46,126**
	Social costs of CO_2 emissions	MT	3,513	0	3,513	$ 24.77	$ 87,031	0.792	**$ 68,937**
2017	Imported water supply	AF	6,582	0	6,582	$ 1,445	$ 9,509,259	0.747	**$ 7,105,871**
	Fertilizer use	lbs	155,327	0	155,327	$ 0.46	$ 71,450	0.747	**$ 53,392**
	Social costs of CO_2 emissions	MT	4,311	0	4,311	$ 25.37	$ 109,350	0.747	**$ 81,713**
2018	Imported water supply	AF	6,790	0	6,790	$ 1,495	$ 10,153,106	0.705	**$ 7,157,539**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.705	**$ 51,964**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 25.98	$ 115,517	0.705	**$ 81,435**
2019	Imported water supply	AF	6,790	0	6,790	$ 1,548	$ 10,508,465	0.665	**$ 6,988,729**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.665	**$ 49,023**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 26.60	$ 118,290	0.665	**$ 78,670**
2020	Imported water supply	AF	6,790	0	6,790	$ 1,602	$ 10,876,261	0.627	**$ 6,823,901**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.627	**$ 46,248**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 27.24	$ 121,129	0.627	**$ 75,998**
2021	Imported water supply	AF	6,790	0	6,790	$ 1,626	$ 11,039,405	0.592	**$ 6,534,207**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.592	**$ 43,630**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 27.89	$ 124,036	0.592	**$ 73,417**
2022	Imported water supply	AF	6,790	0	6,790	$ 1,650	$ 11,204,996	0.558	**$ 6,256,811**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.558	**$ 41,161**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 28.56	$ 127,013	0.558	**$ 70,923**
2023	Imported water supply	AF	6,790	0	6,790	$ 1,675	$ 11,373,071	0.527	**$ 5,991,192**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.527	**$ 38,831**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 29.25	$ 130,061	0.527	**$ 68,515**
2024	Imported water supply	AF	6,790	0	6,790	$ 1,700	$ 11,543,667	0.497	**$ 5,736,849**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.497	**$ 36,633**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 29.95	$ 133,183	0.497	**$ 66,188**
2025	Imported water supply	AF	6,790	0	6,790	$ 1,726	$ 11,716,822	0.469	**$ 5,493,303**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.469	**$ 34,559**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 30.67	$ 136,379	0.469	**$ 63,940**
2026	Imported water supply	AF	6,790	0	6,790	$ 1,751	$ 11,892,574	0.442	**$ 5,260,097**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.442	**$ 32,603**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 31.40	$ 139,652	0.442	**$ 61,768**
2027	Imported water supply	AF	6,790	0	6,790	$ 1,778	$ 12,070,963	0.417	**$ 5,036,791**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.417	**$ 30,758**

	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 32.16	$ 143,004	0.417	**$ 59,670**
2028	Imported water supply	AF	6,790	0	6,790	$ 1,804	$ 12,252,027	0.394	**$ 4,822,965**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.394	**$ 29,017**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 32.93	$ 146,436	0.394	**$ 57,644**
2029	Imported water supply	AF	6,790	0	6,790	$ 1,831	$ 12,435,808	0.371	**$ 4,618,217**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.371	**$ 27,374**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 33.72	$ 149,950	0.371	**$ 55,686**
2030	Imported water supply	AF	6,790	0	6,790	$ 1,859	$ 12,622,345	0.350	**$ 4,422,160**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.350	**$ 25,825**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 34.53	$ 153,549	0.350	**$ 53,795**
2031	Imported water supply	AF	6,790	0	6,790	$ 1,887	$ 12,811,680	0.331	**$ 4,234,427**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.331	**$ 24,363**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 35.36	$ 157,234	0.331	**$ 51,968**
2032	Imported water supply	AF	6,790	0	6,790	$ 1,915	$ 13,003,855	0.312	**$ 4,054,664**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.312	**$ 22,984**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 36.20	$ 161,008	0.312	**$ 50,203**
2033	Imported water supply	AF	6,790	0	6,790	$ 1,944	$ 13,198,913	0.294	**$ 3,882,532**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.294	**$ 21,683**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 37.07	$ 164,872	0.294	**$ 48,498**
2034	Imported water supply	AF	6,790	0	6,790	$ 1,973	$ 13,396,897	0.278	**$ 3,717,707**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.278	**$ 20,456**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 37.96	$ 168,829	0.278	**$ 46,851**
2035	Imported water supply	AF	6,790	0	6,790	$ 2,003	$ 13,597,850	0.262	**$ 3,559,880**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.262	**$ 19,298**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 38.87	$ 172,881	0.262	**$ 45,260**
2036	Imported water supply	AF	6,790	0	6,790	$ 2,033	$ 13,801,818	0.247	**$ 3,408,753**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.247	**$ 18,205**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 39.81	$ 177,030	0.247	**$ 43,723**
2037	Imported water supply	AF	6,790	0	6,790	$ 2,063	$ 14,008,845	0.233	**$ 3,264,042**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.233	**$ 17,175**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 40.76	$ 181,279	0.233	**$ 42,238**
2038	Imported water supply	AF	6,790	0	6,790	$ 2,094	$ 14,218,978	0.220	**$ 3,125,474**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.220	**$ 16,203**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 41.74	$ 185,629	0.220	**$ 40,803**
2039	Imported water supply	AF	6,790	0	6,790	$ 2,126	$ 14,432,263	0.207	**$ 2,992,789**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.207	**$ 15,286**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 42.74	$ 190,084	0.207	**$ 39,417**
2040	Imported water supply	AF	6,790	0	6,790	$ 2,157	$ 14,648,747	0.196	**$ 2,865,736**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.196	**$ 14,420**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 43.77	$ 194,647	0.196	**$ 38,079**
2041	Imported water supply	AF	6,790	0	6,790	$ 2,190	$ 14,868,478	0.185	**$ 2,744,078**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.185	**$ 13,604**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 44.82	$ 199,318	0.185	**$ 36,785**
2042	Imported water supply	AF	6,790	0	6,790	$ 2,223	$ 15,091,505	0.174	**$ 2,627,584**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.174	**$ 12,834**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 45.89	$ 204,102	0.174	**$ 35,536**
2043	Imported water supply	AF	6,790	0	6,790	$ 2,256	$ 15,317,877	0.164	**$ 2,516,036**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.164	**$ 12,108**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 47.00	$ 209,000	0.164	**$ 34,329**
2044	Imported water supply	AF	6,790	0	6,790	$ 2,290	$ 15,547,646	0.155	**$ 2,409,223**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.155	**$ 11,422**

	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 48.12	$ 214,016	0.155	**$ 33,163**
2045	Imported water supply	AF	6,790	0	6,790	$ 2,324	$ 15,780,860	0.146	**$ 2,306,944**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.146	**$ 10,776**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 49.28	$ 219,152	0.146	**$ 32,037**
2046	Imported water supply	AF	6,790	0	6,790	$ 2,359	$ 16,017,573	0.138	**$ 2,209,008**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.138	**$ 10,166**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 50.46	$ 224,412	0.138	**$ 30,949**
2047	Imported water supply	AF	6,790	0	6,790	$ 2,394	$ 16,257,837	0.130	**$ 2,115,229**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.130	**$ 9,590**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 51.67	$ 229,798	0.130	**$ 29,898**
2048	Imported water supply	AF	6,790	0	6,790	$ 2,430	$ 16,501,704	0.123	**$ 2,025,432**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.123	**$ 9,047**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 52.91	$ 235,313	0.123	**$ 28,883**
2049	Imported water supply	AF	6,790	0	6,790	$ 2,467	$ 16,749,230	0.116	**$ 1,939,447**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.116	**$ 8,535**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 54.18	$ 240,961	0.116	**$ 27,902**
2050	Imported water supply	AF	6,790	0	6,790	$ 2,504	$ 17,000,468	0.109	**$ 1,857,112**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.109	**$ 8,052**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 55.48	$ 246,744	0.109	**$ 26,954**
2051	Imported water supply	AF	6,790	0	6,790	$ 2,541	$ 17,255,475	0.103	**$ 1,778,272**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.103	**$ 7,596**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 56.81	$ 252,666	0.103	**$ 26,039**
2052	Imported water supply	AF	6,790	0	6,790	$ 2,579	$ 17,514,308	0.097	**$ 1,702,779**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.097	**$ 7,166**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 58.18	$ 258,730	0.097	**$ 25,154**
2053	Imported water supply	AF	6,790	0	6,790	$ 2,618	$ 17,777,022	0.092	**$ 1,630,491**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.092	**$ 6,761**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 59.57	$ 264,939	0.092	**$ 24,300**
2054	Imported water supply	AF	6,790	0	6,790	$ 2,657	$ 18,043,677	0.087	**$ 1,561,273**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.087	**$ 6,378**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 61.00	$ 271,298	0.087	**$ 23,475**
2055	Imported water supply	AF	6,790	0	6,790	$ 2,697	$ 18,314,333	0.082	**$ 1,494,992**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.082	**$ 6,017**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 62.47	$ 277,809	0.082	**$ 22,677**
2056	Imported water supply	AF	6,790	0	6,790	$ 2,738	$ 18,589,048	0.077	**$ 1,431,525**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.077	**$ 5,677**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 63.97	$ 284,476	0.077	**$ 21,907**
2057	Imported water supply	AF	6,790	0	6,790	$ 2,779	$ 18,867,883	0.073	**$ 1,370,753**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.073	**$ 5,355**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 65.50	$ 291,304	0.073	**$ 21,163**
2058	Imported water supply	AF	6,790	0	6,790	$ 2,820	$ 19,150,902	0.069	**$ 1,312,561**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.069	**$ 5,052**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 67.07	$ 298,295	0.069	**$ 20,444**
2059	Imported water supply	AF	6,790	0	6,790	$ 2,863	$ 19,438,165	0.065	**$ 1,256,839**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.065	**$ 4,766**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 68.68	$ 305,454	0.065	**$ 19,750**
2060	Imported water supply	AF	6,790	0	6,790	$ 2,906	$ 19,729,738	0.061	**$ 1,203,482**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.061	**$ 4,496**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 70.33	$ 312,785	0.061	**$ 19,079**
2061	Imported water supply	AF	6,790	0	6,790	$ 2,949	$ 20,025,684	0.058	**$ 1,152,391**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.058	**$ 4,242**

	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 72.02	$ 320,292	0.058	**$ 18,431**
2062	Imported water supply	AF	6,790	0	6,790	$ 2,994	$ 20,326,069	0.054	**$ 1,103,469**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.054	**$ 4,002**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 73.75	$ 327,979	0.054	**$ 17,805**
2063	Imported water supply	AF	6,790	0	6,790	$ 3,038	$ 20,630,960	0.051	**$ 1,056,624**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.051	**$ 3,775**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 75.52	$ 335,850	0.051	**$ 17,201**
2064	Imported water supply	AF	6,790	0	6,790	$ 3,084	$ 20,940,424	0.048	**$ 1,011,767**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.048	**$ 3,562**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 77.33	$ 343,911	0.048	**$ 16,617**
2065	Imported water supply	AF	6,790	0	6,790	$ 3,130	$ 21,254,531	0.046	**$ 968,815**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.046	**$ 3,360**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 79.19	$ 352,164	0.046	**$ 16,052**
2066	Imported water supply	AF	6,790	0	6,790	$ 3,177	$ 21,573,349	0.043	**$ 927,686**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.043	**$ 3,170**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 81.09	$ 360,616	0.043	**$ 15,507**
2067	Imported water supply	AF	6,790	0	6,790	$ 3,225	$ 21,896,949	0.041	**$ 888,303**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.041	**$ 2,990**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 83.03	$ 369,271	0.041	**$ 14,980**
2068	Imported water supply	AF	6,790	0	6,790	$ 3,273	$ 22,225,403	0.038	**$ 850,592**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.038	**$ 2,821**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 85.03	$ 378,134	0.038	**$ 14,472**
2069	Imported water supply	AF	6,790	0	6,790	$ 3,322	$ 22,558,784	0.036	**$ 814,482**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.036	**$ 2,661**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 87.07	$ 387,209	0.036	**$ 13,980**
2070	Imported water supply	AF	6,790	0	6,790	$ 3,372	$ 22,897,166	0.034	**$ 779,905**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.034	**$ 2,511**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 89.16	$ 396,502	0.034	**$ 13,505**
2071	Imported water supply	AF	6,790	0	6,790	$ 3,423	$ 23,240,623	0.032	**$ 746,796**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.032	**$ 2,369**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 91.30	$ 406,018	0.032	**$ 13,047**
2072	Imported water supply	AF	6,790	0	6,790	$ 3,474	$ 23,589,233	0.030	**$ 715,092**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.030	**$ 2,235**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 93.49	$ 415,762	0.030	**$ 12,604**
2073	Imported water supply	AF	6,790	0	6,790	$ 3,526	$ 23,943,071	0.029	**$ 684,734**
	Fertilizer use	lbs	160,244	0	160,244	$ 0.46	$ 73,712	0.029	**$ 2,108**
	Social costs of CO_2 emissions	MT	4,447	0	4,447	$ 95.73	$ 425,741	0.029	**$ 12,176**
2074	Imported water supply	AF	6754	0	6,754	$ 3,579	$ 24,173,369	0.027	**$ 652,189**
	Fertilizer use	lbs	159402	0	159,402	$ 0.46	$ 73,325	0.027	**$ 1,978**
	Social costs of CO_2 emissions	MT	4423.85	0	4,424	$ 98.03	$ 433,670	0.027	**$ 11,700**
2075	Imported water supply	AF	5878	0	5,878	$ 3,633	$ 21,353,632	0.025	**$ 543,503**
	Fertilizer use	lbs	138725	0	138,725	$ 0.46	$ 63,814	0.025	**$ 1,624**
	Social costs of CO_2 emissions	MT	3849.99	0	3,850	$ 100.38	$ 386,472	0.025	**$ 9,837**
2076	Imported water supply	AF	1426	0	1,426	$ 3,687	$ 5,258,087	0.024	**$ 126,256**
	Fertilizer use	lbs	33650	0	33,650	$ 0.46	$ 15,479	0.024	**$ 372**
	Social costs of CO_2 emissions	MT	933.87	0	934	$ 102.79	$ 95,994	0.024	**$ 2,305**
2077	Imported water supply	AF	208	0	208	$ 3,743	$ 778,462.31	0.023	**$ 17,634**
	Fertilizer use	lbs	4917	0	4,917	$ 0.46	$ 2,262	0.023	**$ 51**
	Social costs of CO_2 emissions	MT	136.45	0	136	$ 105.26	$ 14,363	0.023	**$ 325**
								Total Present Value of Discounted Benefits Based on Unit Value	**$ 178,127,244**
Comments:									

(1) Complete these columns if dollar value is being claimed for the benefit.

Table 19 – Annual Costs of Project (All costs should be in 2012 Dollars) Project: NSDCRRWP - Phase II										
	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost[1]	Annual Costs [2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012								$0	1.000	$0.00
2013	$766,009			$1,909				$767,918	0.943	$724,451.28
2014	$5,745,068			$33,458				$5,778,526	0.890	$5,142,867.38
2015	$8,617,603	$1,440,000		$152,870				$10,210,473	0.840	$8,572,910.41
2016	$3,830,046	$720,000		$263,038				$4,813,084	0.792	$3,812,413.50
2017	$191,502			$279,705				$471,207	0.747	$352,113.18
2018				$283,038				$283,038	0.705	$199,530.76
2019				$283,038				$283,038	0.665	$188,236.57
2020				$283,038				$283,038	0.627	$177,581.67
2021				$283,038				$283,038	0.592	$167,529.88
2022				$283,038				$283,038	0.558	$158,047.05
2023				$283,038				$283,038	0.527	$149,100.99
2024				$283,038				$283,038	0.497	$140,661.31
2025				$283,038				$283,038	0.469	$132,699.35
2026				$283,038				$283,038	0.442	$125,188.07
2027				$283,038				$283,038	0.417	$118,101.95
2028				$283,038				$283,038	0.394	$111,416.94
2029				$283,038				$283,038	0.371	$105,110.32
2030				$283,038				$283,038	0.350	$99,160.68
2031				$283,038		$451,023		$734,061	0.331	$242,616.78
2032				$283,038		$748,500		$1,031,538	0.312	$321,638.49
2033				$283,038				$283,038	0.294	$83,257.22
2034				$283,038				$283,038	0.278	$78,544.54
2035				$283,038				$283,038	0.262	$74,098.63
2036				$283,038				$283,038	0.247	$69,904.36
2037				$283,038				$283,038	0.233	$65,947.51
2038				$283,038				$283,038	0.220	$62,214.64
2039				$283,038				$283,038	0.207	$58,693.05
2040				$283,038				$283,038	0.196	$55,370.80
2041				$283,038				$283,038	0.185	$52,236.61
2042				$283,038				$283,038	0.174	$49,279.82
2043				$283,038				$283,038	0.164	$46,490.39
2044				$283,038				$283,038	0.155	$43,858.86
2045				$283,038				$283,038	0.146	$41,376.29
2046				$283,038				$283,038	0.138	$39,034.23
2047				$283,038		$451,023		$734,061	0.130	$95,505.19
2048				$283,038		$748,500		$1,031,538	0.123	$126,611.80
2049				$283,038				$283,038	0.116	$32,773.89
2050				$283,038				$283,038	0.109	$30,918.77
2051				$283,038				$283,038	0.103	$29,168.65
2052				$283,038				$283,038	0.097	$27,517.59
2053				$283,038				$283,038	0.092	$25,959.99
2054				$283,038				$283,038	0.087	$24,490.56
2055				$283,038				$283,038	0.082	$23,104.30
2056				$283,038				$283,038	0.077	$21,796.51
2057				$283,038				$283,038	0.073	$20,562.75
2058				$283,038				$283,038	0.069	$19,398.82
2059				$283,038				$283,038	0.065	$18,300.77
2060				$283,038				$283,038	0.061	$17,264.88
2061				$283,038				$283,038	0.058	$16,287.62
2062				$283,038				$283,038	0.054	$15,365.68
2063				$283,038		$451,023		$734,061	0.051	$37,595.26
2064				$283,038		$748,500		$1,031,538	0.048	$49,840.26
2065				$283,038				$283,038	0.046	$12,901.32
2066				$283,038				$283,038	0.043	$12,171.06
2067				$283,038				$283,038	0.041	$11,482.13
2068				$283,038				$283,038	0.038	$10,832.20
2069				$283,038				$283,038	0.036	$10,219.05
2070				$283,038				$283,038	0.034	$9,640.62
2071				$283,038				$283,038	0.032	$9,094.92
2072				$283,038				$283,038	0.030	$8,580.12
2073				$283,038				$283,038	0.029	$8,094.45
2074				$279,697				$279,697	0.027	$7,546.12
2075				$236,654				$236,654	0.025	$6,023.43
2076				$78,767				$78,767	0.024	$1,891.33
2077				$18,333				$18,333	0.023	$415.30
	$19,150,228	$2,160,000	$0	$17,194,571	$0	$3,598,569	$0	$42,103,368		$22,603,038.86
Total Present Value of										
Comments:										

(1) If any, based on opportunity costs, sunk costs and associated costs

(2) The incremental change in O&M costs attributable to the project

Table 15 – Annual Benefit (All benefits should be in 2012 dollars)									
Project: Turf Replacement and Agricultural Irrigation Efficiency									
SCWDA Tier 1 real price escalation rate through 2020:		3.5%							
SCWDA Tier 1 real price escalation rate after 2020:		1.5%							
SCWDA Tier 1 real price escalation rate after 2020:		2.4%							
(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 (1) (f) x (g)	Discount Factor (1)	Discounted Benefits (1) (h) x (i)
2013	Avoided Imported Water Supply Purchases	Acre-Feet	0	5	5	$ 1,259	$ 5,666	0.943	**$ 5,345**
	Avoided Wastewater Treatment Costs	Square Feet	0	38,361	38,361	$ 0.02	$ 651	0.943	**$ 614**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	4	4	$ 22.53	$ 95	0.943	**$ 90**
	Avoided Fertilizer Costs	Lbs.	0	1,688	1,688	$ 0.46	$ 911	0.943	**$ 860**
2014	Avoided Imported Water Supply Purchases	Acre-Feet	0	27	27	$ 1,303	$ 35,183	0.890	**$ 31,313**
	Avoided Wastewater Treatment Costs	Square Feet	0	191,804	191,804	$ 0.02	$ 3,254	0.890	**$ 2,896**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	25	25	$ 23.07	$ 584	0.890	**$ 520**
	Avoided Fertilizer Costs	Lbs.	0	8,439	8,439	$ 0.46	$ 4,557	0.890	**$ 4,056**
2015	Avoided Imported Water Supply Purchases	Acre-Feet	0	170	170	$ 1,349	$ 229,274	0.840	**$ 192,503**
	Avoided Wastewater Treatment Costs	Square Feet	0	319,673	319,673	$ 0.02	$ 5,424	0.840	**$ 4,554**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	124	124	$ 23.62	$ 2,931	0.840	**$ 2,461**
	Avoided Fertilizer Costs	Lbs.	0	17,016	17,016	$ 0.46	$ 9,188	0.840	**$ 7,715**
2016	Avoided Imported Water Supply Purchases	Acre-Feet	0	295	295	$ 1,396	$ 411,783	0.792	**$ 326,171**
	Avoided Wastewater Treatment Costs	Square Feet	0	319,673	319,673	$ 0.02	$ 5,424	0.792	**$ 4,296**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	206	206	$ 24.19	$ 4,982	0.792	**$ 3,946**
	Avoided Fertilizer Costs	Lbs.	0	19,966	19,966	$ 0.46	$ 10,781	0.792	**$ 8,540**
2017	Avoided Imported Water Supply Purchases	Acre-Feet	0	295	295	$ 1,445	$ 426,196	0.747	**$ 318,478**
	Avoided Wastewater Treatment Costs	Square Feet	0	319,673	319,673	$ 0.02	$ 5,424	0.747	**$ 4,053**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	206	206	$ 24.77	$ 5,102	0.747	**$ 3,812**
	Avoided Fertilizer Costs	Lbs.	0	19,966	19,966	$ 0.46	$ 10,781	0.747	**$ 8,057**
2018	Avoided Imported Water Supply Purchases	Acre-Feet	0	295	295	$ 1,495	$ 441,113	0.705	**$ 310,967**
	Avoided Wastewater Treatment Costs	Square Feet	0	319,673	319,673	$ 0.02	$ 5,424	0.705	**$ 3,824**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	206	206	$ 25.37	$ 5,224	0.705	**$ 3,683**
	Avoided Fertilizer Costs	Lbs.	0	19,966	19,966	$ 0.46	$ 10,781	0.705	**$ 7,600**
2019	Avoided Imported Water Supply Purchases	Acre-Feet	0	295	295	$ 1,548	$ 456,552	0.665	**$ 303,633**
	Avoided Wastewater Treatment Costs	Square Feet	0	319,673	319,673	$ 0.02	$ 5,424	0.665	**$ 3,607**

	Reduced Social Cost of CO2 Emission	Metric Tons	0	206	206	$ 25.98	$ 5,349	0.665	**$ 3,558**
	Avoided Fertilizer Costs	Lbs.	0	19,966	19,966	$ 0.46	$ 10,781	0.665	**$ 7,170**
2020	Avoided Imported Water Supply Purchases	Acre-Feet	0	295	295	$ 1,602	$ 472,531	0.627	**$ 296,472**
	Avoided Wastewater Treatment Costs	Square Feet	0	319,673	319,673	$ 0.02	$ 5,424	0.627	**$ 3,403**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	206	206	$ 26.60	$ 5,478	0.627	**$ 3,437**
	Avoided Fertilizer Costs	Lbs.	0	19,966	19,966	$ 0.46	$ 10,781	0.627	**$ 6,764**
2021	Avoided Imported Water Supply Purchases	Acre-Feet	0	295	295	$ 1,626	$ 479,619	0.592	**$ 283,886**
	Avoided Wastewater Treatment Costs	Square Feet	0	319,673	319,673	$ 0.02	$ 5,424	0.592	**$ 3,210**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	206	206	$ 27.24	$ 5,609	0.592	**$ 3,320**
	Avoided Fertilizer Costs	Lbs.	0	19,966	19,966	$ 0.46	$ 10,781	0.592	**$ 6,382**
2022	Avoided Imported Water Supply Purchases	Acre-Feet	0	295	295	$ 1,650	$ 486,813	0.558	**$ 271,834**
	Avoided Wastewater Treatment Costs	Square Feet	0	319,673	319,673	$ 0.02	$ 5,424	0.558	**$ 3,029**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	206	206	$ 27.89	$ 5,744	0.558	**$ 3,207**
	Avoided Fertilizer Costs	Lbs.	0	19,966	19,966	$ 0.46	$ 10,781	0.558	**$ 6,020**
2023	Avoided Imported Water Supply Purchases	Acre-Feet	0	295	295	$ 1,675	$ 494,115	0.527	**$ 260,294**
	Avoided Wastewater Treatment Costs	Square Feet	0	319,673	319,673	$ 0.02	$ 5,424	0.527	**$ 2,857**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	206	206	$ 28.56	$ 5,882	0.527	**$ 3,098**
	Avoided Fertilizer Costs	Lbs.	0	19,966	19,966	$ 0.46	$ 10,781	0.527	**$ 5,680**
2024	Avoided Imported Water Supply Purchases	Acre-Feet	0	295	295	$ 1,700	$ 501,527	0.497	**$ 249,244**
	Avoided Wastewater Treatment Costs	Square Feet	0	319,673	319,673	$ 0.02	$ 5,424	0.497	**$ 2,695**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	206	206	$ 29.25	$ 6,023	0.497	**$ 2,993**
	Avoided Fertilizer Costs	Lbs.	0	19,966	19,966	$ 0.46	$ 10,781	0.497	**$ 5,358**
2025	Avoided Imported Water Supply Purchases	Acre-Feet	0	295	295	$ 1,726	$ 509,050	0.469	**$ 238,662**
	Avoided Wastewater Treatment Costs	Square Feet	0	319,673	319,673	$ 0.02	$ 5,424	0.469	**$ 2,543**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	206	206	$ 29.95	$ 6,167	0.469	**$ 2,892**
	Avoided Fertilizer Costs	Lbs.	0	19,966	19,966	$ 0.46	$ 10,781	0.469	**$ 5,055**
2026	Avoided Imported Water Supply Purchases	Acre-Feet	0	295	295	$ 1,751	$ 516,686	0.442	**$ 228,531**
	Avoided Wastewater Treatment Costs	Square Feet	0	319,673	319,673	$ 0.02	$ 5,424	0.442	**$ 2,399**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	206	206	$ 30.67	$ 6,315	0.442	**$ 2,793**
	Avoided Fertilizer Costs	Lbs.	0	19,966	19,966	$ 0.46	$ 10,781	0.442	**$ 4,769**
2027	Avoided Imported Water Supply Purchases	Acre-Feet	0	295	295	$ 1,778	$ 524,436	0.417	**$ 218,829**
	Avoided Wastewater Treatment Costs	Square Feet	0	319,673	319,673	$ 0.02	$ 5,424	0.417	**$ 2,263**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	206	206	$ 31.40	$ 6,467	0.417	**$ 2,698**
	Avoided Fertilizer Costs	Lbs.	0	19,966	19,966	$ 0.46	$ 10,781	0.417	**$ 4,499**
2028	Avoided Imported Water Supply Purchases	Acre-Feet	0	295	295	$ 1,804	$ 532,303	0.394	**$ 209,539**
	Avoided Wastewater Treatment Costs	Square Feet	0	319,673	319,673	$ 0.02	$ 5,424	0.394	**$ 2,135**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	206	206	$ 32.16	$ 6,622	0.394	**$ 2,607**
	Avoided Fertilizer Costs	Lbs.	0	19,966	19,966	$ 0.46	$ 10,781	0.394	**$ 4,244**

2029	Avoided Imported Water Supply Purchases	Acre-Feet	0	295	295	$ 1,831	$ 540,287	0.371	**$ 200,643**
	Avoided Wastewater Treatment Costs	Square Feet	0	319,673	319,673	$ 0.02	$ 5,424	0.371	**$ 2,014**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	206	206	$ 32.93	$ 6,781	0.371	**$ 2,518**
	Avoided Fertilizer Costs	Lbs.	0	19,966	19,966	$ 0.46	$ 10,781	0.371	**$ 4,004**
2030	Avoided Imported Water Supply Purchases	Acre-Feet	0	295	295	$ 1,859	$ 548,391	0.350	**$ 192,126**
	Avoided Wastewater Treatment Costs	Square Feet	0	319,673	319,673	$ 0.02	$ 5,424	0.350	**$ 1,900**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	206	206	$ 33.72	$ 6,944	0.350	**$ 2,433**
	Avoided Fertilizer Costs	Lbs.	0	19,966	19,966	$ 0.46	$ 10,781	0.350	**$ 3,777**
2031	Avoided Imported Water Supply Purchases	Acre-Feet	0	295	295	$ 1,887	$ 556,617	0.331	**$ 183,969**
	Avoided Wastewater Treatment Costs	Square Feet	0	319,673	319,673	$ 0.02	$ 5,424	0.331	**$ 1,793**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	206	206	$ 34.53	$ 7,110	0.331	**$ 2,350**
	Avoided Fertilizer Costs	Lbs.	0	19,966	19,966	$ 0.46	$ 10,781	0.331	**$ 3,563**
2032	Avoided Imported Water Supply Purchases	Acre-Feet	0	295	295	$ 1,915	$ 564,967	0.312	**$ 176,159**
	Avoided Wastewater Treatment Costs	Square Feet	0	319,673	319,673	$ 0.02	$ 5,424	0.312	**$ 1,691**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	206	206	$ 35.36	$ 7,281	0.312	**$ 2,270**
	Avoided Fertilizer Costs	Lbs.	0	19,966	19,966	$ 0.46	$ 10,781	0.312	**$ 3,362**
2033	Avoided Imported Water Supply Purchases	Acre-Feet	0	291	291	$ 1,944	$ 564,694	0.294	**$ 166,108**
	Avoided Wastewater Treatment Costs	Square Feet	0	281,312	281,312	$ 0.02	$ 4,773	0.294	**$ 1,404**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	202	202	$ 36.20	$ 7,303	0.294	**$ 2,148**
	Avoided Fertilizer Costs	Lbs.	0	18,278	18,278	$ 0.46	$ 9,870	0.294	**$ 2,903**
2034	Avoided Imported Water Supply Purchases	Acre-Feet	0	268	268	$ 1,973	$ 528,771	0.278	**$ 146,737**
	Avoided Wastewater Treatment Costs	Square Feet	0	127,869	127,869	$ 0.02	$ 2,170	0.278	**$ 602**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	181	181	$ 37.07	$ 6,696	0.278	**$ 1,858**
	Avoided Fertilizer Costs	Lbs.	0	11,526	11,526	$ 0.46	$ 6,224	0.278	**$ 1,727**
2035	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,003	$ 500,655	0.262	**$ 131,070**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.262	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 37.96	$ 6,215	0.262	**$ 1,627**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.262	**$ 834**
2036	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,033	$ 508,165	0.247	**$ 125,506**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.247	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 38.87	$ 6,365	0.247	**$ 1,572**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.247	**$ 787**
2037	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,063	$ 515,788	0.233	**$ 120,178**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.233	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 39.81	$ 6,517	0.233	**$ 1,519**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.233	**$ 742**
2038	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,094	$ 523,524	0.220	**$ 115,076**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.220	**$ -**

	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 40.76	$ 6,674	0.220	**$ 1,467**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.220	**$ 700**
2039	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,126	$ 531,377	0.207	**$ 110,191**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.207	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 41.74	$ 6,834	0.207	**$ 1,417**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.207	**$ 661**
2040	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,157	$ 539,348	0.196	**$ 105,513**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.196	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 42.74	$ 6,998	0.196	**$ 1,369**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.196	**$ 623**
2041	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,190	$ 547,438	0.185	**$ 101,033**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.185	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 43.77	$ 7,166	0.185	**$ 1,323**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.185	**$ 588**
2042	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,223	$ 555,650	0.174	**$ 96,744**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.174	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 44.82	$ 7,338	0.174	**$ 1,278**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.174	**$ 555**
2043	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,256	$ 563,984	0.164	**$ 92,637**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.164	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 45.89	$ 7,514	0.164	**$ 1,234**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.164	**$ 523**
2044	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,290	$ 572,444	0.155	**$ 88,704**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.155	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 47.00	$ 7,694	0.155	**$ 1,192**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.155	**$ 494**
2045	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,324	$ 581,031	0.146	**$ 84,939**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.146	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 48.12	$ 7,879	0.146	**$ 1,152**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.146	**$ 466**
2046	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,359	$ 589,746	0.138	**$ 81,333**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.138	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 49.28	$ 8,068	0.138	**$ 1,113**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.138	**$ 439**
2047	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,394	$ 598,593	0.130	**$ 77,880**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.130	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 50.46	$ 8,262	0.130	**$ 1,075**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.130	**$ 415**

2048	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,430	$ 607,571	0.123	**$ 74,574**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.123	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 51.67	$ 8,460	0.123	**$ 1,038**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.123	**$ 391**
2049	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,467	$ 616,685	0.116	**$ 71,408**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.116	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 52.91	$ 8,663	0.116	**$ 1,003**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.116	**$ 369**
2050	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,504	$ 625,935	0.109	**$ 68,376**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.109	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 54.18	$ 8,871	0.109	**$ 969**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.109	**$ 348**
2051	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,541	$ 635,324	0.103	**$ 65,474**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.103	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 55.48	$ 9,084	0.103	**$ 936**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.103	**$ 328**
2052	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,579	$ 644,854	0.097	**$ 62,694**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.097	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 56.81	$ 9,302	0.097	**$ 904**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.097	**$ 310**
2053	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,618	$ 654,527	0.092	**$ 60,033**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.092	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 58.18	$ 9,525	0.092	**$ 874**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.092	**$ 292**
2054	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,657	$ 664,345	0.087	**$ 57,484**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.087	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 59.57	$ 9,754	0.087	**$ 844**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.087	**$ 276**
2055	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,697	$ 674,310	0.082	**$ 55,044**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.082	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 61.00	$ 9,988	0.082	**$ 815**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.082	**$ 260**
2056	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,738	$ 684,425	0.077	**$ 52,707**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.077	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 62.47	$ 10,228	0.077	**$ 788**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.077	**$ 245**
2057	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,779	$ 694,691	0.073	**$ 50,469**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.073	**$ -**

	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 63.97	$ 10,473	0.073	**$ 761**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.073	**$ 231**
2058	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,820	$ 705,111	0.069	**$ 48,327**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.069	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 65.50	$ 10,724	0.069	**$ 735**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.069	**$ 218**
2059	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,863	$ 715,688	0.065	**$ 46,275**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.065	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 67.07	$ 10,982	0.065	**$ 710**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.065	**$ 206**
2060	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,906	$ 726,423	0.061	**$ 44,311**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.061	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 68.68	$ 11,245	0.061	**$ 686**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.061	**$ 194**
2061	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,949	$ 737,320	0.058	**$ 42,430**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.058	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 70.33	$ 11,515	0.058	**$ 663**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.058	**$ 183**
2062	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 2,994	$ 748,380	0.054	**$ 40,628**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.054	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 72.02	$ 11,792	0.054	**$ 640**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.054	**$ 173**
2063	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 3,038	$ 759,605	0.051	**$ 38,904**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.051	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 73.75	$ 12,075	0.051	**$ 618**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.051	**$ 163**
2064	Avoided Imported Water Supply Purchases	Acre-Feet	0	250	250	$ 3,084	$ 770,999	0.048	**$ 37,252**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.048	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	164	164	$ 75.52	$ 12,364	0.048	**$ 597**
	Avoided Fertilizer Costs	Lbs.	0	5,900	5,900	$ 0.46	$ 3,186	0.048	**$ 154**
2065	Avoided Imported Water Supply Purchases	Acre-Feet	0	125	125	$ 3,130	$ 391,282	0.046	**$ 17,835**
	Avoided Wastewater Treatment Costs	Square Feet	0	-	-	$ 0.02	$ -	0.046	**$ -**
	Reduced Social Cost of CO2 Emission	Metric Tons	0	82	82	$ 77.33	$ 6,331	0.046	**$ 289**
	Avoided Fertilizer Costs	Lbs.	0	2,950	2,950	$ 0.46	$ 1,593	0.046	**$ 73**
								Total Present Value of Discounted Benefits Based on Unit Value	**$ 7,348,499**

Table 19 – Annual Costs of Project (All costs should be in 2012 Dollars) Project: Turf Replacement and Agricultural Irrigation Efficiency										
	Initial Costs Grand Total Cost from Table 7	Adjusted Grant Total Cost[1]	Annual Costs [2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2013	$ 78,459	$ 69,689		$ 605				$ 148,753	0.943	**$ 140,333**
2014	$ 392,296	$ 398,444		$ 605				$ 791,345	0.890	**$ 704,294**
2015	$ 313,836	$ 328,755		$ 605				$ 643,196	0.840	**$ 540,040**
2016				$ 605				$ 605	0.792	**$ 479**
2017				$ 605				$ 605	0.747	**$ 452**
Total Present Value of Discounted Costs (Sum of column (j))										**$ 1,385,598**

Table 15 – Annual Benefit
(All benefits should be in 2012 dollars)

Project: Rural DAC Program

(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 [1] (f) x (g)	Discount Factor [1]	Discounted Benefits [1] (h) x (i)
2012								1.000	
2013						$ 1,259.00		0.943	
2014	Avoided Imported water	Acre Feet	0	0	0	$ 1,303.07	$ -	0.890	**$ -**
	Reduced CO2e emissions	MT	0	0	0	$ 23.07	$ -	0.890	**$ -**
2015	Avoided Imported water	Acre Feet	782	0	782	$ 1,348.67	$ 1,054,661.72	0.840	**$ 885,514**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 23.62	$ 17,327.97	0.840	**$ 14,549**
2016	Avoided Imported water	Acre Feet	782	0	782	$ 1,395.88	$ 1,091,574.88	0.792	**$ 864,630**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 24.19	$ 17,743.84	0.792	**$ 14,055**
2017	Avoided Imported water	Acre Feet	782	0	782	$ 1,444.73	$ 1,129,780.00	0.747	**$ 844,237**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 24.77	$ 18,169.69	0.747	**$ 13,577**
2018	Avoided Imported water	Acre Feet	782	0	782	$ 1,495.30	$ 1,169,322.30	0.705	**$ 824,326**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 25.37	$ 18,605.77	0.705	**$ 13,116**
2019	Avoided Imported water	Acre Feet	782	0	782	$ 1,547.63	$ 1,210,248.58	0.665	**$ 804,884**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 25.97	$ 19,052.30	0.665	**$ 12,671**
2020	Avoided Imported water	Acre Feet	782	0	782	$ 1,601.80	$ 1,252,607.28	0.627	**$ 785,901**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 26.60	$ 19,509.56	0.627	**$ 12,241**
2021	Avoided Imported water	Acre Feet	782	0	782	$ 1,625.83	$ 1,271,396.39	0.592	**$ 752,538**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 27.24	$ 19,977.79	0.592	**$ 11,825**
2022	Avoided Imported water	Acre Feet	782	0	782	$ 1,650.21	$ 1,290,467.34	0.558	**$ 720,590**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 27.89	$ 20,457.26	0.558	**$ 11,423**
2023	Avoided Imported water	Acre Feet	782	0	782	$ 1,674.97	$ 1,309,824.35	0.527	**$ 689,999**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 28.56	$ 20,948.23	0.527	**$ 11,035**
2024	Avoided Imported water	Acre Feet	782	0	782	$ 1,700.09	$ 1,329,471.71	0.497	**$ 660,707**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 29.24	$ 21,450.99	0.497	**$ 10,660**
2025	Avoided Imported water	Acre Feet	782	0	782	$ 1,725.59	$ 1,349,413.79	0.469	**$ 632,658**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 29.95	$ 21,965.81	0.469	**$ 10,298**
2026	Avoided Imported water	Acre Feet	782	0	782	$ 1,751.48	$ 1,369,654.99	0.442	**$ 605,800**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 30.67	$ 22,492.99	0.442	**$ 9,949**
2027	Avoided Imported water	Acre Feet	782	0	782	$ 1,777.75	$ 1,390,199.82	0.417	**$ 580,082**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 31.40	$ 23,032.82	0.417	**$ 9,611**
2028	Avoided Imported water	Acre Feet	782	0	782	$ 1,804.42	$ 1,411,052.82	0.394	**$ 555,456**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 32.15	$ 23,585.61	0.394	**$ 9,284**
2029	Avoided Imported water	Acre Feet	782	0	782	$ 1,831.48	$ 1,432,218.61	0.371	**$ 531,875**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 32.93	$ 24,151.66	0.371	**$ 8,969**
2030	Avoided Imported water	Acre Feet	782	0	782	$ 1,858.95	$ 1,453,701.89	0.350	**$ 509,295**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 33.72	$ 24,731.30	0.350	**$ 8,664**
2031	Avoided Imported water	Acre Feet	782	0	782	$ 1,886.84	$ 1,475,507.42	0.331	**$ 487,674**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 34.53	$ 25,324.86	0.331	**$ 8,370**
2032	Avoided Imported water	Acre Feet	782	0	782	$ 1,915.14	$ 1,497,640.03	0.312	**$ 466,971**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 35.35	$ 25,932.65	0.312	**$ 8,086**
2033	Avoided Imported water	Acre Feet	782	0	782	$ 1,943.87	$ 1,520,104.63	0.294	**$ 447,147**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 36.20	$ 26,555.04	0.294	**$ 7,811**
2034	Avoided Imported water	Acre Feet	782	0	782	$ 1,973.03	$ 1,542,906.20	0.278	**$ 428,164**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 37.07	$ 27,192.36	0.278	**$ 7,546**
2035	Avoided Imported water	Acre Feet	782	0	782	$ 2,002.62	$ 1,566,049.79	0.262	**$ 409,988**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 37.96	$ 27,844.97	0.262	**$ 7,290**
2036	Avoided Imported water	Acre Feet	782	0	782	$ 2,032.66	$ 1,589,540.54	0.247	**$ 392,582**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 38.87	$ 28,513.25	0.247	**$ 7,042**
2037	Avoided Imported water	Acre Feet	782	0	782	$ 2,063.15	$ 1,613,383.64	0.233	**$ 375,916**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 39.81	$ 29,197.57	0.233	**$ 6,803**
2038	Avoided Imported water	Acre Feet	782	0	782	$ 2,094.10	$ 1,637,584.40	0.220	**$ 359,957**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 40.76	$ 29,898.31	0.220	**$ 6,572**
2039	Avoided Imported water	Acre Feet	782	0	782	$ 2,125.51	$ 1,662,148.16	0.207	**$ 344,676**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 41.74	$ 30,615.87	0.207	**$ 6,349**
2040	Avoided Imported water	Acre Feet	782	0	782	$ 2,157.39	$ 1,687,080.39	0.196	**$ 330,044**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 42.74	$ 31,350.65	0.196	**$ 6,133**
2041	Avoided Imported water	Acre Feet	782	0	782	$ 2,189.75	$ 1,712,386.59	0.185	**$ 316,032**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 43.77	$ 32,103.07	0.185	**$ 5,925**

2042	Avoided Imported water	Acre Feet	782	0	782	$ 2,222.60	$ 1,738,072.39	0.174	**$ 302,616**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 44.82	$ 32,873.54	0.174	**$ 5,724**
2043	Avoided Imported water	Acre Feet	782	0	782	$ 2,255.94	$ 1,764,143.48	0.164	**$ 289,769**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 45.89	$ 33,662.51	0.164	**$ 5,529**
2044	Avoided Imported water	Acre Feet	782	0	782	$ 2,289.78	$ 1,790,605.63	0.155	**$ 277,468**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 46.99	$ 34,470.41	0.155	**$ 5,341**
2045	Avoided Imported water	Acre Feet	782	0	782	$ 2,324.12	$ 1,817,464.71	0.146	**$ 265,688**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 48.12	$ 35,297.70	0.146	**$ 5,160**
2046	Avoided Imported water	Acre Feet	782	0	782	$ 2,358.99	$ 1,844,726.69	0.138	**$ 254,409**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 49.28	$ 36,144.84	0.138	**$ 4,985**
2047	Avoided Imported water	Acre Feet	782	0	782	$ 2,394.37	$ 1,872,397.59	0.130	**$ 243,609**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 50.46	$ 37,012.32	0.130	**$ 4,815**
2048	Avoided Imported water	Acre Feet	782	0	782	$ 2,430.29	$ 1,900,483.55	0.123	**$ 233,267**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 51.67	$ 37,900.61	0.123	**$ 4,652**
2049	Avoided Imported water	Acre Feet	782	0	782	$ 2,466.74	$ 1,928,990.80	0.116	**$ 223,364**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 52.91	$ 38,810.23	0.116	**$ 4,494**
2050	Avoided Imported water	Acre Feet	782	0	782	$ 2,503.74	$ 1,957,925.66	0.109	**$ 213,882**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 54.18	$ 39,741.67	0.109	**$ 4,341**
2051	Avoided Imported water	Acre Feet	782	0	782	$ 2,541.30	$ 1,987,294.55	0.103	**$ 204,802**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 55.48	$ 40,695.47	0.103	**$ 4,194**
2052	Avoided Imported water	Acre Feet	782	0	782	$ 2,579.42	$ 2,017,103.97	0.097	**$ 196,107**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 56.81	$ 41,672.17	0.097	**$ 4,051**
2053	Avoided Imported water	Acre Feet	782	0	782	$ 2,618.11	$ 2,047,360.53	0.092	**$ 187,782**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 58.18	$ 42,672.30	0.092	**$ 3,914**
2054	Avoided Imported water	Acre Feet	782	0	782	$ 2,657.38	$ 2,078,070.94	0.087	**$ 179,810**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 59.57	$ 43,696.43	0.087	**$ 3,781**
2055	Avoided Imported water	Acre Feet	782	0	782	$ 2,697.24	$ 2,109,242.00	0.082	**$ 172,177**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 61.00	$ 44,745.15	0.082	**$ 3,653**
2056	Avoided Imported water	Acre Feet	782	0	782	$ 2,737.70	$ 2,140,880.63	0.077	**$ 164,867**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 62.47	$ 45,819.03	0.077	**$ 3,528**
2057	Avoided Imported water	Acre Feet	782	0	782	$ 2,778.76	$ 2,172,993.84	0.073	**$ 157,868**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 63.97	$ 46,918.69	0.073	**$ 3,409**
2058	Avoided Imported water	Acre Feet	782	0	782	$ 2,820.45	$ 2,205,588.75	0.069	**$ 151,166**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 65.50	$ 48,044.74	0.069	**$ 3,293**
2059	Avoided Imported water	Acre Feet	782	0	782	$ 2,862.75	$ 2,238,672.58	0.065	**$ 144,749**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 67.07	$ 49,197.81	0.065	**$ 3,181**
2060	Avoided Imported water	Acre Feet	782	0	782	$ 2,905.69	$ 2,272,252.67	0.061	**$ 138,604**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 68.68	$ 50,378.56	0.061	**$ 3,073**
2061	Avoided Imported water	Acre Feet	782	0	782	$ 2,949.28	$ 2,306,336.46	0.058	**$ 132,720**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 70.33	$ 51,587.64	0.058	**$ 2,969**
2062	Avoided Imported water	Acre Feet	782	0	782	$ 2,993.52	$ 2,340,931.50	0.054	**$ 127,085**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 72.02	$ 52,825.75	0.054	**$ 2,868**
2063	Avoided Imported water	Acre Feet	782	0	782	$ 3,038.42	$ 2,376,045.48	0.051	**$ 121,690**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 73.75	$ 54,093.56	0.051	**$ 2,770**
2064	Avoided Imported water	Acre Feet	782	0	782	$ 3,084.00	$ 2,411,686.16	0.048	**$ 116,524**
	Reduced CO2e emissions	MT	733.5	0	733.5	$ 75.52	$ 55,391.81	0.048	**$ 2,676**
							Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)		**$ 20,459,925**

	Table 16 – Annual Costs of Avoided Project (All costs should be in 2012 Dollars)						
	Project: Rural DAC Partnership Program						
	Alternative: Purchase of bottled water						
	Avoided Project Description: Currently residnets are required to purchase bottled water to ensure their drinking water supply is safe						
						Discounting Calculations	
		Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance costs	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)	Discount Factor	Discounted Project Costs (h) x (i)
	(a) Year	(b)	(c)	(d)	(e)	(i)	(j)
0	2010				$ -	1.000	$ -
0	2011				$ -	1.000	$ -
0	2012				$ -	1.000	$ -
1	2013				$ -	0.943	$ -
2	2014		$ 91,980		$ 91,980	0.890	$ 81,862
3	2015		$ 91,980		$ 91,980	0.840	$ 77,228
4	2016		$ 91,980		$ 91,980	0.792	$ 72,857
5	2017		$ 91,980		$ 91,980	0.747	$ 68,733
6	2018		$ 91,980		$ 91,980	0.705	$ 64,842
7	2019		$ 91,980		$ 91,980	0.665	$ 61,172
8	2020		$ 91,980		$ 91,980	0.627	$ 57,709
9	2021		$ 91,980		$ 91,980	0.592	$ 54,443
10	2022		$ 91,980		$ 91,980	0.558	$ 51,361
11	2023		$ 91,980		$ 91,980	0.527	$ 48,454
12	2024		$ 91,980		$ 91,980	0.497	$ 45,711
13	2025		$ 91,980		$ 91,980	0.469	$ 43,124
14	2026		$ 91,980		$ 91,980	0.442	$ 40,683
15	2027		$ 91,980		$ 91,980	0.417	$ 38,380
16	2028		$ 91,980		$ 91,980	0.394	$ 36,208
17	2029		$ 91,980		$ 91,980	0.371	$ 34,158
18	2030		$ 91,980		$ 91,980	0.350	$ 32,225
19	2031		$ 91,980		$ 91,980	0.331	$ 30,401
20	2032		$ 91,980		$ 91,980	0.312	$ 28,680
21	2033		$ 91,980		$ 91,980	0.294	$ 27,056
22	2034		$ 91,980		$ 91,980	0.278	$ 25,525
23	2035		$ 91,980		$ 91,980	0.262	$ 24,080
24	2036		$ 91,980		$ 91,980	0.247	$ 22,717
25	2037		$ 91,980		$ 91,980	0.233	$ 21,431
26	2038		$ 91,980		$ 91,980	0.220	$ 20,218
27	2039		$ 91,980		$ 91,980	0.207	$ 19,074
28	2040		$ 91,980		$ 91,980	0.196	$ 17,994
29	2041		$ 91,980		$ 91,980	0.185	$ 16,976
30	2042		$ 91,980		$ 91,980	0.174	$ 16,015
31	2043		$ 91,980		$ 91,980	0.164	$ 15,108
32	2044		$ 91,980		$ 91,980	0.155	$ 14,253
33	2045		$ 91,980		$ 91,980	0.146	$ 13,446
34	2046		$ 91,980		$ 91,980	0.138	$ 12,685
35	2047		$ 91,980		$ 91,980	0.130	$ 11,967
36	2048		$ 91,980		$ 91,980	0.123	$ 11,290
37	2049		$ 91,980		$ 91,980	0.116	$ 10,651
38	2050		$ 91,980		$ 91,980	0.109	$ 10,048

39	2051		$ 91,980		$ 91,980	0.103	$ 9,479
40	2052		$ 91,980		$ 91,980	0.097	$ 8,942
41	2053		$ 91,980		$ 91,980	0.092	$ 8,436
42	2054		$ 91,980		$ 91,980	0.087	$ 7,959
43	2055		$ 91,980		$ 91,980	0.082	$ 7,508
44	2056		$ 91,980		$ 91,980	0.077	$ 7,083
45	2057		$ 91,980		$ 91,980	0.073	$ 6,682
46	2058		$ 91,980		$ 91,980	0.069	$ 6,304
47	2059		$ 91,980		$ 91,980	0.065	$ 5,947
48	2060		$ 91,980		$ 91,980	0.061	$ 5,611
49	2061		$ 91,980		$ 91,980	0.058	$ 5,293
50	2062		$ 91,980		$ 91,980	0.054	$ 4,993
51	2063		$ 91,980		$ 91,980	0.051	$ 4,711
52	2064		$ 91,980		$ 91,980	0.048	$ 4,444
	Total Present Value of Discounted Costs (Sum of Column (g))						**$ 1,372,157**
	(%) Avoided Cost Claimed by Project						
	Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project						
	Comments: By having the YMWC provide drinking water residents will no longer purchase bottled water. The purchase of bottled water						

Table 19 – Annual Costs of Project (All costs should be in 2012 Dollars) Project: Sustaining Healthy Tributaries to the Upper San Diego River and Protecting Local Water Supplies												
	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost(1)	Annual Costs (2)								Discounting Calculations	
			Admin,Labor compliance. Reporting	Assessment & Eval	Design & Permitting & Environ Eval	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)			(d)	(e)	(f)	(g)	(h)	(i)	(j)
2010										$ -	1.000	$ -
2011										$ -	1.000	$ -
2012										$ -	1.000	$ -
2013	$ -									$ -	0.943	$ -
2014	$ 290,964									$ 290,964	0.890	$ 258,957
2015	$ 1,454,822									$ 1,454,822	0.840	$ 1,221,497
2016	$ 2,385,908									$ 2,385,908	0.792	$ 1,889,863
2017	$ 1,687,593									$ 1,687,593	0.747	$ 1,261,068
2018										$ -	0.705	$ -
2019										$ -	0.665	$ -
2020										$ -	0.627	$ -
2021										$ -	0.592	$ -
2022										$ -	0.558	$ -
2023										$ -	0.527	$ -
2024										$ -	0.497	$ -
2025										$ -	0.469	$ -
2026										$ -	0.442	$ -
2027										$ -	0.417	$ -
2028										$ -	0.394	$ -
2029										$ -	0.371	$ -
2030										$ -	0.350	$ -
2031										$ -	0.331	$ -
2032										$ -	0.312	$ -
2033										$ -	0.294	$ -
2034										$ -	0.278	$ -
2035										$ -	0.262	$ -
2036										$ -	0.247	$ -
2037										$ -	0.233	$ -
2038										$ -	0.220	$ -
2039										$ -	0.207	$ -
2040										$ -	0.196	$ -
2041										$ -	0.185	$ -
2042										$ -	0.174	$ -
2043										$ -	0.164	$ -
2044										$ -	0.155	$ -
2045										$ -	0.146	$ -
2046										$ -	0.138	$ -

2047										$ -	0.130	$ -
2048										$ -	0.123	$ -
2049										$ -	0.116	$ -
2050										$ -	0.109	$ -
2051										$ -	0.103	$ -
2052										$ -	0.097	$ -
2053										$ -	0.092	$ -
2054										$ -	0.087	$ -
2055										$ -	0.082	$ -
2056										$ -	0.077	$ -
2057										$ -	0.073	$ -
2058										$ -	0.069	$ -
2059										$ -	0.065	$ -
2060										$ -	0.061	$ -
2061										$ -	0.058	$ -
2062										$ -	0.054	$ -
2063										$ -	0.051	$ -
2064										$ -	0.048	$ -
2065										$ -	0.046	$ -
Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries												**$ 4,631,384**

Comments:

(2) The incremental change in O&M costs attributable to the project

	Table 16 – Annual Costs of Avoided Project (All costs should be in 2012 Dollars)						
	Project: Failsafe Potable Reuse						
	Alternative (Avoided Project Name): Indirect Potable Reuse via San Vicente reservoir						
	Avoided Project Description:Pipeline and pumpstation construction costs saved, including GHG emissions avoided						
						Discounting Calculations	
		Avoided Capital Costs	Avoided GHG Emissions Value in Pipeline	Avoided Operations and Maintenance costs	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)	Discount Factor	Discounted Project Costs (h) x (i)
	(a) Year	(b)	(c)	(d)	(e)	(i)	(j)
0	2010				$ -	1.000	$ -
0	2011				$ -	1.000	$ -
0	2012				$ -	1.000	$ -
1	2013				$ -	0.943	$ -
2	2014				$ -	0.890	$ -
3	2015				$ -	0.840	$ -
4	2016				$ -	0.792	$ -
5	2017				$ -	0.747	$ -
6	2018				$ -	0.705	$ -
7	2019				$ -	0.665	$ -
8	2020				$ -	0.627	$ -
9	2021				$ -	0.592	$ -
10	2022				$ -	0.558	$ -
11	2023				$ -	0.527	$ -
12	2024				$ -	0.497	$ -
13	2025	$ 42,295,528			$ 42,295,528	0.469	$ 19,829,794
14	2026	$ 42,295,528	$ 1,673,111		$ 43,968,640	0.442	$ 19,447,372
15	2027	$ 42,295,528			$ 42,295,528	0.417	$ 17,648,446
16	2028				$ -	0.394	$ -
17	2029				$ -	0.371	$ -
18	2030				$ -	0.350	$ -
19	2031				$ -	0.331	$ -
20	2032				$ -	0.312	$ -
21	2033				$ -	0.294	$ -
22	2034				$ -	0.278	$ -
23	2035				$ -	0.262	$ -
24	2036				$ -	0.247	$ -
25	2037				$ -	0.233	$ -
26	2038				$ -	0.220	$ -
27	2039				$ -	0.207	$ -
28	2040				$ -	0.196	$ -
29	2041				$ -	0.185	$ -
30	2042				$ -	0.174	$ -
31	2043				$ -	0.164	$ -
32	2044				$ -	0.155	$ -
33	2045				$ -	0.146	$ -
34	2046				$ -	0.138	$ -
35	2047				$ -	0.130	$ -
36	2048				$ -	0.123	$ -
37	2049				$ -	0.116	$ -
38	2050				$ -	0.109	$ -
39	2051				$ -	0.103	$ -
40	2052				$ -	0.097	$ -
41	2053				$ -	0.092	$ -
42	2054				$ -	0.087	$ -
43	2055				$ -	0.082	$ -
44	2056				$ -	0.077	$ -
45	2057				$ -	0.073	$ -
46	2058				$ -	0.069	$ -
47	2059				$ -	0.065	$ -
48	2060				$ -	0.061	$ -
49	2061				$ -	0.058	$ -
50	2062				$ -	0.054	$ -
51	2063				$ -	0.051	$ -
52	2064				$ -	0.048	$ -
53	2065				$ -	0.046	$ -
54	2066				$ -	0.043	$ -
55	2067				$ -	0.041	$ -
56	2068				$ -	0.038	$ -

57	2069				$ -	0.036	$ -
	column sum	$ 126,886,585	$ 1,673,111	$ -	$ 128,559,696	1.000	$ 56,925,612
	Total Present Value of Discounted Costs (Sum of Column (g))						$ **56,925,612**
	(%) Avoided Cost Claimed by Project						**10%**
	Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project						$ **5,692,561**
	Comments:						

Table 19 – Annual Costs of Project
(All costs should be in 2012 Dollars)

Project: Failsafe Potable Reuse at the Advanced Water Purification Demonstration Facility

	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost[1]	Annual Costs [2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012	$63,034							$63,034	1.000	$63,034
2013	$315,170							$315,170	0.943	$297,330
2014	$693,375							$693,375	0.890	$617,101
2015	$1,512,817							$1,512,817	0.840	$1,270,190
2016	$567,307							$567,307	0.792	$449,360
column sum	$ 3,151,703	$ -	$ -	$ -	$ -	$ -	$ -	$3,151,703		$2,697,016
Total Present Value of Discounted Costs (Sum of Column (j)) Transfer to Table 17, column (c), Proposal Benefits and Costs Summaries										$2,697,016

(1) If any, based on opportunity costs, sunk costs and associated costs
(2) The incremental change in O&M costs attributable to the project

Table 15 – Annual Benefit (All benefits should be in 2012 dollars) Project: Sustaining Healthy Tributaries to the Upper San Diego River and Protecting Local Water Supplies									
(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 [1] (f) x (g)	Discount Factor [1]	Discounted Benefits [1] (h) x (i)
2012								1.000	
2013								0.943	
2014								0.890	
2015								0.840	
2016								0.792	
2017	Reduction in CO2	MT	0	9.179852	9.179852	$ 25.37	$ 232.86	0.747	**$ 174.01**
2018	Reduction in CO2	MT	0	9.179852	9.179852	$ 25.98	$ 238.45	0.705	**$ 168.10**
2019	Reduction in CO2	MT	0	9.179852	9.179852	$ 26.60	$ 244.17	0.665	**$ 162.39**
2020	Reduction in CO2	MT	0	9.179852	9.179852	$ 27.24	$ 250.03	0.627	**$ 156.87**
2021	Reduction in CO2	MT	0	9.179852	9.179852	$ 27.89	$ 256.03	0.592	**$ 151.55**
2022	Reduction in CO2	MT	0	9.179852	9.179852	$ 28.56	$ 262.18	0.558	**$ 146.40**
2023	Reduction in CO2	MT	0	9.179852	9.179852	$ 29.25	$ 268.47	0.527	**$ 141.43**
2024	Reduction in CO2	MT	0	9.179852	9.179852	$ 29.95	$ 274.91	0.497	**$ 136.62**
2025	Reduction in CO2	MT	0	9.179852	9.179852	$ 30.67	$ 281.51	0.469	**$ 131.98**
2026	Reduction in CO2	MT	0	9.179852	9.179852	$ 31.40	$ 288.27	0.442	**$ 127.50**
2027	Reduction in CO2	MT	0	9.179852	9.179852	$ 32.16	$ 295.19	0.417	**$ 123.17**
2028	Reduction in CO2	MT	0	9.179852	9.179852	$ 32.93	$ 302.27	0.394	**$ 118.99**
2029	Reduction in CO2	MT	0	9.179852	9.179852	$ 33.72	$ 309.53	0.371	**$ 114.95**
2030	Reduction in CO2	MT	0	9.179852	9.179852	$ 34.53	$ 316.95	0.350	**$ 111.04**
2031	Reduction in CO2	MT	0	9.179852	9.179852	$ 35.36	$ 324.56	0.331	**$ 107.27**
2032	Reduction in CO2	MT	0	9.179852	9.179852	$ 36.20	$ 332.35	0.312	**$ 103.63**
2033	Reduction in CO2	MT	0	9.179852	9.179852	$ 37.07	$ 340.33	0.294	**$ 100.11**
2034	Reduction in CO2	MT	0	9.179852	9.179852	$ 37.96	$ 348.49	0.278	**$ 96.71**
2035	Reduction in CO2	MT	0	9.179852	9.179852	$ 38.87	$ 356.86	0.262	**$ 93.42**
2036	Reduction in CO2	MT	0	9.179852	9.179852	$ 39.81	$ 365.42	0.247	**$ 90.25**
2037	Reduction in CO2	MT	0	2.195182	2.195182	$ 40.76	$ 89.48	0.233	**$ 20.85**
2038	Reduction in CO2	MT	0	2.195182	2.195182	$ 41.74	$ 91.63	0.220	**$ 20.14**
2039	Reduction in CO2	MT	0	2.195182	2.195182	$ 42.74	$ 93.83	0.207	**$ 19.46**
2040	Reduction in CO2	MT	0	2.195182	2.195182	$ 43.77	$ 96.08	0.196	**$ 18.80**
2041	Reduction in CO2	MT	0	2.195182	2.195182	$ 44.82	$ 98.39	0.185	**$ 18.16**
2042	Reduction in CO2	MT	0	2.195182	2.195182	$ 45.89	$ 100.75	0.174	**$ 17.54**
2043	Reduction in CO2	MT	0	2.195182	2.195182	$ 47.00	$ 103.16	0.164	**$ 16.95**
2044	Reduction in CO2	MT	0	2.195182	2.195182	$ 48.12	$ 105.64	0.155	**$ 16.37**
2045	Reduction in CO2	MT	0	2.195182	2.195182	$ 49.28	$ 108.18	0.146	**$ 15.81**
2046	Reduction in CO2	MT	0	2.195182	2.195182	$ 50.46	$ 110.77	0.138	**$ 15.28**
2047	Reduction in CO2	MT	0	2.195182	2.195182	$ 51.67	$ 113.43	0.130	**$ 14.76**
2048	Reduction in CO2	MT	0	2.195182	2.195182	$ 52.91	$ 116.15	0.123	**$ 14.26**
2049	Reduction in CO2	MT	0	2.195182	2.195182	$ 54.18	$ 118.94	0.116	**$ 13.77**
2050	Reduction in CO2	MT	0	2.195182	2.195182	$ 55.48	$ 121.80	0.109	**$ 13.30**
2051	Reduction in CO2	MT	0	2.195182	2.195182	$ 56.81	$ 124.72	0.103	**$ 12.85**
2052	Reduction in CO2	MT	0	2.195182	2.195182	$ 58.18	$ 127.71	0.097	**$ 12.42**
2053	Reduction in CO2	MT	0	2.195182	2.195182	$ 59.57	$ 130.78	0.092	**$ 11.99**
2054	Reduction in CO2	MT	0	2.195182	2.195182	$ 61.00	$ 133.92	0.087	**$ 11.59**
2055	Reduction in CO2	MT	0	2.195182	2.195182	$ 62.47	$ 137.13	0.082	**$ 11.19**
2056	Reduction in CO2	MT	0	2.195182	2.195182	$ 63.97	$ 140.42	0.077	**$ 10.81**
2057	Reduction in CO2	MT	0	0.299343	0.299343	$ 65.50	$ 19.61	0.073	**$ 1.42**

2058	Reduction in CO2	MT	0	0.299343	0.299343	$ 67.07	$ 20.08	0.069	**$ 1.38**
2059	Reduction in CO2	MT	0	0.299343	0.299343	$ 68.68	$ 20.56	0.065	**$ 1.33**
2060	Reduction in CO2	MT	0	0.299343	0.299343	$ 70.33	$ 21.05	0.061	**$ 1.28**
2061	Reduction in CO2	MT	0	0.299343	0.299343	$ 72.02	$ 21.56	0.058	**$ 1.24**
2062	Reduction in CO2	MT	0	0.299343	0.299343	$ 73.75	$ 22.08	0.054	**$ 1.20**
2063	Reduction in CO2	MT	0	0.299343	0.299343	$ 75.52	$ 22.61	0.051	**$ 1.16**
2064	Reduction in CO2	MT	0	0.299343	0.299343	$ 77.33	$ 23.15	0.048	**$ 1.12**
2065	Reduction in CO2	MT	0	0.299343	0.299343	$ 79.19	$ 23.70	0.046	**$ 1.08**
2066	Reduction in CO2	MT	0	0.299343	0.299343	$ 81.09	$ 24.27	0.043	**$ 1.04**
								Total Present Value of Discounted Benefits Based on Unit Value	**$ 2,874.94**
Comments:									

(1) Complete these columns if dollar value is being claimed for the benefit.

Table 19 – Annual Costs of Project (All costs should be in 2012 Dollars)												
Project: 5 Sustaining Healthy Tributarties to the Upper San Diego River and Protecting Local Water Supplies												
			Annual Costs (2)								Discounting Calculations	
	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost(1)	Admin,Labor compliance. Reporting	Assessment & Eval	Design & Permitting & Environ Eval	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)			(d)	(e)	(f)	(g)	(h)	(i)	(j)
0 2010										$ -	1.000	$ -
0 2011										$ -	1.000	$ -
0 2012										$ -	1.000	$ -
1 2013	$ 71,185									$ 71,185	0.943	$ 67,156
2 2014	$ 128,134									$ 128,134	0.890	$ 114,039
3 2015	$ 220,675									$ 220,675	0.840	$ 185,283
4 2016	$ 284,742									$ 284,742	0.792	$ 225,542
5 2017	$ 7,119									$ 7,119	0.747	$ 5,320
6 2018										$ -	0.705	$ -
7 2019										$ -	0.665	$ -
8 2020										$ -	0.627	$ -
9 2021										$ -	0.592	$ -
10 2022										$ -	0.558	$ -
11 2023										$ -	0.527	$ -
12 2024										$ -	0.497	$ -
13 2025										$ -	0.469	$ -
14 2026										$ -	0.442	$ -
15 2027										$ -	0.417	$ -
16 2028										$ -	0.394	$ -
17 2029										$ -	0.371	$ -
18 2030										$ -	0.350	$ -
19 2031										$ -	0.331	$ -
20 2032										$ -	0.312	$ -
21 2033												
22 2034										$ -	0.278	$ -
23 2035										$ -	0.262	$ -
24 2036										$ -	0.247	$ -
25 2037										$ -	0.233	$ -
26 2038										$ -	0.220	$ -
27 2039										$ -	0.207	$ -
28 2040										$ -	0.196	$ -
29 2041										$ -	0.185	$ -
30 2042										$ -	0.174	$ -
31 2043										$ -	0.164	$ -
32 2044										$ -	0.155	$ -
33 2045										$ -	0.146	$ -
34 2046										$ -	0.138	$ -
35 2047										$ -	0.130	$ -
36 2048										$ -	0.123	$ -
37 2049										$ -	0.116	$ -
38 2050										$ -	0.109	$ -
39 2051										$ -	0.103	$ -
40 2052										$ -	0.097	$ -
41 2053										$ -	0.092	$ -
42 2054										$ -	0.087	$ -
43 2055										$ -	0.082	$ -
44 2056										$ -	0.077	$ -
45 2057										$ -	0.073	$ -
46 2058										$ -	0.069	$ -
47 2059										$ -	0.065	$ -
48 2060										$ -	0.061	$ -
49 2061										$ -	0.058	$ -
50 2062										$ -	0.054	$ -
51 2063										$ -	0.051	$ -
52 2064										$ -	0.048	$ -
53 2065										$ -	0.046	$ -
54 2066										$ -	0.043	$ -
55 2067										$ -	0.041	$ -
56 2068										$ -	0.038	$ -
57 2069										$ -	0.036	$ -
58 2070										$ -	0.034	$ -
59 2071										$ -	0.032	$ -
60 2072										$ -	0.030	$ -
61 2073										$ -	0.029	$ -
62 2074										$ -	0.027	$ -
63 2075										$ -	0.025	$ -
64 2076										$ -	0.024	$ -
65 2077										$ -	0.023	$ -
66 2078										$ -	0.021	$ -
67 2079										$ -	0.020	$ -
68 2080										$ -	0.019	$ -
69 2081										$ -	0.018	$ -
70 2082										$ -	0.017	$ -
71 2083										$ -	0.016	$ -
72 2084										$ -	0.015	$ -
73 2085										$ -	0.014	$ -
74 2086										$ -	0.013	$ -
75 2087										$ -	0.013	$ -
76 2088										$ -	0.012	$ -

77	2089										$ -	0.011	$ -
78	2090										$ -	0.011	$ -
79	2091										$ -	0.010	$ -
80	2092										$ -	0.009	$ -
81	2093										$ -	0.009	$ -
82	2094										$ -	0.008	$ -
83	2095										$ -	0.008	$ -
84	2096										$ -	0.007	$ -
85	2097										$ -	0.007	$ -
86	2098										$ -	0.007	$ -
87	2099										$ -	0.006	$ -
88	2100										$ -	0.006	$ -
89	2101										$ -	0.006	$ -
90	2102										$ -	0.005	$ -
91	2103										$ -	0.005	$ -
92	2104										$ -	0.005	$ -
93	2105										$ -	0.004	$ -
94	2106										$ -	0.004	$ -
95	2107										$ -	0.004	$ -
96	2108										$ -	0.004	$ -
97	2109										$ -	0.004	$ -
98	2110										$ -	0.003	$ -
99	2111										$ -	0.003	$ -
100	2112										$ -	0.003	$ -
101	2113										$ -	0.003	$ -
102	2114										$ -	0.003	$ -
103	2115										$ -	0.002	$ -
												Total Present Value of Discounted Costs (Sum of column (j))	**$ 597,340**
												Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries	

FRAM annual:	637
sum pv model 1	10040.31
sum pv model 2	7952.862

model 1

initial FRAM output

nyear	year	benefit	pv
0	2012		
1	2013	637	600.9434
2	2014	637	566.9277
3	2015	637	534.8375
4	2016	637	504.5637
5	2017	637	476.0035
6	2018	637	449.0599
7	2019	637	423.6414
8	2020	637	399.6617
9	2021	637	377.0393
10	2022	637	355.6975
11	2023	637	335.5637
12	2024	637	316.5695
13	2025	637	298.6505
14	2026	637	281.7457
15	2027	637	265.7978
16	2028	637	250.7527
17	2029	637	236.5591
18	2030	637	223.169
19	2031	637	210.5368
20	2032	637	198.6196
21	2033	637	187.377
22	2034	637	176.7707
23	2035	637	166.7649
24	2036	637	157.3253
25	2037	637	148.4201
26	2038	637	140.019
27	2039	637	132.0934
28	2040	637	124.6164
29	2041	637	117.5626
30	2042	637	110.9082
31	2043	637	104.6303
32	2044	637	98.70786
33	2045	637	93.12062
34	2046	637	87.84965
35	2047	637	82.87702
36	2048	637	78.18587
37	2049	637	73.76026

model 2

proposed (discounted to reflect actual construction completed in 2016)

nyear	year	benefit	pv
0	2012		
1	2013		0
2	2014		0
3	2015		0
4	2016		0
5	2017	637	476.00346
6	2018	637	449.05986
7	2019	637	423.64138
8	2020	637	399.66168
9	2021	637	377.03932
10	2022	637	355.69747
11	2023	637	335.56365
12	2024	637	316.56948
13	2025	637	298.65046
14	2026	637	281.74571
15	2027	637	265.79784
16	2028	637	250.75268
17	2029	637	236.55913
18	2030	637	223.16899
19	2031	637	210.53679
20	2032	637	198.61961
21	2033	637	187.37699
22	2034	637	176.77075
23	2035	637	166.76486
24	2036	637	157.32534
25	2037	637	148.42013
26	2038	637	140.01899
27	2039	637	132.09339
28	2040	637	124.6164
29	2041	637	117.56264
30	2042	637	110.90815
31	2043	637	104.63033
32	2044	637	98.707862
33	2045	637	93.120624
34	2046	637	87.849646
35	2047	637	82.877024
36	2048	637	78.185872
37	2049	637	73.760256

38	2050	637	69.58515
39	2051	637	65.64637
40	2052	637	61.93053
41	2053	637	58.42503
42	2054	637	55.11795
43	2055	637	51.99807
44	2056	637	49.05478
45	2057	637	46.2781
46	2058	637	43.65858
47	2059	637	41.18734
48	2060	637	38.85598
49	2061	637	36.65659
50	2062	637	34.58169
51	2063		0
52	2064		0
53	2065		0
54	2066		0
55	2067		0
56	2068		0
57	2069		0
58	2070		0
59	2071		0
60	2072		0

38	2050	637	69.585148
39	2051	637	65.646366
40	2052	637	61.930534
41	2053	637	58.425032
42	2054	637	55.117954
43	2055	637	51.99807
44	2056	637	49.054783
45	2057	637	46.278097
46	2058	637	43.658582
47	2059	637	41.187342
48	2060	637	38.855983
49	2061	637	36.656588
50	2062	637	34.581686
51	2063	637	32.624233
52	2064	637	30.777578
53	2065	637	29.035451
54	2066	637	27.391935
55	2067		0
56	2068		0
57	2069		0
58	2070		0
59	2071		0
60	2072		0
			$ 7,953

Table 8-3 (PSP Table 16)
Implementing Nutrient Management in the Santa Margarita River Watershed - Phase II
Annual Costs of Avoided Projects: Avoided Municipal Stormwater Treatment Facility

(2012 dollars)

	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
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	$0	$0	$0	$0	1.000	**$0**
2013	$311,635,546	$0	$0	$311,635,546	0.943	**$293,995,798**
2014	$311,635,546	$0	$0	$311,635,546	0.890	**$277,354,527**
2015	$311,635,546	$0	$0	$311,635,546	0.840	**$261,655,214**
2016	$311,635,546	$0	$0	$311,635,546	0.792	**$246,844,541**
2017	$311,635,546	$0	$0	$311,635,546	0.747	**$232,872,209**
2018	$0	$0	$5,148,026	$5,148,026	0.705	**$3,629,155**
2019	$0	$0	$5,148,026	$5,148,026	0.665	**$3,423,731**
2020	$0	$0	$5,148,026	$5,148,026	0.627	**$3,229,935**
2021	$0	$0	$5,148,026	$5,148,026	0.592	**$3,047,109**
2022	$0	$0	$5,148,026	$5,148,026	0.558	**$2,874,631**
2023	$0	$0	$5,148,026	$5,148,026	0.527	**$2,711,916**
2024	$0	$0	$5,148,026	$5,148,026	0.497	**$2,558,411**
2025	$0	$0	$5,148,026	$5,148,026	0.469	**$2,413,596**
2026	$0	$0	$5,148,026	$5,148,026	0.442	**$2,276,977**
2027	$0	$0	$5,148,026	$5,148,026	0.417	**$2,148,091**
2028	$0	$0	$5,148,026	$5,148,026	0.394	**$2,026,501**
2029	$0	$0	$5,148,026	$5,148,026	0.371	**$1,911,794**
2030	$0	$0	$5,148,026	$5,148,026	0.350	**$1,803,579**
2031	$0	$0	$5,148,026	$5,148,026	0.331	**$1,701,490**
2032	$0	$0	$5,148,026	$5,148,026	0.312	**$1,605,179**
Total Present Value of Discounted Costs						**$1,350,084,385**
(%) Avoided Cost Claimed by Project						**10%**
Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project						**$135,008,438**

Comments: Costs for the Municipal Stormwater Treatment Facility (an avoided project) are shown in the table. Capital costs occur in years 2013 through 2017; operations and maintenance costs occur in years 2018 through 2032. Once construction is finished in 2017, the Municipal Stormwater Treatment Facility has an expected life of 15 years, from 2018 to 2032.

This project claims 10% of the avoided project's costs.

Table 8-4 (PSP Table 19)

(All costs should be in 2012 Dollars)

Project: Implementing Nutrient Management in the Santa Margarita River Watershed - Phase II

		Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost[1]	Annual Costs [2]						Discounting Calculations	
				Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
	Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
0	2010	$ -		$ -	$ -	$ -	$ -	$ -	$ -	1.000	$ -
0	2011	$ 238,580		$ -	$ -	$ -	$ -	$ -	$ 238,580	1.000	$ 238,580
0	2012	$ -		$ -	$ -	$ -	$ -	$ -	$ -	1.000	$ -
1	2013	$ 381,728		$ -	$ -	$ -	$ -	$ -	$ 381,728	0.943	$ 360,121
2	2014	$ 318,106		$ -	$ -	$ -	$ -	$ -	$ 318,106	0.890	$ 283,113
3	2015	$ 286,297		$ -	$ -	$ -	$ -	$ -	$ 286,297	0.840	$ 240,380
4	2016	$ 286,297		$ -	$ -	$ -	$ -	$ -	$ 286,297	0.792	$ 226,774
5	2017	$ 79,527		$ -	$ -	$ -	$ -	$ -	$ 79,527	0.747	$ 59,427
									Total Present Value of Discounted Costs (Sum of column (j))		**$ 1,408,396**
									Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries		