# NORTH COAST INTEGRATED REGIONAL WATER MANAGEMENT PLAN

**Implementation Grant Proposal**
**Proposition 84, Round 2**

## ATTACHMENT 8:

## Benefits & Cost Analysis

**Integrated Regional Water Management Program**
**Applicant: Humboldt County**

**North Coast Integrated Regional Water Management Plan**

**Proposition 84, Round 2 Implementation Grant**

# Attachment 8. Benefits and Cost Analysis

## Introduction

The NCIRWMP addresses the ecological, economic, and social challenges and opportunities of a large and diverse region of California. More so than many areas of California, the North Coast region's economy is closely tied to the productivity of its ecosystems and the functionality of its aged and small scale water and wastewater infrastructure. The region has relatively intact watersheds, a viable though degraded salmon fishery, and some of the highest levels of biological diversity in the world. These resources support commercial salmon fishing, timber harvesting, recreational tourism, and agriculture. These economic activities, in turn, help support the quality of life of those who live in the region's communities. Failing water and wastewater infrastructure compromises the health of both human communities and the ecosystems on which they rely.

The North Coast region has not escaped the economic trends that have driven many similar regions away from natural-resource based economies and caused them to become more reliant on service-based industries. However, the North Coast region's remarkable endowment of natural resources will likely always play a central role in its prosperity. Protecting and enhancing this endowment is critical to the region's long-term success, and considerable challenges remain: legacy environmental degradation from decades of unsustainable natural resource use have strained ecological systems, while new pressures mount each year. Although certain sub-areas within the region are economically stable, much of the region is designated as economically disadvantaged. These communities struggle to maintain aging water supply and wastewater infrastructure, and are often unable to invest in ecosystem restoration.

For this North Coast Integrated Regional Water Management Plan (NCIRWMP) Proposition 84, Round 2 Implementation Proposal (Proposal), thirteen high priority projects were chosen to address these

ecologic, economic, infrastructural and social challenges and opportunities. If funded, the projects will improve the functionality and resiliency of the region's water-related resources, and through that, the economic well-being of the citizens of the state of California.

This attachment presents an economic analysis of the benefits and costs of each of the projects included within the Proposition 84 Round 2 funding proposal for the NCIRWMP. After describing the analytical framework, we include a complete, stand-alone assessment of each project's benefits and costs. For each project, we present a non-monetized benefits analysis (Section D2 and Table 12), followed by a monetized benefits analysis (Section D3 and Tables 15 and 16 as appropriate), which also details the costs of the project (Table 19).[1] Following the project-level economic analyses, we summarize the economic benefits and costs of the proposal package as a whole (Section D5 and Table 20).

## Framework

This benefit-cost analysis follows the instructions outlined in Exhibit D of the *Proposition 84 Proposal Solicitation Package* (DWR 2012). It follows the "DWR Method" for conducting the economic analysis. We analyze each of the thirteen projects included in the proposal package using a benefit-cost approach.

The projects would yield economic benefits to the extent that they increase the value of goods and services available to Californians. The projects have the potential to increase the value of these goods and services in three ways:

1. By lowering the cost of providing a given good or service
   (e.g., by distributing water more efficiently through new pipes)
2. By increasing the supply of a given good or service
   (e.g., by creating new habitat for endangered species)
3. By increasing the demand for a given good or service
   (e.g., by educating consumers about the importance of cleaner rivers)

The projects would produce few goods and services directly; instead, they primarily would enhance the supply of capital necessary to provide goods and services.[2] Thus, the projects would produce benefits to the extent that they increase the region's stock of capital, and the quantity or types of goods and

[1] None of the projects in this proposal package are assessed with a cost-effectiveness analysis (Section D1) or have flood reduction as their primary benefit, requiring a Flood Damage Reduction Benefit Analysis (Section D4).

[2] Economists use the term ***capital*** to describe resources commonly used to produce things people value (e.g., different types of goods and services). Classifications vary, but most economists generally recognize four types of capital: natural, human-built, human, and social. Natural capital refers to the components of nature, e.g., water, trees, and soil, and the interactions between these components. Human-built capital refers to water-delivery infrastructure, roads, and other tangible goods and infrastructure. Human capital refers to the knowledge and skills embodied in people. Social capital refers to social networks, cultural norms, laws, and political systems.

services that flow from it. The projects may also produce benefits to the extent that they affect the demand for, and, hence, the value of certain goods and services.

Consistent with widely accepted professional standards, we consider a broad suite of goods and services in the analysis, including those whose value comes from indirect or non-use of resources (U.S. Environmental Protection Agency 2009, National Research Council 2004, U.S. Environmental Protection Agency 2000). Economic benefits arising from some types of goods and services, especially those derived from changes in the supply of natural capital, human capital and social capital, are often difficult to quantify in monetary terms, because they are not traded in markets and cannot be measured using price data and price-dependent techniques. This does not mean, however, that their value is zero.

Where data are unavailable to quantify the economic benefit in physical terms, monetary terms, or both, we describe the underlying change in relevant conditions with the project (versus without) and identify the sources of demand and illustrations of value related to the benefit. Our presentation of non-monetizable benefits is consistent with Section D2–*Non-Monetized Benefits Analysis.*

Where sufficient data are available to estimate the physical change in the stock or flow of goods and services *and* quantify the economic value of that change, we value the economic benefit in monetary terms, consistent with the instructions outlined in Section D3–*Monetized Benefits Analysis*. Our estimates reflect the marginal, net willingness of Californians to pay, measured in dollars of 2012, for the goods and services that the projects would increase.

In the following sections, we describe our methodology for estimating and describing non-monetized benefits, monetized benefits, and costs. For a few projects, we are only able to describe their economic importance in non-monetized terms. For most projects, however, we describe some benefits in monetized terms and others in non-monetized terms. To understand the total economic value arising from each project, both monetized and non-monetized benefits must be considered together, then compared to the costs of the project.

## Section D2. Non-Monetized Benefits Analysis

For each project, we describe the economic importance of the effects for which insufficient information exists for quantification in monetary terms. From an economic perspective, these effects improve the well-being of Californians, so should be accounted for in the benefit-cost analysis. Ignoring them or discounting their importance relative to the monetized benefits would result in an incomplete and biased analysis. To support the argument that these effects have economic importance, we provide a narrative description for each benefit that includes these categories of information:

- The project's marginal effect on each category of benefit presented in Table 12, comparing the without-project conditions to the with-project conditions. Where applicable, we rely on information presented in Attachment 7 to understand the physical changes arising from the project.
- Evidence of the economic importance of the effect. A biophysical effect is only important from an economic perspective if it provides something people want (and are willing to pay for). This is

true even if the effect cannot be quantified in monetary terms. Thus, we describe the demand for the effect or the goods and services it might generate, including direct use, indirect use, and non-use demands. Wherever possible, we use local information to substantiate evidence of local demand. When local information does not exist, we provide evidence from the economic literature that demonstrates the value of the effect.

- When the benefit might materialize and how long it might persist.
- Who would benefit, and how the benefit would be distributed across stakeholders.
- Sources of uncertainty and how uncertainty might affect how or when the benefit materializes.

In some categories, the project may generate positive effects on biophysical parameters as described in Attachment 7 that have no additional effects from an economic perspective. These effects are not included separately in Table 12 or the accompanying narrative.

## Section D3. Monetized Benefits Analysis

Benefits are monetizable only if sufficient data are available to quantify the physical effect *and* to determine an appropriate economic value. To estimate the value of monetizable benefits, we followed these steps:

- Used a with-vs.-without framework to describe the expected outcome of the project in terms of the expected net marginal increase in the supply of different types of goods and services, the marginal avoided costs of project-related activities, and/or the marginal change in the demand for goods and services. In some cases, this information is presented in biophysical terms in Attachment 7.
- Worked with project proponents and other individuals to identify project-specific information that would help us value the goods and services and avoided costs of the projects. Where project-specific or local information was not directly available, we reviewed the existing economic literature to identify relevant studies that identify the marginal value to Californians of each type of good and service. We used benefit-transfer guidelines expressed by the U.S. Environmental Protection Agency (2010) to apply these values derived from studies conducted elsewhere to value the changes resulting from the project.[3]
- Adjusted each estimate of per-unit value of a good or service or avoided cost to its equivalent value in 2012 dollars, using the update factors provided in Table 14 of the *Proposition 84 Proposal Solicitation Package* (DWR 2012, pg. 50). For updating values before 2007, we use the Consumer Price Index.

[3] Insofar as possible, whenever project-specific estimates of value are not available, we have strived to identify estimates from settings with similar economic and ecological characteristics. We anticipate that the real value of some goods and services, such as high-quality water in streams, healthy riparian forests, and robust salmon populations, will increase over time, all else equal. However, we lack defensible forecasts of the rates of increase and, hence, have not folded these increases into our estimates.

- Estimated the annual value of the expected increase in the supply of each type of good or service by multiplying the expected annual increase in the supply times the per-unit value, in 2012 dollars. For avoided costs, we placed expenditures in the appropriate years they would have occurred or calculated an expected annual value based on the annual probability of occurrence.
- Assessed the uncertainty embodied in each estimate of annual value for each type of good or service, and determined if it is reasonable to conclude that it offers an unbiased representation of the true value of the good or service. In all cases, we selected an estimate of per-unit value that more likely than not yields an *underestimate of the true value* of a project's benefits.
- Completed an internal review process, to ensure the information we provide gives a reasonable description of the benefits and costs for each project.

To support the quantification in the tables, we provide a narrative description for each monetizable benefit that outlines the analytical assumptions, beneficiaries, and sources of uncertainty.

## Section D3. Cost Analysis

To estimate costs—for example, projected expenditures on capital, operations, and maintenance activities—we relied on information provided by project proponents, following the guidelines presented in Section D3 (DWR 2012, pg. 48). Consistent with those guidelines, the cost estimates represent the full cost of the project, inclusive of capital, operations, and maintenance costs, and the opportunity cost of any volunteer labor, land, and other donated inputs required to implement the project.

# 101. *Big Rock Community Services District*, Stabilize Water Storage Tank

## Conditions Without the Project

Big Rock Community Services District (BRCSD), located in Del Norte County, supplies water to about 650 permanent residents of the community of Hiouchi. It also serves about 1,200 tourists who seek lodging during the summer season in Jedediah Smith Redwoods State Park and the Smith River National Park.

BRCSD's water system has a 100,000 gallon water storage tank, which was built in 1971 on a steep hillside with grades between 50 and 70 percent. Water runoff from the mountain above has eroded the tank's foundation. This has increased the likelihood that the gravel fill prism under the tank would fail during a 5.5 or greater magnitude earthquake that occurred during the winter when the ground was saturated. If this should occur, it likely would cause a massive landslide that would destroy the BRCSD's water system, approximately 19 homes in Hiouchi, and portions of Highway 199. This damage would likely result in deaths and would disrupt water service to other customers until the system could be restored. The landslide could eventually reach the Smith River, depositing a large sediment and debris load into the river. This would create water-quality issues for downstream water users and damage salmonid habitat, potentially resulting in local extinctions of this federally listed species.

## Conditions With the Project

The project would replace the system's existing water storage tank with a new tank built to modern seismic standards and anchored into bedrock. BRCSD would build the tank on county land immediately adjacent to the existing site, which BRCSD is in the process of acquiring. Before construction could begin, BCRSD would improve the access road to the storage tank area by grading and placing a compacted aggregate base on the road surface. It would also put in place a temporary water system utilizing an existing 50,000 gallon tank. This would maintain minimum water pressure in the system, but water supply to customers would be reduced. To address the temporary shortage, BCRSD would enact temporary water conservation measures and notify fire suppression agencies to locate alternate sources of water during construction.

Construction would involve excavating the new site to bedrock, building a retaining wall, and installing tank foundation and footings. Site drainage features and features to prevent damage to downslope properties would be installed. BRCSD would then install a new tank, piping, and valves, including a seismic shut off valve, which would prevent a broken pipe from draining the entire tank. Communications, lighting, and monitoring equipment would be installed.

Once construction is complete, the new tank would undergo disinfection and water quality testing before BRCSD brings it back online. Once online, BRCSD would lift water conservation measures and restore fire protection services. BRCSD would dismantle the existing 100,000 gallon tank and sell the Redwood staves.

## Section D2. Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient data are unavailable to quantify in physical terms, monetary terms, or both. Table 12-101 summarizes the non-monetary benefits of this project. We describe these benefits in more detail below the table.

Table 12-101 – Non-monetized Benefits Checklist
*Big Rock Community Services District*, Stabilize Water Storage Tank

| *No.* | *Will the proposal…* | *Response*[1] |
|---|---|---|
| | **Community/Social Benefits** | |
| 1 | Provide education or technology benefits? | No |
| 2 | Provide social recreation or access benefits?<br>Avoided loss of access and water service disruptions to campgrounds and parks | Yes |
| 3 | Help avoid, reduce or resolve various public water resources conflicts? | No |
| 4 | Promote social health and safety?<br>Avoided damage and harm from disrupted emergency services | Yes |
| 5 | Have other social benefits?<br>Avoided costs of emergency repairs. | Yes |
| | **Environmental Stewardship Benefits** | |
| 6 | Benefit wildlife or habitat in ways that were not quantified in Attachment 7?<br>Value of avoiding damage to salmonid habitat | Yes |
| 7 | Improve water quality in ways that were not quantified in Attachment 7?<br>Avoided costs of sediment and debris loading | Yes |
| 8 | Reduce net emissions in ways that were not quantified in Attachment 7? | No |
| 9 | Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4? | No |
| | **Sustainability Benefits** | |
| 10 | Improve the overall, long-term management of California groundwater resources? | No |
| 11 | Reduce demand for net diversions for the regions from the Delta? | No |
| 12 | Provide a long-term solution in place of a short-term one? | No |
| 13 | Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources? | No |
| 14 | Improve water supply reliability in ways not quantified in Attachment 7? | No |
| 15 | Other (If the above listed categories do not apply, provide non-monetized benefit description)? | No |

Notes: [1] A "no" response may mean the project does not produce this benefit, or it may mean the benefit is already quantified in Attachment 7, or monetized directly under Section D3 below.

### 2. Provide social recreation or access benefits: Avoided loss of access and water disruptions to campgrounds and parks

**Relevant change.** Without the project, if the water supply to the parks and recreational facilities were to fail, combined with a landslide that could disrupt travel along Highway 199 and potentially access to the parks and campgrounds, these recreation destinations may be closed to visitors for an extended period of time. The project would reduce the risk that a catastrophic

landslide and water-service disruption would occur. Data are unavailable to develop assumptions about how extensive these closures would be, and how long they would persist.

**Evidence for demand and value.** BRCSD serves 1,200 tourists during the summer season in Jedediah Smith Redwoods State Park and the Smith River National Park. If these areas were closed to visitors for an extended period of time, some people who would have visited might decide to stay home or go elsewhere. To the extent that people who wanted to visit these areas have to change their plans, it could reduce the value they derive from their recreational experiences. To the extent that visitors who would have come to or stayed in California decide to recreate in another state instead, Californian businesses and state parks would experience additional costs from lost tourism spending.

Data are unavailable to develop assumptions about how much spending would be lost from the Californian economy, how much value tourists would place on avoiding these closures, or how most tourists would respond in the event of a closure. With enough warning, people could substitute recreational experiences at a different location that would provide similar value. The benefit of avoiding closures would likely be greatest for those already in the area when the damage occurs, as they would incur costs for traveling elsewhere and sudden changes in expectations.

**Timing and duration.** Project proponents expect to have the new tank in operation by September of 2014. Tourists would experience diminished risk of disruptions in recreational access and services from 2015 throughout the lifespan of the project, 50 years.

**Beneficiaries.** People who visit or plan to visit the area would experience this benefit. Business and state parks in California may also benefit from avoiding losing recreation and tourism expenditures.

**Sources of uncertainty.** The value of this benefit depends on the probability of and extent of damage arising from a tank failure and landslide. It also depends on the demand from potential visitors, as well as the characteristics of the supply of substitute recreational and other leisure opportunities in the area. These variables have the potential to change over time and affect the value of this benefit.

### 4. Promote social health or safety: Avoided damage and harm from disrupted emergency services

**Relevant change.** We quantify the value of costs associated with avoiding loss of life and injury that could occur with a tank failure and landslide in monetized benefit #1 (Value of avoided injury and death) below. However, the tank's failure would also impose additional, unquantifiable costs on public health and safety. We describe those costs in this section.

Big Rock CSD's 100,000 gallon storage tank rests on a steep mountainside above U.S. Highway 199. This highway is one of only three emergency evacuation routes out of the county. If the

tank fails during a natural hazard, it could impede residents' ability to evacuate the area and/or could result in highway delays. If the tank were to fail during a seismic event that also caused a fire, the fire would cause additional damage as the community would not have adequate resources for fighting the fire. Because of the impact on the highway describe above, the response time of fire suppression agencies would increase from three minutes to about twenty minutes. This could cause additional loss of life or injury.

**Evidence for demand and value.** We cannot quantify the value of improved public health and safety, but the benefits related to this category are likely high. The U.S. Environmental Protection Agency estimates the value of a statistical life is $8.14 million, based on willingness to pay for small reductions in mortality risk (EPA 2012).

**Timing and duration.** Project proponents expect to have the new tank in operation by September of 2014. We therefore assume benefits associated with diminishing the risk to public health and safety will begin to accrue in 2015 and would persist for the lifespan of the project, 50 years.

**Beneficiaries.** The beneficiaries of this benefit are the residents of Hiouchi, California. The township of Hiouchi is a disadvantaged community. Beneficiaries may also include visitors to the area who could be similarly affected by a disaster.

**Sources of uncertainty.** The value of this benefit depends on the probability of and extent of damage arising from a tank failure and landslide, the preparedness of the agencies responsible for responding to emergencies during these types of disasters, and the responses of individuals affected by the event.

### 5. Have other social benefits: Avoided costs of emergency repairs

**Relevant change.** Utility lines feeding two of the five townships in the county lie in the path of the landslide. So do Highway 199, and numerous other structures. Without the project, these structures risk severe damage or failure, should a landslide occur. The project reduces the risk that a landslide would occur and cause damage to this infrastructure.

**Evidence for demand and value.** If the tank failed and a landslide occurred, BRCSD and other agencies would incur costs to make emergency repairs to damaged infrastructure in its path. We do not have sufficient information to estimate the costs of these emergency repairs, but they are likely substantial.

**Timing and duration.** Project proponents expect to have the new tank in operation by September of 2014. We therefore assume the reduced risk would start in 2015. We assume these benefits would persist at least for the engineering lifespan of the new tank, which is 50 years.

**Beneficiaries.** The beneficiaries of this benefit are the residents of Hiouchi, California, the ratepayers of BRCSD, and taxpayers of California who would have to cover the costs of emergency repairs. The township of Hiouchi is a disadvantaged community. To the extent that federal funds are made available in the event of an emergency, other beneficiaries may include federal taxpayers or beneficiaries of services that could be funded if federal dollars were not used for this disaster.

**Sources of uncertainty.** The value of this benefit depends on the probability of and extent of damage arising from a tank failure and landslide, the preparedness of the agencies responsible for responding to emergencies during these types of disasters, and the availability of labor and materials after a disaster.

### 6. Benefit wildlife or habitat: Value of avoiding damage to salmonid habitat

**Relevant change.** If the tank fails large amounts of sediment and debris would enter the Smith River. The Smith River is a Wild and Scenic river and a salmonid-bearing stream. Data are unavailable to quantify the extent of the physical damage to salmonid habitat and the resulting effect on salmonid populations, but the project would significantly reduce the risk of habitat damage.

**Evidence for demand and value.** Individuals derive value from increases in salmon and steelhead populations in two ways: some (e.g., recreational anglers and commercial fishermen) directly interact with salmon and steelhead populations and derive benefit by catching and consuming the fish, others (including some from the former group) derive value from the fish solely based on the salmon and steelhead's existence. Studies have shown that regardless of direct interaction with fish populations, many Californians hold a positive willingness to pay to ensure the long-term survival of salmon and steelhead (Pate and Loomis 1997).

Several studies have attempted to estimate the passive use value of increases in salmon and steelhead populations among households in California and neighboring states. Passive use value, in this case, refers to the benefit individuals derive from knowing that healthy salmon and steelhead populations exist, regardless of their intent to directly interact with salmon and steelhead through fishing or some other means. In general, these studies have estimated households' average willingness to pay to implement policies that would increase salmon and steelhead populations. At the per fish level, these studies reveal that households are willing to pay only fractions of a penny for increases in salmon populations. When summed across a region, however, the total value Californians are willing to pay for increases in fish populations is considerable. Applying the results of two studies that have estimated willingness to pay values for increases in salmon and steelhead populations suggest that Californians, in total, would be willing to pay between $497 (Olsen, Richards, and Scott 1991) and $4,351 (Loomis 1996) per fish.[4]

[4] This is based on about 12.4 million households in California (U.S. Census Bureau 2007-2011).

**Timing and duration.** Project proponents expect to have the new tank in operation by September of 2014. We therefore assume the reduced risk to salmonid habitat would start in 2015. We assume these benefits would persist at least for the engineering lifespan of the new tank, which is 50 years.

**Beneficiaries.** The beneficiaries of this benefit are the people of California who value the continued existence of aquatic wildlife and habitat, particularly critical habitat for Chinook salmon, Coho salmon, and steelhead.

**Sources of uncertainty.** The value of this benefit depends on how a landslide would affect salmonid habitat and fish populations. Significant uncertainty surrounds predictions, but even if the extent of damage were modeled with certainty, the ecosystem's response to a landslide could be highly variable depending on the season, location of damage, and other factors.

There is also uncertainty associated with the economic value of avoiding losses to fish populations. The results from the studies listed above depend crucially on survey methodology and public perceptions on the current state of salmonid populations. Both studies listed above were conducted in the Pacific Northwest, which may over or underestimate Californians' willingness to pay for salmon.

### 7. Improve water quality: Avoided costs of sediment and debris loading

**Relevant change.** If the tank fails large amounts of sediment and debris would enter the Smith River, temporarily affecting the water quality at and downstream of the landslide. The Smith River is a Wild and Scenic river. Data are unavailable to estimate the tons of sediment and debris that would enter the Smith River if the landslide occurs, and how far downstream the adverse effects on water quality would persist.

**Evidence for demand and value.** The Smith River provides water supplies, clean water for recreation, and fish and wildlife habitat. A landslide would degrade the water quality and would reduce the value associated with these uses. We cannot quantify the costs associated with sediment and debris loading to the Smith River in the event of a tank failure, but these costs, both in the short-term to downstream users and in the long-term to the ecosystem and those dependent on ecosystem services, could be sizeable. They would likely diminish over the short term as the landslide and debris washes downstream. The magnitude and persistence of the damage would depend on the season, as baseline turbidity and flows and active uses of the water vary across the year.

**Timing and duration.** Project proponents expect to have the new tank in operation by September of 2014. We therefore assume the reduced risk to downstream users would start in 2015. We assume these benefits would persist at least for the engineering lifespan of the new tank, which is 50 years.

**Beneficiaries.** The beneficiaries of this benefit are water users downstream of a possible landslide, including agricultural and municipal users, recreational users, and people who care about damage to fish and wildlife habitat from increased sedimentation.

**Sources of uncertainty.** The value of this benefit depends on the probability and extent of a landslide, the ecosystem's response to the debris entering the Smith River, the degree to which downstream water users are using river water when the event occurs, and the degree to which their systems are able to respond to turbidity and large debris.

## Section D3. Monetized Benefits Analysis

The present value of the monetized benefits in 2012 dollars, discounted annually at 6 percent over the 50-year lifespan of the project, is $22,159,362. The calculations for each monetized benefit are shown in Tables 15.1-101, 15.2-101, 15.3-101, and 15.4-101, at the end of this section.

The first two benefits in this section were estimated using the FEMA Benefit-Cost Model (version 4.5.5.), and are based on assumptions for three possible events:

1. Under an earthquake magnitude of 5.0 with a modified Mercalli intensity index of VI-VII, the connections under the water tank would break. The District would dig up the line, find the break, and install a new section of pipe. There would be no loss of life. The recurrence interval of this event is 45 years, with an annual probability of 2.22 percent.
2. Under an earthquake magnitude of 5.5 with a modified Mercalli intensity index of VII, the tank would endure the damage under event (1) and additional damage to the foundation from shift and warping of the steel bands that hold the redwood tank boards together, which would prevent the tank from holding water. This would leave the system without water storage. There would be no loss of life. The recurrence interval of this event is 80 years, with an annual probability of 1.25 percent.
3. Under an earthquake of magnitude 6.0 with a modified Mercalli intensity index of VIII, the entire tank would fail. The tank, foundation, and fill prism would initiate a landslide that would reach into the community approximately 500 feet, destroying 19 homes and taking out major sections of the distribution system. There are 62 people living in the 19 homes in the initial impact area, half of which would lose their lives. An additional 19 people would sustain major injuries and 12 people would sustain minor injuries. The recurrence interval of this event is 145 years, with an annual probability of 0.69 percent.

### 1. Value of avoided injury and death

**Relevant change.** Without the project, under scenario 3 above, the model assumes that those living in homes closest to the landslide—where the event would bury residences under ten feet of mud, rock, and water—would not survive. Those further away would experience a combination of major injury and minor injuries. The project has a high level of effectiveness and

is anticipated to reduce loss of life and injuries described above to zero for all three modeled events.

**Evidence for demand and value.** Using FEMA's Benefit Cost Analysis Software Version 4.4.5, BRCSD estimated the net present value of this benefit is $19,808,156 in 2012 dollars, using a 7 percent discount rate, over a 50-year period. This value assumes a FEMA standard value of $5,800,000 per death; $1,483,000 per major injury; and $12,000 per minor injury (FEMA 2009).[5]

**Timing and duration.** Project proponents expect to have the new tank in operation by September of 2014. We therefore assume these benefits will begin to accrue in 2015. We assume these benefits would accrue for the lifespan of the project, 50 years.

**Beneficiaries.** The beneficiaries of this benefit are the residents of Hiouchi, California. The township of Hiouchi is a disadvantaged community. Beneficiaries may also include visitors to the area would could be similarly affected by a disaster.

**Sources of uncertainty.** The actual value of this benefit depends on the probability of and extent of damage, injury, and death arising from a tank failure and landslide, the preparedness of the agencies responsible for responding to emergencies during these types of disasters, and the responses of individuals affected by the event. FEMA's Benefit Cost Analysis Software Version 4.4.5 uses a set discount rate of 7 percent (FEMA 2009). Since DWR specifies a 6 percent discount rate for all analyses, this calculation underestimates the true value of this benefit.

## 2. Avoided costs of improved water supply reliability

**Relevant change.** Without the project, each of the events described above would result in a loss of water supply to the community. It assumes a loss of potable water services for all CSD customers for 1 day under event (1); fifty percent of CSD customers for a total length of 30 days under event (2); and all CSD customers for at least 4 months under event (3). The project has a high level of effectiveness and is anticipated to reduce loss of function time to zero for all three modeled events.

**Evidence for demand and value.** Using FEMA's Benefit Cost Analysis Software Version 4.4.5, BRCSD estimated the net present value of this benefit is $829,549 in 2012 dollars, using a 7 percent discount rate, over a 50-year period. This value assumes a FEMA standard value of $93 per day per person for a complete loss of potable water service (FEMA 2009).[6]

[5] FEMA documentation of the Benefit-Cost Model does not explain how these values were derived or provide a citation to an underlying data source.

[6] FEMA documentation of the Benefit-Cost Model does not explain how these values were derived or provide a citation to an underlying data source.

**Timing and duration.** Project proponents expect to have the new tank in operation by September of 2014. We therefore assume these benefits will begin to accrue in 2015. We assume these benefits would accrue for the lifespan of the project, 50 years.

**Beneficiaries.** The beneficiaries of this benefit are the potable water customers of the BRCSD.

**Sources of uncertainty.** The actual value of this benefit depends on the probability of potable water disruption arising from a tank failure and landslide, the ability of BRCSD to respond to the failure, and the availability of labor and materials following the disaster. It also depends on the applicability of FEMA's standard value for customers' willingness to pay to avoid potable water shortages to the customers of the BRCSD. FEMA's Benefit Cost Analysis Software Version 4.4.5 uses a set discount rate of 7 percent (FEMA 2009). Since DWR specifies a 6 percent discount rate for all analyses, this calculation underestimates the true value of this benefit.

### 3. Avoided costs of property damage

**Relevant change.** The tank rests above the community of Hiouchi. If the tank foundation were to fail, it would create a landslide that would destroy 19 residential structures. Many families would be displaced from their homes. The project has a high level of effectiveness and is anticipated to reduce the risk of destroying property to zero for all three modeled events.

**Evidence for demand and value.** The median home value (five-year rolling average between 2005 and 2011) in Hiouchi, California is $68,800 (U.S. Census Bureau 2005-2011). Because this benefit was not specifically included in the results of the benefit-cost analysis run using the FEMA model, we multiply this cost by the annual probability of event (3), 0.69 percent, and the number of homes that would be destroyed in a landslide, to estimate the annual, undiscounted value of this benefit at $9,019.

**Timing and duration.** Project proponents expect to have the new tank in operation by September of 2014. We therefore assume these benefits will begin to accrue in 2015. We assume these benefits would accrue for the lifespan of the project, 50 years.

**Beneficiaries.** The beneficiaries of this benefit are property owners in Hiouchi, California. The township of Hiouchi is a disadvantaged community.

**Sources of uncertainty.** The actual value of this benefit depends on the probability and extent of damage arising from a tank failure and landslide. This value also assumes the 19 residential structures in the landslides' path are representative of the average value of a home in Hiouchi. To the extent that these homes represent values greater or less than the average, we have under or overestimated the value of this benefit. This value also does not take into consideration additional property damage to other residential structures, automobiles, or infrastructure. Given that a landslide would also result in damage to other types of properties, we have likely underestimated the value of this benefit.

## 4. Reduced operations and maintenance costs

**Relevant change.** The project would reduce the annual amount BRCSD pays to maintain the storage tank. Currently, BRCSD conducts annual inspection and tightening of the steel bands, re-roofing every five years, and monthly checks on the telemetry system, vandalism inspections, and lightening rod inspection. With the project, the BRCSD would conduct monthly checks on the system, would repaint the tank every 20 years, and perform some general upkeep and maintenance.

**Evidence for demand and value.** Without the project, BRCSD's annual maintenance costs include $2,500 for annual inspection and tightening of the steel bands on the tank, an annual cost of $400 for re-roofing every 5 years, and $480 for monthly checks on the telemetry system, vandalism inspections, and lightening rod inspection. With the project, the annual maintenance of the storage tank would include $480 for monthly checks on the system, an annualized cost of $1,000 to repaint the tank every 20 years, and $500 for general maintenance and upkeep. Thus, the project would reduce the annual cost of maintenance for the current system from $3,380 to $1,980 per year, for an annual, undiscounted benefit of $1,400.

**Timing and duration.** Project proponents expect to have the new tank in operation by September of 2014. We therefore assume these benefits will begin to accrue in 2015. We assume these benefits would accrue for the lifespan of the project, 50 years.

**Beneficiaries.** The beneficiaries of this benefit are the BRCSD and its ratepayers. BRCSD is located within the disadvantaged community of Hiouchi, California.

**Sources of uncertainty.** This annual value assumes that the maintenance costs materialize as BRCSD's managers expect, as described above. To the extent that the new system requires more or less frequent maintenance, the benefit would be greater or less than described here.

| Table 15.1-101 – Annual Benefit : Value of Avoided Injury and Death<br>(All benefits should be in 2012 dollars)<br>Project: 101 - Big Rock Community Services District, Stabilize Water Storage Tank | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
| Year | Type of Benefit | Measure of Benefit (Units) | Without Project | With Project | Change Resulting from Project (e) – (d) | Unit $ Value | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Value of Avoiding Injury and Death | Dollars | 0 | 1 | 1 | $ 19,808,156 | $ 19,808,156 | 1.000 | $ 19,808,156 |
| | | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | $ 19,808,156 |
| Comments: The valuation of this benefit uses FEMA's Benefit Cost Analysis Software Version 4.4.5. See the narrative description for more information. Although this benefit is placed in the year 2012, this is a function of the FEMA modeling software. The project would be completed in 2014, at which time benefits associated with avoided injury and death would begin. | | | | | | | | | |

| Table 15.2-101 – Annual Benefit : Avoided Costs of Improved Water Supply Reliability<br>(All benefits should be in 2012 dollars)<br>Project: 101 - Big Rock Community Services District, Stabilize Water Storage Tank | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
| Year | Type of Benefit | Measure of Benefit (Units) | Without Project | With Project | Change Resulting from Project (e) – (d) | Unit $ Value | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Water Supply Reliability | Dollars | 0 | 1 | 1 | $ 829,549 | $ 829,549 | 1.000 | $ 829,549 |
| | | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | $ 829,549 |
| Comments: The valuation of this benefit uses FEMA's Benefit Cost Analysis Software Version 4.4.5. See the narrative description for more information. Although this benefit is placed in the year 2012, this is a function of the FEMA modeling software. The project would be completed in 2014, at which time benefits associated with water supply reliability would begin. | | | | | | | | | |

Table 15.3-101 – Annual Benefit : Avoided Costs of Property Damage
(All benefits should be in 2012 dollars)

Project: 101 - Big Rock Community Services District, Stabilize Water Storage Tank

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Reduced property damage | properties | 0 | 0 | 0 | $ 474.72 | $ - | 1.000 | $ - |
| 2013 | Reduced property damage | properties | 0 | 0 | 0 | $ 474.72 | $ - | 0.943 | $ - |
| 2014 | Reduced property damage | properties | 0 | 0 | 0 | $ 474.72 | $ - | 0.890 | $ - |
| 2015 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.840 | $ 7,573 |
| 2016 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.792 | $ 7,144 |
| 2017 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.747 | $ 6,740 |
| 2018 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.705 | $ 6,359 |
| 2019 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.665 | $ 5,999 |
| 2020 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.627 | $ 5,659 |
| 2021 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.592 | $ 5,339 |
| 2022 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.558 | $ 5,037 |
| 2023 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.527 | $ 4,751 |
| 2024 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.497 | $ 4,483 |
| 2025 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.469 | $ 4,229 |
| 2026 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.442 | $ 3,989 |
| 2027 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.417 | $ 3,764 |
| 2028 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.394 | $ 3,551 |
| 2029 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.371 | $ 3,350 |
| 2030 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.350 | $ 3,160 |
| 2031 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.331 | $ 2,981 |
| 2032 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.312 | $ 2,812 |
| 2033 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.294 | $ 2,653 |
| 2034 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.278 | $ 2,503 |
| 2035 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.262 | $ 2,361 |
| 2036 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.247 | $ 2,228 |
| 2037 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.233 | $ 2,102 |
| 2038 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.220 | $ 1,983 |
| 2039 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.207 | $ 1,870 |
| 2040 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.196 | $ 1,765 |
| 2041 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.185 | $ 1,665 |
| 2042 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.174 | $ 1,570 |
| 2043 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.164 | $ 1,482 |
| 2044 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.155 | $ 1,398 |
| 2045 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.146 | $ 1,319 |
| 2046 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.138 | $ 1,244 |
| 2047 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.130 | $ 1,174 |
| 2048 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.123 | $ 1,107 |
| 2049 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.116 | $ 1,044 |
| 2050 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.109 | $ 985 |
| 2051 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.103 | $ 930 |
| 2052 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.097 | $ 877 |
| 2053 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.092 | $ 827 |
| 2054 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.087 | $ 780 |
| 2055 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.082 | $ 736 |
| 2056 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.077 | $ 695 |
| 2057 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.073 | $ 655 |
| 2058 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.069 | $ 618 |
| 2059 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.065 | $ 583 |
| 2060 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.061 | $ 550 |
| 2061 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.058 | $ 519 |
| 2062 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.054 | $ 490 |
| 2063 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.051 | $ 462 |
| 2064 | Reduced property damage | properties | 0 | 19 | 19 | $ 474.72 | $ 9,019.68 | 0.048 | $ 436 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 126,528 |

Comments: This value arises from avoiding the loss of 19 homes in the path of the landslide. These costs are not modeled in the FEMA results in Tables 15-1 and 15-2, so we include them separately here.

Table 15.4-101 – Annual Benefit : Reduced Operations and Maintenance Costs
(All benefits should be in 2012 dollars)

Project: 101 - Big Rock Community Services District, Stabilize Water Storage Tank

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Reduced O&M Costs | Dollars | $ 3,380 | $ 3,380 | $ - | -1 | $ - | 1.000 | $ - |
| 2013 | Reduced O&M Costs | Dollars | $ 3,380 | $ 3,380 | $ - | -1 | $ - | 0.943 | $ - |
| 2014 | Reduced O&M Costs | Dollars | $ 3,380 | $ 3,380 | $ - | -1 | $ - | 0.890 | $ - |
| 2015 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.840 | $ 1,175 |
| 2016 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.792 | $ 1,109 |
| 2017 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.747 | $ 1,046 |
| 2018 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.705 | $ 987 |
| 2019 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.665 | $ 931 |
| 2020 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.627 | $ 878 |
| 2021 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.592 | $ 829 |
| 2022 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.558 | $ 782 |
| 2023 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.527 | $ 738 |
| 2024 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.497 | $ 696 |
| 2025 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.469 | $ 656 |
| 2026 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.442 | $ 619 |
| 2027 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.417 | $ 584 |
| 2028 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.394 | $ 551 |
| 2029 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.371 | $ 520 |
| 2030 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.350 | $ 490 |
| 2031 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.331 | $ 463 |
| 2032 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.312 | $ 437 |
| 2033 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.294 | $ 412 |
| 2034 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.278 | $ 389 |
| 2035 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.262 | $ 367 |
| 2036 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.247 | $ 346 |
| 2037 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.233 | $ 326 |
| 2038 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.220 | $ 308 |
| 2039 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.207 | $ 290 |
| 2040 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.196 | $ 274 |
| 2041 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.185 | $ 258 |
| 2042 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.174 | $ 244 |
| 2043 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.164 | $ 230 |
| 2044 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.155 | $ 217 |
| 2045 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.146 | $ 205 |
| 2046 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.138 | $ 193 |
| 2047 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.130 | $ 182 |
| 2048 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.123 | $ 172 |
| 2049 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.116 | $ 162 |
| 2050 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.109 | $ 153 |
| 2051 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.103 | $ 144 |
| 2052 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.097 | $ 136 |
| 2053 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.092 | $ 128 |
| 2054 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.087 | $ 121 |
| 2055 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.082 | $ 114 |
| 2056 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.077 | $ 108 |
| 2057 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.073 | $ 102 |
| 2058 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.069 | $ 96 |
| 2059 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.065 | $ 91 |
| 2060 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.061 | $ 85 |
| 2061 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.058 | $ 81 |
| 2062 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.054 | $ 76 |
| 2063 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.051 | $ 72 |
| 2064 | Reduced O&M Costs | Dollars | $ 3,380 | $ 1,980 | $ (1,400.00) | -1 | $ 1,400.00 | 0.048 | $ 68 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 19,639 |

Comments: This value arises from reducing O&M associated with the current tank.

## Section D3. Project Costs

The present value of the project's costs, which would occur between 2013 and 2014, is $1,375,489 in 2012 dollars, discounted at a 6-percent annual rate. These costs would fund labor, planning, equipment, and materials necessary to implement the project.[7]

Not included in this cost estimate are costs incurred by customers related to the temporary water conservation measures BRCSD would enact during construction of the new tank. It also does not include the costs associated with temporary reductions in water available for fire protection agencies. This project could increase the risk associated with fire damage if these agencies are not able to secure substitute water supplies that are at least as convenient and reliable as those currently provided by BRCSD. These costs could be even higher if a wildfire occurred in the area during the temporary construction period. Data are unavailable to quantify these costs.

Table 19-101 – Annual Costs of Project
(All costs should be in 2012 Dollars)

Project: 101 - Big Rock Community Services District, Stabilize Water Storage Tank

| | Initial Costs Grand Total Cost from Table 7 (row (i), column (d)) | Adjusted Grant Total Cost | 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 | | | | | | | | $ - | 1.000 | $ - |
| 2013 | $ 3 55,000 | | | | | | | $ 355,000 | 0.943 | $ 334,906 |
| 2014 | $ 1 ,169,200 | | | | | | ** | $ 1,169,200 | 0.890 | $ 1,040,584 |
| Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries | | | | | | | | | | $ 1,375,489 |

Comments: These costs do not include costs incurred by customers related to temporary water conservation measures or temporary reductions in water available for fire fighting during consruction. Data are unavailable to estimate these costs, but they would likley occur during 2014.

[7] We have distributed the costs outlined Table 7 across the project's implementation period based on the expected timing and phasing described in the Work Plan. Actual distribution of costs during this period may differ somewhat.

# 320. *Mendocino County Resource Conservation District*, Working Landscapes Riparian Enhancement Project

## Conditions Without the Project

Riparian ecosystems are some of the most threatened and impaired landscapes on the North Coast. Mendocino County's working landscapes are a mosaic of agriculture, forestry, fishing, and aggregate production. Approximately fifty percent of the riparian vegetation in the Russian and Navarro Rivers has been lost since 1942, leading to degraded habitat for threatened and endangered salmon populations. Consequently, local and regional watershed plans identify riparian restoration as a primary strategy to improve water quality and ecological health.

In 2012, staff from the MCRCD performed an in-channel mapping exercise of *Arundo*, a highly invasive, noxious perennial grass, from Tomki Road on the West Fork Russian River downstream on the mainstem Russian River to the confluence of Dooley Creek. Over the distance of approximately 30 miles, the crew identified over 60 stands of *Arundo*. Managers have identified the *Arundo* invasion as one of the most serious threats to the remaining habitat in the Russian River, as it directly impacts threatened Chinook salmon, endangered Coho salmon, and steelhead habitat. In addition to degrading salmon habitat, *Arundo* increases fuel loads and contributes to wildfire risk. It also has the potential to exacerbate flooding and contribute to downstream flood damage.

In Denmark Creek, work has been underway to restore the stream channel. A failing culvert sits just upstream of this newly restored habitat, cutting off access to 0.4 miles of additional spawning and rearing grounds for steelhead trout. The culvert is on an abandoned segment of Highway 128. Water flows through and under the pipe, further eroding the stream channel. Project proponents expect that within the next 20 years it is nearly certain that the culvert will fail and deliver fill to the channel, damaging downstream structures and restored habitat.

## Conditions With the Project

MCRCD is proposing two riparian demonstration projects on working landscapes in the Upper Russian and Navarro Rivers watersheds. These include: (1) Upper Russian River *Arundo* removal and riparian enhancement on agricultural land; and (2) Phase 2 of Denmark Creek Riparian Restoration.

In the first part of the project, MCRCD will work with agricultural operators with large patches of *Arundo* on the bank of the Russian River to remove the giant reed. MCRCD would also follow-up with the landowners with a restoration program of native plantings over a three-year period, particularly in areas where bank erosion is a concern. MCRCD will use willow sprigging or willow mattresses on bank slopes and native species on upland areas. Monitoring and maintenance—which includes checking for re-invasion, controlling new infestations, and ensuring that revegetation maintains a sustainable survival rate—will occur for three years. This process would remove 24,240 square feet (0.5 acres) of *Arundo*.

In the second part of the project, MCRCD will complete Phase 2 of the Denmark Creek Riparian Restoration Project. MCRCD conducted Phase 1 of the Denmark Creek Restoration Project in 2008-2009

with EPA Clean Water Act funds, restoring approximately 0.24 miles of stream. In this Phase, MCRCD will remove the failing culvert upstream of the newly restored habitat, opening approximately 0.4 miles of upstream habitat available to steelhead trout for spawning and rearing. With the project, MCRCD will also pull banks back to a 2:1 slope and revegetate them with native California trees and shrubs, seed with native erosion control seed mix, and mulch with weed-free rice straw, creating approximately 0.3 acres of riparian habitat.

These projects will inform the working landscape community of effective solutions using best management practices by networking with constituents of the Farm Bureau, UC Cooperative Extension, and the County Agricultural Department. Workshops for landowners will be held and tours of the project sites will be conducted in an effort to promote the use of the BMPs on other properties within the watersheds.

## Section D2. Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient data are unavailable to quantify in physical terms, monetary terms, or both. Table 12-320 summarizes the non-monetary benefits of this project. We describe these benefits in more detail below the table.

Table 12-320 – Non-monetized Benefits Checklist
*Mendocino County Resource Conservation District, Working Landscapes Riparian Enhancement Project*

| *No.* | *Will the proposal…* | *Response*[1] |
|---|---|---|
| | **Community/Social Benefits** | |
| 1 | Provide education or technology benefits? Demonstrate effective best practices | Yes |
| 2 | Provide social recreation or access benefits? Enhance amenity values for recreationists | Yes |
| 3 | Help avoid, reduce or resolve various public water resources conflicts? | No |
| 4 | Promote social health and safety? | No |
| 5 | Have other social benefits? Cultural importance associated with increases in salmon populations | Yes |
| | **Environmental Stewardship Benefits** | |
| 6 | Benefit wildlife or habitat in ways that were not quantified in Attachment 7? Passive-use value associated with increases in salmon populations | Yes |
| 7 | Improve water quality in ways that were not quantified in Attachment 7? | No |
| 8 | Reduce net emissions in ways that were not quantified in Attachment 7? | No |
| 9 | Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4? | No |
| | **Sustainability Benefits** | |
| 10 | Improve the overall, long-term management of California groundwater resources? | No |
| 11 | Reduce demand for net diversions for the regions from the Delta? | No |
| 12 | Provide a long-term solution in place of a short-term one? | No |
| 13 | Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources? | No |
| 14 | Improve water supply reliability in ways not quantified in Attachment 7? | No |
| 15 | Other (If the above listed categories do not apply, provide non-monetized benefit description)? | No |

Notes: [1] A "no" response may mean the project does not produce this benefit, or it may mean the benefit is already quantified in Attachment 7, or monetized directly under Section D3 below.

## 1. Provide education or technology benefits: Demonstrate effective education and outreach best practices

**Relevant change.** The project would demonstrate effective best practices for using riparian restoration efforts to educate and communicate with the public. Some of the techniques would include: time-lapse photography, photo-print monitoring on two websites, and a tour with 50 partners and working landscape community members. MCRCD would also hold a tour of these and other restoration sites to demonstrate the benefits of implementing BMPs and ways to prevent water diversions, down-cutting, and erosion on working lands.

**Evidence for demand and economic value.** In the *California Noxious & Invasive Weed Action Plan*, the California Department of Food and Agriculture and California Invasive Weed Awareness Coalition identify education as "one of our best tools in preventing new noxious and invasive species from being introduced and eliminating further spread" (Schoenig 2005). The California Department of Food and Agriculture and California Invasive Weed Awareness Coalition also identify effective public awareness and education, especially to affected property owners, as an integral element to an early detection and rapid response system. As they note, early detection is "the single most important element in successful and economical eradication of new weeds before they become established in new localities" (Schoenig 2005).

The *Arundo* removal project, in particular, is an important part of expanding support for these types of eradication efforts within the agricultural community; a key to solving the *Arundo* problem in the watershed. Colleagues of the participating landowners will be able to see how the process works, what it costs, and how the MCRCD performs. The nature of *Arundo* eradication requires a long-term relationship with the landowner and the treatment sites. As the project builds upon its successes, more landowners will support future, similar efforts.

**Timing and duration.** The project would begin conferring education benefits after MCRCD conducts the first site tour, in 2016. These benefits would persist for the professional lifetimes of the participants.

**Beneficiaries.** The primary beneficiaries of this benefit are the landowners and other residents who participate in the tours and demonstrations, as well as those landowners and other residents who receive other educational and outreach materials. This project would reach people in the disadvantaged communities of Boonville, Philo, Talmage, Ukiah, Hopland Band of Pomo Indians, and the Hintl Tribe.

**Sources of uncertainty.** The education benefits from the project would depend on the extent to which the project effectively delivers information through the educational programs for landowners and, significantly, the extent to which these landowners alter their behavior.

## 2. Provide social recreation or access benefits: Enhance amenity values for recreationists

**Relevant change.** The area around the Denmark Creek Restoration Project, along Highway 128, is a popular destination for tourists and recreationists. Denmark Creek itself is highly visible from this area, including between several vineyards and grazing lands. Bicycling, hunting, horseback riding, sight-seeing, and wine tasting are common activities between Boonville and Philo. By improving the aesthetic amenities associated with Denmark Creek, the project would contribute to an improvement in the aesthetic attributes of the watershed, which may contribute to a marginal improvement in the quality of recreation in the area.

**Evidence for demand and economic value.** The aesthetic improvements to Denmark Creek would provide economic benefits if they:

- improve the recreation experience for visitors who already visit the area, by providing new amenities they care about, such as improved views of scenery or wildlife
- attract new recreationists who wouldn't have otherwise gone somewhere else
- attracted tourists and recreationists who would have gone somewhere else, but chose to visit Denmark Creek because it provides equivalent amenities with less travel expense

Quantifying the extent to which any of these effects would occur is difficult, given that data about current recreational use of this area are not collected in a systematic way.

Another source of value comes from people who haven't actually used the area around the Denmark Creek Restoration Project, but are willing to pay to have the option of using it at some point in the future, if they choose. Data are not available to determine if this "option value" is an important component of the value of the creek's restoration, but given that it is a popular destination for recreation and tourism, it is plausible that this would be a source of value.

**Timing and duration.** Project proponents expect to complete the streambank removal and revegetation within 18 months after the project start date in November of 2013. We therefore assume the project would begin accruing benefits related to social recreation and access in 2015.

**Beneficiaries.** Anyone who recreates or visits the area, or who would value the opportunity to recreate or visit the area at some point in the future would benefit from the recreational aspects of the project.

**Sources of uncertainty.** The value of recreation associated with the improved aesthetics of Denmark Creek depend on the demand from potential recreationalists and visitors, as well as the characteristics of the supply of substitute recreational opportunities in the area. Both of these variables have the potential to change over time and affect the value of the improved aesthetics.

### 5. Have other social benefits: Cultural importance associated with increases in salmon populations

**Relevant change.** Both the Russian River *Arundo* removal project and Denmark Creek Riparian Restoration project would contribute to improvements in aquatic habitat. See our description of non-monetized benefit #6 (benefit habitat or wildlife) below for a full description of the process by which these projects confer this benefit.

**Evidence for demand and economic value.** Unlike many Californians who ascribe a monetary willingness to pay to protect salmon, even if they never intend to directly fish or watch them, many Native Americans recognize the importance of salmon outside the cultural framework and economic terms western society often imposes (Malloy 1992). Accordingly, they reject the validity of applying a dollar value to fish that constitute a core element of their cultural and spiritual well-being. For this reason, we recognize the cultural significance that arises from the projects' improvements to salmonid populations and their habitat apart from the quantified passive-use value or other measures of economic benefits.

**Timing and duration.** Project proponents expect to complete the culvert removal and streambank removal within 18 months after the project start date in November of 2013. Likewise, project proponents expect to complete *Arundo* eradication and riparian restoration by November of 2015. To reduce the risk that we overestimate this benefit, we therefore assume the project would begin accruing benefits related to improvements in salmon and steelhead populations in 2016. These benefits likely would increase over time, as restoration matures, and would persist over the long run (at least 50 years).

**Beneficiaries.** The beneficiaries of this benefit would include members of Native American tribes – both within and outside of the region – who believe the continued existence of salmonid populations and their habitat is essential to cultural and spiritual well-being. In particular, two tribes, the Hopland Band of Pomo Indians and the Hintl Tribe, have members immediately downstream from the project site on the Russian River Watershed.

**Sources of uncertainty.** Uncertainty associated with increases in salmonid populations involves the extent to which the project alone confers enough biophysical benefit to result in increased salmon populations given circumstances beyond the project proponent's control, such as weather changes due to climate change or changes in ocean conditions that affect adult salmonid populations during the ocean phase of their life cycle.

### 6. Benefit habitat or wildlife: Passive-use value associated with increases in salmon populations

**Relevant change.** The project would provide an additional 0.4 miles of spawning and rearing habitat for Chinook salmon, Coho salmon, and steelhead trout on Denmark Creek. It would also increase shade and recruitment of large woody debris and increase stream complexity, which would improve habitat for salmonids and other aquatic species. The stream gradient above the

project site is not too steep for steelhead production and the riparian is well-shaded, suggesting the Creek would provide potential summer refugia for juvenile salmonids. However, project proponents cannot quantify the fish population increases as a result of the project because there is insufficient information to determine how much water remains in the channel during the summer months. Anecdotally, MCRCD staff have observed residual pools present even during drought conditions, suggesting the Creek has the potential to support increases in populations of salmonids.

*Arundo* removal in the Russian River also has the potential to improve salmon habitat. *Arundo* has many abiotic and biotic impacts, including changes to geomorphic form and function, hydrology, and water use, which all, often negatively, affect habitat for wildlife, particularly instream habitat for aquatic wildlife. By removing invasive species on the Russian River, the project would provide stream shading and temperature improvements on a stretch of river that supports the populations of threatened Chinook salmon, endangered Coho salmon, and steelhead habitat. Quantifying the project's effects on salmonid populations in the Russian River is impossible, however, given available data. It is unlikely that the increase would be large, compared to the size of the existing populations.

**Evidence for demand and economic value.** Individuals derive value from increases in salmon and steelhead populations in two ways: some (e.g., recreational anglers and commercial fishermen) directly interact with salmon and steelhead populations and derive benefit by catching and consuming the fish, others (including some from the former group) derive value from the fish solely based on the salmon and steelhead's existence. Studies have shown that regardless of direct interaction with fish populations, many Californians hold a positive willingness to pay to ensure the long-term survival of salmon and steelhead (Pate and Loomis 1997).

Several studies have attempted to estimate the passive use value of increases in salmon and steelhead populations among households in California and neighboring states. Passive use value, in this case, refers to the benefit individuals derive from knowing that healthy salmon and steelhead populations exist, regardless of their intent to directly interact with salmon and steelhead through fishing or some other means. In general, these studies have estimated households' average willingness to pay to implement policies that would increase salmon and steelhead populations. At the per fish level, these studies reveal that households are willing to pay only fractions of a penny for increases in salmon populations. When summed across a region, however, the total value Californians are willing to pay for increases in fish populations is considerable. Applying the results of two studies that have estimated willingness to pay values for increases in salmon and steelhead populations suggest that Californians, in total, would be willing to pay between $497 (Olsen, Richards, and Scott 1991) and $4,351 (Loomis 1996) per fish.[8]

[8] This is based on about 12.4 million households in California (U.S. Census Bureau 2007-2011).

**Timing and duration.** Project proponents expect to complete the culvert removal and streambank removal within 18 months after the project start date in November of 2013. Project proponents expect to complete *Arundo* eradication and riparian restoration by November of 2015. To reduce the risk that we overestimate this benefit, we therefore assume the project would begin accruing benefits related to improvements in salmon and steelhead populations in 2016. These benefits likely would increase over time, as restoration matures, and would persist over the long run (at least 50 years).

**Beneficiaries.** The beneficiaries of this benefit are the people of California who value the continued existence of aquatic wildlife and habitat, particularly critical habitat for Chinook salmon, Coho salmon, and steelhead.

**Sources of uncertainty.** Uncertainty associated with increases in salmonid populations involves the extent to which the project alone confers enough biophysical benefit to result in increased salmon populations given circumstances beyond the project proponent's control, such as weather changes due to climate change or changes in ocean conditions that affect adult salmonid populations during the ocean phase of their life cycle.There is also uncertainty associated with the marginal economic value of increases in fish populations described above. The results from the studies listed above depend crucially on survey methodology and public perceptions on the current state of salmonid populations. Of the studies listed, three were conducted in the Pacific Northwest, which may over or underestimate Californian's willingness to pay for salmon.

## Section D3. Monetized Benefits Analysis

The present value of the monetized benefits in 2012 dollars, discounted annually at 6 percent over the lifespan of the project, is $73,976. The calculations for each monetized benefit are shown in Tables 15.-1, 15-2, 15-3, and 15-4, at the end of this section.

### 1. Avoided emergency repair costs associated with culvert failure

**Relevant change.** The project would remove an aging culvert that is rapidly deteriorating. The risk that it will fail increases each year. Without the project, project proponents expect the culvert would fail within the next 20 years. When it fails, the fill associated with the culvert would enter the stream and degrade the newly restored riparian and in-channel habitat. The failure also would likely damage a portion of Highway 128. For the purposes of this analysis, we assume that, without the project, the culvert would fail within the next 20 years, with an annual probability of failure of 5 percent. Since the culvert is already failing, this is likely a conservative assumption.

**Evidence for demand and economic value.** If the culvert fails, MCRCD would incur approximately $75,000 in emergency costs and property damages, including the potential damage to investments made in restoration downstream and Highway 128. These estimates are generally conservative. If the downstream bioengineering and restoration sites fail due to the

upstream culvert's failure, the potential loss in investment would be closer to $175,000. Accounting for the annual probability of the culvert's failure, assuming the smaller amount of property damage, the annual undiscounted value of this benefit is $3,750.

**Timing and duration.** Project proponents expect to complete the culvert removal and streambank removal within 18 months after the project start date in November of 2013. We therefore assume the project would begin accruing benefits related to the avoided cost associated with a reduced probability of culvert failure in 2015. Assuming the culvert would fail over the next 20 years beginning today (by 2032), these benefits would persist for 18 years.

**Beneficiaries.** The beneficiaries of this benefit are Mendocino County taxpayers and downstream property owners who would not incur emergency repair costs related to the culvert failure. In particular the residents of Philo and Boonville, both disadvantaged communities in the vicinity of the project, may directly benefit from these avoided costs.

**Sources of uncertainty.** Sources of uncertainty associated with this benefit include the probability of the culvert's failure without the project and the estimate of costs associated with emergency repair and damages. Both estimates are generally conservative—the probability of culvert failure is likely higher than the 5 percent we assume and the costs associated with culvert failure could range from $75,000 (our estimate) to $175,000. To the extent that our estimates lie below the true value of either of these values, we have underestimated this benefit.

### 2. Avoided costs associated with reduced road maintenance

**Relevant change.** A local landowner currently conducts periodic maintenance activities on the essentially abandoned 0.1 miles of road that lies atop the culvert slated for removal. Since the road is abandoned and to reduce the risk that we overestimate this benefit, we assume these periodic maintenance activities would only be conducted once in the foreseeable future. With the project, the landowner would no longer need to conduct these activities.

**Evidence for demand and economic value.** The landowner spends approximately $500 on road maintenance activities periodically. With the project, the landowner will no longer conduct maintenance activities on this section of road and costs related to the road will be zero.

**Timing and duration.** Project proponents expect to complete the culvert removal and streambank removal within 18 months after the project start date in November of 2013. We therefore assume the project would begin accruing benefits related to the avoided cost associated with reduced road maintenance in 2015. These road maintenance activities occur every 5 years, so we assume these avoided costs occur in year 2017. As we noted above, to reduce the risk that we overestimate this benefit, we only include these activities once.

**Beneficiaries.** The beneficiary of this benefit is the landowner who will no longer conduct maintenance activities on this section of abandoned road, and would be able to devote the time and resources to other priorities, which may have other beneficiaries.

**Sources of uncertainty.** Sources of uncertainty associated with this benefit include the probability of the culvert's failure without the project and the estimate of costs associated with road maintenance activities.

### 3. Avoided costs associated with reduced probability of sediment deposition

**Relevant change.** The project would remove an aging culvert that is rapidly deteriorating the risk that it will fail increases each year. Without the project, project proponents expect the culvert will fail within the next 20 years. When it fails, the fill associated with the culvert would deliver 7,172 tons of sediment to Denmark Creek. For the purposes of this analysis, we assume the culvert would fail within the next 20 years, with an annual probability of failure of 5 percent. Since the culvert is already failing, this is likely a conservative assumption.

**Evidence for demand and economic value.** Economic studies have examined and monetized some of the costs that materialize when excessive sediment impairs streams, rivers, estuaries, and the marine environment. A study conducted by the U.S. Department of Agriculture identified 13 types of costs that sediment abatement projects can reduce (Hansen and Ribaudo 2008). The researchers then modeled the potential value associated with reducing sediment, per ton, for each watershed across the country. For our analysis, we apply the average value for the counties in the Russian watershed, $10.28 per ton, to estimate the benefits derived from the prevention of sediment deposition. Included in this value are the regional benefits associated with the impacts of sediment on:

- Water-based recreation – cleaner fresh water recreation
- Irrigation ditches and channels – reduced cost of removing sediment and aquatic plants from irrigation channels
- Road drainage ditches – less damage to and flooding of roads
- Municipal water treatment – lower sediment-removal costs for water treatment plants
- Flood damage – reduced flooding and damage from flooding
- Marine fisheries – improved catch rates for marine commercial fisheries
- Marine recreational fishing – improved catch rates for marine recreational fishing
- Municipal and industrial water use – reduced damages from salts and minerals dissolved from sediment
- Steam power plants – reduced plant growth on heat exchangers
- Soil productivity – reduced losses in soil productivity
- Dust cleaning – decrease in cleaning due to reduced wind-borne particulates.
- Reservoir services – less sediment in reservoirs
- Navigation – shipping industry avoidance of damages from groundings

Accounting for the annual probability of the culvert's failure, the annual undiscounted value of this benefit is $73,728.

**Timing and duration.** Project proponents expect to complete the culvert removal and streambank removal within 18 months after the project start date in November of 2013. We therefore assume the project would begin accruing benefits related to the avoided cost of sediment deposition associated with a reduced probability of culvert failure in 2015. Assuming the culvert will fail over the next 20 years beginning today (by 2033), these benefits would persist for 18 years.

**Beneficiaries.** The beneficiaries of this benefit are the wide array of downstream users associated with each of the benefits listed above. To some extent, these beneficiaries include the general public, municipal water treatment operators and their ratepayers, irrigators, recreationalists, downstream property owners, and fishermen.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of reduced sedimentation would also affect the economic benefit estimate described here. Several factors suggest that the value of sediment we use underestimates the true value of the sediment-reduction benefits. First, the value does not reflect many potential benefits, such as the goods and services derived from potential impacts on riparian habitat and endangered species. Second, this estimate does not anticipate increases in value that occur over time. We anticipate that the value of some of the sediment-reduction benefits identified above will increase, relative to the general price index, but have not accounted for this increase in our calculations.

### 4. Passive use value associated with enhanced and increased riparian habitat

**Relevant change.** Both the Russian River *Arundo* removal project and Denmark Creek Riparian Restoration project would contribute to improvements in riparian habitat. In the Russian River *Arundo* removal project, MCRCD would work with agricultural operators to remove large patches of *Arundo* and restore the area with native plantings over a three-year period, particularly in areas where bank erosion is a concern. The total riparian habitat benefit from this component of the project is 0.5 acres. In the Denmark Creek Riparian Restoration project, MCRCD will stabilize stream banks and re-vegetate them with native California trees and shrubs irrigated with Driwater, seeded with native erosion control seed mix, and mulched with weed-free rice straw. The total riparian habitat benefit from this component of the project is 0.3 acres. The total physical benefit from the project associated with enhanced and improved riparian habitat is 0.8 acres. We assume that neither the *Arundo*-infested riparian area nor the eroded banks of Denmark Creek are providing any habitat of ecological value, and after restoration they would provide at least average value, increasing in function over time as vegetation matures.

**Evidence for demand and economic value.** In their cost benefit analysis, the California Invasive Plant Council uses a value of $25,000 per acre for the benefit of habitat enhancement and restoration that occurs when *Arundo* is controlled between Monterey and San Diego (Giessow

et al. 2011). This value represents the approximate cost of restoring equivalent acres of riparian habitat in Southern California, not including land acquisition costs. While this value may be reasonable, it is not based on restoration costs for equivalent habitat in the Russian River area.

Thus, instead we employ a value that accounts for people's willingness to pay for the flow of goods and services from an acre of forested riparian habitat. In 2009, researchers conducted several meta-analyses estimating various use and nonuse values associated with forestland. In estimating the passive use value of forestland, the researchers compiled data from 23 relevant studies (Chiabai et al. 2009). Their results identify per-acre estimates for passive use values by geographic region and forest biome. For our analysis, we use the passive use value associated with North American forestland in the cool coniferous biome, $125 per acre per year. Once habitat reaches maturity, after 15 years, the undiscounted value of this benefit is $100 per year.

**Timing and duration.** Project proponents expect to complete the culvert removal and streambank stabilization and revegetation within 18 months after the project start date in November of 2013. Likewise, project proponents expect to complete *Arundo* eradication and riparian restoration by November of 2015. To reduce the risk that we overestimate this benefit, we therefore assume the project would begin accruing benefits related to improvements in riparian habitat in 2016. These benefits likely would increase over time, as restoration matures, and would persist over the long run (at least 50 years).

**Beneficiaries.** The beneficiaries of this benefit are the people of California who value enhanced riparian habitat in the Russian River and Denmark Creek.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of the riparian habitat created would also affect the economic benefit estimate described here. The value described above estimates society's total willingness to pay for fully-restored forest land in cool coniferous forests in North America. Insofar as this estimate considers only passive use values, it likely underestimates the total economic value of riparian and other forest-based restoration because direct users of the restored habitat likely are willing to pay more for its restoration. It also likely underestimates the value because, as human populations and incomes grow in California, the marginal value of forest land probably will increase, as will the value of restoration efforts. Because we found no reliable estimate of the rate of increase, we did not fold this increase into our estimates. For these reasons, it seems reasonable to conclude that the value estimates derived in the past underestimate, perhaps substantially, the true value of future increases in fully-restored riparian and other forest habitat.

Finally, to the extent that the Russian River *Arundo* removal project also prevents the further proliferation of this invasive species downstream, the economic value of the benefit presented above may represent an underestimate of the true value of this benefit. In particular, there are two properties along the mainstem of the Russian River that are currently participating in an *Arundo* eradication effort and the Sotoyome RCD has an active *Arundo* eradication program in Sonoma County. By minimizing the number of viable *Arundo* stems floating downstream during

storm events, this project would may improve the viability of these downstream projects, creating additional riparian habitat benefits.

Table 15.1-320 – Annual Benefit: Avoided Emergency Repair (Culvert Failure)
(All benefits should be in 2012 dollars)

Project: 320 - Mendocino County Resource Conservation District, Working Landscapes Riparian Enhancement Project

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Avoided damage from culvert failure | probability of failure | 5% | 5% | 0% | $ 75,000.00 | $ - | 1.000 | $ - |
| 2013 | Avoided damage from culvert failure | probability of failure | 5% | 5% | 0% | $ 75,000.00 | $ - | 0.943 | $ - |
| 2014 | Avoided damage from culvert failure | probability of failure | 5% | 5% | 0% | $ 75,000.00 | $ - | 0.890 | $ - |
| 2015 | Avoided damage from culvert failure | probability of failure | 0% | 5% | 5% | $ 75,000.00 | $ 3,750.00 | 0.840 | $ 3,149 |
| 2016 | Avoided damage from culvert failure | probability of failure | 0% | 5% | 5% | $ 75,000.00 | $ 3,750.00 | 0.792 | $ 2,970 |
| 2017 | Avoided damage from culvert failure | probability of failure | 0% | 5% | 5% | $ 75,000.00 | $ 3,750.00 | 0.747 | $ 2,802 |
| 2018 | Avoided damage from culvert failure | probability of failure | 0% | 5% | 5% | $ 75,000.00 | $ 3,750.00 | 0.705 | $ 2,644 |
| 2019 | Avoided damage from culvert failure | probability of failure | 0% | 5% | 5% | $ 75,000.00 | $ 3,750.00 | 0.665 | $ 2,494 |
| 2020 | Avoided damage from culvert failure | probability of failure | 0% | 5% | 5% | $ 75,000.00 | $ 3,750.00 | 0.627 | $ 2,353 |
| 2021 | Avoided damage from culvert failure | probability of failure | 0% | 5% | 5% | $ 75,000.00 | $ 3,750.00 | 0.592 | $ 2,220 |
| 2022 | Avoided damage from culvert failure | probability of failure | 0% | 5% | 5% | $ 75,000.00 | $ 3,750.00 | 0.558 | $ 2,094 |
| 2023 | Avoided damage from culvert failure | probability of failure | 0% | 5% | 5% | $ 75,000.00 | $ 3,750.00 | 0.527 | $ 1,975 |
| 2024 | Avoided damage from culvert failure | probability of failure | 0% | 5% | 5% | $ 75,000.00 | $ 3,750.00 | 0.497 | $ 1,864 |
| 2025 | Avoided damage from culvert failure | probability of failure | 0% | 5% | 5% | $ 75,000.00 | $ 3,750.00 | 0.469 | $ 1,758 |
| 2026 | Avoided damage from culvert failure | probability of failure | 0% | 5% | 5% | $ 75,000.00 | $ 3,750.00 | 0.442 | $ 1,659 |
| 2027 | Avoided damage from culvert failure | probability of failure | 0% | 5% | 5% | $ 75,000.00 | $ 3,750.00 | 0.417 | $ 1,565 |
| 2028 | Avoided damage from culvert failure | probability of failure | 0% | 5% | 5% | $ 75,000.00 | $ 3,750.00 | 0.394 | $ 1,476 |
| 2029 | Avoided damage from culvert failure | probability of failure | 0% | 5% | 5% | $ 75,000.00 | $ 3,750.00 | 0.371 | $ 1,393 |
| 2030 | Avoided damage from culvert failure | probability of failure | 0% | 5% | 5% | $ 75,000.00 | $ 3,750.00 | 0.350 | $ 1,314 |
| 2031 | Avoided damage from culvert failure | probability of failure | 0% | 5% | 5% | $ 75,000.00 | $ 3,750.00 | 0.331 | $ 1,239 |
| 2032 | Avoided damage from culvert failure | probability of failure | 0% | 5% | 5% | $ 75,000.00 | $ 3,750.00 | 0.312 | $ 1,169 |
| | | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | $ 36,137 |

Comments: The cost of emergency costs and property damage is estimated to be $75,000 and would only occur once, but timing is indeterminant.

Table 15.2-320 – Annual Benefit: Reduced Road Maintenance
(All benefits should be in 2012 dollars)

Project: 320 - Mendocino County Resource Conservation District, Working Landscapes Riparian Enhancement Project

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | | | | | 0 | | $ - | 1.000 | $ - |
| 2013 | | | | | 0 | | $ - | 0.943 | $ - |
| 2014 | | | | | 0 | | $ - | 0.890 | $ - |
| 2015 | | | | | 0 | | $ - | 0.840 | $ - |
| 2016 | | | | | 0 | | $ - | 0.792 | $ - |
| 2017 | Avoided Road Maintenance | dollars | 0 | 500 | 500 | $ 1.00 | $ 500.00 | 0.747 | $ 374 |
| | | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | $ 374 |

Comments: Road maintenance is currently required once every 5 years. The project would avoide one such required maintenance.

Table 15.3-320 – Annual Benefit: Reduced Sediment Deposition

(All benefits should be in 2012 dollars)

Project: 320 - Mendocino County Resource Conservation District, Working Landscapes Riparian Enhancement Project

| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
|---|---|---|---|---|---|---|---|---|---|
| Year | Type of Benefit | Measure of Benefit (Units) | Without Project | With Project | Change Resulting from Project (e) – (d) | Unit $ Value | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Reduced chance of downstream sediment | Reduced probability | 5% | 5% | 0% | $ 73,728.00 | $ - | 1.000 | $ - |
| 2013 | Reduced chance of downstream sediment | Reduced probability | 5% | 5% | 0% | $ 73,728.00 | $ - | 0.943 | $ - |
| 2014 | Reduced chance of downstream sediment | Reduced probability | 5% | 5% | 0% | $ 73,728.00 | $ - | 0.890 | $ - |
| 2015 | Reduced chance of downstream sediment | Reduced probability | 0% | 5% | 5% | $ 73,728.00 | $ 3,686.40 | 0.840 | $ 3,095 |
| 2016 | Reduced chance of downstream sediment | Reduced probability | 0% | 5% | 5% | $ 73,728.00 | $ 3,686.40 | 0.792 | $ 2,920 |
| 2017 | Reduced chance of downstream sediment | Reduced probability | 0% | 5% | 5% | $ 73,728.00 | $ 3,686.40 | 0.747 | $ 2,755 |
| 2018 | Reduced chance of downstream sediment | Reduced probability | 0% | 5% | 5% | $ 73,728.00 | $ 3,686.40 | 0.705 | $ 2,599 |
| 2019 | Reduced chance of downstream sediment | Reduced probability | 0% | 5% | 5% | $ 73,728.00 | $ 3,686.40 | 0.665 | $ 2,452 |
| 2020 | Reduced chance of downstream sediment | Reduced probability | 0% | 5% | 5% | $ 73,728.00 | $ 3,686.40 | 0.627 | $ 2,313 |
| 2021 | Reduced chance of downstream sediment | Reduced probability | 0% | 5% | 5% | $ 73,728.00 | $ 3,686.40 | 0.592 | $ 2,182 |
| 2022 | Reduced chance of downstream sediment | Reduced probability | 0% | 5% | 5% | $ 73,728.00 | $ 3,686.40 | 0.558 | $ 2,058 |
| 2023 | Reduced chance of downstream sediment | Reduced probability | 0% | 5% | 5% | $ 73,728.00 | $ 3,686.40 | 0.527 | $ 1,942 |
| 2024 | Reduced chance of downstream sediment | Reduced probability | 0% | 5% | 5% | $ 73,728.00 | $ 3,686.40 | 0.497 | $ 1,832 |
| 2025 | Reduced chance of downstream sediment | Reduced probability | 0% | 5% | 5% | $ 73,728.00 | $ 3,686.40 | 0.469 | $ 1,728 |
| 2026 | Reduced chance of downstream sediment | Reduced probability | 0% | 5% | 5% | $ 73,728.00 | $ 3,686.40 | 0.442 | $ 1,630 |
| 2027 | Reduced chance of downstream sediment | Reduced probability | 0% | 5% | 5% | $ 73,728.00 | $ 3,686.40 | 0.417 | $ 1,538 |
| 2028 | Reduced chance of downstream sediment | Reduced probability | 0% | 5% | 5% | $ 73,728.00 | $ 3,686.40 | 0.394 | $ 1,451 |
| 2029 | Reduced chance of downstream sediment | Reduced probability | 0% | 5% | 5% | $ 73,728.00 | $ 3,686.40 | 0.371 | $ 1,369 |
| 2030 | Reduced chance of downstream sediment | Reduced probability | 0% | 5% | 5% | $ 73,728.00 | $ 3,686.40 | 0.350 | $ 1,292 |
| 2031 | Reduced chance of downstream sediment | Reduced probability | 0% | 5% | 5% | $ 73,728.00 | $ 3,686.40 | 0.331 | $ 1,218 |
| 2032 | Reduced chance of downstream sediment | Reduced probability | 0% | 5% | 5% | $ 73,728.00 | $ 3,686.40 | 0.312 | $ 1,149 |
| 2033 | Reduced chance of downstream sediment | Reduced probability | 0% | 5% | 5% | $ 73,728.00 | $ 3,686.40 | 0.294 | $ 1,084 |
| 2034 | Reduced chance of downstream sediment | Reduced probability | 0% | 5% | 5% | $ 73,728.00 | $ 3,686.40 | 0.278 | $ 1,025 |
| | | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | $ 36,608 |

Comments: The culvert is likely to fail in the 20 years between 2013-2032. When this occurs, it would deliver 7,172 tons of sediment to the stream at a cost of $10.28 per ton.

Table 15.4-320 – Annual Benefit: Riparian Habitat
(All benefits should be in 2012 dollars)

Project: 320 - Mendocino County Resource Conservation District, Working Landscapes Riparian Enhancement Project

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Increased Riparian Habitat | Acres | 0 | 0 | 0 | $ 125.00 | $ - | 1.000 | $ - |
| 2013 | Increased Riparian Habitat | Acres | 0 | 0 | 0 | $ 125.00 | $ - | 0.943 | $ - |
| 2014 | Increased Riparian Habitat | Acres | 0 | 0 | 0 | $ 125.00 | $ - | 0.890 | $ - |
| 2015 | Increased Riparian Habitat | Acres | 0 | 0 | 0 | $ 125.00 | $ - | 0.840 | $ - |
| 2016 | Increased Riparian Habitat | Acres | 0 | 0.06 | 0.06 | $ 125.00 | $ 7.14 | 0.792 | $ 6 |
| 2017 | Increased Riparian Habitat | Acres | 0 | 0.11 | 0.11 | $ 125.00 | $ 14.29 | 0.747 | $ 11 |
| 2018 | Increased Riparian Habitat | Acres | 0 | 0.17 | 0.17 | $ 125.00 | $ 21.43 | 0.705 | $ 15 |
| 2019 | Increased Riparian Habitat | Acres | 0 | 0.23 | 0.23 | $ 125.00 | $ 28.57 | 0.665 | $ 19 |
| 2020 | Increased Riparian Habitat | Acres | 0 | 0.29 | 0.29 | $ 125.00 | $ 35.71 | 0.627 | $ 22 |
| 2021 | Increased Riparian Habitat | Acres | 0 | 0.34 | 0.34 | $ 125.00 | $ 42.86 | 0.592 | $ 25 |
| 2022 | Increased Riparian Habitat | Acres | 0 | 0.40 | 0.40 | $ 125.00 | $ 50.00 | 0.558 | $ 28 |
| 2023 | Increased Riparian Habitat | Acres | 0 | 0.46 | 0.46 | $ 125.00 | $ 57.14 | 0.527 | $ 30 |
| 2024 | Increased Riparian Habitat | Acres | 0 | 0.51 | 0.51 | $ 125.00 | $ 64.29 | 0.497 | $ 32 |
| 2025 | Increased Riparian Habitat | Acres | 0 | 0.57 | 0.57 | $ 125.00 | $ 71.43 | 0.469 | $ 33 |
| 2026 | Increased Riparian Habitat | Acres | 0 | 0.63 | 0.63 | $ 125.00 | $ 78.57 | 0.442 | $ 35 |
| 2027 | Increased Riparian Habitat | Acres | 0 | 0.69 | 0.69 | $ 125.00 | $ 85.71 | 0.417 | $ 36 |
| 2028 | Increased Riparian Habitat | Acres | 0 | 0.74 | 0.74 | $ 125.00 | $ 92.86 | 0.394 | $ 37 |
| 2029 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.371 | $ 37 |
| 2030 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.350 | $ 35 |
| 2031 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.331 | $ 33 |
| 2032 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.312 | $ 31 |
| 2033 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.294 | $ 29 |
| 2034 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.278 | $ 28 |
| 2035 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.262 | $ 26 |
| 2036 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.247 | $ 25 |
| 2037 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.233 | $ 23 |
| 2038 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.220 | $ 22 |
| 2039 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.207 | $ 21 |
| 2040 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.196 | $ 20 |
| 2041 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.185 | $ 18 |
| 2042 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.174 | $ 17 |
| 2043 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.164 | $ 16 |
| 2044 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.155 | $ 15 |
| 2045 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.146 | $ 15 |
| 2046 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.138 | $ 14 |
| 2047 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.130 | $ 13 |
| 2048 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.123 | $ 12 |
| 2049 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.116 | $ 12 |
| 2050 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.109 | $ 11 |
| 2051 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.103 | $ 10 |
| 2052 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.097 | $ 10 |
| 2053 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.092 | $ 9 |
| 2054 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.087 | $ 9 |
| 2055 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.082 | $ 8 |
| 2056 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.077 | $ 8 |
| 2057 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.073 | $ 7 |
| 2058 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.069 | $ 7 |
| 2059 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.065 | $ 6 |
| 2060 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.061 | $ 6 |
| 2061 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.058 | $ 6 |
| 2062 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.054 | $ 5 |
| 2063 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.051 | $ 5 |
| 2064 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.048 | $ 5 |
| 2065 | Increased Riparian Habitat | Acres | 0 | 0.80 | 0.8 | $ 125.00 | $ 100.00 | 0.046 | $ 5 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 856 |

Comments: The Arundo project would contribute 0.5 acres, the Denmark component would contribute 0.3 acres. This benefits linearly increases to the max of 0.8 functional acres over the first 15 years after project completion to account for the time it takes for habitat to grow.

## Section D3. Project Costs

The present value of the project's costs, which would occur between 2012 and 2014, is $369,908 in 2012 dollars, discounted at a 6-percent annual rate. These costs would fund labor, planning, equipment, and materials necessary to implement the project.[9]

Table 19-320 – Annual Costs of Project
(All costs should be in 2012 Dollars)

Project: 320 - Mendocino County Resource Conservation District, Working Landscapes Riparian Enhancement Project

| | Initial Costs Grand Total Cost from Table 7 (row (i), column (d)) | Adjusted Grant Total Cost | 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 | $ 26,548 | | $ - | $ - | $ - | $ - | | $ 26,548 | 1.000 | $ 26,548 |
| 2013 | $ 11,006 | | $ 1,000 | $ - | $ - | $ - | | $ 12,006 | 0.943 | $ 11,326 |
| 2014 | $ 170,342 | | $ 5,000 | $ 151,000 | $ - | $ - | | $ 326,342 | 0.890 | $ 290,443 |
| 2015 | $ - | | $ 1,000 | $ 12,038 | $ 4,772 | $ 3,672 | $ 2,907 | $ 24,389 | 0.840 | $ 20,477 |
| 2016 | $ - | | $ 4,478 | $ 12,037 | $ 4,700 | $ - | $ 5,440 | $ 26,655 | 0.792 | $ 21,113 |
| | | | | | | | | Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries | | $ 369,908 |

Comments:

[9] We have distributed the costs outlined Table 7 across the project's implementation period based on the expected timing and phasing described in the Work Plan. Actual distribution of costs during this period may differ somewhat.

## 522. *Gualala River Watershed Council*, Sediment Reduction Program: Lower Rockpile Creek Planning Watershed

### Conditions Without the Project

The USEPA Clean Water Act §303(d) lists the Gualala River as an impaired water body due to excessive sedimentation and high water temperature, which has resulted in declines in salmonid populations. In 2003 the Gualala River Technical Support Document (TSD) estimated that the Gualala River watershed's present erosion rate was 1,220 t/mi$^2$/yr, with a background erosion rate of 380 t/mi$^2$/yr. Newer sediment source assessments conducted at the scale of planning watersheds in the Gualala are consistent with the TSD finding . The Gualala River TSD finds that road-related erosion accounts for 58 percent of the total estimated watershed erosion rate and 85 percent of the anthropogenic portion of the estimated erosion rate.

In the 1990s a local coalition of restoration organizations, environmental groups, stakeholders, and state and federal agencies formed the Gualala River Watershed Council (GRWC) in response to the Clean Water Act §303(d) listing. Its board includes nine members who represent landowners, the community at large, and community organizations.

Both the Gualala River TMDL and the GRWC have the mutual goals of lowering sediment load to 25 percent above the background erosion level (475 t/mi$^2$/year). The Gualala River Reduction Program, established by stakeholders in the watershed, is a cooperative effort to implement basin-wide sediment reduction strategies in a coordinated way that prioritizes projects to most effectively attain TMDL limits.

### Conditions With the Project

The project partners the Gualala River Watershed Council with landowners to treat sediment sources on high and medium priority road networks to prevent sediment from entering the watercourses in the Lower Rockpile basin, a highly erosive area with excessively high in-stream sediment deposits in the Gualala River Watershed.

By following industry standards, roads can be 95 percent hydrologically disconnected from streams, reducing delivery of sediment from road sources by as much as 95 percent and potentially decreasing the human-caused erosion by 80 percent.

With the project, the GRWC will replace 16 aging culverts, all of which would likely fail in the next ten years, with new culverts with a design life to meet current standards of 100 years. In addition, with the project, GRWC will restore 11 miles of road and decommission 1 mile of road.

### Section D2. Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient data are unavailable to quantify in physical terms, monetary terms, or both. Table 12-522 summarizes the non-monetary benefits of this project. We describe these benefits in more detail below the table.

| Table 12-522 – Non-monetized Benefits Checklist<br>*Gualala River Watershed Council, Sediment Reduction Program: Lower Rockpile Creek Planning Watershed* | | |
|---|---|---|
| *No.* | *Will the proposal…* | *Response[1]* |
| **Community/Social Benefits** | | |
| 1 | Provide education or technology benefits? | No |
| 2 | Provide social recreation or access benefits? Enhance the value of sportfishing | Yes |
| 3 | Help avoid, reduce or resolve various public water resources conflicts? | No |
| 4 | Promote social health and safety? | No |
| 5 | Have other social benefits? Cultural importance associated with increases in salmon populations | Yes |
| **Environmental Stewardship Benefits** | | |
| 6 | Benefit wildlife or habitat in ways that were not quantified in Attachment 7? Passive-use value associated with improved salmonid populations | Yes |
| 7 | Improve water quality in ways that were not quantified in Attachment 7? | No |
| 8 | Reduce net emissions in ways that were not quantified in Attachment 7? | No |
| 9 | Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4? | No |
| **Sustainability Benefits** | | |
| 10 | Improve the overall, long-term management of California groundwater resources? | No |
| 11 | Reduce demand for net diversions for the regions from the Delta? | No |
| 12 | Provide a long-term solution in place of a short-term one? | No |
| 13 | Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources? | No |
| 14 | Improve water supply reliability in ways not quantified in Attachment 7? | No |
| 15 | Other (If the above listed categories do not apply, provide non-monetized benefit description)? | No |

Notes: [1] A "no" response may mean the project does not produce this benefit, or it may mean the benefit is already quantified in Attachment 7, or monetized directly under Section D3 below.

## 2. Provide social recreation or access benefits: Enhance the value of sportfishing

**Relevant change.** Project proponents anticipate an increase in the quality or quantity of sport fishing in the area as a result of the project. By reducing sediment, restoring riparian habitat, and improving habitat for aquatic species on 12.9 miles of blue line streams, the project would help remediate impacts of declines in salmonid populations and restore recreational fisheries (see non-monetized benefit #6 benefit wildlife and habitat for more information).

**Evidence for demand and economic value.** There is demand for recreational sport fishing in the Gualala. Between 2003 and 2005, there were 316 steelhead fishing trips to the Gualala River and recreational angling in the Gualala River accounted for nearly 2 percent of the total statewide effort (Jackson and Manji 2007). The increases in steelhead populations in the Gualala River as a result of the project would provide economic benefits if they:

- improved the recreational experience for anglers who already fish the Gualala, by increasing the catch success rate or otherwise enhancing fishing conditions
- attracted new anglers who wouldn't have otherwise visited another site

- attracted anglers who would have visited another site, but choose the Gualala River because it better-satisfies their preferences for angling or reduces their travel costs

Quantifying the extent to which any of these effects would occur is difficult, given that data are unavailable to quantify the increase in fish populations that would result from the project or the increase in quality of recreational experiences on the Gualala River.

Another source of value comes from people who don't sport fish in the Gualala River, but are willing to pay to have the option of using it at some point in the future, if they choose. Data are not available to determine if this "option value" is an important component of the value fishery improvements in the Gualala, but given that it is a popular destination for sport fishers, it is plausible that this would be a source of value.

**Timing and duration.** The project would begin delivering benefits after the first winter of project completion, in 2014, but project proponents note that sediment reductions from the project would begin delivering appreciable benefits to salmonid habitat over a 10 to 20-year horizon. In combination with other habitat restoration efforts, including the in-stream large wood projects, project proponents estimate the benefits related to fish population increases would occur within 5 years, in 2018. These ecological benefits are likely to persist over the long-run (at least the next 50 years).

**Beneficiaries.** Anyone who recreates or visits the area, or who would value the opportunity to recreate or visit the area at some point in the future would benefit from the recreational aspects of the project.

**Sources of uncertainty.** Uncertainty associated with increases in salmonid populations involves the extent to which the project alone confers enough biophysical benefit to result in increased salmon populations given circumstances beyond the project proponent's control, such as weather changes due to climate change or changes in ocean conditions that affect adult salmonid populations during the ocean phase of their life cycle. The value of improvements in sportfishing associated with the improved recreational fisheries in the Gualala River depend on the demand from potential recreationalists, as well as the characteristics of the supply of recreational opportunities in the area. Both of these variables have the potential to change over time and affect the value of the benefit.

### 5. Have other social benefits: Cultural importance associated with increases in salmon populations

**Relevant change.** By reducing sediment, restoring riparian habitat, and improving habitat for aquatic species on 12.9 miles of blue line streams, the project would likely enhance salmonid populations in the Gualala River (see non-monetize benefit #6 benefit wildlife and habitat for more detail).

**Evidence for demand and economic value.** The Native American tribes of Northern California have a special relationship with salmon, relying on the fish for subsistence, cultural identity, and spiritual significance (Norgaard 2005). Unlike many Californians who ascribe a monetary willingness to pay to protect salmon, even if they never intend to directly fish or watch them, many Native Americans recognize the importance of salmon outside the cultural framework and economic terms western society often imposes (Malloy 1992). Accordingly, they reject the validity of applying a dollar value to fish that constitute a core element of their cultural and spiritual well-being. For this reason, we recognize the cultural significance that arises from the projects' improvements to salmonid populations and their habitat apart from the quantified passive-use value or other measures of economic benefits.

**Timing and duration.** The project would begin delivering benefits after the first winter of project completion, in 2014, but project proponents note that sediment reductions from the project would begin delivering appreciable benefits to salmonid habitat over a 10 to 20-year horizon. In combination with other habitat restoration efforts, including the in-stream large wood projects, project proponents estimate the benefits related to fish population increases would occur within 5 years, in 2018. These ecological benefits are likely to persist over the long-run (at least the next 50 years).

**Beneficiaries.** The beneficiaries of this benefit would include members of Native American tribes – both within and outside of the region – who believe the continued existence of salmonid populations and their habitat is essential to cultural and spiritual well-being.

**Sources of uncertainty.** Uncertainty associated with increases in salmonid populations involves the extent to which the project alone confers enough biophysical benefit to result in increased salmon populations given circumstances beyond the project proponent's control, such as weather changes due to climate change or changes in ocean conditions that affect adult salmonid populations during the ocean phase of their life cycle.

### 6. Benefit wildlife or habitat: <u>Passive-use value associated with improved salmonid populations</u>

**Relevant change.** By removing sediment, restoring riparian habitat, and improving habitat for aquatic species on 12.9 miles of blue line streams,[10] the project would directly benefit salmonid habitat on blue line streams. In particular, sediment from poorly constructed roads systems are causing aggradations in Rockpile Creek, increasing subsurface flows and stream dewatering.

The project improves water quality and quantity by lowering sediment inputs and suspended sediment loads allowing for increased pool depth and formation, increasing cold-water habitat, reducing thermal escarpment, and increasing channel complexity and depth. These changes

[10] "Blue-line stream" are those streams that appear as a broken or solid blue line (or a purple line) on a USGS topographic map.

would promote spawning migration, increase the quality of spawning gravels, and improve habitat for juvenile salmonid migration. Quantifying the benefits attributable to this project in biophysical or economic terms, however, is impossible given the lack of relevant data.

In addition to this non-monetized benefit, we also quantify the economic value of the project for the related riparian habit, in monetized benefit #4 (Passive use value associated with enhanced and improved riparian habitat), below.

**Evidence for demand and economic value.** Individuals derive value from increases in salmon and steelhead populations in two ways: some (e.g., recreational anglers and commercial fishermen) directly interact with salmon and steelhead populations and derive benefit by catching and consuming the fish, others (including some from the former group) derive value from the fish solely based on the salmon and steelhead's existence. Studies have shown that regardless of direct interaction with fish populations, many Californians hold a positive willingness to pay to ensure the long-term survival of salmon and steelhead (Pate and Loomis 1997).

Several studies have attempted to estimate the passive use value of increases in salmon and steelhead populations among households in California and neighboring states. Passive use value, in this case, refers to the benefit individuals derive from knowing that healthy salmon and steelhead populations exist, regardless of their intent to directly interact with salmon and steelhead through fishing or some other means. In general, these studies have estimated households' average willingness to pay to implement policies that would increase salmon and steelhead populations. At the per fish level, these studies reveal that households are willing to pay only fractions of a penny for increases in salmon populations. When summed across a region, however, the total value Californians are willing to pay for increases in fish populations is considerable. Applying the results of two studies that have estimated willingness to pay values for increases in salmon and steelhead populations suggest that Californians, in total, would be willing to pay between $497 (Olsen, Richards, and Scott 1991) and $4,351 (Loomis 1996) per fish.[11]

Biophysical data are not available to estimate the increase in salmon, so we are unable to quantify this benefit in monetary terms.

**Timing and duration.** The project would begin delivering benefits after the first winter of project completion, in 2014, but project proponents note that sediment reductions from the project would begin delivering appreciable benefits to salmonid habitat over a 10 to 20-year horizon. In combination with other habitat restoration efforts, including the in-stream large wood projects, project proponents estimate the benefits related to fish population increases would occur within 5 years, in 2018. These ecological benefits are likely to persist over the long-run (at least the next 50 years).

[11] This is based on about 12.4 million households in California (U.S. Census Bureau 2007-2011).

**Beneficiaries.** The beneficiaries of this benefit are the people of California who value the continued existence of aquatic wildlife and habitat, particularly critical habitat for juvenile salmonids.

**Sources of uncertainty.** Uncertainty associated with increases in salmonid populations involves the extent to which the project alone confers enough biophysical benefit to result in increased salmon populations given circumstances beyond the project proponent's control, such as weather changes due to climate change or changes in ocean conditions that affect adult salmonid populations during the ocean phase of their life cycle. There is also uncertainty associated with the marginal economic value of increases in fish populations described above. The results from the studies listed above depend crucially on survey methodology and public perceptions on the current state of salmonid populations. Of the studies listed, three were conducted in the Pacific Northwest, which may over or underestimate Californians' willingness to pay for salmon.

## Section D3. Monetized Benefits Analysis

The present value of the monetized benefits in 2012 dollars, discounted annually at 6 percent over the relevant lifespan of each component of the project (described for each benefit below), is $543,091. The calculations for each monetized benefit are shown in Tables 15-1, 15-2, 15-3, and 15-4 at the end of this section.

### 1. Avoided costs associated with reduced sediment deposition

**Relevant change.** By treating sediment sources on high and medium priority road networks the project would prevent 25,827 cubic yards of sediment (or 1,464 tons per year) from entering 12.9 miles of watercourses in the Lower Rockpile basin, a highly erosive area with excessively high in-stream sediment deposits in the Gualala River Watershed.

**Evidence for demand and economic value.** Economic studies have examined and monetized some of the costs that materialize when excessive sediment impairs streams, rivers, estuaries, and the marine environment. A study conducted by the U.S. Department of Agriculture identified 13 types of costs that sediment abatement projects can reduce (Hansen and Ribaudo 2008). The researchers then modeled the potential value associated with reducing sediment, per ton, for each watershed across the country. For our analysis, we apply the average value for the counties in the Gualala River watershed, $7.80 per ton, to estimate the benefits derived from the prevention of sediment deposition. Included in this value are the regional benefits associated with the impacts of sediment on:

- Water-based recreation – cleaner fresh water recreation
- Irrigation ditches and channels – reduced cost of removing sediment and aquatic plants from irrigation channels
- Road drainage ditches – less damage to and flooding of roads
- Municipal water treatment – lower sediment-removal costs for water treatment plants

- Flood damage – reduced flooding and damage from flooding
- Marine fisheries – improved catch rates for marine commercial fisheries
- Marine recreational fishing – improved catch rates for marine recreational fishing
- Municipal and industrial water use – reduced damages from salts and minerals dissolved from sediment
- Soil productivity – reduced losses in soil productivity
- Dust cleaning – decrease in cleaning due to reduced wind-borne particulates.
- Reservoir services – less sediment in reservoirs
- Navigation – shipping industry avoidance of damages from groundings

There is evidence to suggest there is significant local demand for sediment reduction activities in the Gualala River watershed. Scientific and technical reports related to the Gualala consistently recommend three priority management strategies to enhance the beneficial uses and improve watershed: (1) reduce upslope NPS sediment inputs through road upgrades, repairs and decommissioning; (2) increase instream habitat through sediment reduction and large woody debris placement; and (3) continue and expand the Cal EPA approved GRWC monitoring program to increase understanding of the watershed processes and evaluate resource management strategies.

Moreover, the Gualala River Watershed Council, in itself, represents evidence for local demand for sediment reduction. In the 1990s a local coalition of restoration organizations, environmental groups, stakeholders, and state and federal agencies formed the GRWC in response to the Clean Water Act §303(d) listing. Its board includes nine members who represent landowners, the community at large, and community organizations.

The annual undiscounted value of this benefit is $11,419.

**Timing and duration.** Implementing erosion prevention and storm-proofing exhibit immediate benefits to in terms of sediment reduction. As a result, project proponents expect the project to begin delivering sediment reduction benefits within the first year of completion of the project, 2015. These benefits will accrue for the lifespan of the project, 10 years, until 2024.

**Beneficiaries.** The beneficiaries of this benefit are the wide array of downstream users associated with each of the benefits listed above. To some extent, these beneficiaries include the general public, municipal water treatment operators and their ratepayers, irrigators, recreationalists, downstream property owners, and fishermen.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of reduced sedimentation would also affect the economic benefit estimate described here. See Attachment 7 for a description of these biophysical sources of uncertainty.

Several factors suggest that the value of sediment we use underestimates the true value of the sediment-reduction benefits. First, the value does not reflect many potential benefits, such as

the goods and services derived from potential impacts on riparian habitat and endangered species. Second, the estimates of sediment erosion that the projects would reduce are based on current sediment erosion rates. Climate change is expected to increase the frequency and intensity of storm events, which would likely increase the rate of sediment erosion absent the projects (Masden and Figdor 2007). If future sediment erosion rates exceed current rates, the without-project sediment erosion is likely to increase, and thus, the expected benefit of each project's sediment control activities is likely to be an underestimate. Third, this estimate does not anticipate increases in value that occur over time. We anticipate that the value of sediment-reduction benefits will increase, relative to the general price index, but have not accounted for this increase in our calculations. Finally, for the reasons listed above, the evidence points to strong local demand for sediment reduction activities in the Gualala River watershed. To the extent that local residents would benefit from these sediment reduction activities beyond those listed above, our value represents an underestimate of the true value of this benefit.

## 2. Avoided emergency repair costs associated with culvert failures

**Relevant change.** With the project, GRWC will replace 16 aging culverts, all of which project proponents expect to fail within the next 10 years. For the purposes of this analysis, we assume that, without the project, the culverts would fail within the next 10 years, with an annual probability of failure of 10 percent. With the project, the culverts will meet current design standards with an expected project lifespan of 100 years, which implies an annual probability of failure of 1 percent. The change in probability of failure attributable to the project is, therefore, 9 percent.

**Evidence for demand and economic value.** The project would install 16 culverts at a cost of $160,000 (a cost per culvert of $10,000). Assuming there would be no additional costs associated with replacing a culvert when it fails, rather than beforehand, this value provides a reliable estimate for the replacement cost of these culverts. Accounting for the annual probability of the culvert's failure, the annual undiscounted expected value of this benefit is $14,490.

**Timing and duration.** Project proponents expect to complete the culvert removal and replacement by October of 2015. We therefore assume the project would begin conferring benefits related to the avoided cost associated with a reduced probability of culvert failure in 2016. This benefit would last for the next ten years, when all of the culverts likely would have failed and been replaced without the project (in 2022).

**Beneficiaries.** The beneficiaries of this benefit are the owners of infrastructure (e.g., roads) dependent on culverts and downstream property owners who would not incur emergency repair costs related to the culvert failure. Some of these beneficiaries may include members of disadvantaged communities, as about fifty percent of the Gualala River Watershed is considered a disadvantaged community with financial support dependent on fishing and timber.

**Sources of uncertainty.** Sources of uncertainty associated with this benefit include the probability of the culvert's failure with the project and the estimate of costs associated with emergency repair and damages. Both estimates are generally conservative. We do not include any estimates of downstream property impacts of culvert failure, nor do we include additional costs related to emergency repair, both of which are likely to materialize given the failure of one or more culvert. To the extent that our estimates lie below the true value of either of these values, we have underestimated this benefit.

### 3. Avoided costs associated with reduced road maintenance

**Relevant change.** The project would restore 11 miles of road and decommission 1 mile of road.

**Evidence for demand and economic value.** Gualala Redwoods, Inc., the owner of these roads, currently pays $2,500 per mile per year to maintain these roads. With the project, Gualala Redwoods, Inc. would pay $300 per mile per year for the restored roads (for an annual avoided cost of $2,200 per mile) and would no longer pay maintenance costs associated with the decommissioned road (for an annual benefit of $2,500 per mile). The annual undiscounted value of this benefit is therefore $26,700.

**Timing and duration.** Project proponents expect to complete the road decommissioning and restoration within by October of 2015. We therefore assume the project would begin accruing benefits related to the avoided cost associated with a reduced road maintenance costs in 2016. These benefits would persist for the design lifespan of the restored roads, 25 years. The road decommissioning costs would likely persist in perpetuity, but we assume the same 25-year lifespan to address uncertainty in the without-project scenario.

**Beneficiaries.** The beneficiary of this benefit is Gualala Redwoods, Inc.

**Sources of uncertainty.** The major source of uncertainty surrounding this benefit comes from the estimate of costs associated with road maintenance activities, especially regarding the assumptions of road maintenance in the future without the project. This assumes these activities would have happened in the way described. To the extent that the roads would have required more maintenance, we are underestimating the cost of the benefit. To the extent that less maintenance would have actually occurred, we overestimate the benefit.

### 4. Passive use value associated with enhanced riparian forest habitat

**Relevant change.** With the project, GRWC would restore 189 acres of existing, but impaired, riparian habitat. The project would improve the riparian habitat by decreasing channel aggradations, which elevate the stream bed and widen the channel, decreasing riparian function and eliminating riparian species, including grasses, willow, and alder. Project proponents expect a healthier riparian habitat will lead to increase in riparian habitat diversity, sediment, chemical and nutrient filter, bank stabilization, moderation of downstream flood peaks through temporary upstream storage of water, and aquifer recharge. We assume the existing habitat

provides 50 percent functionality, and restoration would fully increase its function as it matures over a 15-year period. Once the restoration reaches year 15, the function persists for the long-run, at least 50 years.

**Evidence for demand and economic value.** Economic studies have shown that people are willing to pay for the flow of goods and services from an acre of forested riparian habitat. In 2009, researchers conducted several meta-analyses estimating various use and nonuse values associated with forestland. In estimating the passive use value of forestland, the researchers compiled data from 23 relevant studies (Chiabai et al. 2009). Their results identify per-acre estimates for passive use values by geographic region and forest biome. For our analysis, we use the passive use value associated with North American forestland in the cool coniferous biome, $125 per acre per year.

The restored riparian areas increase in ecological function over time as vegetation matures. Our annual value reflects this steady improvement, using a simple assumption that the quantity of ecological services—and thus people's willingness to pay for them—increases linearly over a 50-year period.

**Timing and duration.** Habitat restoration will be complete within six months of the start date, in early 2015. We assume these benefits begin accruing in that year. These benefits likely would increase over time, as restoration matures, and would persist over the long run (at least 50 years).

**Beneficiaries.** The beneficiaries of this benefit are the people of California who value enhanced riparian habitat in the Gualala River.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of the riparian habitat created would also affect the economic benefit estimate described here. The value described above estimates society's total willingness to pay for fully-restored forest land in cool coniferous forests in North America. Insofar as this estimate considers only passive use values, it likely underestimates the total economic value of riparian and other forest-based restoration because direct users of the restored habitat likely are willing to pay more for its restoration. It also likely underestimates the value because, as human populations and incomes grow in California, the marginal value of forest land probably will increase, as will the value of restoration efforts. Because we found no reliable estimate of the rate of increase, we did not fold this increase into our estimates. For these reasons, it seems reasonable to conclude that the value estimates derived in the past underestimate, perhaps substantially, the true value of future increases in fully-restored riparian and other forest habitat.

| Table 15.1-522 – Annual Benefit: Reduced Sediment Deposition<br>(All benefits should be in 2012 dollars)<br>Project: 522 - Gualala River Watershed Council, Sediment Reduction Program: Lower Rockpile Creek Planning Watershed | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
| Year | Type of Benefit | Measure of Benefit (Units) | Without Project | With Project | Change Resulting from Project (e) – (d) | Unit $ Value | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Reduced sediment | tons | 0 | 0 | 0 | $ 7.80 | $ - | 1.000 | $ - |
| 2013 | Reduced sediment | tons | 0 | 0 | 0 | $ 7.80 | $ - | 0.943 | $ - |
| 2014 | Reduced sediment | tons | 0 | 0 | 0 | $ 7.80 | $ - | 0.890 | $ - |
| 2015 | Reduced sediment | tons | 0 | 1,464 | 1,464 | $ 7.80 | $ 11,419.20 | 0.840 | $ 9,588 |
| 2016 | Reduced sediment | tons | 0 | 1,464 | 1,464 | $ 7.80 | $ 11,419.20 | 0.792 | $ 9,045 |
| 2017 | Reduced sediment | tons | 0 | 1,464 | 1,464 | $ 7.80 | $ 11,419.20 | 0.747 | $ 8,533 |
| 2018 | Reduced sediment | tons | 0 | 1,464 | 1,464 | $ 7.80 | $ 11,419.20 | 0.705 | $ 8,050 |
| 2019 | Reduced sediment | tons | 0 | 1,464 | 1,464 | $ 7.80 | $ 11,419.20 | 0.665 | $ 7,594 |
| 2020 | Reduced sediment | tons | 0 | 1,464 | 1,464 | $ 7.80 | $ 11,419.20 | 0.627 | $ 7,165 |
| 2021 | Reduced sediment | tons | 0 | 1,464 | 1,464 | $ 7.80 | $ 11,419.20 | 0.592 | $ 6,759 |
| 2022 | Reduced sediment | tons | 0 | 1,464 | 1,464 | $ 7.80 | $ 11,419.20 | 0.558 | $ 6,376 |
| 2023 | Reduced sediment | tons | 0 | 1,464 | 1,464 | $ 7.80 | $ 11,419.20 | 0.527 | $ 6,015 |
| 2024 | Reduced sediment | tons | 0 | 1,464 | 1,464 | $ 7.80 | $ 11,419.20 | 0.497 | $ 5,675 |
| Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | | | | | | | | $ 74,801 |
| Comments: Reduced erosion would lead to a reduction of 1,464 tons of sediment per year. | | | | | | | | | |

| Table 15.2-522 – Annual Benefit: Avoided Emergency Repairs (Culvert Failure)<br>(All benefits should be in 2012 dollars)<br>Project: 522 - Gualala River Watershed Council, Sediment Reduction Program: Lower Rockpile Creek Planning Watershed | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
| Year | Type of Benefit | Measure of Benefit (Units) | Without Project | With Project | Change Resulting from Project (e) – (d) | Unit $ Value | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Avoided cost of emergency culvert repair | Reduced probability | 0 | 0 | 0 | $ 161,000.00 | $ - | 1.000 | $ - |
| 2013 | Avoided cost of emergency culvert repair | Reduced probability | 0 | 0 | 0 | $ 161,000.00 | $ - | 0.943 | $ - |
| 2014 | Avoided cost of emergency culvert repair | Reduced probability | 0 | 0 | 0 | $ 161,000.00 | $ - | 0.890 | $ - |
| 2015 | Avoided cost of emergency culvert repair | Reduced probability | 0 | 0 | 0 | $ 161,000.00 | $ - | 0.840 | $ - |
| 2016 | Avoided cost of emergency culvert repair | Reduced probability | 0 | 0.09 | 0.09 | $ 161,000.00 | $ 14,490.00 | 0.792 | $ 11,477 |
| 2017 | Avoided cost of emergency culvert repair | Reduced probability | 0 | 0.09 | 0.09 | $ 161,000.00 | $ 14,490.00 | 0.747 | $ 10,828 |
| 2018 | Avoided cost of emergency culvert repair | Reduced probability | 0 | 0.09 | 0.09 | $ 161,000.00 | $ 14,490.00 | 0.705 | $ 10,215 |
| 2019 | Avoided cost of emergency culvert repair | Reduced probability | 0 | 0.09 | 0.09 | $ 161,000.00 | $ 14,490.00 | 0.665 | $ 9,637 |
| 2020 | Avoided cost of emergency culvert repair | Reduced probability | 0 | 0.09 | 0.09 | $ 161,000.00 | $ 14,490.00 | 0.627 | $ 9,091 |
| 2021 | Avoided cost of emergency culvert repair | Reduced probability | 0 | 0.09 | 0.09 | $ 161,000.00 | $ 14,490.00 | 0.592 | $ 8,577 |
| 2022 | Avoided cost of emergency culvert repair | Reduced probability | 0 | 0.09 | 0.09 | $ 161,001.00 | $ 14,490.09 | 0.558 | $ 8,091 |
| Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | | | | | | | | $ 67,916 |
| Comments: The old culverts had an annual failure chance of 10%, thus guaranteed to fail by 2022. The new culverts have a probability of failure of 1%. In the without project conditions, we assume the culverts would have failed by 2022. | | | | | | | | | |

Table 15.3-522 – Annual Benefit: Reduced Road Maintenance
(All benefits should be in 2012 dollars)

Project: 522 - Gualala River Watershed Council, Sediment Reduction Program: Lower Rockpile Creek Planning Watershed

| (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 | Lump Decommisioned Road Benefit | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2012 | Reduced road maintenace | miles | 11 | 11 | 0 | $ 2,200.00 | $ - | $ - | 1.000 | $ - |
| 2013 | Reduced road maintenace | miles | 11 | 11 | 0 | $ 2,200.00 | $ - | $ - | 0.943 | $ - |
| 2014 | Reduced road maintenace | miles | 11 | 11 | 0 | $ 2,200.00 | $ - | $ - | 0.890 | $ - |
| 2015 | Reduced road maintenace | miles | 11 | 11 | 0 | $ 2,200.00 | $ - | $ - | 0.840 | $ - |
| 2016 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.792 | $ 21,149 |
| 2017 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.747 | $ 19,952 |
| 2018 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.705 | $ 18,822 |
| 2019 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.665 | $ 17,757 |
| 2020 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.627 | $ 16,752 |
| 2021 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.592 | $ 15,804 |
| 2022 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.558 | $ 14,909 |
| 2023 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.527 | $ 14,065 |
| 2024 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.497 | $ 13,269 |
| 2025 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.469 | $ 12,518 |
| 2026 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.442 | $ 11,809 |
| 2027 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.417 | $ 11,141 |
| 2028 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.394 | $ 10,510 |
| 2029 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.371 | $ 9,915 |
| 2030 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.350 | $ 9,354 |
| 2031 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.331 | $ 8,825 |
| 2032 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.312 | $ 8,325 |
| 2033 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.294 | $ 7,854 |
| 2034 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.278 | $ 7,409 |
| 2035 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.262 | $ 6,990 |
| 2036 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.247 | $ 6,594 |
| 2037 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.233 | $ 6,221 |
| 2038 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.220 | $ 5,869 |
| 2039 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.207 | $ 5,537 |
| 2040 | Reduced road maintenace | miles | 0 | 11 | 11 | $ 2,200.00 | $ 2,500.00 | $ 26,700.00 | 0.196 | $ 5,223 |
| | | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 286,575 |

Comments: Without the project, the owner of the road would pay $2,500 per mile to maintain 12 miles of road. With the project, the owner would pay $300 per mile for 11 miles and $0 per mile for one mile (the road which would be decomissioned).

Table 15.4-522 – Annual Benefit: Enhanced Riparian Habitat
(All benefits should be in 2012 dollars)

Project: 522 - Gualala River Watershed Council, Sediment Reduction Program: Lower Rockpile Creek Planning Watershed

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Functional Habitat | Acres | 94.5 | 94.5 | 0 | $ 125.00 | $ - | 1.000 | $ - |
| 2013 | Functional Habitat | Acres | 94.5 | 94.5 | 0 | $ 125.00 | $ - | 0.943 | $ - |
| 2014 | Functional Habitat | Acres | 94.5 | 94.5 | 0 | $ 125.00 | $ - | 0.890 | $ - |
| 2015 | Functional Habitat | Acres | 94.5 | 101.25 | 6.75 | $ 125.00 | $ 843.75 | 0.840 | $ 708 |
| 2016 | Functional Habitat | Acres | 94.5 | 108 | 13.5 | $ 125.00 | $ 1,687.50 | 0.792 | $ 1,337 |
| 2017 | Functional Habitat | Acres | 94.5 | 114.75 | 20.25 | $ 125.00 | $ 2,531.25 | 0.747 | $ 1,891 |
| 2018 | Functional Habitat | Acres | 94.5 | 121.5 | 27 | $ 125.00 | $ 3,375.00 | 0.705 | $ 2,379 |
| 2019 | Functional Habitat | Acres | 94.5 | 128.25 | 33.75 | $ 125.00 | $ 4,218.75 | 0.665 | $ 2,806 |
| 2020 | Functional Habitat | Acres | 94.5 | 135 | 40.5 | $ 125.00 | $ 5,062.50 | 0.627 | $ 3,176 |
| 2021 | Functional Habitat | Acres | 94.5 | 141.75 | 47.25 | $ 125.00 | $ 5,906.25 | 0.592 | $ 3,496 |
| 2022 | Functional Habitat | Acres | 94.5 | 148.5 | 54 | $ 125.00 | $ 6,750.00 | 0.558 | $ 3,769 |
| 2023 | Functional Habitat | Acres | 94.5 | 155.25 | 60.75 | $ 125.00 | $ 7,593.75 | 0.527 | $ 4,000 |
| 2024 | Functional Habitat | Acres | 94.5 | 162 | 67.5 | $ 125.00 | $ 8,437.50 | 0.497 | $ 4,193 |
| 2025 | Functional Habitat | Acres | 94.5 | 168.75 | 74.25 | $ 125.00 | $ 9,281.25 | 0.469 | $ 4,351 |
| 2026 | Functional Habitat | Acres | 94.5 | 175.5 | 81 | $ 125.00 | $ 10,125.00 | 0.442 | $ 4,478 |
| 2027 | Functional Habitat | Acres | 94.5 | 182.25 | 87.75 | $ 125.00 | $ 10,968.75 | 0.417 | $ 4,577 |
| 2028 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.394 | $ 4,650 |
| 2029 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.371 | $ 4,387 |
| 2030 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.350 | $ 4,138 |
| 2031 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.331 | $ 3,904 |
| 2032 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.312 | $ 3,683 |
| 2033 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.294 | $ 3,475 |
| 2034 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.278 | $ 3,278 |
| 2035 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.262 | $ 3,092 |
| 2036 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.247 | $ 2,917 |
| 2037 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.233 | $ 2,752 |
| 2038 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.220 | $ 2,597 |
| 2039 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.207 | $ 2,450 |
| 2040 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.196 | $ 2,311 |
| 2041 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.185 | $ 2,180 |
| 2042 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.174 | $ 2,057 |
| 2043 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.164 | $ 1,940 |
| 2044 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.155 | $ 1,830 |
| 2045 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.146 | $ 1,727 |
| 2046 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.138 | $ 1,629 |
| 2047 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.130 | $ 1,537 |
| 2048 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.123 | $ 1,450 |
| 2049 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.116 | $ 1,368 |
| 2050 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.109 | $ 1,290 |
| 2051 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.103 | $ 1,217 |
| 2052 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.097 | $ 1,148 |
| 2053 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.092 | $ 1,083 |
| 2054 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.087 | $ 1,022 |
| 2055 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.082 | $ 964 |
| 2056 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.077 | $ 910 |
| 2057 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.073 | $ 858 |
| 2058 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.069 | $ 810 |
| 2059 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.065 | $ 764 |
| 2060 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.061 | $ 721 |
| 2061 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.058 | $ 680 |
| 2062 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.054 | $ 641 |
| 2063 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.051 | $ 605 |
| 2064 | Functional Habitat | Acres | 94.5 | 189 | 94.5 | $ 125.00 | $ 11,812.50 | 0.048 | $ 571 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 113,800 |

Comments: The 189 acres of habitat are currently 50% functional (94.5 acres). The project will improve this to 100% functional for 50 years beginning in 2015. This benefits linearly increases to the max of 189 functional acres over the first 15 years after project completion to account for the time it takes for habitat to grow.

## Section D3. Project Costs

The present value of the project's costs, which would occur between 2013 and 2025, is $469,330 in 2012 dollars, discounted at a 6-percent annual rate. These costs would fund labor, planning, equipment, and materials necessary to implement the project.[12]

Table 19-522 – Annual Costs of Project
(All costs should be in 2012 Dollars)

Project: 522 - Gualala River Watershed Council, Sediment Reduction Program: Lower Rockpile Creek Planning Watershed

| | Initial Costs | Adjusted | Annual Costs (2) | | | | | | Discounting Calculations | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Grand Total Cost from Table 7 (row (i), column (d)) | Grant Total Cost | 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 | $ - | | $ - | $ - | | | | $ - | 1.000 | $ - |
| 2013 | $ 10,820.00 | | $ - | $ - | | | | $ 10,820 | 0.943 | $ 10,208 |
| 2014 | $ 264,230.04 | | $ - | $ - | | | | $ 264,230 | 0.890 | $ 235,164 |
| 2015 | $ 264,230.04 | | $ 100.00 | $ 200.00 | | | | $ 264,530 | 0.840 | $ 222,105 |
| 2016 | | | $ 100.00 | $ 200.00 | | | | $ 300 | 0.792 | $ 238 |
| 2017 | | | $ 100.00 | $ 200.00 | | | | $ 300 | 0.747 | $ 224 |
| 2018 | | | $ 100.00 | $ 200.00 | | | | $ 300 | 0.705 | $ 211 |
| 2019 | | | $ 100.00 | $ 200.00 | | | | $ 300 | 0.665 | $ 200 |
| 2020 | | | $ 100.00 | $ 200.00 | | | | $ 300 | 0.627 | $ 188 |
| 2021 | | | $ 100.00 | $ 200.00 | | | | $ 300 | 0.592 | $ 178 |
| 2022 | | | $ 100.00 | $ 200.00 | | | | $ 300 | 0.558 | $ 168 |
| 2023 | | | $ 100.00 | $ 200.00 | | | | $ 300 | 0.527 | $ 158 |
| 2024 | | | $ 100.00 | $ 200.00 | | | | $ 300 | 0.497 | $ 149 |
| 2025 | | | $ 100.00 | $ 200.00 | | | | $ 300 | 0.469 | $ 141 |
| Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries | | | | | | | | | | $ 469,330 |

Comments:

[12] We have distributed the costs outlined Table 7 across the project's implementation period based on the expected timing and phasing described in the Work Plan. Actual distribution of costs during this period may differ somewhat.

## 421. *Siskiyou County*, Septage Pond Closure

### Conditions Without the Project

There is an unpermitted septage receiving facility on Siskiyou County Airport property in the Shasta and Klamath River watersheds. Permitted septage haulers discharge an estimated 750,000 gallons per year of raw sewage into the unlined pond that has exceeded its design life. Much of these waste is from port-a-potties and septic tank emptiers. The septage haulers do not pay fees associated with waste disposal. The site is located approximately 900' east of Oregon Slough, a tributary to Shasta River, which is a tributary to the Klamath River. Both Shasta and Klamath rivers are 303(d) listed streams affected by organic enrichment and low dissolved oxygen.

Siskiyou is under a long-standing North Coast Regional Water Quality Control Board directive to close the facility. Siskiyou County's Board of Supervisors committed to closing the site by November 1, 2013. The County has closed three other unpermitted septage ponds, but lacks adequate resources to close this remaining site. In October 2009, the Klamath Riverkeeper notified the County and North Coast Regional Water Quality Control Board of its intent to file a preemptory writ of mandate regarding use of the unpermitted facility (Klamath Riverkeeper 2009).

Without funding, the County would likely be unable to close the receiving pond and would continue to operate it until the Water Board threatened to or issued a cease and desist order or Riverkeeper filed a lawsuit, likely at least three months. If these conditions materialized, the County would pay legal fees and penalties from the County's General Fund.

### Conditions With the Project

The project would excavate and dry septage and impacted soil on an impermeable surface located on adjacent County-owned airport property and then apply the dried material on adjacent County-owned agricultural land. If the dried waste does not meet the criteria for land application, the County will haul it to a lined landfill for disposal. The County intends to dispose of as much waste as possible with available funding and phase the remaining disposal as additional funds become available.

With the project, the permitted haulers who currently discharge waste into the receiving pond would likely transport waste out of the County to a permitted facility approximately 115 miles south in Anderson, CA.

### Section D2. Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient data are unavailable to quantify in physical terms, monetary terms, or both. Table 12-421 summarizes the non-monetary benefits of this project. We describe these benefits in more detail below the table.

| Table 12-421 – Non-monetized Benefits Checklist<br>*Siskiyou County, Septage Pond Closure* | | |
|---|---|---|
| *No.* | *Will the proposal…* | *Response[1]* |
| | **Community/Social Benefits** | |
| 1 | Provide education or technology benefits? | No |
| 2 | Provide social recreation or access benefits? | No |
| 3 | Help avoid, reduce or resolve various public water resources conflicts? Remove a highly contentious and long-standing source of pollution | Yes |
| 4 | Promote social health and safety? Reduced contact with bacteria and other pollutants | Yes |
| 5 | Have other social benefits? | No |
| | **Environmental Stewardship Benefits** | |
| 6 | Benefit wildlife or habitat in ways that were not quantified in Attachment 7? Passive-use value associated with improved salmonid populations | Yes |
| 7 | Improve water quality in ways that were not quantified in Attachment 7? Reduce risk of water contamination | Yes |
| 8 | Reduce net emissions in ways that were not quantified in Attachment 7? | No |
| 9 | Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4? Avoided costs by reducing regulated pollutants | Yes |
| | **Sustainability Benefits** | |
| 10 | Improve the overall, long-term management of California groundwater resources? Reduce risk of groundwater contamination | Yes |
| 11 | Reduce demand for net diversions for the regions from the Delta? | No |
| 12 | Provide a long-term solution in place of a short-term one? | No |
| 13 | Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources? | No |
| 14 | Improve water supply reliability in ways not quantified in Attachment 7? | No |
| 15 | Other (If the above listed categories do not apply, provide non-monetized benefit description)? Avoided costs associated with reduced fertilizer purchases | Yes |

Notes: [1] A "no" response may mean the project does not produce this benefit, or it may mean the benefit is already quantified in Attachment 7, or monetized directly under Section D3 below.

### 3. Help avoid, reduce or resolve various public water resources conflicts: Remove a highly contentious and long-standing source of pollution

**Relevant change.** The County has experienced ongoing conflicts over a resolution to the septage pond closure both internally and externally for several years. Klamath Riverkeeper and the North Coast Regional Water Quality Control Board have both threatened legal and regulatory action in response to the County's failure to close the facility. The North Coast Regional Board issued its first notice to the County in 2003, in a letter encouraging Siskiyou County to develop a long-tem, county-wide septage management plan (NCRWQCB 2009). Similarly, Klamath Riverkeeper wrote a writ of mandate in October 2009 demanding that Siskiyou County comply immediately with its mandatory duties under California's Porter-Cologne Water Quality Act (Klamath Riverkeeper 2009). The group plans to seek court-ordered compliance if the County does not close the septage pond by November 1, 2013.

Without the project, the County would keep the septage pond open and continue to operate it until the Water Board issued a cease and desist order or Riverkeeper filed a lawsuit. Project proponents expect this would occur within six to nine months of the date by which the Siskiyou County's Board of Supervisors has committed to closing the site: November 1, 2013. With the project, the County would close the septage pond before the closure date and would not incur fines or legal fees associated with the site.

**Evidence for demand and economic value.** We quantify the avoided costs associated with either legal fees or regulatory fines the County would have incurred but for the project in monetized benefit #1 (Avoided fines and legal fees), below. However, the baseline conditions pose additional, unquantifiable, costs associated with water conflicts that we do not capture in these avoided costs. These costs include the opportunity costs of time spent by the employees of Siskiyou County, the North Coast Regional Water Quality Control Board and/or Klamath Riverkeeper as they work to find a solution to the problem. Water conflicts also erode valuable social capital insofar as they reduce trust and communication. In this case, the conflict would erode social capital between groups who otherwise have a mutual goal and would benefit from working together, rather than at odds. While some of this damage has already been done, if the situation intensifies to the point at which the County is incurring fines or litigation, the effect on social capital and opportunity costs for all parties involved will be much more severe.

**Timing and duration.** With the project, the County would incur the costs associated with water resources conflicts in the six to nine months following the committed closure date, November 1, 2013. However, the costs associated with the conflict, particularly reductions in social capital, would likely persist for years after the closure of the septage pond.

**Beneficiaries.** The beneficiaries of this benefit are Siskiyou County and its taxpayers, Klamath Riverkeeper and its members, and the North Coast Regional Water Quality Control Board.

**Sources of uncertainty.** There are several uncertainties associated with this benefit, that could lead to an under or overestimate of its economic value. The County is unsure what would happen in the event that they do not close the septage pond, but realistically expect either a lawsuit or a cease and desist order to arise.

### 4. Promote Health and Safety: Reduced contact with bacteria and other pollutants

**Relevant change.** The open septage pond potential exposes people and wildlife to untreated sewage, containing bacteria and other pollutants. If these pollutants are reaching the Shasta and Klamath Rivers, these pollutants could contaminate the water and cause more widespread risk to public health. See the discussion under non-monetized benefit #7 (Improve water quality), below, for more details on the likelihood that contaminates are seeping into sub-surface and surface water.

**Evidence for demand and economic value.** If the project reduces the likelihood that pathogens from the septage would reach the Shasta and Klamath Rivers, it could produce economic

benefits by reducing the risk of infection caused by contact with water while swimming or boating. A study of the public-health costs of bacterial contamination of public beaches in Southern California suggests that swimmers are willing to pay between $42 and $350 to avoid getting sick from swimming in contaminated water (Given, Pendleton and Boehm 2006). The higher end of this range represents both market and non-market costs associated with gastro-intestinal (GI) illness, including loss of time at work, medical expenses, and the psychological impacts of getting sick, while the lower estimate only includes market costs associated with water-borne GI infections. Because data are insufficient at this time to support an estimate of the project's likely effect on pathogen levels in the Shasta and Klamath Rivers, however, we leave this benefit unquantified.

**Timing and duration.** With the project, the potential for contamination would be reduced for several months, the difference between the expected closure date with the project and the closure date without the project.

**Beneficiaries.** The beneficiaries of this benefit are people who come into contact with the Klamath River downstream of the septage pond.

**Sources of uncertainty.** There is considerable uncertainty about whether bacterial contamination from the septage pond is actually reaching the Shasta and Klamath Rivers. If it isn't, actual costs society may be experiencing associated with this benefit would not be avoided, but people may still experience a benefit from knowing that a potential risk has been diminished.

### 6. Benefit wildlife or habitat: Passive-use value associated with improved salmonid populations

**Relevant change.** The septage facility may be a source of nitrate and dissolved oxygen to the Shasta and Klamath Rivers through surface waters' interactions with shallow sub-surface and direct surface water treatment (see non-monetized benefit #9 Avoided costs by reducing regulated pollutants). By avoiding potential future nitrate and dissolved oxygen content waste, the project may reduce potential impacts to critical habitat for adult and juvenile salmonids in the Shasta and Klamath Rivers. Quantifying the effects on salmonid populations attributable to this project in biophysical or economic terms, however, is impossible given the lack of relevant data.

**Evidence for demand and economic value.** Individuals derive value from increases in salmon and steelhead populations in two ways: some (e.g., recreational anglers and commercial fishermen) directly interact with salmon and steelhead populations and derive benefit by catching and consuming the fish, others (including some from the former group) derive value from the fish solely based on the salmon and steelhead's existence. Studies have shown that regardless of direct interaction with fish populations, many Californians hold a positive

willingness to pay to ensure the long-term survival of salmon and steelhead (Pate and Loomis 1997).

Several studies have attempted to estimate the passive use value of increases in salmon and steelhead populations among households in California and neighboring states. Passive use value, in this case, refers to the benefit individuals derive from knowing that healthy salmon and steelhead populations exist, regardless of their intent to directly interact with salmon and steelhead through fishing or some other means. In general, these studies have estimated households' average willingness to pay to implement policies that would increase salmon and steelhead populations. At the per fish level, these studies reveal that households are willing to pay only fractions of a penny for increases in salmon populations. When summed across a region, however, the total value Californians are willing to pay for increases in fish populations is considerable. Applying the results of two studies that have estimated willingness to pay values for increases in salmon and steelhead populations suggest that Californians, in total, would be willing to pay between $497 (Olsen, Richards, and Scott 1991) and $4,351 (Loomis 1996) per fish.[13]

**Timing and duration.** With the project, the potential for contamination would be reduced for several months, the difference between the expected closure date with the project and the closure date without the project.

**Beneficiaries.** The beneficiaries of this benefit are the people of California who value the continued existence of aquatic wildlife and habitat, particularly critical habitat for Chinook salmon, Coho salmon, and steelhead.

**Sources of uncertainty.** The value of this benefit depends on the uncertainty associated with the extent to the project confers a biophysical benefit that will result in increased salmon populations. There is also uncertainty associated with the marginal economic value of increases in fish populations described above. The results from the studies listed above depend crucially on survey methodology and public perceptions on the current state of salmonid populations. Of the studies listed, three were conducted in the Pacific Northwest, which may over or underestimate Californians' willingness to pay for salmon.

### 7. Improve water quality: <u>Reduce risk of water contamination</u>

**Relevant change.** The project would eliminate a potential source of water contamination, both for current and future human use. Groundwater is located less than 10 feet below ground of the unpermitted septage receiving facility. There has been no groundwater sampling in the vicinity of the project site nor has there been any evidence collected to directly tie the septage pond to groundwater contamination. However, based on the area's shallow groundwater, the lack of a protective lining at the receiving pond, and the County office's supposition that the pond's

[13] This is based on about 12.4 million households in California (U.S. Census Bureau 2007-2011).

drains are open,[14] it is quite likely that contaminants from the septage pond are seeping into the soil. Moreover, USGS information indicates the Shasta River watershed is largely composed of highly permeable quaternary volcaniclastic material (avalanche deposits filled with air pockets) that would increase the likelihood of groundwater contamination (USGS 2010).

**Evidence for demand and economic value.** There are several regulatory and advocacy organizations who are concerned about water contamination and supportive of closure, including the North Coast Regional Board, Klamath Riverkeeper, and the Airport Advisory Committee. In a letter to Siskiyou County on October 30, 2008 the North Coast Regional Board warned that continued "use of this uncontrolled, poorly designed facility adjacent to the Siskiyou County Airport near Montague presents a huge liability to the County in the event that water contamination occurs." The Siskiyou County Board of Supervisors-appointed Airport Advisory Committee is also supportive of the project and has been recommending closure of the facility for the past fifteen years. The Board of Supervisors has made closure of the facility a high priority since 2009.

There are significant economic benefits associated with preventing water contamination, both current and potential. Some of these include better human health, passive-use value associated with environmental quality, and option value for future use. The economic literature suggests people are willing to pay both for clean water now and the option to secure clean water in the future. For example, Crutchfield et al. (1999) found survey respondents in Indiana, Nebraska, Susquehanna, and Washington would be willing to pay $62 to $83 per household per month to reduce the level of nitrates in their drinking water from exceeding EPA safety standards. Likewise, Sun et al. (1992) found the mean option price of groundwater pollution abatement in Southwest Georgia was between $679 and $1,227 per household.

**Timing and duration.** With the project, the potential for contamination would be reduced for several months, the difference between the expected closure date with the project and the closure date without the project.

**Beneficiaries.** The beneficiaries of this benefit are the current and future water users in the area, as well as any Californians who value the protection of water quality in Siskiyou County now or in the future. Some of these direct beneficiaries include residents of Census Block Group 1 in Siskiyou County, which is economically disadvantaged and Census Block Group 2, which is severely disadvantaged.

**Sources of uncertainty.** There is both biophysical and economic uncertainty associated with this benefit. While there is a great deal of anecdotal and inferential evidence that suggest the septage pond is polluting sub-surface and surface water in the area, there is no definitive evidence to conclude this is the case. In the unlikely case the septage pond is not polluting sub-surface and surface water and will not pollute in the future, we have overestimated the value of

[14] Siskiyou Airport Infrastructure Improvement Plan quoted in Klamath Riverkeeper. 2009.

this benefit. There is also uncertainty associated with the marginal economic value of use, passive use, and option value of protecting groundwater quality. The results from the studies listed above depend crucially on survey methodology and public perceptions on the current state of groundwater in the area. There is also inherent economic uncertainty associated with using benefit transfer to apply values derived from elsewhere in the United States to Californians' willingness to pay for protecting water resources. Both studies were conducted outside of California, which may over or underestimate Californians' willingness to pay for protecting water resources.

### 9. Provide other environmental stewardship benefits: Avoided costs by reducing regulated pollutants

**Relevant change.** The septage facility may be a source of nitrate and dissolved oxygen content waste to the Shasta and Klamath Rivers through surface waters' interactions with shallow groundwater and direct surface water treatment (See discussion under non-monetized benefit #7 Improve water quality above). With the project, responsibly closing the unpermitted septage receiving facility would eliminate this known source of high nitrate and dissolved oxygen content waste to the Shasta and Klamath Rivers.

**Evidence for demand and economic value.** Both Shasta and Klamath rivers are 303(d) listed streams affected by organic enrichment and low dissolved oxygen. To the extent that this project reduces the costs for downstream users, either by lowering the levels of pollutants they must address prior to using the water, or lowering the baseline load of pollutants dischargers must treat before discharging water back to the river, it would produce benefits. The project may also have cumulative effects, combined with other efforts to reduce pollutants, that may affect the overall regulatory framework and associated compliance costs for users of the Gualala River.

**Timing and duration.** With the project, the potential for contamination would be reduced for several months, the difference between the expected closure date with the project and the closure date without the project.

**Beneficiaries.** Taxpayers, property owners, water users, and other stakeholders in the watershed.

**Sources of uncertainty.** The economic value associated with this benefit, while not quantifiable, is also particularly contingent on whether this project would reduce pollutants below a level that translates into cost savings. This is unlikely, but there is also value associated with the project's contribution to an overall effort to reduce contamination below levels that trigger regulation and impose costs on other dischargers. The degree to which the project would generate any of these benefits is uncertain both on a biophysical and economic level.

### 10. Improve the overall, long-term management of California's water resources Reduce risk of groundwater contamination

For the reasons described above in non-monetized benefit #7 (Improve water quality), the project has the potential to improve the overall, long-term management of California water resources.

### 15. Other: Avoided costs associated with reduced fertilizer purchases

**Relevant change.** The County will use the dried waste from the Siskiyou septage pond closure project for fertilizer in land application. To reduce project-related costs related to hauling, the County will apply the dried waste to nearby agricultural land. This land is owned by the County, but leased by an agricultural producer who grows fodder for cattle.

**Evidence for demand and economic value.** By providing an agricultural producer with an alternate source of fertilizer for fodder crops, the project may reduce his fertilizer costs.

**Timing and duration.** Land application of the waste would occur during the summer of 2014 through fall 2014. To reduce the risk that we overestimate this benefit, we assume the benefits from reduced fertilizer purchases begin to accrue in 2015. The benefits would last for one year.

**Beneficiaries.** The aforementioned grower.

**Sources of uncertainty.** The value of this benefit depends on the extent to which the grower uses dried waste from the septage pond to replace purchases of fertilizer or to the extent that the dried waste improves the productivity of his agricultural land.

## Section D3. Monetized Benefits Analysis

The present value of the monetized benefits in 2012 dollars, discounted annually at 6 percent over the lifespan of the project, is $137,504. The calculations for each monetized benefit are shown in Table 15-1, at the end of this section.

### 1. Avoided RWCQB fines or legal fees

**Relevant change.** Without the project, the County would keep the septage pond open and continue to operate it until the Water Board issued a cease and desist order or Riverkeeper filed a lawsuit. Project proponents expect litigation would occur within six to nine months of the date by which the Siskiyou County's Board of Supervisors has committed to closing the site: November 1, 2013. Project proponents except the State Water Board to issue a cease and desist order immediately. With the project, the County would close the septage pond before the closure date and would not incur fines or legal fees associated with the site.

**Evidence for demand and economic value.** Both actions in the without project conditions are associated with costs for the County. The RWCQB cease and desist order include a fine for the

County, which would likely reach $10,000 per day. Similarly, project proponents expect the cost of a groundwater degradation lawsuit with Klamath Riverkeeper would exceed $750,000.

Given that project proponents expect the State Water Board to issue a cease and desist order before Riverkeeper files suit, project proponents expect they would pay fines in the without project conditions, rather than litigation fees. These may persist for several months, until the County is able to gather sufficient resources to close the facility. To reduce the risk that we overestimate this benefit, we assume the avoided costs associated with fines from failing to close the septage pond on time would be $150,000.

**Timing and duration.** With the project, the County would incur the costs described above in the six to nine months following the committed closure date, November 1, 2013. Using the six month figure To reduce the risk that we overestimate this benefit, we therefore assume the County would have incurred $75,000 in fines 2013 and $75,000 in 2014.

**Beneficiaries.** The beneficiaries of this benefit are Siskiyou County and its taxpayers.

**Sources of uncertainty.** There are several uncertainties associated with this benefit, that could lead to an under or overestimate of its economic value. The County is unsure what would happen in the event that they do not close the septage pond, but realistically expect either a lawsuit or a cease and desist order to arise.

Table 15.1-421 – Annual Benefit: Avoided Fines and Legal Fees
(All benefits should be in 2012 dollars)

Project: 421 - Siskiyou County, Septage Pond Closure

| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
|---|---|---|---|---|---|---|---|---|---|
| Year | Type of Benefit | Measure of Benefit (Units) | Without Project | With Project | Change Resulting from Project (e) – (d) | Unit $ Value | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Legal Fines and Fees | dollars | 0 | 0 | 0 | $ 1.00 | $ - | 1.000 | $ - |
| 2013 | Legal Fines and Fees | dollars | 0 | 75,000 | 75,000 | $ 1.00 | $ 75,000.00 | 0.943 | $ 70,755 |
| 2014 | Legal Fines and Fees | dollars | 0 | 75,000 | 75,000 | $ 1.00 | $ 75,000.00 | 0.890 | $ 66,750 |
| Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | | | | | | | | $ 137,504 |

Comments: The RWCQB cease and desist order would include a fine for the County, likely reaching $10,000 / day for a total of $150,000.

## Section D3. Project Costs

The present value of the project's costs, which would occur between 2012 and 2013, is $493,347 in 2012 dollars, discounted at a 6-percent annual rate. These costs would fund labor, planning, equipment, and materials necessary to implement the project.[15]

The project may also result in additional, unquantifiable costs to the permitted haulers, the residents of Siskiyou County, or both. When the County closes the septage pond, haulers would have to transport waste they are currently depositing in the pond to Anderson, California, which is approximately 115 miles south of the project site. The additional travel expense related to hauling the waste will bear a significant impact on local businesses that currently service septic tanks. Businesses will have to purchase the appropriate equipment, i.e. larger tanker trucks, to transport greater volumes of waste to the Anderson facility. These business may pass their increased costs along to consumers, decreasing demand for general maintenance services. One or more of the hauling businesses could exit the market in the face of diminished demand. These costs are generally unquantifiable and we have not incorporated them into our calculations.

Table 19-421 – Annual Costs of Project
(All costs should be in 2012 Dollars)

Project: 421 - Siskiyou County, Septage Pond Closure

| | Initial Costs | Adjusted | Annual Costs [2] | | | | | | Discounting Calculations | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Grand Total Cost from Table 7 (row (i), column (d)) | Grant Total Cost | 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 | $ 54,730.00 | | | | | | | $ 54,730 | 1.000 | $ 54,730 |
| 2013 | $ 464,934.29 | | | | | | | $ 464,934 | 0.943 | $ 438,617 |
| Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries | | | | | | | | | | $ 493,347 |
| Comments: | | | | | | | | | | |

[15] We have distributed the costs outlined Table 7 across the project's implementation period based on the expected timing and phasing described in the Work Plan. Actual distribution of costs during this period may differ somewhat.

## 739. *Karuk Tribe*, Lower Mid-Klamath (Red Cap /Perch Creek) Habitat Protection-Road Decommissioning Implementation Project

### Conditions Without the Project

Thirty miles of road within the Mid-Klamath Watershed near the town of Orleans, California are a source of anthropogenic sediment discharge in Red Cap and Pearch Creek, 303(d) listed water bodies in the Klamath River Basin. The Red Cap Creek drainage does not meet fines or embeddedness values for the National Marine Fisheries Service Matrix of Factors and Indicators, or reference streams. These road networks are the primary threat to future and current function of salmonid refugia, spawning, overall water quality, wildlife, and cultural beneficial uses in these waterbodies.

The road and culverts were designed and constructed using a 20-year flood standard and do not meet the current design standard (100-years). Carolyn Cook, a Hydrologist with Six Rivers National Forest, has predicted these culverts will fail during a 10-15 year storm event, which include events with 6 to 8 inches of precipitation within a 24 hour period. The culverts also present a future erosion risk from failure, potentially delivering 98,700 to 5,800,000 cubic yards of sediment to the watershed during one of these events.

### Conditions With the Project

The Karuk Tribe determined the proposed road removal within the project area is a high priority. The project would decommission 30 miles of road, removing unstable fill at stream crossings, swales, springs, seeps, and reestablish the natural hillslope drainage pattern along the intervening road reaches.

### Section D2. Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient data are unavailable to quantify in physical terms, monetary terms, or both. Table 12-739 summarizes the non-monetary benefits of this project. We describe these benefits in more detail below the table.

| Table 12-739 – Non-monetized Benefits Checklist<br>*Karuk Tribe, Lower Mid-Klamath (Red Cap /Perch Creek) Habitat Protection-Road Decommissioning Implementation Project* | | |
|---|---|---|
| *No.* | *Will the proposal…* | *Response*[1] |
| **Community/Social Benefits** | | |
| 1 | Provide education or technology benefits? | No |
| 2 | Provide social recreation or access benefits? | No |
| 3 | Help avoid, reduce or resolve various public water resources conflicts? | No |
| 4 | Promote social health and safety? Reduce the risk of landslides | Yes |
| 5 | Have other social benefits? Cultural importance associated with increases in salmon populations | Yes |
| **Environmental Stewardship Benefits** | | |
| 6 | Benefit wildlife or habitat in ways that were not quantified in Attachment 7? Passive-use value associated with improved salmonid populations | Yes |
| 7 | Improve water quality in ways that were not quantified in Attachment 7? Avoided costs by reducing regulated pollutants | Yes |
| 8 | Reduce net emissions in ways that were not quantified in Attachment 7? | No |
| 9 | Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4? | No |
| **Sustainability Benefits** | | |
| 10 | Improve the overall, long-term management of California groundwater resources? | No |
| 11 | Reduce demand for net diversions for the regions from the Delta? | No |
| 12 | Provide a long-term solution in place of a short-term one? | No |
| 13 | Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources? | No |
| 14 | Improve water supply reliability in ways not quantified in Attachment 7? | No |
| 15 | Other (If the above listed categories do not apply, provide non-monetized benefit description)? | No |

Notes: [1] A "no" response may mean the project does not produce this benefit, or it may mean the benefit is already quantified in Attachment 7, or monetized directly under Section D3 below.

## 4. Promote social health and safety: Reduce the risk of landslides

**Relevant change.** By decommissioning 30 miles of road, the project would reduce the number of road-related landslides. Without the project, the probability of these landslides occurring is very high, particularly given a 10 to 15 year storm event, although the timing and slope position of the road would influence the probability of occurrence.

**Evidence for demand and value.** The extent of the damage from a landslide could vary from a few thousand dollars to hundreds of thousands of dollars, depending on the size of the storm, the position of the road, the timing of the storm, and the extent of damage that results. Project proponents note the extent could range from some material on the road bed that needs removal with a truck blade, to a destroyed road prism, which would require Federal Emergency Relief (ERFO) funds to resolve. If these landslides impact the Karuk fisheries, they could also result in a loss of access to traditional foods, which directly impacts the public health of a disadvantaged community (Norgaard 2005). Landslides could also negatively impact private domestic water systems in the area.

**Timing and duration.** Project proponents estimate they would complete construction and implementation of the project by December of 2015. We therefore assume benefits related to increased social health and safety would begin to accrue in 2016. These benefits would persist for the lifespan of the project, 50 years.

**Beneficiaries.** The beneficiary of this benefit is the Orleans/Ukonom Ranger District, which pays for road maintenance activities, and the residents nearby, including members of the Karuk Tribe and the residents of Orleans, California, a disadvantaged community.

**Sources of uncertainty.** Because the location and probability of road failure is not known with certainty, the economic value of this benefit is likewise uncertain.

### 5. Have other social benefits: Cultural use value associated with increases in salmon populations

**Relevant change.** The project would protect and enhance the habitat of Coho salmon, Chinook salmon, and steelhead trout on roughly 14 miles of stream, potential increasing the populations of those fish. See our description of non-monetized benefit #6 (Passive-use value associated with increases in salmon populations) below for a full description of the process by which this project confers this benefit.

**Evidence for demand and economic value.** Unlike many Californians who ascribe a monetary willingness to pay to protect salmon, even if they never intend to directly fish or watch them, many Native Americans recognize the importance of salmon outside the cultural framework and economic terms western society often imposes (Malloy 1992). Accordingly, they reject the validity of applying a dollar value to fish that constitute a core element of their cultural and spiritual well-being. For this reason, we recognize the cultural significance that arises from the projects' improvements to salmonid populations and their habitat apart from the quantified passive-use value or other measures of economic benefits.

**Timing and duration.** Project proponents estimate they would complete construction and implementation of the project by December of 2015. We therefore assume benefits related to cultural-use value associated with increases in salmon populations would begin to accrue in 2016. These benefits likely would increase over time, as restoration matures, and would persist over the long run (at least 50 years).

**Beneficiaries.** The beneficiaries of this benefit would include members of Native American tribes – both within and outside of the region – who believe the continued existence of salmonid populations and their habitat is essential to cultural and spiritual well-being. In particular, the Karuk Tribe would experience a concentration of this benefit.

**Sources of uncertainty.** The value of this benefit depends on the uncertainty associated with the extent to the project confers a biophysical benefit that will result in increased salmon populations.

## 6. Benefit wildlife or habitat: Passive-use value associated with increases in salmon populations

**Relevant change.** By restoring riparian habitat the project would protect and enhance the habitat of Coho salmon, Chinook salmon, and steelhead trout on roughly 14 miles of stream, potentially increasing populations of those fish. The project also enhances salmon habitat by decreasing present and future erosion and subsequent sediment deposition from roads. The implementation plan for the Klamath River TMDL describes roads on federal lands as a major threat to water quality in the watershed (State of California 2010). The project addresses these concerns by focusing on controlling sediment discharges and protecting riparian vegetation in the tributaries amongst others. Project proponents are unable to quantify the increases in salmonid populations that would result from the project.

**Evidence for demand and value.** Individuals derive value from increases in salmon and steelhead populations in two ways: some (e.g., recreational anglers and commercial fishermen) directly interact with salmon and steelhead populations and derive benefit by catching and consuming the fish, others (including some from the former group) derive value from the fish solely based on the salmon and steelhead's existence. Studies have shown that regardless of direct interaction with fish populations, many Californians hold a positive willingness to pay to ensure the long-term survival of salmon and steelhead (Pate and Loomis 1997).

Several studies have attempted to estimate the passive use value of increases in salmon and steelhead populations among households in California and neighboring states. Passive use value, in this case, refers to the benefit individuals derive from knowing that healthy salmon and steelhead populations exist, regardless of their intent to directly interact with salmon and steelhead through fishing or some other means. In general, these studies have estimated households' average willingness to pay to implement policies that would increase salmon and steelhead populations. At the per fish level, these studies reveal that households are willing to pay only fractions of a penny for increases in salmon populations. When summed across a region, however, the total value Californians are willing to pay for increases in fish populations is considerable. Applying the results of two studies that have estimated willingness to pay values for increases in salmon and steelhead populations suggest that Californians, in total, would be willing to pay between $497 (Olsen, Richards, and Scott 1991) and $4,351 (Loomis 1996) per fish.[16]

**Timing and duration.** Project proponents estimate they would complete construction and implementation of the project by December of 2015. We therefore assume benefits related to passive-use value associated with increases in salmon populations would begin to accrue in 2016. These benefits likely would increase over time, as restoration matures, and would persist over the long run (at least 50 years).

[16] This is based on about 12.4 million households in California (U.S. Census Bureau 2007-2011).

**Beneficiaries.** The beneficiaries of this benefit are the people of California who value the continued existence of aquatic wildlife and habitat, particularly critical habitat for Chinook salmon, Coho salmon, and steelhead.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of increased salmon populations would also affect the economic benefit estimate described here. There is also uncertainty associated with the marginal economic value of increases in fish populations described above. The results from the studies listed above depend crucially on survey methodology and public perceptions on the current state of salmonid populations. Of the studies listed, three were conducted in the Pacific Northwest, which may over or underestimate Californians' willingness to pay for salmon.

### 7. Improve water quality: Avoided costs by reducing regulated pollutants

**Relevant change.** The project would help meet the Klamath River TMDL for sediment. The Red Cap Creek drainage does not meet fines or embeddedness values for the National Marine Fisheries Service Matrix of Factors and Indicators, or reference streams.

**Evidence for demand and value.** The implementation plan for the Klamath River TMDL describes roads as a priority threat to water quality. The plan focuses on controlling sediment discharges and protecting riparian vegetation in the tributaries amongst others. To the extent that this project reduces the costs for downstream users, either by lowering the levels of pollutants they must address prior to using the water, or lowering the baseline load of pollutants dischargers must treat before discharging water back to the river, it would produce benefits. The project may also have cumulative effects, combined with other efforts to reduce pollutants, that may affect the overall regulatory framework and associated compliance costs for users of the Klamath River.

**Timing and duration.** Project proponents estimate they would complete construction and implementation of the project by December of 2015. We therefore assume benefits related to improved water quality would begin to accrue in 2016. These benefits likely would increase over time, as restoration matures, and would persist over the long run (at least 50 years).

**Beneficiaries.** Taxpayers, property owners, water users, and other stakeholders in the watershed.

**Sources of uncertainty.** The economic value associated with this benefit, while not quantifiable, is also particularly contingent on threshold effects, which are uncertain both on a biophysical and economic sense.

## Section D3. Monetized Benefits Analysis

The present value of the monetized benefits in 2012 dollars, discounted annually at 6 percent over the relevant lifespan of each component of the project (described for each benefit below), is $1,523,612.

The calculations for each monetized benefit are shown in Tables 15-1, 15-2, 15-3, and 15-4, at the end of this section.

### 1. Reduced probability of culvert failure

**Relevant change.** Project proponents estimate the eight culverts in the project area will fail in a 10 to 15 year storm event, with an annual probability of failure of 6.6 to 10 percent. With the project, the culverts will meet current design standards for 100 year flood events—an annual probability of failure of 1 percent. Using the conservative value from range presented above, the project would reduce the annual probability of culvert failure by 5.6 percent.

**Evidence for demand and value.** Project proponents estimate the cost of replacing a culvert, given failure, is $10,000. The annual, undiscounted value of this benefit is $560.

**Timing and duration.** Project proponents estimate they would complete road decommissioning by December of 2015. We therefore assume benefits related to reduced probability of culvert failure would begin to accrue in 2016. These benefits would persist until the culverts would have failed under current conditions, in 2027.

**Beneficiaries.** The beneficiaries of this benefit are the owners of the culvert and downstream property owners who would not incur emergency repair costs related to the culvert failure. Some of these beneficiaries may include members of disadvantaged communities, as about fifty percent of the Gualala River Watershed is considered a disadvantaged community with financial support dependent on fishing and timber.

**Sources of uncertainty.** Sources of uncertainty associated with this benefit include the probability of the culvert's failure with the project and the estimate of costs associated with emergency repair and damages. Both estimates are generally conservative. We do not include any estimates of downstream property impacts of culvert failure, nor do we include additional costs related to emergency repair, both of which are likely to materialize given the failure of one or more culvert. To the extent that our estimates lie below the true value of either of these values, we have underestimated this benefit.

### 2. Avoided costs associated with reduced sediment deposition

**Relevant change.** The project would decommission 30 miles of road, removing unstable stream crossings, swales, springs, seeps, and reestablish the natural hillside drainage patterns along the intervening road reaches. These actions would allow the project would reduce sediment disposition to Red Cap and Pearch Creeks by 22,458 tons per year.

The project would also reduce the probability of sediment deposition associated with culvert failure. If the culverts fail, they would deliver an estimated 166,803 to 9,802,000 tons of

sediment to the watershed.[17] Given the probability of culvert failure with and without the project we discussed in monetized benefit #1 (reduced probability of culvert failure), above, the project would reduce sediment delivery by 9,341 to 548,912 tons per year. To reduce the risk that we overestimate this benefit, we use the low-end of this range. We multiply this amount by the expected probability of failure of the culvert (5.6 percent) to estimate the annual avoided sediment delivery as a result of the project, 523 tons. As a result, the total expected reduction in sediment delivery to Red Cap and Pearch Creeks is 22,981 tons per year.

**Evidence for demand and value.** Economic studies have examined and monetized some of the benefits that materialize when excessive sediment does not impair streams, rivers, estuaries, and the marine environment. A study conducted by the U.S. Department of Agriculture identified 13 types of benefits associated with decreasing sediment (Hansen and Ribaudo 2008). For each benefit, the researchers modeled the potential value associated with reducing sediment, per ton, for each county across the country. For our analysis, we apply the average value for the counties in the Lower Klamath watershed, $9.24 per ton, to estimate the benefits derived from the prevention of sediment deposition . Included in this value are the regional benefits associated with the impacts of sediment on:

- Water-based recreation – cleaner fresh water recreation
- Irrigation ditches and channels – reduced cost of removing sediment and aquatic plants from irrigation channels
- Road drainage ditches – less damage to and flooding of roads
- Municipal water treatment – lower sediment-removal costs for water treatment plants
- Flood damage – reduced flooding and damage from flooding
- Marine fisheries – improved catch rates for marine commercial fisheries
- Marine recreational fishing – improved catch rates for marine recreational fishing
- Municipal and industrial water use – reduced damages from salts and minerals dissolved from sediment
- Steam power plants – reduced plant growth on heat exchangers
- Soil productivity – reduced losses in soil productivity
- Dust cleaning – decrease in cleaning due to reduced wind-borne particulates.
- Reservoir services – less sediment in reservoirs
- Navigation – shipping industry avoidance of damages from groundings

The annual undiscounted value of the avoided costs related to sediment reduction is $293,823.

**Timing and duration.** Project proponents estimate they would complete road decommissioning by December of 2015. We therefore assume benefits related to reduced sediment deposition would begin to accrue in 2016. These benefits would persist until the culverts would have failed under current conditions, in 2027.

[17] Converted from cubic yards to tons using a conversion rate of 1.69 tons per cubic yard.

**Beneficiaries.** The beneficiaries of this benefit are the wide array of downstream users associated with each of the benefits listed above. To some extent, these beneficiaries include the general public, municipal water treatment operators and their ratepayers, irrigators, recreationalists, downstream property owners, and fishermen.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of reduced sedimentation would also affect the economic benefit estimate described here. For example, the actual rate of sediment deposition is dependent on water year type, sediment yields, location and roughness of the flood prone surface, among other factors.

At least three major factors suggest that the value of sediment we use underestimates the true value of the sediment-reduction benefits. First, the value does not reflect many potential benefits, such as the goods and services derived from potential impacts on wetlands and endangered species. Second, the estimates of sediment erosion that the projects would reduce are based on current sediment erosion rates. Climate change is expected to increase the frequency and intensity of storm events, which would likely increase the rate of sediment erosion absent the projects (Masden and Figdor 2007). If future sediment erosion rates exceed current rates, the without-project sediment erosion is likely to increase, and thus, the expected benefit of each project's sediment control activities is likely to be an underestimate. Third, this estimate does not anticipate increases in value that occur over time. We anticipate that the value of sediment-reduction benefits will increase, relative to the general price index, but have not accounted for this increase in our calculations.

### 3. Avoided costs associated with reduced road maintenance

**Relevant change.** By decommissioning 30 miles of road, the project avoids road maintenance costs for the Orleans/Ukonom Ranger District, which pays for maintenance activities on these roads.

**Evidence for demand and value.** Project proponents estimate the cost of road maintenance in the region is approximately $60 per mile. The road maintenance budget for the Orleans/Ukonom Ranger District is approximately $25,000. The total annual, undiscounted value of this benefit is therefore $1,800.

**Timing and duration.** Project proponents estimate they would complete construction and implementation of the project by December of 2015. We therefore assume benefits related to reduced road maintenance activities would begin to accrue in 2016. These benefits likely would increase over time, as restoration matures, and would persist over the long run (at least 50 years).

**Beneficiaries.** The beneficiary of this benefit is the Orleans/Ukonom Ranger District.

**Sources of uncertainty.** The major source of uncertainty surrounding this benefit comes from the estimate of costs associated with road maintenance activities, especially regarding the

assumptions of road maintenance in the future without the project. This assumes these activities would have happened in the way described. To the extent that the roads would have required more maintenance, we are underestimating the cost of the benefit. To the extent that less maintenance would have actually occurred, we overestimate the benefit.

### 4. Passive-use value associated with enhanced riparian habitat

**Relevant change. T**he project would restore 2 acres of riparian habitat. In the project area, the riparian habitat does provide some functionality for various salmonid species, so we assume the existing habitat provides 50 percent functionality, and restoration would fully increase its function as it matures over a 15-year period. Once the restoration reaches year 15, the function persists for the long-run, at least 50 years.

**Evidence for demand and value.** Data are insufficient to delineate specific impacts of the project's restoration efforts on the ecosystem services provided by this area of riparian habitat. Thus, instead we employ a value that accounts for people's willingness to pay for the flow of goods and services from an acre of forested riparian habitat. In 2009, researchers conducted several meta-analyses estimating various use and nonuse values associated with forestland. In estimating the passive use value of forestland, the researchers compiled data from 23 relevant studies (Chiabai et al. 2009). Their results identify per-acre estimates for passive use values by geographic region and forest biome. For our analysis, we use the passive use value associated with North American forestland in the cool coniferous biome, $125 per acre per year.

The restored riparian areas increase in ecological function over time as vegetation matures. Our annual value reflects this steady improvement, using a simple assumption that the quantity of ecological services—and thus people's willingness to pay for them—increases linearly over a 50-year period.

**Timing and duration.** Project proponents estimate they would complete construction and implementation of the project by December of 2015. We therefore assume benefits related to passive-use value associated with increased riparian habitat would begin to accrue in 2016. These benefits likely would increase over time, as restoration matures, and would persist over the long run (at least 50 years).

**Beneficiaries.** The beneficiaries of this benefit are the residents nearby and individuals in California who value the continued existence of riparian habitat in the state.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of increased riparian habitat acreage and functionality would also affect the economic benefit estimate described here. The value described above estimates society's total willingness to pay for fully-restored forest land in cool coniferous forests in North America. Insofar as this estimate considers only passive use values, it likely underestimates the total economic value of riparian and other forest-based restoration because direct users of the restored habitat likely are willing to pay more for its restoration. It also likely underestimates the value because, as human

populations and incomes grow in California, the marginal value of forest land probably will increase, as will the value of restoration efforts. Because we found no reliable estimate of the rate of increase, we did not fold this increase into our estimates. For these reasons, it seems reasonable to conclude that the value estimates derived in the past underestimate, perhaps substantially, the true value of future increases in fully-restored riparian and other forest habitat.

Table 15.1-739 – Annual Benefit: Avoided Culvert Failures
(All benefits should be in 2012 dollars)

Project: 739 - Karuk Tribe, Lower Mid-Klamath (Red Cap / Perch Creek) Habitat Protection-Road Decommissioning

| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
|---|---|---|---|---|---|---|---|---|---|
| Year | Type of Benefit | Measure of Benefit (Units) | Without Project | With Project | Change Resulting from Project (e) – (d) | Unit $ Value | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Reduced chance of culvert failure | Reduced probability | 0% | 0.0% | 0.0% | $ 10,000.00 | $ - | 1.000 | $ - |
| 2013 | Reduced chance of culvert failure | Reduced probability | 0% | 0.0% | 0.0% | $ 10,000.00 | $ - | 0.943 | $ - |
| 2014 | Reduced chance of culvert failure | Reduced probability | 0% | 0.0% | 0.0% | $ 10,000.00 | $ - | 0.890 | $ - |
| 2015 | Reduced chance of culvert failure | Reduced probability | 0% | 0.0% | 0.0% | $ 10,000.00 | $ - | 0.840 | $ - |
| 2016 | Reduced chance of culvert failure | Reduced probability | 0% | 5.6% | 5.6% | $ 10,000.00 | $ 560.00 | 0.792 | $ 444 |
| 2017 | Reduced chance of culvert failure | Reduced probability | 0% | 5.6% | 5.6% | $ 10,000.00 | $ 560.00 | 0.747 | $ 418 |
| 2018 | Reduced chance of culvert failure | Reduced probability | 0% | 5.6% | 5.6% | $ 10,000.00 | $ 560.00 | 0.705 | $ 395 |
| 2019 | Reduced chance of culvert failure | Reduced probability | 0% | 5.6% | 5.6% | $ 10,000.00 | $ 560.00 | 0.665 | $ 372 |
| 2020 | Reduced chance of culvert failure | Reduced probability | 0% | 5.6% | 5.6% | $ 10,000.00 | $ 560.00 | 0.627 | $ 351 |
| 2021 | Reduced chance of culvert failure | Reduced probability | 0% | 5.6% | 5.6% | $ 10,000.00 | $ 560.00 | 0.592 | $ 331 |
| 2022 | Reduced chance of culvert failure | Reduced probability | 0% | 5.6% | 5.6% | $ 10,000.00 | $ 560.00 | 0.558 | $ 313 |
| 2023 | Reduced chance of culvert failure | Reduced probability | 0% | 5.6% | 5.6% | $ 10,000.00 | $ 560.00 | 0.527 | $ 295 |
| 2024 | Reduced chance of culvert failure | Reduced probability | 0% | 5.6% | 5.6% | $ 10,000.00 | $ 560.00 | 0.497 | $ 278 |
| 2025 | Reduced chance of culvert failure | Reduced probability | 0% | 5.6% | 5.6% | $ 10,000.00 | $ 560.00 | 0.469 | $ 263 |
| 2026 | Reduced chance of culvert failure | Reduced probability | 0% | 5.6% | 5.6% | $ 10,000.00 | $ 560.00 | 0.442 | $ 248 |
| 2027 | Reduced chance of culvert failure | Reduced probability | 0% | 5.6% | 5.6% | $ 10,000.00 | $ 560.00 | 0.417 | $ 234 |
| | | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | $ 3,942 |

Comments: Project proponents estimate that the eight culverts are likely to fail in a 15 year storm event, or a 6.6% probability of failure, and would cost $10,000 in the event of failure. The project would reduce the annual probability of failure to 1% for a total reduced probability of 5.6%.

| Table 15.2-739 – Annual Benefit: Reduced Sediment Deposition<br>(All benefits should be in 2012 dollars)<br>Project: 739 - Karuk Tribe, Lower Mid-Klamath (Red Cap /Perch Creek) Habitat Protection-Road Decommissioning | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| (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 (d) – (e) | Unit $ Value | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Reduced Sediment Deposits | tons | 0 | 0 | 0 | $ 9.24 | $ - | 1.000 | $ - |
| 2013 | Reduced Sediment Deposits | tons | 0 | 0 | 0 | $ 9.24 | $ - | 0.943 | $ - |
| 2014 | Reduced Sediment Deposits | tons | 0 | 0 | 0 | $ 9.24 | $ - | 0.890 | $ - |
| 2015 | Reduced Sediment Deposits | tons | 0 | 0 | 0 | $ 9.24 | $ - | 0.840 | $ - |
| 2016 | Reduced Sediment Deposits | tons | 0 | 22,981 | 22,981 | $ 9.24 | $ 212,344 | 0.792 | $ 168,197 |
| 2017 | Reduced Sediment Deposits | tons | 0 | 22,981 | 22,981 | $ 9.24 | $ 212,344 | 0.747 | $ 158,676 |
| 2018 | Reduced Sediment Deposits | tons | 0 | 22,981 | 22,981 | $ 9.24 | $ 212,344 | 0.705 | $ 149,694 |
| 2019 | Reduced Sediment Deposits | tons | 0 | 22,981 | 22,981 | $ 9.24 | $ 212,344 | 0.665 | $ 141,221 |
| 2020 | Reduced Sediment Deposits | tons | 0 | 22,981 | 22,981 | $ 9.24 | $ 212,344 | 0.627 | $ 133,228 |
| 2021 | Reduced Sediment Deposits | tons | 0 | 22,981 | 22,981 | $ 9.24 | $ 212,344 | 0.592 | $ 125,686 |
| 2022 | Reduced Sediment Deposits | tons | 0 | 22,981 | 22,981 | $ 9.24 | $ 212,344 | 0.558 | $ 118,572 |
| 2023 | Reduced Sediment Deposits | tons | 0 | 22,981 | 22,981 | $ 9.24 | $ 212,344 | 0.527 | $ 111,860 |
| 2024 | Reduced Sediment Deposits | tons | 0 | 22,981 | 22,981 | $ 9.24 | $ 212,344 | 0.497 | $ 105,529 |
| 2025 | Reduced Sediment Deposits | tons | 0 | 22,981 | 22,981 | $ 9.24 | $ 212,344 | 0.469 | $ 99,555 |
| 2026 | Reduced Sediment Deposits | tons | 0 | 22,981 | 22,981 | $ 9.24 | $ 212,344 | 0.442 | $ 93,920 |
| 2027 | Reduced Sediment Deposits | tons | 0 | 22,981 | 22,981 | $ 9.24 | $ 212,344 | 0.417 | $ 88,604 |
| Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | | | | | | | | $ 1,494,743 |
| Comments: The project would reduce sediment delivery by 22,458 tons per year, plus an additional annual expected reduction of sediment delivery based on the probability of culvert failure from Table 15-1. | | | | | | | | | |

Table 15.3-739 – Annual Benefit: Reduced Road Maintenance

(All benefits should be in 2012 dollars)

Project: 739 - Karuk Tribe, Lower Mid-Klamath (Red Cap /Perch Creek) Habitat Protection-Road Decommissioning

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Reduced road maintenance | miles | 0 | 0 | 0 | $ 60.00 | $ - | 1.000 | $ - |
| 2013 | Reduced road maintenance | miles | 0 | 0 | 0 | $ 60.00 | $ - | 0.943 | $ - |
| 2014 | Reduced road maintenance | miles | 0 | 0 | 0 | $ 60.00 | $ - | 0.890 | $ - |
| 2015 | Reduced road maintenance | miles | 0 | 0 | 0 | $ 60.00 | $ - | 0.840 | $ - |
| 2016 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.792 | $ 1,426 |
| 2017 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.747 | $ 1,345 |
| 2018 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.705 | $ 1,269 |
| 2019 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.665 | $ 1,197 |
| 2020 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.627 | $ 1,129 |
| 2021 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.592 | $ 1,065 |
| 2022 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.558 | $ 1,005 |
| 2023 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.527 | $ 948 |
| 2024 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.497 | $ 895 |
| 2025 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.469 | $ 844 |
| 2026 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.442 | $ 796 |
| 2027 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.417 | $ 751 |
| 2028 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.394 | $ 709 |
| 2029 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.371 | $ 668 |
| 2030 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.350 | $ 631 |
| 2031 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.331 | $ 595 |
| 2032 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.312 | $ 561 |
| 2033 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.294 | $ 529 |
| 2034 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.278 | $ 500 |
| 2035 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.262 | $ 471 |
| 2036 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.247 | $ 445 |
| 2037 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.233 | $ 419 |
| 2038 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.220 | $ 396 |
| 2039 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.207 | $ 373 |
| 2040 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.196 | $ 352 |
| 2041 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.185 | $ 332 |
| 2042 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.174 | $ 313 |
| 2043 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.164 | $ 296 |
| 2044 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.155 | $ 279 |
| 2045 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.146 | $ 263 |
| 2046 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.138 | $ 248 |
| 2047 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.130 | $ 234 |
| 2048 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.123 | $ 221 |
| 2049 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.116 | $ 208 |
| 2050 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.109 | $ 197 |
| 2051 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.103 | $ 185 |
| 2052 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.097 | $ 175 |
| 2053 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.092 | $ 165 |
| 2054 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.087 | $ 156 |
| 2055 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.082 | $ 147 |
| 2056 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.077 | $ 139 |
| 2057 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.073 | $ 131 |
| 2058 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.069 | $ 123 |
| 2059 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.065 | $ 116 |
| 2060 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.061 | $ 110 |
| 2061 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.058 | $ 104 |
| 2062 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.054 | $ 98 |
| 2063 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.051 | $ 92 |
| 2064 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.048 | $ 87 |
| 2065 | Reduced road maintenance | miles | 0 | 30 | 30 | $ 60.00 | $ 1,800.00 | 0.046 | $ 82 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 23,821 |

Comments: The project would reduce road maintenance costs on 30 miles of road.

Table 15.4-739 – Annual Benefit: Enhanced Riparian Habitat
(All benefits should be in 2012 dollars)

Project: 739 - Karuk Tribe, Lower Mid-Klamath (Red Cap /Perch Creek) Habitat Protection-Road Decommissioning

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Riparian Habitat | functional acres | 1 | 1 | 0 | $ 125.00 | $ - | 1.000 | $ - |
| 2013 | Riparian Habitat | functional acres | 1 | 1 | 0 | $ 125.00 | $ - | 0.943 | $ - |
| 2014 | Riparian Habitat | functional acres | 1 | 1 | 0 | $ 125.00 | $ - | 0.890 | $ - |
| 2015 | Riparian Habitat | functional acres | 1 | 1 | 0 | $ 125.00 | $ - | 0.840 | $ - |
| 2016 | Riparian Habitat | functional acres | 1 | 1.07 | 0.07 | $ 125.00 | $ 8.33 | 0.792 | $ 7 |
| 2017 | Riparian Habitat | functional acres | 1 | 1.13 | 0.13 | $ 125.00 | $ 16.67 | 0.747 | $ 12 |
| 2018 | Riparian Habitat | functional acres | 1 | 1.20 | 0.20 | $ 125.00 | $ 25.00 | 0.705 | $ 18 |
| 2019 | Riparian Habitat | functional acres | 1 | 1.27 | 0.27 | $ 125.00 | $ 33.33 | 0.665 | $ 22 |
| 2020 | Riparian Habitat | functional acres | 1 | 1.33 | 0.33 | $ 125.00 | $ 41.67 | 0.627 | $ 26 |
| 2021 | Riparian Habitat | functional acres | 1 | 1.40 | 0.40 | $ 125.00 | $ 50.00 | 0.592 | $ 30 |
| 2022 | Riparian Habitat | functional acres | 1 | 1.47 | 0.47 | $ 125.00 | $ 58.33 | 0.558 | $ 33 |
| 2023 | Riparian Habitat | functional acres | 1 | 1.53 | 0.53 | $ 125.00 | $ 66.67 | 0.527 | $ 35 |
| 2024 | Riparian Habitat | functional acres | 1 | 1.60 | 0.60 | $ 125.00 | $ 75.00 | 0.497 | $ 37 |
| 2025 | Riparian Habitat | functional acres | 1 | 1.67 | 0.67 | $ 125.00 | $ 83.33 | 0.469 | $ 39 |
| 2026 | Riparian Habitat | functional acres | 1 | 1.73 | 0.73 | $ 125.00 | $ 91.67 | 0.442 | $ 41 |
| 2027 | Riparian Habitat | functional acres | 1 | 1.80 | 0.80 | $ 125.00 | $ 100.00 | 0.417 | $ 42 |
| 2028 | Riparian Habitat | functional acres | 1 | 1.87 | 0.87 | $ 125.00 | $ 108.33 | 0.394 | $ 43 |
| 2029 | Riparian Habitat | functional acres | 1 | 1.93 | 0.93 | $ 125.00 | $ 116.67 | 0.371 | $ 43 |
| 2030 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.350 | $ 44 |
| 2031 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.331 | $ 41 |
| 2032 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.312 | $ 39 |
| 2033 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.294 | $ 37 |
| 2034 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.278 | $ 35 |
| 2035 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.262 | $ 33 |
| 2036 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.247 | $ 31 |
| 2037 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.233 | $ 29 |
| 2038 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.220 | $ 27 |
| 2039 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.207 | $ 26 |
| 2040 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.196 | $ 24 |
| 2041 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.185 | $ 23 |
| 2042 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.174 | $ 22 |
| 2043 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.164 | $ 21 |
| 2044 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.155 | $ 19 |
| 2045 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.146 | $ 18 |
| 2046 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.138 | $ 17 |
| 2047 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.130 | $ 16 |
| 2048 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.123 | $ 15 |
| 2049 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.116 | $ 14 |
| 2050 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.109 | $ 14 |
| 2051 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.103 | $ 13 |
| 2052 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.097 | $ 12 |
| 2053 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.092 | $ 11 |
| 2054 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.087 | $ 11 |
| 2055 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.082 | $ 10 |
| 2056 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.077 | $ 10 |
| 2057 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.073 | $ 9 |
| 2058 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.069 | $ 9 |
| 2059 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.065 | $ 8 |
| 2060 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.061 | $ 8 |
| 2061 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.058 | $ 7 |
| 2062 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.054 | $ 7 |
| 2063 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.051 | $ 6 |
| 2064 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.048 | $ 6 |
| 2065 | Riparian Habitat | functional acres | 1 | 2 | 1 | $ 125.00 | $ 125.00 | 0.046 | $ 6 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 1,106 |

Comments: Restored acres of riparian habitat taken time to grow and reach their full benefit. This time is assumed to be 15 years, which begins with the completion of the project.

## Section D3. Project Costs

The present value of the project's costs, which would occur between 2014 and 2015, is $324,303 in 2012 dollars, discounted at a 6-percent annual rate. These costs would fund labor, planning, equipment, and materials necessary to implement the project.

Table 19-739 – Annual Costs of Project
(All costs should be in 2012 Dollars)

Project: 739 - Karuk Tribe, Lower Mid-Klamath (Red Cap /Perch Creek) Habitat Protection-Road Decommissioning

| | Initial Costs | Adjusted | Annual Costs [2] | | | | | | Discounting Calculations | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Grand Total Cost from Table 7 (row (i), column (d)) | Grant Total Cost | 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 | $ - | | $ - | | | | | $ - | 1.000 | $ - |
| 2013 | $ - | | $ - | | | | | $ - | 0.943 | $ - |
| 2014 | $ 178,710.00 | | $ 8,790.00 | | | | | $ 187,500.00 | 0.890 | $ 166,874 |
| 2015 | $ 178,710.00 | | $ 8,790.00 | | | | | $ 187,500.00 | 0.840 | $ 157,429 |
| Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries | | | | | | | | | | $ 324,303 |

Comments:

# 740. *Yurok Tribe*, Restoration of Lower Klamath River Habitats

## Conditions Without the Project

The Yurok Tribe harvests anadromous fish from the Klamath River and consider the Lower Klamath River habitats "salmon strongholds." Though anthropogenic activities over the past century have resulted in declines of these populations, the area supports natal (Lower Klamath populations) and non-natal (Mid & Upper Klamath, Trinity populations).

In the Lower Klamath River Sub-basin, anthropogenic activities occurring since the mid-1850s have resulted in substantial declines to Klamath fish runs and drastically degraded associated habitats. Fish runs in the Hunter Creek and Terwer Creek watersheds have steadily improving as a result of improved forest practices and ongoing upslope and instream restoration. However, past agricultural practices and intense timber harvest and road-building activities have simplified these watershed. Historic agricultural and logging practices that included stream clearing activities also resulted in significant losses of floodplain and forest habitats, fluvial wood accumulations, and wood recruitment to tributary and riverine systems. This severe loss of habitat complexity and channel structure resulting from the loss of instream wood and old growth forests is a primary limitation to the survival of native fish of the Lower Klamath, especially salmonids. Large floods occurring over the last 150 years have exacerbated degraded watershed conditions by increasing rates of riparian loss, channel widening, and valley aggradation.

## Conditions With the Project

The project would restore spawning and rearing habitat for native salmonids (Chinook, Coho, steelhead, coastal cutthroat) on two miles in each two priority Lower Klamath tributaries: Terwer Creek and Hunter creek (four miles total). Project activities will include: feasible restoration designs, building constructed wood jams, implementing complimentary bioengineering techniques (willow baffles), and planting riparian habitats with native conifers.

## Section D2. Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient data are unavailable to quantify in physical terms, monetary terms, or both. Table 12-740 summarizes the non-monetary benefits of this project. We describe these benefits in more detail below the table.

| Table 12-740 – Non-monetized Benefits Checklist<br>*Yurok Tribe*, Restoration of Lower Klamath River Habitats | | |
|---|---|---|
| *No.* | *Will the proposal…* | *Response*[1] |
| | **Community/Social Benefits** | |
| 1 | Provide education or technology benefits? Enhance public understanding of environmental issues | Yes |
| 2 | Provide social recreation or access benefits? | No |
| 3 | Help avoid, reduce or resolve various public water resources conflicts? | No |
| 4 | Promote social health and safety? | No |
| 5 | Have other social benefits? Reduce wood piracy<br>Enhance cultural use value associated with increases in salmon populations | Yes |
| | **Environmental Stewardship Benefits** | |
| 6 | Benefit wildlife or habitat in ways that were not quantified in Attachment 7? | No |
| 7 | Improve water quality in ways that were not quantified in Attachment 7? Reduce future costs associated with water-quality compliance | Yes |
| 8 | Reduce net emissions in ways that were not quantified in Attachment 7? | No |
| 9 | Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4? | No |
| | **Sustainability Benefits** | |
| 10 | Improve the overall, long-term management of California groundwater resources? Enhance use and non-use values of groundwater | Yes |
| 11 | Reduce demand for net diversions for the regions from the Delta? | No |
| 12 | Provide a long-term solution in place of a short-term one? | No |
| 13 | Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources? | No |
| 14 | Improve water supply reliability in ways not quantified in Attachment 7? | No |
| 15 | Other (If the above listed categories do not apply, provide non-monetized benefit description)? | No |

Notes: [1] A "no" response may mean the project does not produce this benefit, or it may mean the benefit is already quantified in Attachment 7, or monetized directly under Section D3 below.

## 1. Provide education or technology benefits: Enhance public understanding of environmental issues

**Relevant change.** As part of the project, the Yurok Tribe would engage students from the Klamath Early College of the Redwoods and Humboldt State University in stream restoration learning opportunities. The Tribe will provide multiple classroom lectures (4-6 hrs/class/year for approximately 2 years) and will lead students on field tours of the project areas to provide a more tangible learning environment (6-8 hrs/class/year for ~2 years).

The project would also provide YTFP Heavy Equipment Operators (HEO) and staff with continued education on the science and practice of river and stream restoration.

Yurok Tribe members will also present the techniques and results of the proposed restoration at professional conferences, symposiums and workshops such as Salmonid Restoration Federation and the American Fisheries Society.

**Evidence for demand and value.** The lectures described above would provide students with an understanding of the geomorphic processes necessary for maintaining healthy river systems, describe the historic land use activities that have resulted in habitat degradation and declining fish runs, and describe stream restoration techniques employed to re-establish the beneficial self-maintaining processes necessary for restoring our fisheries on the north coast. Field tours would give students the opportunities to see both degraded conditions, as well as recently implemented restoration projects to provide a better understanding of the concepts presented during the classroom lectures.

Drawing a cause-and-effect relationship between educational efforts and specific water-supply or water-quality outcomes is difficult, but there are several ways the project could produce tangible economic benefits through its education components:

- Outreach for this project may increase the public's understanding of and support or demand for future watershed-enhancement projects. Increased community support for and participation in future public projects may make watershed restoration projects easier to implement and less costly to complete, resulting in additional water quality and quantity benefits at lower cost to the community.

- Opportunities to participate in educational programs and restoration opportunities improve the well-being of people who choose to participate. These improvements may not result in water-supply or water-quality benefits directly, but they may better people's lives in other ways that have economic importance. Spending time outdoors may improve an individual's emotional and physical health, which constitutes an investment in human capital. Working with others in restoration efforts has the potential to strengthen the relationships among community members, which constitutes an investment in social capital. Both of these effects may contribute to an overall improvement in quality of life.

These effects may be small, but subtle changes arising from education should not be dismissed. For example, interactions among community members in the context of this project may be brief, compared to all of the other interactions that go on day-to-day, but the effect combined with all of the other small effects may accumulate into measurable improvements in quality of life in the long run. Similarly, staff who work with community members on watershed education attest that a public better educated about watershed issues generates dividends in future projects. The efforts of this project, in combination with other sustained efforts in the long run, likely will translate to economic benefits for the community that reach beyond this project.

**Timing and duration.** We assume educational opportunities would occur after project construction is complete, in 2016. These benefits would persist for the professional lifetimes of the participating students and staff members.

**Beneficiaries.** The beneficiaries of this benefit are the students from the Klamath Early College of the Redwoods and Humboldt State University, the staff members who received continuing

education, and the participants at the Salmonid Restoration Federation and American Fisheries Society workshops.

**Sources of uncertainty.** The education benefits from the project would depend on the extent to which the project effectively delivers information through the educational programs for students and, significantly, the extent to which these students apply their knowledge in ways that reduces future costs. Without detailed program evaluations of educational efforts, it is difficult to predict when particular benefits to education, outreach, and public engagement activities might emerge and what their impact might be. The peer-reviewed literature on this topic is scant, and results from one study may not be broadly transferrable to other programs because specifics of program design, delivery, and audience may affect the level of benefits achieved.

### 5. Have other social benefits: Reduced wood piracy

**Relevant change.** The project area currently suffers from wood piracy, the act of people illegally trespassing on private land and stealing wood, specifically, windfall and fluvial deposited wood for personal gain (e.g. to use or sell as firewood or to sell to local lumber mills). In most cases people enter lands via dry creek beds and remove fallen old growth redwood trees and other forest materials. The project would reduce wood piracy within the project area and perhaps a wider area by increasing channel complexity that will limit vehicle access, work with stakeholders and agencies to improve public awareness and law enforcement, and foster stewardship of natural resources by engaging community members on the topic. Project proponents expect the project could reduce wood piracy by as much as 3,500 cubic feet per year.

**Evidence for demand and value.** Wood piracy has environmental effects, which translate into economic costs. Wood piracy may reduce the value of investments in restoration efforts, by disturbing the changes made to help the ecosystem function better. Wood piracy also has the potential to erode social capital, by discouraging people from allowing others on their land or to pass through their land and creates costs for local law enforcement insofar as it increases conflict and confrontation between people. Reducing the accessibility of some areas to wood piracy would potentially reduce or avoid some of these economic costs. If the project is successful, it may provide a model for more landowners to implement, which could result in a broader solution for avoiding wood piracy.

**Timing and duration.** The Yurok Tribe would implement the project over a three year period, beginning in May of 2014. We assume the benefits related to reduced wood piracy and water resources conflicts would begin to accrue in 2017.

**Beneficiaries.** The Yurok Tribe and other local community members.

**Sources of uncertainty.** The benefits of this project would only materialize if the project is successful at deterring acts of wood piracy. It also assumes that people would not go elsewhere

to steal wood, shifting the costs from one set of landowners to another. If it proves to be a successful model, it could help solve the larger problem and generate benefits for the region.

### 5. Have other social benefits: Cultural use value associated with increases in salmon populations

**Relevant change.** The project would result in an increase in survival of adult steelhead by 20 fish per year; an increase of 15 Coho salmon per year; and an average escapement of an additional 150 Chinook salmon per year. See our description of monetized benefit #1 (passive-use value associated with increases in salmon populations) below for a full description of the process by which these projects confer this benefit.

**Evidence for demand and economic value.** Unlike many Californians who ascribe a monetary willingness to pay to protect salmon, even if they never intend to directly fish or watch them, many Native Americans recognize the importance of salmon outside the cultural framework and economic terms western society often imposes (Malloy 1992). Accordingly, they reject the validity of applying a dollar value to fish that constitute a core element of their cultural and spiritual well-being. For this reason, we recognize the cultural significance that arises from the projects' improvements to salmonid populations and their habitat apart from the quantified passive-use value or other measures of economic benefits.

This project site is of special importance to the Yurok Tribe—California's largest tribe with over 6,000 members—and may confer additional cultural benefits as a result. A healthy river and resilient and robust salmon fishery are central to the perpetuation of Yurok tradition, cultural practices and well-being. In particular, Reclamation (2012) has described the cultural benefits of a restored river and its fishery for the Yurok Tribe. Some of these benefits include: resetting the environmental and ecological context in support of the continuation of cultural practices, religion, language, and the physical and mental health and welfare of families and individuals.

**Timing and duration.** The Yurok Tribe would implement the project over a three year period, beginning in May of 2014. The cultural use values associated with this project are likely to materialize as soon as the project begins. These benefits likely would increase over time, as populations grow, and would persist over the long run (at least 50 years).

**Beneficiaries.** The beneficiaries of this benefit would include members of the Yurok Tribe and other Native American tribes – both within and outside of the region – who believe the continued existence of salmonid populations and their habitat is essential to cultural and spiritual well-being.

**Sources of uncertainty.** The value of this benefit depends on the uncertainty associated with the extent to the project confers a biophysical benefit that will result in increased salmon populations.

### 7. Improve water quality: Reduce future costs associated with water-quality compliance

**Relevant change.** The project would improve water quality by reducing sediment delivery, restoring riparian habitat, and restoring watersheds for cooler water temperatures. The project would benefit the following 303(d) listed bodies: Lower Klamath River, Hunter Creek and Terwer Creek.

**Evidence for demand and value.** These activities support implementation actions prescribed in the Klamath River TMDL Action Plan. While the project likely will not have a quantifiable impact on the TMDL regulation or compliance efforts, the project could provide an incremental improvement in water quality that will reduce costs of future efforts associated with TMDL compliance. We quantify a portion of this benefit, avoided costs associated with reductions in sediment deposition, in monetized benefit #2, below.

**Timing and duration.** The Yurok Tribe would implement the project over a three year period, beginning in May of 2014. We assume the benefits related improved to improved water quality would begin to accrue in 2017. These benefits likely would increase over time, as restoration matures, and would persist over the long run (at least 50 years).

**Beneficiaries.** Californian taxpayers, property owners, water users, and other stakeholders in the watershed.

**Sources of uncertainty.** The economic value associated with this benefit, while not quantifiable, is also particularly contingent on whether this project would reduce pollutants below a level that translates into cost savings. This is unlikely, but there is also value associated with the project's contribution to an overall effort to reduce contamination below levels that trigger regulation and impose costs on other dischargers. The degree to which the project would generate any of these benefits is uncertain both on a biophysical and economic level.

### 10. Improve the overall, long-term management of California's groundwater resources: Enhance use and non-use values of groundwater

**Relevant change.** The project's restoration techniques, such as construction of complex fish habitat structures and riparian forest rehabilitation, may increase groundwater recharge. These activities would also help rebuild productive floodplain soils that should help reduce evapotranspiration and heating of groundwater. Data are not available to quantify these effects.

**Evidence for demand and value.** Economists who study the economic importance of groundwater describe this importance using two major categories of value: extractive values and *in situ* values (CVG 1997). The major extractive values include the economic importance of groundwater consumption by municipalities, business and industry, and agricultural producers. Groundwater aquifers offer significant advantages over surface storage for consumptive uses including: no costs for storage facility, no loss through evaporation, and groundwater also protect water quality at no or little cost relative to surface storage. Another advantage of

groundwater aquifers is their capacity to distribute water over long distances at little to no cost. Constructing pipe systems on the surface is much more expensive than relying on an existing aquifer for water movement.

*In situ* values derive from the services that groundwater provides in place, rather than through consumptive use. *In situ* values include:

- Buffer values—given that supplies of surface water can fluctuate, groundwater supplies can help smooth out, or buffer, variability in water supplies in cases where water districts manage groundwater conjunctively with surface water. One study found that the buffer capacity of groundwater can represent over 80 percent of the total value of surface and groundwater (CVG 1997, page 60.).
- Environmental values—groundwater can help assimilate harmful pollutants. These assimilative properties helps avoid filtration and related costs that water users would otherwise face. Groundwater also often supports surface water flows and riparian and wetland ecosystems during parts of the year.
- Subsidence-avoidance values—the structural services that groundwater provides *in situ* help avoid ground subsidence and related damages to roads, pipeline, foundations and other structures and infrastructure. One way of describing the associated economic values is the avoided costs of subsidence damage.

Because data aren't available to quantify the biophysical effects, we are unable to estimate them in monetary terms.

**Timing and duration.** The Yurok Tribe would implement the project over a three year period, beginning in May of 2014. While the benefits from increased groundwater recharge are likely to present before 2017, To reduce the risk that we overestimate this benefit we assume the annual increases in groundwater recharge begin to accrue in that year. These benefits likely would increase over time, as restoration matures, and would persist over the long run (at least 50 years).

**Beneficiaries.** The beneficiaries of this benefit are groundwater users in the area, potentially other surface water users in the region, and people who value the ecological services provided by enhancing groundwater recharge and building the resiliency of groundwater-surface water interactions.

**Sources of uncertainty.** Data are insufficient to estimate the changes in the environment related to groundwater resources, so it is difficult to identify the potential magnitude of this benefit—it could be very small, or it could be very large, depending on the effects and the resources and users influenced by the effects.

## Section D3. Monetized Benefits Analysis

The present value of the monetized benefits in 2012 dollars, discounted annually at 6 percent over the relevant lifespan of each component of the project (described for each benefit below), is $877,161. The calculations for each monetized benefit are shown in Tables 15-1, 15-2, 15-3, 15-4, and 15-5, at the end of this section.

### 1. Use and Passive-use value associated with increases in salmon populations

**Relevant change.** The project would reduce width to depth ratios and increase pool count in the project reaches by concentrating flows and causing scour (i.e. deeper and more narrow channel). An outcome of these changes will be to prolong the duration and quantity of surface flows during periods of low rainfall and stream flow. YTFP and FGS has documented low and subsurface flows in a majority of Lower Klamath tributaries, even during winter. The proposed actions would not increase winter flows but would rather create more available fish habitat by exposing existing subsurface flow through channel incision. Incision into the aggraded streambed and the resulting deeper channel will increase overwinter survival of juvenile salmonids by decreasing predation by overhead predators and desiccation during prolonged periods with no to very low precipitation. Channel incision and reduced width-to-depth ratio may also prolong the duration of surface flows in spring and thereby allow more juvenile salmonids to outmigrate before flows become subsurface.

Project proponents estimate these actions could lead to increase of overwinter survival of thousands of juveniles every year. They also estimate the actions would lead to an increase in survival of adult steelhead that spawn during late-early spring, increasing spawning steelhead by 20-30 fish every year. Translating habitat improvements to increased fish populations can be difficult. Project proponents estimate, however, that the project would result in an increase in survival of adult steelhead by 20 fish per year; an increase of 15 Coho salmon per year; and an additional 150 Chinook salmon per year after 10 years of establishment and population stabilization.

In addition to these fish, restoration activities on Terwer Creek may increase the number and volume of pools that will persist through low flow periods and thereby increase overwinter and oversummer survival by 500 to 1,000 fish per year, especially where proposed CWJs will be installed in these locations to increase cover elements and by providing increased visual isolation of conspecifics which has been shown to increase densities within rearing areas. Given the uncertainty regarding the increase in fish population from this portion of the project, however, we do not include these fish in our estimates of economic benefit below.

**Evidence for demand and value.** Individuals derive value from increases in salmon and steelhead populations in two ways. Some (e.g., recreational anglers, tribal fishermen, and commercial fishermen) directly interact with salmon and steelhead populations and derive benefit by catching and consuming the fish. Others (including some from the former group) derive value from the fish solely based on the salmon and steelhead's existence. Studies have

shown that regardless of direct interaction with fish populations, many Californians hold a positive willingness to pay to ensure the long-term survival of salmon and steelhead (Pate and Loomis 1997).

***Use Value.*** The average value paid to Yurok Tribal Fishermen for Chinook is $100 per fish. After the population stabilizes, the estimated exploitation rate of these additional fish is assumed to be 60 percent. The undiscounted value associated with tribal Chinook harvest is $9,000 per year. Additional value could come from recreational or commercial fisheries—depending on the location of the catch and season, the value per fish could be less than or greater than this value.

***Passive Use Value.*** Several studies have attempted to estimate the passive use value of increases in salmon and steelhead populations among households in California and neighboring states. Passive use value, in this case, refers to the benefit individuals derive from knowing that healthy salmon and steelhead populations exist, regardless of their intent to directly interact with salmon and steelhead through fishing or some other means. In general, these studies have estimated households' average willingness to pay to implement policies that would increase salmon and steelhead populations.

At the per fish level, these studies reveal that households are willing to pay only fractions of a penny for increases in salmon populations. When summed across a region, however, the total value Californians are willing to pay for increases in fish populations can become several thousands of dollars per fish. With about 12.4 million households in California, two studies that have estimated willingness to pay values for increases in salmon and steelhead populations suggest that Californians, in total, would be willing to pay these values per fish per year (in 2012 dollars): $497 (Olsen, Richards, and Scott 1991) and $4,351 (Loomis 1996). In eliciting willingness to pay estimates from respondents, these studies told respondents that hypothetical policies would increase salmon populations by 2.5 million and 300,000, respectively. To reduce the risk that we overestimate this benefit, we employ a value of $500 per fish per year as a rough estimate of the benefit of increases in salmon populations.

The total annual undiscounted value of increases in steelhead population is therefore $10,000; the annual undiscounted value of increases in Coho salmon is $7,500 per year; and the annual undiscounted value of the increase in Chinook salmon is $75,000. These values are additive.

**Timing and duration.** The Yurok Tribe would implement the project over a three year period, beginning in May of 2014. While the benefits from increased fish populations are likely to begin to accrue before 2017, To reduce the risk that we overestimate this benefit we assume the annual increases in steelhead and Coho salmon begin in that year. Project proponents expect the project to result in an average escapement of an additional 150 Chinook salmon within 10 years of the project construction completion. We assume the values associated with Chinook

would then begin to accrue in 2027, although they could materialize earlier. Both use and passive use value derived from increases in salmon populations would persist over the long run, at least 50 years.

**Beneficiaries.** The beneficiaries of this benefit are the tribal members of people of California who value the continued existence of aquatic wildlife and habitat, particularly critical habitat for Chinook salmon, Coho salmon, and steelhead.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of increased salmon populations would also affect the economic benefit estimate described here. There is also uncertainty associated with the marginal economic value of increases in fish populations described above. The results from the studies listed above depend crucially on survey methodology and public perceptions on the current state of salmonid populations. Of the studies listed, three were conducted in the Pacific Northwest, which may over or underestimate Californians' willingness to pay for salmon.

All studies we reviewed found that the willingness to pay per fish for an increase in salmon populations decreases as the hypothetical increase in salmon stocks increases. In all cases however, the increases in population were several degrees of magnitude larger than the increases expected by this project. The projects would yield small potential increases in salmon populations, relative to the size of existing populations. There is no data in the literature measuring respondents' willingness to pay for population increases in the scope of the project. If the marginal value per fish of increases in salmon populations diminishes as the size of the project becomes very small, the value of salmon may lie at the lower end of the range presented above. If the value per additional fish resulting from the projects resembles the upper end of the range, we have likely underestimated the true value of this benefit.

## 2. Avoided costs associated with reduced probability of sediment deposition

**Relevant change.** The project would use log jams and other bioengineering features that will have a complementary effect to promote riparian reforestation and protection, and trap and store fine sediments on existing flood prone surfaces. The proposed treatment areas in Hunter and Terwer Creeks are 1.4 and 8.7 acres, respectively.

Project proponents estimated the project would reduce sediment by 297 tons per year. This calculation used the low-end of a range of deposition rates based on field observations for fine grain sediments. On existing floodplain and riparian restoration sites, these ranged from 0.125 to 0.58 inches/year. Project proponents also assumed a sediment trapping efficiency of 5 percent to account for variability in deposition rates and a bulk density for loam of 1.30 tons/cubic foot to convert sediment volume to mass.

**Evidence for demand and value.** Economic studies have examined and monetized some of the benefits that materialize when excessive sediment does not impair streams, rivers, estuaries, and the marine environment. A study conducted by the U.S. Department of Agriculture

identified 13 types of benefits associated with decreasing sediment (Hansen and Ribaudo 2008). For each benefit, the researchers modeled the potential value associated with reducing sediment, per ton, for each county across the country. For our analysis, we apply the average value for the counties in the Lower Klamath watershed, $9.24 per ton, to estimate the benefits derived from the prevention of sediment deposition. Included in this value are the regional benefits associated with the impacts of sediment on:

- Water-based recreation – cleaner fresh water recreation
- Irrigation ditches and channels – reduced cost of removing sediment and aquatic plants from irrigation channels
- Road drainage ditches – less damage to and flooding of roads
- Municipal water treatment – lower sediment-removal costs for water treatment plants
- Flood damage – reduced flooding and damage from flooding
- Marine fisheries – improved catch rates for marine commercial fisheries
- Marine recreational fishing – improved catch rates for marine recreational fishing
- Municipal and industrial water use – reduced damages from salts and minerals dissolved from sediment
- Steam power plants – reduced plant growth on heat exchangers
- Soil productivity – reduced losses in soil productivity
- Dust cleaning – decrease in cleaning due to reduced wind-borne particulates.
- Reservoir services – less sediment in reservoirs
- Navigation – shipping industry avoidance of damages from groundings

The annual undiscounted value of the avoided costs related to sediment reduction is $2,744.

**Timing and duration.** The Yurok Tribe would implement the project over a three year period, beginning in May of 2014. While the benefits from reduced sediment deposition are likely to begin to accrue before 2017, To reduce the risk that we overestimate this benefit we assume the annual economic value of this benefit begins to accrue in that year and last for the project's duration of 50 years.

**Beneficiaries.** The beneficiaries of this benefit are the wide array of downstream users associated with each of the benefits listed above. To some extent, these beneficiaries include the general public, municipal water treatment operators and their ratepayers, irrigators, recreationalists, downstream property owners, and fishermen.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of reduced sedimentation would also affect the economic benefit estimate described here. For example, the actual rate of sediment deposition is dependent on water year type, sediment yields, location and roughness of the flood prone surface, among other factors.

At least three major factors suggest that the value of sediment we use underestimates the true value of the sediment-reduction benefits. First, the value does not reflect many potential

benefits, such as the goods and services derived from potential impacts on wetlands and endangered species. Second, the estimates of sediment erosion that the projects would reduce are based on current sediment erosion rates. Climate change is expected to increase the frequency and intensity of storm events, which would likely increase the rate of sediment erosion absent the projects (Masden and Figdor 2007). If future sediment erosion rates exceed current rates, the without-project sediment erosion is likely to increase, and thus, the expected benefit of each project's sediment control activities is likely to be an underestimate. Third, this estimate does not anticipate increases in value that occur over time. We anticipate that the value of sediment-reduction benefits will increase, relative to the general price index, but have not accounted for this increase in our calculations.

### 3. Passive use value associated with increased riparian habitat

**Relevant change.** Without the project, riparian habitats within the project areas will continue to provide limited habitat functionality. Historic logging removed the majority of old growth redwoods and other conifers from riparian habitats. As a result, red alder and other deciduous species currently dominate riparian forests. These deciduous trees rarely attain diameters large enough to affect pool habitat formation or sediment storage, do not provide long-term habitat complexity and channel stability, and do not provide meaningful wood recruitment to these streams. The current riparian forests likely provide less than 10 percent of the ecosystem benefits relative to a mature conifer dominated riparian forest. The project would use log jams and other bioengineering features that will promote riparian reforestation and protection on 50 acres.

In the project area the riparian habitat does provide some functionality for various salmonid species. Project proponents estimate the existing habitat provides 10 percent functionality, and restoration would fully increase its function as it matures over a 15-year period. Once the restoration reaches year 15, we assume the function would persist for the long-run, at least 50 years.

**Evidence for demand and value.** Data are insufficient to delineate specific impacts of the project's restoration efforts on the ecosystem services provided by this area of riparian habitat. Thus, instead we employ a value that accounts for people's willingness to pay for the flow of goods and services from an acre of forested riparian habitat. In 2009, researchers conducted several meta-analyses estimating various use and nonuse values associated with forestland. In estimating the passive use value of forestland, the researchers compiled data from 23 relevant studies (Chiabai et al. 2009). Their results identify per-acre estimates for passive use values by geographic region and forest biome. For our analysis, we use the passive use value associated with North American forestland in the cool coniferous biome, $125 per acre per year.

The restored riparian areas increase in ecological function over time as vegetation matures. Our annual value reflects this steady improvement, using a simple assumption that the quantity of

ecological services—and thus people's willingness to pay for them—increases linearly over a 50-year period.

**Timing and duration.** The Yurok Tribe would implement the project over a three year period, beginning in May of 2014. While the benefits from increased riparian habitat are likely to present before 2017, To reduce the risk that we overestimate this benefit we assume the annual economic value of this benefit begins to accrue in that year. These benefits likely would increase over time, as restoration matures, and would persist over the long run (at least 50 years).

**Beneficiaries.** The beneficiaries of this benefit are the residents nearby and individuals in California who value the continued existence of riparian habitat in the state.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of increased riparian habitat acreage and functionality would also affect the economic benefit estimate described here. The value described above estimates society's total willingness to pay for fully-restored forest land in cool coniferous forests in North America. Insofar as this estimate considers only passive use values, it likely underestimates the total economic value of riparian and other forest-based restoration because direct users of the restored habitat likely are willing to pay more for its restoration. It also likely underestimates the value because, as human populations and incomes grow in California, the marginal value of forest land probably will increase, as will the value of restoration efforts. Because we found no reliable estimate of the rate of increase, we did not fold this increase into our estimates. For these reasons, it seems reasonable to conclude that the value estimates derived in the past underestimate, perhaps substantially, the true value of future increases in fully-restored riparian and other forest habitat.

### 4. Enhanced and increased wetland habitat

**Relevant change.** Without the project, wetland habitats within the project areas would continue to provide limited habitat functionality. The project would restore or protect 2 acres of wetland habitat. We assume 0 percent functionality in the without project conditions.

**Evidence for demand and value.** The value of the improved and expanded wetland habitat is based on estimates of the existence value of wetland habitat as reported in Woodward and Wui (2001). In this case, existence value represents the value of protecting the wetland habitat for current and future generations. Woodward and Wui (2001) estimate the annual nonuse value of habitat of a single-service wetland is $167 to $1,723 per acre. To reflect the uncertainty over the quality of the wetland habitat created by this project, we use the lower end of this range, $167.

This value is multiplied by the number of acres of improved wetland based on the net increase in the number of acres of wetland that the project is expected to create, to estimate the annual value of this benefit at $334 per year.

**Timing and duration.** The Yurok Tribe would implement the project over a three year period, beginning in May of 2014. While the benefits from increased riparian habitat are likely to present before 2017, To reduce the risk that we overestimate this benefit we assume the annual economic value of this benefit begins to accrue in that year.

**Beneficiaries.** The beneficiaries of this benefit are the nearby residents and the people of California who value the existence of wetland habitat in the state.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of increased riparian habitat acreage and functionality would also affect the economic benefit estimate described here. Applying a value derived from studies conducted elsewhere in the United States may over or underestimate the total economic value of increases in certain types of habitat. The value described above estimates society's willingness to pay for one fully-restored acre of wetland habitat in North America. This value is generally applicable to seasonal wetland habitat in California. By only considering passive use, we likely underestimate the total value of the benefits derived from wetland restoration because this value ignores direct users of restored habitat that are likely willing to pay more for its restoration. This value also may underestimate the total value to the extent that it does not account for potential increases in the biodiversity of habitat adjacent to the restored area. Moreover, as human populations and incomes in California grow, the marginal value of natural landscapes will increase, as will the value of restoration.

## 5. Avoided costs of climate change from carbon sequestration

**Relevant change.** The project would facilitate carbon sequestration through the use of whole tree materials to build log jams and other features. For the purposes of this calculation, project proponents assumed that: (1) log jams and treated floodplain areas will use a minimum of 50,000 cubic feet of wood; (2) log Jams and treated floodplain areas will result in a riparian forest with density of >20 trees/acre; (3) treatment will produces or protect 5 acres of mature riparian forest during a 50 year design life; and (4) fine and coarse organic carbon to soils at treated floodplain areas will exhibit a minimum accumulation rate of 8 ton/acre/year (this is an aggregate of values for shrubs, grasses and soil) (Mader 2007).

Project proponents estimate the soil would sequester 8 tons of carbon. The riparian restoration and protection would also involve the planting of 20 trees per acre, over 5 acres.

**Evidence for demand and value.** The International Panel on Climate Change has identified anthropogenic greenhouse gas emissions as the main contributor of global warming and climate change. Carbon dioxide emissions have received the most attention as they account for the majority of these emissions – 77 percent in 2004 (IPCC 2007). Expected impacts of climate change include decreased ecosystem resilience, increased extinction rates, fluctuations in cropland productivity, increased erosion and flooding in coastal areas, and decreased availability of clean drinking water. These impacts could result in the displacement of hundreds of millions

of people, increased morbidity, and irreversible damages to critical life-support systems within the environment (IPCC 2007).

Economists use the social cost of carbon to estimate the value of changes in greenhouse gas emissions. The social cost of carbon represents "the full global cost today of emitting an incremental unit of carbon at some point of time in the future, and it includes the sum of the global cost of the damage it imposes on the entire time it is in the atmosphere." (Shaw 2009) There are currently over 200 different estimates of the social cost of carbon. One review of the literature found values ranging from about $7 to $111 per ton of carbon dioxide equivalent ($2007) (Shaw 2009). Another analysis suggests increasing the social cost of carbon, in real terms, by 2–3 percent per year to reflect the rising damages from climate change (Nordhaus 2008).

California's cap-and-trade system for carbon provides one such estimate of the social cost of carbon. The cap-and-trade system, which took effect January 1, 2012, allots credits through auctions. The second such auction on February 19, 2013 elicited bids that ranged from $10.71-$50.01, with a mean and median price of $14.71 and $12.56, respectively (California Air Resources Board 2012). The cap-and-trade market, however, only applies to large producers of carbon and producers are allowed to offset up to 8 percent of carbon emissions.[18] Thus, while this range of costs for carbon is well within the broader range of costs, this market is not the appropriate mechanism for determining the cost of carbon beyond the cost for large producers.

For this analysis, we use a value of $13 per ton of carbon dioxide equivalent sequestered to represent the social cost of carbon. We inflate this value by 2.5 percent per year, in real terms, to reflect the rising damages from climate change.

We calculate the carbon sequestration benefits of the project over a 100 year period using a 6 percent discount rate. There are two forms of carbon dioxide sequestration in this scenario: reforestation and soil sequestration each for 20 trees per acre over 5 acres. Reforestation results in 232 tons of sequestered carbon over a 100 year span with a net present value of $1,715. Soil sequestration results in 4,000 tons of sequestered carbon dioxide over 100 years with a net present value of $15,200. The total net present value of sequestration is $16,916.

**Timing and duration.** The Yurok Tribe would implement the project over a three year period, beginning in May of 2014. Our calculation for carbon sequestration of trees considers the time required for stand establishment, so we assume the project would begin accruing benefits related to carbon sequestration in 2017. These would persist for the lifespan of the project, 50 years.

[18] These projects may currently include, and may only include forestry, urban forestry, dairy manure digesters, and the destruction of ozone depleting substances. California Environmental Protection Agency - Air Resources Board. Air Resources Board sets stage for carbon offset projects. December 14, 2012.

**Beneficiaries.** The beneficiaries of this benefit are all residents of California.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of increased carbon dioxide sequestered would also affect the economic benefit estimate described here. In particular, the estimate of carbon sequestration does not account for the expected mortality rates of the planted trees, the age of the trees at planting, or other environmental factors that could effect the total amount of sequestered carbon. To the extent that these factors reduce the amount of carbon sequestered by the project, we are overestimating the value of the project. However, because we are using a low estimate of the value of the social cost of carbon, it is likely that we are underestimating the real value of carbon sequestration from the project in the long run.

Table 15.1-740 – Annual Benefit: Increase in Salmon Populations

(All benefits should be in 2012 dollars)

Project: 740 - Yurok Tribe, Restoration of Lower Klamath River Habitats

| (a) | (b) | (c) | (d) | (e-1) | (e-2) | (f) | (g-1) | (g-2) | (h) | (i) | (j) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Type of Benefit | Measure of Benefit (Units) | Without Project | With Project - Coho & Steelhead | With Project - Chinook | Change Resulting from Project (e) – (d) | Unit $ Value - passive use | Unit $ Value - use | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Increased salmon survival | Fish | 0 | 0 | 0 | 0 | $ 500.00 | $ 100.00 | $ - | 1.000 | $ - |
| 2013 | Increased salmon survival | Fish | 0 | 0 | 0 | 0 | $ 500.00 | $ 100.00 | $ - | 0.943 | $ - |
| 2014 | Increased salmon survival | Fish | 0 | 0 | 0 | 0 | $ 500.00 | $ 100.00 | $ - | 0.890 | $ - |
| 2015 | Increased salmon survival | Fish | 0 | 0 | 0 | 0 | $ 500.00 | $ 100.00 | $ - | 0.840 | $ - |
| 2016 | Increased salmon survival | Fish | 0 | 0 | 0 | 0 | $ 500.00 | $ 100.00 | $ - | 0.792 | $ - |
| 2017 | Increased salmon survival | Fish | 0 | 35 | 0 | 35 | $ 500.00 | $ 100.00 | $ 17,500.00 | 0.747 | $ 13,077 |
| 2018 | Increased salmon survival | Fish | 0 | 35 | 0 | 35 | $ 500.00 | $ 100.00 | $ 17,500.00 | 0.705 | $ 12,337 |
| 2019 | Increased salmon survival | Fish | 0 | 35 | 0 | 35 | $ 500.00 | $ 100.00 | $ 17,500.00 | 0.665 | $ 11,638 |
| 2020 | Increased salmon survival | Fish | 0 | 35 | 0 | 35 | $ 500.00 | $ 100.00 | $ 17,500.00 | 0.627 | $ 10,980 |
| 2021 | Increased salmon survival | Fish | 0 | 35 | 0 | 35 | $ 500.00 | $ 100.00 | $ 17,500.00 | 0.592 | $ 10,358 |
| 2022 | Increased salmon survival | Fish | 0 | 35 | 0 | 35 | $ 500.00 | $ 100.00 | $ 17,500.00 | 0.558 | $ 9,772 |
| 2023 | Increased salmon survival | Fish | 0 | 35 | 0 | 35 | $ 500.00 | $ 100.00 | $ 17,500.00 | 0.527 | $ 9,219 |
| 2024 | Increased salmon survival | Fish | 0 | 35 | 0 | 35 | $ 500.00 | $ 100.00 | $ 17,500.00 | 0.497 | $ 8,697 |
| 2025 | Increased salmon survival | Fish | 0 | 35 | 0 | 35 | $ 500.00 | $ 100.00 | $ 17,500.00 | 0.469 | $ 8,205 |
| 2026 | Increased salmon survival | Fish | 0 | 35 | 0 | 35 | $ 500.00 | $ 100.00 | $ 17,500.00 | 0.442 | $ 7,740 |
| 2027 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.417 | $ 42,352 |
| 2028 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.394 | $ 39,955 |
| 2029 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.371 | $ 37,693 |
| 2030 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.350 | $ 35,560 |
| 2031 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.331 | $ 33,547 |
| 2032 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.312 | $ 31,648 |
| 2033 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.294 | $ 29,857 |
| 2034 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.278 | $ 28,167 |
| 2035 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.262 | $ 26,572 |
| 2036 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.247 | $ 25,068 |
| 2037 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.233 | $ 23,649 |
| 2038 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.220 | $ 22,311 |
| 2039 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.207 | $ 21,048 |
| 2040 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.196 | $ 19,856 |
| 2041 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.185 | $ 18,733 |
| 2042 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.174 | $ 17,672 |
| 2043 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.164 | $ 16,672 |
| 2044 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.155 | $ 15,728 |
| 2045 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.146 | $ 14,838 |
| 2046 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.138 | $ 13,998 |
| 2047 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.130 | $ 13,206 |
| 2048 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.123 | $ 12,458 |
| 2049 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.116 | $ 11,753 |
| 2050 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.109 | $ 11,088 |
| 2051 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.103 | $ 10,460 |
| 2052 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.097 | $ 9,868 |
| 2053 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.092 | $ 9,309 |
| 2054 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.087 | $ 8,783 |
| 2055 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.082 | $ 8,285 |
| 2056 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.077 | $ 7,816 |
| 2057 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.073 | $ 7,374 |
| 2058 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.069 | $ 6,957 |
| 2059 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.065 | $ 6,563 |
| 2060 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.061 | $ 6,191 |
| 2061 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.058 | $ 5,841 |
| 2062 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.054 | $ 5,510 |
| 2063 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.051 | $ 5,198 |
| 2064 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.048 | $ 4,904 |
| 2065 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.046 | $ 4,627 |
| 2066 | Increased salmon survival | Fish | 0 | 35 | 150 | 185 | $ 500.00 | $ 100.00 | $ 101,500.00 | 0.043 | $ 4,365 |
| | | | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 777,505 |

Comments: Beginning in 2017, an additional 20 adult Steelhead and 15 Coho will survive each year. Chinook adults survival will increase by 10% each year for 10 years to a max of 150, for a total of 185 additional salmon surviving.

Table 15.2-740 – Annual Benefit: Reduced Sediment Deposition
(All benefits should be in 2012 dollars)

Project: 740 - Yurok Tribe, Restoration of Lower Klamath River Habitats

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Reduced Sediment | tons | 0 | 0 | 0 | $ 9.24 | $ - | 1.000 | $ - |
| 2013 | Reduced Sediment | tons | 0 | 0 | 0 | $ 9.24 | $ - | 0.943 | $ - |
| 2014 | Reduced Sediment | tons | 0 | 0 | 0 | $ 9.24 | $ - | 0.890 | $ - |
| 2015 | Reduced Sediment | tons | 0 | 0 | 0 | $ 9.24 | $ - | 0.840 | $ - |
| 2016 | Reduced Sediment | tons | 0 | 0 | 0 | $ 9.24 | $ - | 0.792 | $ - |
| 2017 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.747 | $ 2,051 |
| 2018 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.705 | $ 1,935 |
| 2019 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.665 | $ 1,825 |
| 2020 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.627 | $ 1,722 |
| 2021 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.592 | $ 1,624 |
| 2022 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.558 | $ 1,532 |
| 2023 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.527 | $ 1,446 |
| 2024 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.497 | $ 1,364 |
| 2025 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.469 | $ 1,287 |
| 2026 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.442 | $ 1,214 |
| 2027 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.417 | $ 1,145 |
| 2028 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.394 | $ 1,080 |
| 2029 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.371 | $ 1,019 |
| 2030 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.350 | $ 961 |
| 2031 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.331 | $ 907 |
| 2032 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.312 | $ 856 |
| 2033 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.294 | $ 807 |
| 2034 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.278 | $ 762 |
| 2035 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.262 | $ 718 |
| 2036 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.247 | $ 678 |
| 2037 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.233 | $ 639 |
| 2038 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.220 | $ 603 |
| 2039 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.207 | $ 569 |
| 2040 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.196 | $ 537 |
| 2041 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.185 | $ 506 |
| 2042 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.174 | $ 478 |
| 2043 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.164 | $ 451 |
| 2044 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.155 | $ 425 |
| 2045 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.146 | $ 401 |
| 2046 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.138 | $ 378 |
| 2047 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.130 | $ 357 |
| 2048 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.123 | $ 337 |
| 2049 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.116 | $ 318 |
| 2050 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.109 | $ 300 |
| 2051 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.103 | $ 283 |
| 2052 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.097 | $ 267 |
| 2053 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.092 | $ 252 |
| 2054 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.087 | $ 237 |
| 2055 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.082 | $ 224 |
| 2056 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.077 | $ 211 |
| 2057 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.073 | $ 199 |
| 2058 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.069 | $ 188 |
| 2059 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.065 | $ 177 |
| 2060 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.061 | $ 167 |
| 2061 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.058 | $ 158 |
| 2062 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.054 | $ 149 |
| 2063 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.051 | $ 141 |
| 2064 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.048 | $ 133 |
| 2065 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.046 | $ 125 |
| 2066 | Reduced Sediment | tons | 0 | 297 | 297 | $ 9.24 | $ 2,744.28 | 0.043 | $ 118 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 34,262 |

Comments:

Table 15.3-740 – Annual Benefit: Enhanced Riparian Habitat
(All benefits should be in 2012 dollars)
Project: 740 - Yurok Tribe, Restoration of Lower Klamath River Habitats

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Riparian Habitat | Functional Acres | 5 | 5 | 0 | $ 125.00 | $ - | 1.000 | $ - |
| 2013 | Riparian Habitat | Functional Acres | 5 | 5 | 0 | $ 125.00 | $ - | 0.943 | $ - |
| 2014 | Riparian Habitat | Functional Acres | 5 | 5 | 0 | $ 125.00 | $ - | 0.890 | $ - |
| 2015 | Riparian Habitat | Functional Acres | 5 | 5 | 0 | $ 125.00 | $ - | 0.840 | $ - |
| 2016 | Riparian Habitat | Functional Acres | 5 | 5 | 0 | $ 125.00 | $ - | 0.792 | $ - |
| 2017 | Riparian Habitat | Functional Acres | 5 | 8.21 | 3.21 | $ 125.00 | $ 401.79 | 0.747 | $ 300 |
| 2018 | Riparian Habitat | Functional Acres | 5 | 11.43 | 6.43 | $ 125.00 | $ 803.57 | 0.705 | $ 566 |
| 2019 | Riparian Habitat | Functional Acres | 5 | 14.64 | 9.64 | $ 125.00 | $ 1,205.36 | 0.665 | $ 802 |
| 2020 | Riparian Habitat | Functional Acres | 5 | 17.86 | 12.86 | $ 125.00 | $ 1,607.14 | 0.627 | $ 1,008 |
| 2021 | Riparian Habitat | Functional Acres | 5 | 21.07 | 16.07 | $ 125.00 | $ 2,008.93 | 0.592 | $ 1,189 |
| 2022 | Riparian Habitat | Functional Acres | 5 | 24.29 | 19.29 | $ 125.00 | $ 2,410.71 | 0.558 | $ 1,346 |
| 2023 | Riparian Habitat | Functional Acres | 5 | 27.50 | 22.50 | $ 125.00 | $ 2,812.50 | 0.527 | $ 1,482 |
| 2024 | Riparian Habitat | Functional Acres | 5 | 30.71 | 25.71 | $ 125.00 | $ 3,214.29 | 0.497 | $ 1,597 |
| 2025 | Riparian Habitat | Functional Acres | 5 | 33.93 | 28.93 | $ 125.00 | $ 3,616.07 | 0.469 | $ 1,695 |
| 2026 | Riparian Habitat | Functional Acres | 5 | 37.14 | 32.14 | $ 125.00 | $ 4,017.86 | 0.442 | $ 1,777 |
| 2027 | Riparian Habitat | Functional Acres | 5 | 40.36 | 35.36 | $ 125.00 | $ 4,419.64 | 0.417 | $ 1,844 |
| 2028 | Riparian Habitat | Functional Acres | 5 | 43.57 | 38.57 | $ 125.00 | $ 4,821.43 | 0.394 | $ 1,898 |
| 2029 | Riparian Habitat | Functional Acres | 5 | 46.79 | 41.79 | $ 125.00 | $ 5,223.21 | 0.371 | $ 1,940 |
| 2030 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.350 | $ 1,971 |
| 2031 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.331 | $ 1,859 |
| 2032 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.312 | $ 1,754 |
| 2033 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.294 | $ 1,655 |
| 2034 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.278 | $ 1,561 |
| 2035 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.262 | $ 1,473 |
| 2036 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.247 | $ 1,389 |
| 2037 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.233 | $ 1,311 |
| 2038 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.220 | $ 1,236 |
| 2039 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.207 | $ 1,166 |
| 2040 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.196 | $ 1,100 |
| 2041 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.185 | $ 1,038 |
| 2042 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.174 | $ 979 |
| 2043 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.164 | $ 924 |
| 2044 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.155 | $ 872 |
| 2045 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.146 | $ 822 |
| 2046 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.138 | $ 776 |
| 2047 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.130 | $ 732 |
| 2048 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.123 | $ 690 |
| 2049 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.116 | $ 651 |
| 2050 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.109 | $ 614 |
| 2051 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.103 | $ 580 |
| 2052 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.097 | $ 547 |
| 2053 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.092 | $ 516 |
| 2054 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.087 | $ 487 |
| 2055 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.082 | $ 459 |
| 2056 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.077 | $ 433 |
| 2057 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.073 | $ 409 |
| 2058 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.069 | $ 386 |
| 2059 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.065 | $ 364 |
| 2060 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.061 | $ 343 |
| 2061 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.058 | $ 324 |
| 2062 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.054 | $ 305 |
| 2063 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.051 | $ 288 |
| 2064 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.048 | $ 272 |
| 2065 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.046 | $ 256 |
| 2066 | Riparian Habitat | Functional Acres | 5 | 50 | 45 | $ 125.00 | $ 5,625.00 | 0.043 | $ 242 |
| | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | | | $ 48,229 |

Comments: This calculation accounts for functionality by including 10 percent of the project's acres in the without project conditions. After project completion, the riparian habitat takes 15 years to grow to its full potential. This is depicted by a linear increase between 2016 and 2030.

Table 15.4-740 – Annual Benefit: Enhanced Wetland Habitat

(All benefits should be in 2012 dollars)

Project: 740 - Yurok Tribe, Restoration of Lower Klamath River Habitats

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Wetland Habitat | acres | 0 | 0 | 0 | $ 167.00 | $ - | 1.000 | $ - |
| 2013 | Wetland Habitat | acres | 0 | 0 | 0 | $ 167.00 | $ - | 0.943 | $ - |
| 2014 | Wetland Habitat | acres | 0 | 0 | 0 | $ 167.00 | $ - | 0.890 | $ - |
| 2015 | Wetland Habitat | acres | 0 | 0 | 0 | $ 167.00 | $ - | 0.840 | $ - |
| 2016 | Wetland Habitat | acres | 0 | 0 | 0 | $ 167.00 | $ - | 0.792 | $ - |
| 2017 | Wetland Habitat | acres | 0 | 0.14 | 0.14 | $ 167.00 | $ 23.86 | 0.747 | $ 18 |
| 2018 | Wetland Habitat | acres | 0 | 0.29 | 0.29 | $ 167.00 | $ 47.71 | 0.705 | $ 34 |
| 2019 | Wetland Habitat | acres | 0 | 0.43 | 0.43 | $ 167.00 | $ 71.57 | 0.665 | $ 48 |
| 2020 | Wetland Habitat | acres | 0 | 0.57 | 0.57 | $ 167.00 | $ 95.43 | 0.627 | $ 60 |
| 2021 | Wetland Habitat | acres | 0 | 0.71 | 0.71 | $ 167.00 | $ 119.29 | 0.592 | $ 71 |
| 2022 | Wetland Habitat | acres | 0 | 0.86 | 0.86 | $ 167.00 | $ 143.14 | 0.558 | $ 80 |
| 2023 | Wetland Habitat | acres | 0 | 1.00 | 1.00 | $ 167.00 | $ 167.00 | 0.527 | $ 88 |
| 2024 | Wetland Habitat | acres | 0 | 1.14 | 1.14 | $ 167.00 | $ 190.86 | 0.497 | $ 95 |
| 2025 | Wetland Habitat | acres | 0 | 1.29 | 1.29 | $ 167.00 | $ 214.71 | 0.469 | $ 101 |
| 2026 | Wetland Habitat | acres | 0 | 1.43 | 1.43 | $ 167.00 | $ 238.57 | 0.442 | $ 106 |
| 2027 | Wetland Habitat | acres | 0 | 1.57 | 1.57 | $ 167.00 | $ 262.43 | 0.417 | $ 110 |
| 2028 | Wetland Habitat | acres | 0 | 1.71 | 1.71 | $ 167.00 | $ 286.29 | 0.394 | $ 113 |
| 2029 | Wetland Habitat | acres | 0 | 1.86 | 1.86 | $ 167.00 | $ 310.14 | 0.371 | $ 115 |
| 2030 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.350 | $ 117 |
| 2031 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.331 | $ 110 |
| 2032 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.312 | $ 104 |
| 2033 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.294 | $ 98 |
| 2034 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.278 | $ 93 |
| 2035 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.262 | $ 87 |
| 2036 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.247 | $ 82 |
| 2037 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.233 | $ 78 |
| 2038 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.220 | $ 73 |
| 2039 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.207 | $ 69 |
| 2040 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.196 | $ 65 |
| 2041 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.185 | $ 62 |
| 2042 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.174 | $ 58 |
| 2043 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.164 | $ 55 |
| 2044 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.155 | $ 52 |
| 2045 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.146 | $ 49 |
| 2046 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.138 | $ 46 |
| 2047 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.130 | $ 43 |
| 2048 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.123 | $ 41 |
| 2049 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.116 | $ 39 |
| 2050 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.109 | $ 36 |
| 2051 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.103 | $ 34 |
| 2052 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.097 | $ 32 |
| 2053 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.092 | $ 31 |
| 2054 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.087 | $ 29 |
| 2055 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.082 | $ 27 |
| 2056 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.077 | $ 26 |
| 2057 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.073 | $ 24 |
| 2058 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.069 | $ 23 |
| 2059 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.065 | $ 22 |
| 2060 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.061 | $ 20 |
| 2061 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.058 | $ 19 |
| 2062 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.054 | $ 18 |
| 2063 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.051 | $ 17 |
| 2064 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.048 | $ 16 |
| 2065 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.046 | $ 15 |
| 2066 | Wetland Habitat | acres | 0 | 2 | 2 | $ 167.00 | $ 334.00 | 0.043 | $ 14 |
| | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | | | $ 2,864 |

Comments: After project completion, the wetland habitat takes 15 years to grow to its full potential. This is depicted by a linear increase between 2016 and 2030.

Table 15.5-740 – Annual Benefit: Avoided Costs from Carbon Sequestration

(All benefits should be in 2012 dollars)

Project: 740 - Yurok Tribe, Restoration of Lower Klamath River Habitats

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Carbon Sequestration | tons | 0 | 0 | 0 | $ 13.00 | $ - | 1.000 | $ - |
| 2013 | Carbon Sequestration | tons | 0 | 0 | 0 | $ 13.33 | $ - | 0.943 | $ - |
| 2014 | Carbon Sequestration | tons | 0 | 0 | 0 | $ 13.66 | $ - | 0.890 | $ - |
| 2015 | Carbon Sequestration | tons | 0 | 0 | 0 | $ 14.00 | $ - | 0.840 | $ - |
| 2016 | Carbon Sequestration | tons | 0 | 0 | 0 | $ 14.35 | $ - | 0.792 | $ - |
| 2017 | Carbon Sequestration | tons | 0 | 40.1835 | 40.1835 | $ 14.71 | $ 591.03 | 0.747 | $ 442 |
| 2018 | Carbon Sequestration | tons | 0 | 40.27525 | 40.27525 | $ 15.08 | $ 607.19 | 0.705 | $ 428 |
| 2019 | Carbon Sequestration | tons | 0 | 40.367 | 40.367 | $ 15.45 | $ 623.79 | 0.665 | $ 415 |
| 2020 | Carbon Sequestration | tons | 0 | 40.45875 | 40.45875 | $ 15.84 | $ 640.84 | 0.627 | $ 402 |
| 2021 | Carbon Sequestration | tons | 0 | 40.56885 | 40.56885 | $ 16.24 | $ 658.64 | 0.592 | $ 390 |
| 2022 | Carbon Sequestration | tons | 0 | 40.67895 | 40.67895 | $ 16.64 | $ 676.94 | 0.558 | $ 378 |
| 2023 | Carbon Sequestration | tons | 0 | 40.8074 | 40.8074 | $ 17.06 | $ 696.06 | 0.527 | $ 367 |
| 2024 | Carbon Sequestration | tons | 0 | 40.93585 | 40.93585 | $ 17.48 | $ 715.70 | 0.497 | $ 356 |
| 2025 | Carbon Sequestration | tons | 0 | 41.0643 | 41.0643 | $ 17.92 | $ 735.90 | 0.469 | $ 345 |
| 2026 | Carbon Sequestration | tons | 0 | 41.2111 | 41.2111 | $ 18.37 | $ 756.99 | 0.442 | $ 335 |
| 2027 | Carbon Sequestration | tons | 0 | 41.3579 | 41.3579 | $ 18.83 | $ 778.68 | 0.417 | $ 325 |
| 2028 | Carbon Sequestration | tons | 0 | 41.5047 | 41.5047 | $ 19.30 | $ 800.98 | 0.394 | $ 315 |
| 2029 | Carbon Sequestration | tons | 0 | 41.66985 | 41.66985 | $ 19.78 | $ 824.27 | 0.371 | $ 306 |
| 2030 | Carbon Sequestration | tons | 0 | 41.81665 | 41.81665 | $ 20.28 | $ 847.86 | 0.350 | $ 297 |
| 2031 | Carbon Sequestration | tons | 0 | 41.9818 | 41.9818 | $ 20.78 | $ 872.48 | 0.331 | $ 288 |
| 2032 | Carbon Sequestration | tons | 0 | 42.1653 | 42.1653 | $ 21.30 | $ 898.21 | 0.312 | $ 280 |
| 2033 | Carbon Sequestration | tons | 0 | 42.33045 | 42.33045 | $ 21.83 | $ 924.27 | 0.294 | $ 272 |
| 2034 | Carbon Sequestration | tons | 0 | 42.51395 | 42.51395 | $ 22.38 | $ 951.48 | 0.278 | $ 264 |
| 2035 | Carbon Sequestration | tons | 0 | 42.69745 | 42.69745 | $ 22.94 | $ 979.48 | 0.262 | $ 256 |
| 2036 | Carbon Sequestration | tons | 0 | 42.88095 | 42.88095 | $ 23.51 | $ 1,008.28 | 0.247 | $ 249 |
| 2037 | Carbon Sequestration | tons | 0 | 43.06445 | 43.06445 | $ 24.10 | $ 1,037.91 | 0.233 | $ 242 |
| 2038 | Carbon Sequestration | tons | 0 | 43.2663 | 43.2663 | $ 24.70 | $ 1,068.84 | 0.220 | $ 235 |
| 2039 | Carbon Sequestration | tons | 0 | 43.46815 | 43.46815 | $ 25.32 | $ 1,100.67 | 0.207 | $ 228 |
| 2040 | Carbon Sequestration | tons | 0 | 43.67 | 43.67 | $ 25.95 | $ 1,133.43 | 0.196 | $ 222 |
| 2041 | Carbon Sequestration | tons | 0 | 43.87185 | 43.87185 | $ 26.60 | $ 1,167.14 | 0.185 | $ 215 |
| 2042 | Carbon Sequestration | tons | 0 | 44.0737 | 44.0737 | $ 27.27 | $ 1,201.82 | 0.174 | $ 209 |
| 2043 | Carbon Sequestration | tons | 0 | 44.2939 | 44.2939 | $ 27.95 | $ 1,238.02 | 0.164 | $ 203 |
| 2044 | Carbon Sequestration | tons | 0 | 44.5141 | 44.5141 | $ 28.65 | $ 1,275.28 | 0.155 | $ 198 |
| 2045 | Carbon Sequestration | tons | 0 | 44.7343 | 44.7343 | $ 29.37 | $ 1,313.63 | 0.146 | $ 192 |
| 2046 | Carbon Sequestration | tons | 0 | 44.9545 | 44.9545 | $ 30.10 | $ 1,353.09 | 0.138 | $ 187 |
| 2047 | Carbon Sequestration | tons | 0 | 45.1747 | 45.1747 | $ 30.85 | $ 1,393.71 | 0.130 | $ 181 |
| 2048 | Carbon Sequestration | tons | 0 | 45.41325 | 45.41325 | $ 31.62 | $ 1,436.10 | 0.123 | $ 176 |
| 2049 | Carbon Sequestration | tons | 0 | 45.63345 | 45.63345 | $ 32.41 | $ 1,479.14 | 0.116 | $ 171 |
| 2050 | Carbon Sequestration | tons | 0 | 45.872 | 45.872 | $ 33.22 | $ 1,524.05 | 0.109 | $ 166 |
| 2051 | Carbon Sequestration | tons | 0 | 46.11055 | 46.11055 | $ 34.05 | $ 1,570.27 | 0.103 | $ 162 |
| 2052 | Carbon Sequestration | tons | 0 | 46.36745 | 46.36745 | $ 34.91 | $ 1,618.49 | 0.097 | $ 157 |
| 2053 | Carbon Sequestration | tons | 0 | 46.606 | 46.606 | $ 35.78 | $ 1,667.49 | 0.092 | $ 153 |
| 2054 | Carbon Sequestration | tons | 0 | 46.84455 | 46.84455 | $ 36.67 | $ 1,717.93 | 0.087 | $ 149 |
| 2055 | Carbon Sequestration | tons | 0 | 47.10145 | 47.10145 | $ 37.59 | $ 1,770.53 | 0.082 | $ 145 |
| 2056 | Carbon Sequestration | tons | 0 | 47.35835 | 47.35835 | $ 38.53 | $ 1,824.69 | 0.077 | $ 141 |
| 2057 | Carbon Sequestration | tons | 0 | 47.61525 | 47.61525 | $ 39.49 | $ 1,880.46 | 0.073 | $ 137 |
| 2058 | Carbon Sequestration | tons | 0 | 47.87215 | 47.87215 | $ 40.48 | $ 1,937.87 | 0.069 | $ 133 |
| 2059 | Carbon Sequestration | tons | 0 | 48.12905 | 48.12905 | $ 41.49 | $ 1,996.97 | 0.065 | $ 129 |
| 2060 | Carbon Sequestration | tons | 0 | 48.4043 | 48.4043 | $ 42.53 | $ 2,058.60 | 0.061 | $ 126 |
| 2061 | Carbon Sequestration | tons | 0 | 48.6612 | 48.6612 | $ 43.59 | $ 2,121.27 | 0.058 | $ 122 |
| 2062 | Carbon Sequestration | tons | 0 | 48.93645 | 48.93645 | $ 44.68 | $ 2,186.60 | 0.054 | $ 119 |
| 2063 | Carbon Sequestration | tons | 0 | 49.2117 | 49.2117 | $ 45.80 | $ 2,253.87 | 0.051 | $ 115 |
| 2064 | Carbon Sequestration | tons | 0 | 49.48695 | 49.48695 | $ 46.94 | $ 2,323.14 | 0.048 | $ 112 |
| 2065 | Carbon Sequestration | tons | 0 | 49.7622 | 49.7622 | $ 48.12 | $ 2,394.46 | 0.046 | $ 109 |
| 2066 | Carbon Sequestration | tons | 0 | 50.0558 | 50.0558 | $ 49.32 | $ 2,468.80 | 0.043 | $ 106 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 11,650 |

Comments: Carbon Sequestration includes two forms, soil and tree sequestration. After project completion, each of 5 acres of soil sequesters 8 tons of carbon. The carbon sequestered by trees increases as the trees grow through year 60. These calculations do not account for tree mortality rates or the age of the trees at planting, both of which affect the total sequestration of trees

## Section D3. Project Costs

The present value of the project's costs, which would occur between 2013 and 2015, is $1,125,250 in 2012 dollars, discounted at a 6-percent annual rate. These costs would fund labor, planning, equipment, and materials necessary to implement the project.

Table 19-740 – Annual Costs of Project
(All costs should be in 2012 Dollars)

Project: 740 - Yurok Tribe, Restoration of Lower Klamath River Habitats

| | Initial Costs | Adjusted | Annual Costs [2] | | | | | | Discounting Calculations | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Grand Total Cost from Table 7 (row (i), column (d)) | Grant Total Cost | 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 | $ - | | $ - | | | | | $ - | 1.000 | $ - |
| 2013 | $ 1,017,550.40 | | $ 3,709.66 | | | | | $ 1,021,260 | 0.943 | $ 963,453 |
| 2014 | $ 105,718.62 | | $ 3,709.65 | | | | | $ 109,428 | 0.890 | $ 97,391 |
| 2015 | $ 72,998.86 | | $ 3,709.65 | | | | | $ 76,709 | 0.840 | $ 64,406 |
| Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries | | | | | | | | | | $ 1,125,250 |

Comments:

## 635. *Salyer Mutual Water Company*, Distribution System and Hydrants

### Conditions Without the Project

The Salyer Mutual Water Company (SMWC), located in the City of Salyer, California, draws water from a river gallery in the Trinity River with 18 feet of cover. Salyer is part of the Trinity River Hydrographic Unit, Burnt Ranch subunit watershed.

Since 1998, the California Department of Public Health has maintained a standing boil order advisory for water users in the Salyer Mutual Water Company (SMWC) service area because the unfiltered source water does not meet Safe Drinking Water Act requirements. The SMWC took over the operation of the previously privately owned water company in 2012 after regulatory violations and deferred maintenance resulted in leaks, low water pressure, lack of proper chlorination and unsafe water for some customers. Willow Creek Community Services District (CSD) has loaned SMWC equipment for water supply repairs and on occasion provides expertise for addressing water-supply issues.

SMWC has two storage tanks; each hold 10,000 gallons. SMWC serves 110 residents, which represent 59 active connections. About one fourth of these are summer homes. Residents level to the tanks experience low pressure. Power outages and frequent leaks lead to frequent water outages and require extreme water conservation to avoid shortages, including purchases of bottled water and bulk water deliveries. The system is insufficient for fire protection; Salyer is considered at high risk from wildland fires.

SMWC does not have any fire hydrants, only 7 flushing standpipes that are not compatible with Salyer VFD's equipment. Also the sediment in the unfiltered system would cause damage to the fire engine's pump. The American Water Works Association (AWWA) standard for fire hydrants is every 500 feet.

### Conditions With the Project

The project would build a new storage tank(s) and a dedicated water line to storage tank(s) and new water mains throughout; install a master meter at pump house and meters at customer's homes; and install fire hydrants for fire protection. The project would eliminate the short-term and long-term water outages.

### Section D2. Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient information to quantify in monetary terms does not exist. Table 12-635 identifies the non-monetized benefits the project would likely generate.

| Table 12-635 – Non-monetized Benefits Checklist<br>*Salyer Mutual Water Company*, Distribution System and Hydrants | | |
|---|---|---|
| *No.* | *Will the proposal…* | *Response*[1] |
| | **Community/Social Benefits** | |
| 1 | Provide education or technology benefits? | No |
| 2 | Provide social recreation or access benefits? | No |
| 3 | Help avoid, reduce or resolve various public water resources conflicts? | No |
| 4 | Promote social health and safety? Reduce risk of fire damage and loss of life | Yes |
| 5 | Have other social benefits? | No |
| | **Environmental Stewardship Benefits** | |
| 6 | Benefit wildlife or habitat in ways that were not quantified in Attachment 7? | No |
| 7 | Improve water quality in ways that were not quantified in Attachment 7? Reduce costs associated with boil water advisory | Yes |
| 8 | Reduce net emissions in ways that were not quantified in Attachment 7? | No |
| 9 | Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4? | No |
| | **Sustainability Benefits** | |
| 10 | Improve the overall, long-term management of California groundwater resources? | No |
| 11 | Reduce demand for net diversions for the regions from the Delta? | No |
| 12 | Provide a long-term solution in place of a short-term one? | No |
| 13 | Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources? | No |
| 14 | Improve water supply reliability in ways not quantified in Attachment 7? | No |
| 15 | Other (If the above listed categories do not apply, provide non-monetized benefit description)? | No |

Notes: [1] A "no" response may mean the project does not produce this benefit, or it may mean the benefit is already quantified in Attachment 7, or monetized directly under Section D3 below.

## 4. Promote social health and safety: Reduce risk of fire damage and loss of life

**Relevant change.** The City of Salyer is in a wildfire prone area and currently does not have sufficient fire protection. Residents in Salyer currently have a rural fire protection rating of 10, which indicates the highest risk. The project would improve public health and safety by installing fire hydrants, which would improve fire protection for the community and meet a regulatory requirement. Project proponents estimate the project could reduce their fire protection rating to 7, a moderate risk.

**Evidence for demand and economic value.** The improvements in fire protection would have a real impact on the public health and safety of residents in Salyer, by reducing the likelihood and degree of damage from fire, including reduced risk of injuries and death. While we cannot quantify the value of these improvements, they are likely significant. We quantify the benefit associated with reduced hazard insurance premiums in monetized benefit #1 (Reduced Costs of Hazard Insurance), below. These benefits would likely be at least partially additive, as people's willingness to pay to avoid these damages is probably higher than they pay for insurance.

**Timing and duration.** Project proponents expect to complete design, construction, implementation, and installation of fire hydrants by the end of 2015. To reduce the risk that we overestimate this benefit, we assume the project would begin conferring benefits related to improved social health and safety in 2016. The benefits would accrue for the lifespan of the project, 40 years.

**Beneficiaries.** The beneficiaries of this benefit are the residents of the City of Salyer.

**Sources of uncertainty.** The degree to which this benefit would materialize depends on how much extra protection the improvements make in reducing the risk of fire damage. Data do not exist to describe the impacts of sub-standard fire protection today in Salyer, but the fire protection rating suggests that, on average across California, communities with systems similar to Salyer's do experience higher costs associated with fire damage.

### 7. Improve water quality: Reduced costs associated with boil water advisory

**Relevant change.** Because Salyer's water system does not meet regulatory standards, and residents have been on a standing alert to boil the water for potable use. As a result of the project, the community would no longer be on a boil advisory from regulatory violations.

**Evidence for demand and economic value.** The value of this benefit is the avoided costs to residents of the City of Salyer from obtaining water that is safe to drink--either by boiling water for drinking or purchasing bottled water. Project proponents are not aware of how many residents purchase bottled water versus boiling. Anecdotally, there are examples of households that purchase bottled water at a cost of approximately $220 per year. The costs to customers who boil their water include the opportunity cost of their time, and the cost of electricity or propane use. There is insufficient information to quantify the value of this benefit, but it is likely sizeable. Residents who drink and cook with tap water without boiling it would potential also experience benefits by reducing the risks of drinking water that does not meet regulatory standards.

**Timing and duration.** Project proponents expect to complete design, construction, implementation, and installation of hydrants, meters, storage tanks, and water mains by the end of 2015. To reduce the risk that we overestimate this benefit, we assume the project would begin conferring benefits related to improved water quality in 2016. The benefits will accrue for the lifespan of the project, 40 years.

**Beneficiaries.** The beneficiaries of this benefit are the water users in the City of Salyer, a disadvantaged community.

**Sources of uncertainty.** Because so little is known about how residents are responding to the standing boil water advisory, it is difficult to describe the economic benefits of remedying the underlying issue. The value is certainly greater than zero.

## Section D3. Monetized Benefits Analysis

The present value of the monetized benefits in 2012 dollars, discounted annually at 6 percent over the relevant lifespan of each component of the project (described for each benefit below), is $375,769. The calculations for each monetized benefit are shown in Tables 15-1 through 15-9, at the end of this section.

### 1. Reduced Costs of Hazard Insurance

**Relevant change.** The City of Salyer has a rural fire protection area with a rating of 10, which carries the highest insurance premium rate. With the project, most properties will lie within 1,000 feet of a fire hydrant and 5 miles of a fire department. As a result of this high rating, some residents have prohibitively high premiums, while others are unable to purchase fire insurance protection at all. Anecdotally, there have been a few recent cases of fire insurance companies cancelling insurance policies with residents of Salyer because of their vulnerability to property damage from fires. As a result of the recent number of wild fires in the area, insurance carriers have recently been increasingly reluctant to write policies for residents in the City of Salyer. With the project, the City of Salyer may improve this rate from 10 to 7, which represents a more moderate risk.

**Evidence for demand and economic value.** The literature has documented examples of reductions in fire insurance premiums as a result of changes in fire protection ratings. A study of the impacts of changes in the insurance services office (ISO) ratings in North Monterey County found that improvements in operations and planning involving fire protection can result in reductions in insurance premiums for residents and businesses. The study found that after the North County Fire District implemented training programs, and began documenting and improving pump tests, training, and hose pressure tests, insurance premiums for businesses and residents decreased between 15 and 30 percent.[19] If the City reduces its fire protection rating to 7, project proponents expect residents would save approximately 30 to 45 percent on their current fire insurance premiums.

Data are not available on the total amount the residents of Salyer pay on home hazard insurance each year currently. In particular, we were able to locate data to describe the range of rates per $1,000 of home value based on ISO rating. However, based on average home insurance rates in California and assuming the median home price of $240,000 in the nearby Willow Creek Census Designated Place is similar to Salyer (data are not available for Salyer itself), the annual premium would be about $850. Reducing this by 30 percent would save the average resident of Salyer about $250 per year. Assuming all 59 residences in Salyer must purchase hazard insurance, the total annual undiscounted value of this benefit would be about $15,000.

[19] Orman, C. 2006. *The Impacts of Changes in the Use of ISO Ratings by Insurance Companies Serving North Monterey County.* North County Fire District. Monterey, California.

**Timing and duration.** Project proponents expect to complete design, construction, implementation, and installation of fire hydrants by the end of 2015. To reduce the risk that we overestimate this benefit, we assume the project would begin conferring benefits related reduced fire insurance premiums in 2016. The benefits will accrue for the lifespan of the project, 40 years.

**Beneficiaries.** The beneficiaries of this benefit are the property owners in the City of Salyer.

**Sources of uncertainty.** This benefit depends on the ability of the project to reduce the City's fire protection rating. If the project does not result in this reduction, this benefit will not materialize. The economic value we estimate here assumes that our assumptions for average hazard insurance premium, average home value, and risk reduction percent are reasonable. Because we use the median expected hazard insurance rate as a percent of home value in California to calculate the current insurance amount, we likely are not accounting for the community's high ISO rating.

### 2. Avoided costs of bottled water purchases associated with short-term water outages

**Relevant change.** With the project, SMWC water users would no longer need to buy bottled water during short-term water outages. These outages, which each last less than 24 hours, occur approximately five times per year. We assume that during each outage, the 110 residents of Salyer purchase one gallon of bottled water each, for a total marginal reduction in bottled water purchases of 550 gallons per year.

**Evidence for demand and economic value.** We assume each unit of bottled water costs $1.38. The total undiscounted value of this benefit is $759 per year.

**Timing and duration.** Project proponents expect to complete design, construction, implementation, and installation of hydrants, meters, storage tanks, and water mains by the end of 2015. To reduce the risk that we overestimate this benefit, we assume the project would begin conferring benefits related to avoided water bottle purchases in 2016. The benefits will accrue for the lifespan of the project, 40 years.

**Beneficiaries.** The beneficiaries of this benefit are the water users in the City of Salyer who will no longer need to purchase bottled water.

**Sources of uncertainty.** Actual unit costs associated with bottled water purchases may be higher or lower than the value presented above, depending on the quantity purchased by user. The actual cost of purchasing bottled water should also include the transaction costs associated with the water purchases and the costs of inconvenience to the water users, which we do not include the estimate above. For these reasons, our estimate likely represents an underestimate of the true value of this benefit.

### 3. Avoided costs of bulk water purchases associated with long-term water outages

**Relevant change.** With the project, water users in the City of Salyer would not longer need to purchase bulk water deliveries during long-term water outages. These outages, which last more than 24 hours, occur approximately once a year. We assume that during each severe conservation event, approximately 200 gallons of water are delivered to each household.

**Evidence for demand and economic value.** We assume residents of Salyer pay $0.20 / gallon for bulk water deliveries. We calculate this amount based on the cost of deliveries from a local licensed potable water hauler, which charges $80 per hour. This charge is based on a four-hour, round trip for a 1,600 gallon load from Kneeland, California to Salyer, plus a fee for residential delivery. The total undiscounted value of this benefit ($0.20 / gallon x 200 gallons x 59 households) is $2,360 per year.

**Timing and duration.** Project proponents expect to complete design, construction, implementation, and installation of hydrants, meters, storage tanks, and water mains by the end of 2015. To reduce the risk that we overestimate this benefit, we assume the project would begin conferring benefits related to avoided bulk water purchases in 2016. The benefits will accrue for the lifespan of the project, 40 years.

**Beneficiaries.** The beneficiaries of this benefit are the water users in the City of Salyer who will no longer need to purchase bulk water deliveries.

**Sources of uncertainty.** All sources of uncertainty surrounding the physical estimate of the quantity of water delivered and purchased during a severe water outage would also affect the economic benefit estimate described here. See Attachment 7 for a description of these biophysical sources of uncertainty. However, this physical estimate is likely conservative; the Small Water Systems Handbook, Conference of State Sanitary Engineers, assumes a single household uses approximately 400 gallons of water per day.

### 4. Avoided costs associated with reduced energy demands

**Relevant change.** By preventing future and current leaks, the project would reduce water use, thereby reducing the energy demands of the water system and reducing energy costs to SMWC. Assuming 30 percent of the water's system is lost to undetected leaks from aging distribution lines and assuming that the project would reduce these water loses to zero, the project would save SMWC 30 percent of its variable energy costs.

**Evidence for demand and economic value.** Between 2006 and 2010, SMWC paid an average of $5,352 per year for energy. Assuming SMWC would save 30 percent of its energy costs, we calculate its annual savings from reduced energy demands is $1,600.

**Timing and duration.** Project proponents expect to complete design, construction, implementation, and installation of hydrants, meters, storage tanks, and water mains by the end

of 2015. To reduce the risk that we overestimate this benefit, we assume the project would begin conferring benefits related to reduced energy costs in 2016. The benefits will accrue for the lifespan of the project, 40 years.

**Beneficiaries.** Assuming SMWC passes along its savings to customers, the beneficiaries of this benefit are SMWC ratepayers.

**Sources of uncertainty.** All sources of uncertainty surrounding the physical estimate of the reduced water system demands would also affect the economic benefit estimate described here.

### 5. Avoided costs of climate change from reduced carbon emissions

**Relevant change.** By reducing water use, the project would reduce the energy demands of the water system, which would reduce net emissions of greenhouse gases. From the information in the previous benefit, we know SMWC will reduce its costs related to energy by $1,600 per year. The average electricity costs for medium general demand metered service customers of PG&E range from $0.10959 to $0.14335 per kWh in the summer months (these vary by secondary, primary, and transmission voltage). Using the high end of the range to remain conservative, we calculate SMWC would reduce its energy use by 11,161 kWh per year. Using a conversion factor from EPA's Greenhouse Gas Calculator for electricity use in California, estimate this would result in a reduction of 5.04 metric tons of $CO_2$e per year.

**Evidence for demand and value.** The International Panel on Climate Change has identified anthropogenic greenhouse gas emissions as the main contributor of global warming and climate change. Carbon dioxide emissions have received the most attention as they account for the majority of these emissions – 77 percent in 2004 (IPCC 2007). Expected impacts of climate change include decreased ecosystem resilience, increased extinction rates, fluctuations in cropland productivity, increased erosion and flooding in coastal areas, and decreased availability of clean drinking water. These impacts could result in the displacement of hundreds of millions of people, increased morbidity, and irreversible damages to critical life-support systems within the environment (IPCC 2007).

Economists use the social cost of carbon to estimate the value of changes in greenhouse gas emissions. The social cost of carbon represents "the full global cost today of emitting an incremental unit of carbon at some point of time in the future, and it includes the sum of the global cost of the damage it imposes on the entire time it is in the atmosphere." (Shaw 2009) There are currently over 200 different estimates of the social cost of carbon. One review of the literature found values ranging from about $7 to $111 per ton of carbon dioxide equivalent ($2007) (Shaw 2009). Another analysis suggests increasing the social cost of carbon, in real terms, by 2–3 percent per year to reflect the rising damages from climate change (Nordhaus 2008).

California's cap-and-trade system for carbon provides one such estimate of the social cost of carbon. The cap-and-trade system, which took effect January 1, 2012, allots credits through auctions. The second such auction on February 19, 2013 elicited bids that ranged from $10.71-$50.01, with a mean and median price of $14.71 and $12.56, respectively (California Air Resources Board 2012). The cap-and-trade market, however, only applies to large producers of carbon and producers are allowed to offset up to 8 percent of carbon emissions.[20] Thus, while this range of costs for carbon is well within the broader range of costs, this market is not the appropriate mechanism for determining the cost of carbon beyond the cost for large producers.

For this analysis, we use a value of $13 per ton of carbon dioxide equivalent sequestered to represent the social cost of carbon. The annual, undiscounted value of this benefit is $65. We inflate this value by 2.5 percent per year, in real terms, to reflect the rising damages from climate change.

**Timing and duration.** Project proponents expect to complete design, construction, implementation, and installation of hydrants, meters, storage tanks, and water mains by the end of 2015. To reduce the risk that we overestimate this benefit, we assume the project would begin conferring benefits related to reduced net emissions in 2016. The benefits will accrue for the lifespan of the project, 40 years.

**Beneficiaries.** The beneficiaries of this benefit are all residents of California.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of increased carbon dioxide sequestered would also affect the economic benefit estimate described here. If the true cost of carbon dioxide lies closer to the upper or lower end of the range we presented above, our unit value would represent an under or overestimate.

### 6. Avoided costs associated with emergency repairs

**Relevant change.** By replacing aging infrastructure that suffers from frequent failures and major leaks, the project would reduce periodic costs associated with emergency repairs as a result of mechanical failures.

**Evidence for demand and economic value.** Project proponents estimate the project would avoid SMWC expenditures of approximately $3,090 for professional pluming repairs and $1,000 for water operator for unexpected repairs. The total undiscounted value of this benefit is $4,090 per year.

**Timing and duration.** Project proponents expect to complete design, construction, implementation, and installation of hydrants, meters, storage tanks, and water mains by the end

[20] These projects may currently include, and may only include forestry, urban forestry, dairy manure digesters, and the destruction of ozone depleting substances. California Environmental Protection Agency - Air Resources Board. Air Resources Board sets stage for carbon offset projects. December 14, 2012.

of 2015. To reduce the risk that we overestimate this benefit, we assume the project would begin conferring benefits related to avoided costs associated with emergency repairs in 2016. The benefits will accrue for the lifespan of the project, 40 years.

**Beneficiaries.** Assuming SMWC passes along its savings to customers, the beneficiaries of this benefit are the ratepayers of the Salyer Mutual Water Company.

**Sources of uncertainty.** All sources of uncertainty surrounding the physical estimate of the reduced water system demands would also affect the economic benefit estimate described here.

### 7. Reduced uncompensated water loss

**Relevant change.** By installing master meter and customer water meters, the project would allow the SMWC to document flows, improve the accuracy of customer meters for proper billing, and detect unauthorized water uses. The current distribution system crosses properties haphazardly and it is therefore difficult to detect and prove theft, project proponents estimate the water system has at least two current unauthorized users.

**Evidence for demand and economic value.** SMWC estimates that uncompensated water loss from unauthorized connections represents an opportunity cost of at least $720 per year. If this water were not going to unauthorized uses, it could be used to meet demands for water district customers. Alternately, Salyer could reduce the amount of water it must treat and distribute, and experience cost savings. We estimate the undiscounted value of this benefit at $720 per year.

**Timing and duration.** Project proponents expect to complete design, construction, implementation, and installation of water meters by the end of 2015. To reduce the risk that we overestimate this benefit, we assume the project would begin conferring benefits related to avoided costs associated with emergency repairs in 2016. The benefits will accrue for the lifespan of the project, 40 years.

**Beneficiaries.** Assuming SMWC passes along its savings to customers, the beneficiaries of this benefit are the ratepayers of the Salyer Mutual Water Company.

**Sources of uncertainty.** The value of this benefit rests on the assumption that there are two unauthorized water users in Salyer and when these unauthorized users are curtailed, Salyer would be able to meet currently unmet demands for the water. If it instead treats and distributes less water, the benefit to Salyer could differ somewhat.

### 8. Avoided costs associated with operations and maintenance

**Relevant change.** By replacing aging infrastructure and water mains that frequently leak, the project would avoid costs related to operations and maintenance of the current water supply system.

**Evidence for demand and economic value.** Project proponents estimate SMWC would save $2,000 per year in labor by addressing leaks and breaks with new water mains, rather than conducting operations and maintenance activities as they arise.

**Timing and duration.** Project proponents expect to complete design, construction, implementation, and installation of hydrants, meters, storage tanks, and water mains by the end of 2015. To reduce the risk that we overestimate this benefit, we assume the project would begin conferring benefits related to avoided costs associated with emergency repairs in 2016. The benefits will accrue for the lifespan of the project, 40 years.

**Beneficiaries.** Assuming SMWC passes along its savings to customers, the beneficiaries of this benefit are the ratepayers of the Salyer Mutual Water Company.

**Sources of uncertainty.** All sources of uncertainty surrounding the physical estimate of the reduced water system demands would also affect the economic benefit estimate described here.

## 8. Reduced water treatment costs

**Relevant change.** The project would reduce water withdrawals by reducing the frequency and intensity of leaks. Decreasing the volume of water wasted would reduce costs to the community's surface water treatment plant.

**Evidence for demand and economic value.** The daily costs for operating a surface water treatment plant are for electricity, chemicals, equipment calibration standards, reagents, and labor. Of the daily O&M costs, electricity, chemicals, and calibration costs are volume dependent. Project proponents estimate the consumables cost annual to a system without leaks is $5,850 and the added costs of chemicals to treat water lost to leaks and breaks would be $2,510 annually.

In addition to these costs, treating water that would be wasted to leaks and breaks will also result in increased wear and tear on equipment. This would result in increased costs related to the frequency of replacing filter sand media, as well as the long-term planning for replacement of monitoring equipment and pumps. SMWC estimates its future surface water plant will require about $50,000 in pumps, motors, and monitoring equipment for pH, turbidities, flow rates, temperature, and chlorine. Wear and tear on these types of equipment are volume/flow-dependent. Media replacement, which costs about $15,000, is also volume/flow-dependent and would be performed every 10 to 15 years. It is difficult to quantify the costs to the Mutual resulting from an increased frequency of material and equipment replacements for treating wasted water. However, CDPH engineering representative estimates that by eliminating water loss, there would be a resulting $1,000 annual savings to us from reduced frequency of media and equipment replacement.

The total annual, undiscounted value of this benefit is therefore $3,150.

**Timing and duration.** Project proponents expect to complete design, construction, implementation, and installation of hydrants, meters, storage tanks, and water mains by the end of 2015. To reduce the risk that we overestimate this benefit, we assume the project would begin conferring benefits related to reduced water treatment costs in 2015. The benefits will accrue for the lifespan of the project, 40 years.

**Beneficiaries.** The beneficiaries of this benefit are the Salyer Mutual Water Company and its ratepayers.

**Sources of uncertainty.** All sources of uncertainty surrounding the physical estimate of the reduced water system demands would also affect the economic benefit estimate described here.

## 9. Increased instream flows for environmental purposes

**Relevant change.** The project would reduce water withdrawals by reducing the frequency and intensity of leaks. Decreasing the volume of water wasted would preserve flows in the Trinity River, protecting salmon habitat, safeguarding adequate water supplies for beneficial uses downstream, and providing additional water for management flexibility. Project proponents estimate, based an average annual usage of 6 million gallons, that by reducing unaccounted pumped water lost by 30 percent they would reduce water withdrawals by 2.6 million gallons or 8 acre feet per year.[21]

**Evidence for demand and economic value.** An economic analysis of water transactions between 1990 and 2003 found that the median price paid in California to acquire water for environmental purposes was $77 per acre-foot (Brown 2007). We use this value, to measure the value of additional water for instream flows to enhance ecosystems, water-quality, and salmon populations for all projects that would generate this benefit. The median value is a better estimator of the true willingness to pay for water supplies than the mean, insofar as some transactions exhibiting extreme values are distorted by political and other factors. We estimate the annual, undiscounted value of this benefit is $616.

**Timing and duration.** Project proponents expect to complete design, construction, implementation, and installation of hydrants, meters, storage tanks, and water mains by the end of 2015. To reduce the risk that we overestimate this benefit, we assume the project would begin conferring benefits related to increased instream flows for environmental purposes in 2015. The benefits will accrue for the lifespan of the project, 40 years.

**Beneficiaries.** The beneficiaries of this benefit would include several groups of stakeholders including commercial fishermen and recreational anglers in both marine and freshwater fisheries, and the general public insofar as they value an increase in fish populations regardless

[21] Total volume pumped = volume delivered + volume lost (8.6 MG = 6 MG + 2.6 MG)

of any potential future direct use or exposure to the impacted fish populations. It would also benefit other recreational users of water, such as kayakers and wildlife watchers, Californians who place a non-use value on maintaining sufficient instream flows for environmental purposes, and other water users, such as irrigators, who bear increased regulatory pressure and costs to increase instream flows by reducing their own use of water.

**Sources of uncertainty.** The value we derive from the findings of Brown (2007) embodies the uncertainty inherent in the individual study as well as from applying results from past research to future conditions. There is, however, no obvious reason to conclude that the estimate systematically overestimates the true marginal value of water for environmental purposes in the North Coast region. As human populations and incomes grow in California, the marginal value of wild salmonid populations and other benefits derived from instream flows for environmental purposes is likely to increase, as will the value of stream flows that support their continued existence. Because we found no reliable estimate of the rate of increase, we did not fold this increase into our estimates. For these reasons, it seems reasonable to conclude that the value estimates we apply in this analysis underestimate—perhaps substantially—the true value of future increases in water supplies that would result from the projects. The recent implementation of AB 2121, the state's instream flow policy that applies to the North Coast region, creates additional regulatory pressure for maintaining or increasing instream flows, potentially further increasing the demand and associated willingness to pay for instream flows above these estimates.

Table 15.1-635 – Annual Benefit: Reduced Cost of Hazard Insurance
(All benefits should be in 2012 dollars)

Project: 635 - Salyer Mutual Water Company, Distribution System and Hydrants

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Reduced Cost of Hazard Insurance | properties | 0 | 0 | 0 | $ 250.00 | $ - | 1.000 | $ - |
| 2013 | Reduced Cost of Hazard Insurance | properties | 0 | 0 | 0 | $ 250.00 | $ - | 0.943 | $ - |
| 2014 | Reduced Cost of Hazard Insurance | properties | 0 | 0 | 0 | $ 250.00 | $ - | 0.890 | $ - |
| 2015 | Reduced Cost of Hazard Insurance | properties | 0 | 0 | 0 | $ 250.00 | $ - | 0.840 | $ - |
| 2016 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.792 | $ 11,683 |
| 2017 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.747 | $ 11,022 |
| 2018 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.705 | $ 10,398 |
| 2019 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.665 | $ 9,810 |
| 2020 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.627 | $ 9,254 |
| 2021 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.592 | $ 8,731 |
| 2022 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.558 | $ 8,236 |
| 2023 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.527 | $ 7,770 |
| 2024 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.497 | $ 7,330 |
| 2025 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.469 | $ 6,915 |
| 2026 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.442 | $ 6,524 |
| 2027 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.417 | $ 6,155 |
| 2028 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.394 | $ 5,806 |
| 2029 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.371 | $ 5,478 |
| 2030 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.350 | $ 5,168 |
| 2031 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.331 | $ 4,875 |
| 2032 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.312 | $ 4,599 |
| 2033 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.294 | $ 4,339 |
| 2034 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.278 | $ 4,093 |
| 2035 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.262 | $ 3,862 |
| 2036 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.247 | $ 3,643 |
| 2037 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.233 | $ 3,437 |
| 2038 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.220 | $ 3,242 |
| 2039 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.207 | $ 3,059 |
| 2040 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.196 | $ 2,886 |
| 2041 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.185 | $ 2,722 |
| 2042 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.174 | $ 2,568 |
| 2043 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.164 | $ 2,423 |
| 2044 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.155 | $ 2,286 |
| 2045 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.146 | $ 2,156 |
| 2046 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.138 | $ 2,034 |
| 2047 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.130 | $ 1,919 |
| 2048 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.123 | $ 1,810 |
| 2049 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.116 | $ 1,708 |
| 2050 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.109 | $ 1,611 |
| 2051 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.103 | $ 1,520 |
| 2052 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.097 | $ 1,434 |
| 2053 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.092 | $ 1,353 |
| 2054 | Reduced Cost of Hazard Insurance | properties | 0 | 59 | 59 | $ 250.00 | $ 14,750.00 | 0.087 | $ 1,276 |
| | | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | $ 185,135 |

Comments: The project would reduce the costs of fire insurance to property owners by $250 per year.

Table 15.2-635 – Annual Benefit: Avoided Cost of Bottle Water Purchases

(All benefits should be in 2012 dollars)

Project: 635 - Salyer Mutual Water Company, Distribution System and Hydrants

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Reduced Bottled Water Purchases | gallons | 0 | 0 | 0 | $ 1.38 | $ - | 1.000 | $ - |
| 2013 | Reduced Bottled Water Purchases | gallons | 0 | 0 | 0 | $ 1.38 | $ - | 0.943 | $ - |
| 2014 | Reduced Bottled Water Purchases | gallons | 0 | 0 | 0 | $ 1.38 | $ - | 0.890 | $ - |
| 2015 | Reduced Bottled Water Purchases | gallons | 0 | 0 | 0 | $ 1.38 | $ - | 0.840 | $ - |
| 2016 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.792 | $ 601 |
| 2017 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.747 | $ 567 |
| 2018 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.705 | $ 535 |
| 2019 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.665 | $ 505 |
| 2020 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.627 | $ 476 |
| 2021 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.592 | $ 449 |
| 2022 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.558 | $ 424 |
| 2023 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.527 | $ 400 |
| 2024 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.497 | $ 377 |
| 2025 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.469 | $ 356 |
| 2026 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.442 | $ 336 |
| 2027 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.417 | $ 317 |
| 2028 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.394 | $ 299 |
| 2029 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.371 | $ 282 |
| 2030 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.350 | $ 266 |
| 2031 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.331 | $ 251 |
| 2032 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.312 | $ 237 |
| 2033 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.294 | $ 223 |
| 2034 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.278 | $ 211 |
| 2035 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.262 | $ 199 |
| 2036 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.247 | $ 187 |
| 2037 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.233 | $ 177 |
| 2038 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.220 | $ 167 |
| 2039 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.207 | $ 157 |
| 2040 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.196 | $ 148 |
| 2041 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.185 | $ 140 |
| 2042 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.174 | $ 132 |
| 2043 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.164 | $ 125 |
| 2044 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.155 | $ 118 |
| 2045 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.146 | $ 111 |
| 2046 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.138 | $ 105 |
| 2047 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.130 | $ 99 |
| 2048 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.123 | $ 93 |
| 2049 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.116 | $ 88 |
| 2050 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.109 | $ 83 |
| 2051 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.103 | $ 78 |
| 2052 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.097 | $ 74 |
| 2053 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.092 | $ 70 |
| 2054 | Reduced Bottled Water Purchases | gallons | 0 | 550 | 550 | $ 1.38 | $ 759.00 | 0.087 | $ 66 |
| | | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | $ 9,527 |

Comments: Without the project, each of 110 residents is assumed to purchase 1 gallon of water during brief water outages, which occur approximately 5 times per year.

Table 15.3-635 – Annual Benefit: Avoided Bulk Water Purchases

(All benefits should be in 2012 dollars)

Project: 635 - Salyer Mutual Water Company, Distribution System and Hydrants

| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
|---|---|---|---|---|---|---|---|---|---|
| Year | Type of Benefit | Measure of Benefit (Units) | Without Project | With Project | Change Resulting from Project (e) – (d) | Unit $ Value | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Reduced Bulk Water Purchases | gallons | 0 | 0 | 0 | $ 0.20 | $ - | 1.000 | $ - |
| 2013 | Reduced Bulk Water Purchases | gallons | 0 | 0 | 0 | $ 0.20 | $ - | 0.943 | $ - |
| 2014 | Reduced Bulk Water Purchases | gallons | 0 | 0 | 0 | $ 0.20 | $ - | 0.890 | $ - |
| 2015 | Reduced Bulk Water Purchases | gallons | 0 | 0 | 0 | $ 0.20 | $ - | 0.840 | $ - |
| 2016 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.792 | $ 1,869 |
| 2017 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.747 | $ 1,764 |
| 2018 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.705 | $ 1,664 |
| 2019 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.665 | $ 1,570 |
| 2020 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.627 | $ 1,481 |
| 2021 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.592 | $ 1,397 |
| 2022 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.558 | $ 1,318 |
| 2023 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.527 | $ 1,243 |
| 2024 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.497 | $ 1,173 |
| 2025 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.469 | $ 1,106 |
| 2026 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.442 | $ 1,044 |
| 2027 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.417 | $ 985 |
| 2028 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.394 | $ 929 |
| 2029 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.371 | $ 876 |
| 2030 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.350 | $ 827 |
| 2031 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.331 | $ 780 |
| 2032 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.312 | $ 736 |
| 2033 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.294 | $ 694 |
| 2034 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.278 | $ 655 |
| 2035 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.262 | $ 618 |
| 2036 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.247 | $ 583 |
| 2037 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.233 | $ 550 |
| 2038 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.220 | $ 519 |
| 2039 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.207 | $ 489 |
| 2040 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.196 | $ 462 |
| 2041 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.185 | $ 436 |
| 2042 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.174 | $ 411 |
| 2043 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.164 | $ 388 |
| 2044 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.155 | $ 366 |
| 2045 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.146 | $ 345 |
| 2046 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.138 | $ 325 |
| 2047 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.130 | $ 307 |
| 2048 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.123 | $ 290 |
| 2049 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.116 | $ 273 |
| 2050 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.109 | $ 258 |
| 2051 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.103 | $ 243 |
| 2052 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.097 | $ 229 |
| 2053 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.092 | $ 216 |
| 2054 | Reduced Bulk Water Purchases | gallons | 0 | 11,800 | 11,800 | $ 0.20 | $ 2,360.00 | 0.087 | $ 204 |
| | | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | $ 29,622 |

Comments: During long term power outages each of 59 households consumes approximately 200 gallons of bulk water. These outages occur about once a year.

Table 15.4-635 – Annual Benefit: Reduced Energy Demands
(All benefits should be in 2012 dollars)

Project: 635 - Salyer Mutual Water Company, Distribution System and Hydrants

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Reduced energy | dollars | 0 | 0 | 0 | $ 1.00 | $ - | 1.000 | $ - |
| 2013 | Reduced energy | dollars | 0 | 0 | 0 | $ 1.00 | $ - | 0.943 | $ - |
| 2014 | Reduced energy | dollars | 0 | 0 | 0 | $ 1.00 | $ - | 0.890 | $ - |
| 2015 | Reduced energy | dollars | 0 | 0 | 0 | $ 1.00 | $ - | 0.840 | $ - |
| 2016 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.792 | $ 1,267 |
| 2017 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.747 | $ 1,196 |
| 2018 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.705 | $ 1,128 |
| 2019 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.665 | $ 1,064 |
| 2020 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.627 | $ 1,004 |
| 2021 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.592 | $ 947 |
| 2022 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.558 | $ 893 |
| 2023 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.527 | $ 843 |
| 2024 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.497 | $ 795 |
| 2025 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.469 | $ 750 |
| 2026 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.442 | $ 708 |
| 2027 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.417 | $ 668 |
| 2028 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.394 | $ 630 |
| 2029 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.371 | $ 594 |
| 2030 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.350 | $ 561 |
| 2031 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.331 | $ 529 |
| 2032 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.312 | $ 499 |
| 2033 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.294 | $ 471 |
| 2034 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.278 | $ 444 |
| 2035 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.262 | $ 419 |
| 2036 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.247 | $ 395 |
| 2037 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.233 | $ 373 |
| 2038 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.220 | $ 352 |
| 2039 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.207 | $ 332 |
| 2040 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.196 | $ 313 |
| 2041 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.185 | $ 295 |
| 2042 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.174 | $ 279 |
| 2043 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.164 | $ 263 |
| 2044 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.155 | $ 248 |
| 2045 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.146 | $ 234 |
| 2046 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.138 | $ 221 |
| 2047 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.130 | $ 208 |
| 2048 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.123 | $ 196 |
| 2049 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.116 | $ 185 |
| 2050 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.109 | $ 175 |
| 2051 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.103 | $ 165 |
| 2052 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.097 | $ 156 |
| 2053 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.092 | $ 147 |
| 2054 | Reduced energy | dollars | 0 | 1,600 | 1,600 | $ 1.00 | $ 1,600.00 | 0.087 | $ 138 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 20,082 |

Comments: By preventing future and current leaks, the project would reduce water use, reducing the energy demands of the water system. These costs are approximately $1,600 per year.

Table 15.5-635 – Annual Benefit: Reduced Carbon Emissions
(All benefits should be in 2012 dollars)

Project: 635 - Salyer Mutual Water Company, Distribution System and Hydrants

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Reduced CO2 emissions | tons | 0 | 0 | 0 | $ 13.00 | $ - | 1.000 | $ - |
| 2013 | Reduced CO2 emissions | tons | 0 | 0 | 0 | $ 13.33 | $ - | 0.943 | $ - |
| 2014 | Reduced CO2 emissions | tons | 0 | 0 | 0 | $ 13.66 | $ - | 0.890 | $ - |
| 2015 | Reduced CO2 emissions | tons | 0 | 0 | 0 | $ 14.00 | $ - | 0.840 | $ - |
| 2016 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 14.35 | $ 72.32 | 0.792 | $ 57 |
| 2017 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 14.71 | $ 74.13 | 0.747 | $ 55 |
| 2018 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 15.08 | $ 75.98 | 0.705 | $ 54 |
| 2019 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 15.45 | $ 77.88 | 0.665 | $ 52 |
| 2020 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 15.84 | $ 79.83 | 0.627 | $ 50 |
| 2021 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 16.24 | $ 81.83 | 0.592 | $ 48 |
| 2022 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 16.64 | $ 83.87 | 0.558 | $ 47 |
| 2023 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 17.06 | $ 85.97 | 0.527 | $ 45 |
| 2024 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 17.48 | $ 88.12 | 0.497 | $ 44 |
| 2025 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 17.92 | $ 90.32 | 0.469 | $ 42 |
| 2026 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 18.37 | $ 92.58 | 0.442 | $ 41 |
| 2027 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 18.83 | $ 94.89 | 0.417 | $ 40 |
| 2028 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 19.30 | $ 97.26 | 0.394 | $ 38 |
| 2029 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 19.78 | $ 99.70 | 0.371 | $ 37 |
| 2030 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 20.28 | $ 102.19 | 0.350 | $ 36 |
| 2031 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 20.78 | $ 104.74 | 0.331 | $ 35 |
| 2032 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 21.30 | $ 107.36 | 0.312 | $ 33 |
| 2033 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 21.83 | $ 110.05 | 0.294 | $ 32 |
| 2034 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 22.38 | $ 112.80 | 0.278 | $ 31 |
| 2035 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 22.94 | $ 115.62 | 0.262 | $ 30 |
| 2036 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 23.51 | $ 118.51 | 0.247 | $ 29 |
| 2037 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 24.10 | $ 121.47 | 0.233 | $ 28 |
| 2038 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 24.70 | $ 124.51 | 0.220 | $ 27 |
| 2039 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 25.32 | $ 127.62 | 0.207 | $ 26 |
| 2040 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 25.95 | $ 130.81 | 0.196 | $ 26 |
| 2041 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 26.60 | $ 134.08 | 0.185 | $ 25 |
| 2042 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 27.27 | $ 137.43 | 0.174 | $ 24 |
| 2043 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 27.95 | $ 140.87 | 0.164 | $ 23 |
| 2044 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 28.65 | $ 144.39 | 0.155 | $ 22 |
| 2045 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 29.37 | $ 148.00 | 0.146 | $ 22 |
| 2046 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 30.10 | $ 151.70 | 0.138 | $ 21 |
| 2047 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 30.85 | $ 155.49 | 0.130 | $ 20 |
| 2048 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 31.62 | $ 159.38 | 0.123 | $ 20 |
| 2049 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 32.41 | $ 163.36 | 0.116 | $ 19 |
| 2050 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 33.22 | $ 167.45 | 0.109 | $ 18 |
| 2051 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 34.05 | $ 171.63 | 0.103 | $ 18 |
| 2052 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 34.91 | $ 175.93 | 0.097 | $ 17 |
| 2053 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 35.78 | $ 180.32 | 0.092 | $ 17 |
| 2054 | Reduced CO2 emissions | tons | 0 | 5.04 | 5.04 | $ 36.67 | $ 184.83 | 0.087 | $ 16 |
| | | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | $ 1,267 |

Comments: The project would reduce emissions of carbon dioxide by reducing energy use. The social cost of carbon begins at a baseline of $13/ton and increases by 2.5% per year

Table 15.6-635 – Annual Benefit: Avoided Emergency Repairs
(All benefits should be in 2012 dollars)

Project: 635 - Salyer Mutual Water Company, Distribution System and Hydrants

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Reduced Plumbing Repairs | fees | 0 | $ - | $ - | 1 | $ - | 1.000 | $ - |
| 2013 | Reduced Plumbing Repairs | fees | 0 | $ - | $ - | 1 | $ - | 0.943 | $ - |
| 2014 | Reduced Plumbing Repairs | fees | 0 | $ - | $ - | 1 | $ - | 0.890 | $ - |
| 2015 | Reduced Plumbing Repairs | fees | 0 | $ - | $ - | 1 | $ - | 0.840 | $ - |
| 2016 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.792 | $ 3,240 |
| 2017 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.747 | $ 3,056 |
| 2018 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.705 | $ 2,883 |
| 2019 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.665 | $ 2,720 |
| 2020 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.627 | $ 2,566 |
| 2021 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.592 | $ 2,421 |
| 2022 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.558 | $ 2,284 |
| 2023 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.527 | $ 2,155 |
| 2024 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.497 | $ 2,033 |
| 2025 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.469 | $ 1,918 |
| 2026 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.442 | $ 1,809 |
| 2027 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.417 | $ 1,707 |
| 2028 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.394 | $ 1,610 |
| 2029 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.371 | $ 1,519 |
| 2030 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.350 | $ 1,433 |
| 2031 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.331 | $ 1,352 |
| 2032 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.312 | $ 1,275 |
| 2033 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.294 | $ 1,203 |
| 2034 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.278 | $ 1,135 |
| 2035 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.262 | $ 1,071 |
| 2036 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.247 | $ 1,010 |
| 2037 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.233 | $ 953 |
| 2038 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.220 | $ 899 |
| 2039 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.207 | $ 848 |
| 2040 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.196 | $ 800 |
| 2041 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.185 | $ 755 |
| 2042 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.174 | $ 712 |
| 2043 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.164 | $ 672 |
| 2044 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.155 | $ 634 |
| 2045 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.146 | $ 598 |
| 2046 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.138 | $ 564 |
| 2047 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.130 | $ 532 |
| 2048 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.123 | $ 502 |
| 2049 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.116 | $ 474 |
| 2050 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.109 | $ 447 |
| 2051 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.103 | $ 421 |
| 2052 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.097 | $ 398 |
| 2053 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.092 | $ 375 |
| 2054 | Reduced Plumbing Repairs | fees | 0 | $ 4,090 | $ 4,090 | 1 | $ 4,090.00 | 0.087 | $ 354 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 51,336 |

Comments: The project would reduce the costs associated with emergency repairs by $4,090 per year.

Table 15.7-635– Annual Benefit: Reduced Uncompensated Water Loss
(All benefits should be in 2012 dollars)

Project: 635 - Salyer Mutual Water Company, Distribution System and Hydrants

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Users with increased revenues | users | 0 | 0 | 0 | $ 360.00 | $ - | 1.000 | $ - |
| 2013 | Users with increased revenues | users | 0 | 0 | 0 | $ 360.00 | $ - | 0.943 | $ - |
| 2014 | Users with increased revenues | users | 0 | 0 | 0 | $ 360.00 | $ - | 0.890 | $ - |
| 2015 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.840 | $ 605 |
| 2016 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.792 | $ 570 |
| 2017 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.747 | $ 538 |
| 2018 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.705 | $ 508 |
| 2019 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.665 | $ 479 |
| 2020 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.627 | $ 452 |
| 2021 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.592 | $ 426 |
| 2022 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.558 | $ 402 |
| 2023 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.527 | $ 379 |
| 2024 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.497 | $ 358 |
| 2025 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.469 | $ 338 |
| 2026 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.442 | $ 318 |
| 2027 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.417 | $ 300 |
| 2028 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.394 | $ 283 |
| 2029 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.371 | $ 267 |
| 2030 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.350 | $ 252 |
| 2031 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.331 | $ 238 |
| 2032 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.312 | $ 224 |
| 2033 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.294 | $ 212 |
| 2034 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.278 | $ 200 |
| 2035 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.262 | $ 188 |
| 2036 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.247 | $ 178 |
| 2037 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.233 | $ 168 |
| 2038 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.220 | $ 158 |
| 2039 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.207 | $ 149 |
| 2040 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.196 | $ 141 |
| 2041 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.185 | $ 133 |
| 2042 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.174 | $ 125 |
| 2043 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.164 | $ 118 |
| 2044 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.155 | $ 112 |
| 2045 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.146 | $ 105 |
| 2046 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.138 | $ 99 |
| 2047 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.130 | $ 94 |
| 2048 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.123 | $ 88 |
| 2049 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.116 | $ 83 |
| 2050 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.109 | $ 79 |
| 2051 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.103 | $ 74 |
| 2052 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.097 | $ 70 |
| 2053 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.092 | $ 66 |
| 2054 | Users with increased revenues | users | 0 | 2 | 2 | $ 360.00 | $ 720.00 | 0.087 | $ 62 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 9,642 |

Comments: By installing meters, the project would allow SMWC to document flows and detect unauthorized users. With the project, SMWC would reduce uncompensated water loss by $720 per year.

Table 15.8-635 – Annual Benefit: Avoided Operations and Maintenance Costs
(All benefits should be in 2012 dollars)

Project: 635 - Salyer Mutual Water Company, Distribution System and Hydrants

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Reduced O&M Costs | dollars | 0 | $ - | $ - | 1 | $ - | 1.000 | $ - |
| 2013 | Reduced O&M Costs | dollars | 0 | $ - | $ - | 1 | $ - | 0.943 | $ - |
| 2014 | Reduced O&M Costs | dollars | 0 | $ - | $ - | 1 | $ - | 0.890 | $ - |
| 2015 | Reduced O&M Costs | dollars | 0 | $ - | $ - | 1 | $ - | 0.840 | $ - |
| 2016 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.792 | $ 1,584 |
| 2017 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.747 | $ 1,495 |
| 2018 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.705 | $ 1,410 |
| 2019 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.665 | $ 1,330 |
| 2020 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.627 | $ 1,255 |
| 2021 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.592 | $ 1,184 |
| 2022 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.558 | $ 1,117 |
| 2023 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.527 | $ 1,054 |
| 2024 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.497 | $ 994 |
| 2025 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.469 | $ 938 |
| 2026 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.442 | $ 885 |
| 2027 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.417 | $ 835 |
| 2028 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.394 | $ 787 |
| 2029 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.371 | $ 743 |
| 2030 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.350 | $ 701 |
| 2031 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.331 | $ 661 |
| 2032 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.312 | $ 624 |
| 2033 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.294 | $ 588 |
| 2034 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.278 | $ 555 |
| 2035 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.262 | $ 524 |
| 2036 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.247 | $ 494 |
| 2037 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.233 | $ 466 |
| 2038 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.220 | $ 440 |
| 2039 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.207 | $ 415 |
| 2040 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.196 | $ 391 |
| 2041 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.185 | $ 369 |
| 2042 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.174 | $ 348 |
| 2043 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.164 | $ 329 |
| 2044 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.155 | $ 310 |
| 2045 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.146 | $ 292 |
| 2046 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.138 | $ 276 |
| 2047 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.130 | $ 260 |
| 2048 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.123 | $ 245 |
| 2049 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.116 | $ 232 |
| 2050 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.109 | $ 218 |
| 2051 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.103 | $ 206 |
| 2052 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.097 | $ 194 |
| 2053 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.092 | $ 183 |
| 2054 | Reduced O&M Costs | dollars | 0 | $ 2,000.00 | $ 2,000.00 | 1 | $ 2,000.00 | 0.087 | $ 173 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 25,103 |

Comments: With the project, SMWC would reduce its O&M costs by $2,000 per year.

Table 15.9-635 – Annual Benefit: Avoided Treatment Costs

(All benefits should be in 2012 dollars)

Project: 635 - Salyer Mutual Water Company, Distribution System and Hydrants

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Reduced treatment costs | dollars | 0 | $ - | $ - | 1 | $ - | 1.000 | $ - |
| 2013 | Reduced treatment costs | dollars | 0 | $ - | $ - | 1 | $ - | 0.943 | $ - |
| 2014 | Reduced treatment costs | dollars | 0 | $ - | $ - | 1 | $ - | 0.890 | $ - |
| 2015 | Reduced treatment costs | dollars | 0 | $ - | $ - | 1 | $ - | 0.840 | $ - |
| 2016 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.792 | $ 2,780 |
| 2017 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.747 | $ 2,623 |
| 2018 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.705 | $ 2,474 |
| 2019 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.665 | $ 2,334 |
| 2020 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.627 | $ 2,202 |
| 2021 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.592 | $ 2,078 |
| 2022 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.558 | $ 1,960 |
| 2023 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.527 | $ 1,849 |
| 2024 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.497 | $ 1,744 |
| 2025 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.469 | $ 1,646 |
| 2026 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.442 | $ 1,552 |
| 2027 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.417 | $ 1,465 |
| 2028 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.394 | $ 1,382 |
| 2029 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.371 | $ 1,303 |
| 2030 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.350 | $ 1,230 |
| 2031 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.331 | $ 1,160 |
| 2032 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.312 | $ 1,094 |
| 2033 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.294 | $ 1,032 |
| 2034 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.278 | $ 974 |
| 2035 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.262 | $ 919 |
| 2036 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.247 | $ 867 |
| 2037 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.233 | $ 818 |
| 2038 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.220 | $ 772 |
| 2039 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.207 | $ 728 |
| 2040 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.196 | $ 687 |
| 2041 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.185 | $ 648 |
| 2042 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.174 | $ 611 |
| 2043 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.164 | $ 577 |
| 2044 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.155 | $ 544 |
| 2045 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.146 | $ 513 |
| 2046 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.138 | $ 484 |
| 2047 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.130 | $ 457 |
| 2048 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.123 | $ 431 |
| 2049 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.116 | $ 406 |
| 2050 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.109 | $ 383 |
| 2051 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.103 | $ 362 |
| 2052 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.097 | $ 341 |
| 2053 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.092 | $ 322 |
| 2054 | Reduced treatment costs | dollars | 0 | $ 3,510.00 | $ 3,510.00 | 1 | $ 3,510.00 | 0.087 | $ 304 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 44,056 |

Comments: By reducing the frequency and intensity of leaks, with the project SMWC would reduce its annual water treatment costs by $3,510, which includes fewer chemicals and less frequent changing of media and equipment in the filtration process.

## Section D3. Project Costs

The present value of the project's costs, which would occur between 2013 and 2055, is $193,765 in 2012 dollars, discounted at a 6-percent annual rate. These costs would fund labor, planning, equipment, and materials necessary to implement the project.[22]

Additional costs arising from the project, not included in the estimate above, involves the costs to unauthorized water users, who, once detected and removed from the system, would have to locate and likely pay for alternate supplies of water.

[22] We have distributed the costs outlined Table 7 across the project's implementation period based on the expected timing and phasing described in the Work Plan. Actual distribution of costs during this period may differ somewhat.

**Table 19-635 – Annual Costs of Project**
(All costs should be in 2012 Dollars)

Project: 635 - Salyer Mutual Water Company, Distribution System and Hydrants

| | Initial Costs Grand Total Cost from Table 7 (row (i), column (d)) | Adjusted Grant Total Cost | 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 | $ - | | | | $ - | | | $ - | 1.000 | $ - |
| 2013 | $ 15,000.00 | | | | $ - | | | $ 15,000 | 0.943 | $ 14,151 |
| 2014 | $ 190,000.00 | | | | $ - | | | $ 190,000 | 0.890 | $ 169,099 |
| 2015 | $ 5,000.00 | | | | $ - | | | $ 5,000 | 0.840 | $ 4,198 |
| 2016 | | | | | $ 500.00 | | | $ 500 | 0.792 | $ 396 |
| 2017 | | | | | $ 500.00 | | | $ 500 | 0.747 | $ 374 |
| 2018 | | | | | $ 500.00 | | | $ 500 | 0.705 | $ 352 |
| 2019 | | | | | $ 500.00 | | | $ 500 | 0.665 | $ 333 |
| 2020 | | | | | $ 500.00 | | | $ 500 | 0.627 | $ 314 |
| 2021 | | | | | $ 500.00 | | | $ 500 | 0.592 | $ 296 |
| 2022 | | | | | $ 500.00 | | | $ 500 | 0.558 | $ 279 |
| 2023 | | | | | $ 500.00 | | | $ 500 | 0.527 | $ 263 |
| 2024 | | | | | $ 500.00 | | | $ 500 | 0.497 | $ 248 |
| 2025 | | | | | $ 500.00 | | | $ 500 | 0.469 | $ 234 |
| 2026 | | | | | $ 500.00 | | | $ 500 | 0.442 | $ 221 |
| 2027 | | | | | $ 500.00 | | | $ 500 | 0.417 | $ 209 |
| 2028 | | | | | $ 500.00 | | | $ 500 | 0.394 | $ 197 |
| 2029 | | | | | $ 500.00 | | | $ 500 | 0.371 | $ 186 |
| 2030 | | | | | $ 500.00 | | | $ 500 | 0.350 | $ 175 |
| 2031 | | | | | $ 500.00 | | | $ 500 | 0.331 | $ 165 |
| 2032 | | | | | $ 500.00 | | | $ 500 | 0.312 | $ 156 |
| 2033 | | | | | $ 500.00 | | | $ 500 | 0.294 | $ 147 |
| 2034 | | | | | $ 500.00 | | | $ 500 | 0.278 | $ 139 |
| 2035 | | | | | $ 500.00 | | | $ 500 | 0.262 | $ 131 |
| 2036 | | | | | $ 500.00 | | | $ 500 | 0.247 | $ 123 |
| 2037 | | | | | $ 500.00 | | | $ 500 | 0.233 | $ 116 |
| 2038 | | | | | $ 500.00 | | | $ 500 | 0.220 | $ 110 |
| 2039 | | | | | $ 500.00 | | | $ 500 | 0.207 | $ 104 |
| 2040 | | | | | $ 500.00 | | | $ 500 | 0.196 | $ 98 |
| 2041 | | | | | $ 500.00 | | | $ 500 | 0.185 | $ 92 |
| 2042 | | | | | $ 500.00 | | | $ 500 | 0.174 | $ 87 |
| 2043 | | | | | $ 500.00 | | | $ 500 | 0.164 | $ 82 |
| 2044 | | | | | $ 500.00 | | | $ 500 | 0.155 | $ 77 |
| 2045 | | | | | $ 500.00 | | | $ 500 | 0.146 | $ 73 |
| 2046 | | | | | $ 500.00 | | | $ 500 | 0.138 | $ 69 |
| 2047 | | | | | $ 500.00 | | | $ 500 | 0.130 | $ 65 |
| 2048 | | | | | $ 500.00 | | | $ 500 | 0.123 | $ 61 |
| 2049 | | | | | $ 500.00 | | | $ 500 | 0.116 | $ 58 |
| 2050 | | | | | $ 500.00 | | | $ 500 | 0.109 | $ 55 |
| 2051 | | | | | $ 500.00 | | | $ 500 | 0.103 | $ 52 |
| 2052 | | | | | $ 500.00 | | | $ 500 | 0.097 | $ 49 |
| 2053 | | | | | $ 500.00 | | | $ 500 | 0.092 | $ 46 |
| 2054 | | | | | $ 500.00 | | | $ 500 | 0.087 | $ 43 |
| | | | | | | | | Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries | | $ 193,724 |

Comments: These project costs include initial capital costs and additional O&M costs of $500 per year to operate the new portions of the system.

## 636. *Trinity County Resource Conservation District*, West Weaver Creek Channel and Floodplain Rehabilitation

### Conditions Without the Project

West Weaver Creek is a branch of Weaver Creek, a headwater tributary to the Trinity River. West Weaver Creek lies just west of the town of Weaverville, Trinity County, California. It has good water quality and is ideal for supporting habitat for Coho and Steelhead. West Weaver Creek has a reach 1,000 feet upstream of its confluence with Grub Gulch, adjacent to Highway 299 and mostly within the Weaverville Community Forest, which has been degraded by historic hydraulic mining and recent fires. This reach has poor salmonid habitat, and supplies fine sediment to Trinity River downstream. Currently, the project reach is incised with prominent in-channel bedrock exposure, minimal in-channel cover, little substrate to support spawning and macroinvertebrate productivity, and no high-flow refugia.

### Conditions With the Project

The project would involve pool and riffle construction, spawning gravel augmentation, and riparian planting to improve instream habitat though an increase in-channel and floodplain sediment sorting and retention, decrease fine sediment yield, improve passage to upstream habitat, increase spawning and rearing habitat, increase colonization surfaces for macroinvertebrates, and increase high flow refugia. The project would reduce water temperature in Willow Creek by increasing hyporheic exchange from gravel augmentation. The Forest Service Redwood Science Lab would continue their fish population monitoring and modeling of the creek, and their post-project monitoring would document the fish population response and benefits of the project in relation to the wider region.

### Section D2. Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient information to quantify in monetary terms does not exist. Table 12-635 identifies the non-monetized benefits the project would likely generate.

| Table 12-636 – Non-monetized Benefits Checklist<br>*Trinity County Resource Conservation District*, West Weaver Creek Channel and Floodplain Rehabilitation | | |
|---|---|---|
| *No.* | *Will the proposal…* | *Response*[1] |
| **Community/Social Benefits** | | |
| 1 | Provide education or technology benefits? Demonstration of new monitoring methodology | Yes |
| 2 | Provide social recreation or access benefits? | No |
| 3 | Help avoid, reduce or resolve various public water resources conflicts? | No |
| 4 | Promote social health and safety? | No |
| 5 | Have other social benefits? Cultural use value associated with increases in salmon populations | Yes |
| **Environmental Stewardship Benefits** | | |
| 6 | Benefit wildlife or habitat in ways that were not quantified in Attachment 7? | No |
| 7 | Improve water quality in ways that were not quantified in Attachment 7? | No |
| 8 | Reduce net emissions in ways that were not quantified in Attachment 7? | No |
| 9 | Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4? | No |
| **Sustainability Benefits** | | |
| 10 | Improve the overall, long-term management of California groundwater resources? Enhance use and non-use values of groundwater | Yes |
| 11 | Reduce demand for net diversions for the regions from the Delta? | No |
| 12 | Provide a long-term solution in place of a short-term one? | No |
| 13 | Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources? | No |
| 14 | Improve water supply reliability in ways not quantified in Attachment 7? | No |
| 15 | Other (If the above listed categories do not apply, provide non-monetized benefit description)? | No |

Notes: [1] A "no" response may mean the project does not produce this benefit, or it may mean the benefit is already quantified in Attachment 7, or monetized directly under Section D3 below.

## 1. Provide education or technology benefits: Demonstration of new monitoring methodology

**Relevant change.** The project would advance a technical methodology for salmonid and steelhead restoration with modeling / monitoring and performance measures with a number of regional benefits. For example, the technology benefits would:

1) Help guide future projects on optimum restoration design elements for similar settings in the region.
2) Present costs and challenges that will help reduce will be reduced costs associated with other efforts, to the extent that the region uses this effort to develop and establish procedures/tools.
3) Provide future projects with a way to optimize their performance, reducing future costs associated with similar efforts.

The Redwood Science Lab is developing cutting edge salmonid and steelhead restoration with modeling / monitoring and performance measures to ensure that projects that utilize these methods are afford the latest science in regards to project performance measures.

**Evidence for demand and value.** To the extent that these programs improve the efficiency and/or reduce the costs of future water supply and water-quality related projects, they deliver a benefit to society.

**Timing and duration.** The monitoring activities would occur for 3 years prior to implementation and 5 years post-implementation, through 2019. The benefits to other projects from techniques developed and refined for this project would persist for the long-run.

**Beneficiaries.** The beneficiaries associated with this benefit are the stakeholders and decision makers in the region who will improve decision making, reduce costs, and improve the efficiency of future projects as a result of a better understanding and more information.

**Sources of uncertainty.** It is impossible to predict with certainty how the techniques developed for this project would produce the economic effects described above for projects in the future. That largely depends on the transferability of the techniques, and other managers' decisions to adopt them. If they take off, the future benefits would be large. If they don't, the benefits would be more limited.

### 5. Have other social benefits: Cultural use value associated with increases in salmon populations

**Relevant change.** Project proponents expect the project to increase populations of Coho salmon and steelhead by 540 fish per year. See our description of monetized benefit #1 (passive-use value associated with increases in salmon populations) below for a full description of the process by which these projects confer this benefit.

**Evidence for demand and economic value.** Unlike many Californians who ascribe a monetary willingness to pay to protect salmon, even if they never intend to directly fish or watch them, many Native Americans recognize the importance of salmon outside the cultural framework and economic terms western society often imposes (Malloy 1992). Accordingly, they reject the validity of applying a dollar value to fish that constitute a core element of their cultural and spiritual well-being. For this reason, we recognize the cultural significance that arises from the projects' improvements to salmonid populations and their habitat apart from the quantified passive-use value or other measures of economic benefits.

**Timing and duration.** Project proponents expect to complete construction of habitat restoration by November of 2014. To reduce the risk that we overestimate this benefit, we assume the project begins conferring benefits related to cultural-use value associated with increases in salmon populations in 2015. These benefits likely would increase over time, as restoration matures, and would persist over the long run (at least 50 years).

**Beneficiaries.** The beneficiaries of this benefit would include members of Native American tribes – both within and outside of the region – who believe the continued existence of salmonid populations and their habitat is essential to cultural and spiritual well-being.

**Sources of uncertainty.** The value of this benefit depends on the uncertainty associated with the extent to the project confers a biophysical benefit that will result in increased salmon populations.

### 10. Improve the overall, long-term management of California's groundwater resources: Enhance use and non-use values of groundwater

**Relevant change.** The project's restoration techniques, such as construction of complex fish habitat structures and riparian forest rehabilitation, may increase groundwater recharge. These activities would also help rebuild productive floodplain soils that should help reduce evapotranspiration and heating of groundwater. Data are not available to quantify these effects directly.

**Evidence for demand and value.** Economists who study the economic importance of groundwater describe this importance using two major categories of value: extractive values and *in situ* values (CVG 1997). The major extractive values include the economic importance of groundwater consumption by municipalities, business and industry, and agricultural producers. Groundwater aquifers offer significant advantages over surface storage for consumptive uses including: no costs for storage facility, no loss through evaporation, and groundwater also protect water quality at no or little cost relative to surface storage. Another advantage of groundwater aquifers is their capacity to distribute water over long distances at little to no cost. Constructing pipe systems on the surface is much more expensive than relying on an existing aquifer for water movement.

*In situ* values derive from the services that groundwater provides in place, rather than through consumptive use. *In situ* values include:

- Buffer values—given that supplies of surface water can fluctuate, groundwater supplies can help smooth out, or buffer, variability in water supplies in cases where water districts manage groundwater conjunctively with surface water. One study found that the buffer capacity of groundwater can represent over 80 percent of the total value of surface and groundwater (CVG 1997, page 60.).
- Environmental values—groundwater can help assimilate harmful pollutants. These assimilative properties helps avoid filtration and related costs that water users would otherwise face. Groundwater also often supports surface water flows and riparian and wetland ecosystems during parts of the year.
- Subsidence-avoidance values—the structural services that groundwater provides *in situ* help avoid ground subsidence and related damages to roads, pipeline, foundations and other structures and infrastructure. One way of describing the associated economic values is the avoided costs of subsidence damage.

Because data aren't available to quantify the biophysical effects, we are unable to estimate them in monetary terms.

**Timing and duration.** Project proponents expect to complete construction of habitat restoration by November of 2014. To reduce the risk that we overestimate this benefit, we assume the project begins conferring benefits in 2015. These benefits likely would increase over time, as restoration matures, and would persist over the long run (at least 50 years).

**Beneficiaries.** The beneficiaries of this benefit are groundwater users in the area, potentially other surface water users in the region, and people who value the ecological services provided by enhancing groundwater recharge and building the resiliency of groundwater-surface water interactions.

**Sources of uncertainty.** Data are insufficient to estimate the changes in the environment related to groundwater resources, so it is difficult to identify the potential magnitude of this benefit—it could be very small, or it could be very large, depending on the effects and the resources and users influenced by the effects.

## Section D3. Monetized Benefits Analysis

The present value of the monetized benefits in 2012 dollars, discounted annually at 6 percent over the relevant lifespan of each component of the project (described for each benefit below), is $2,911,606. The calculations for each monetized benefit are shown in Tables 15-1, 15-2, and 15-3, at the end of this section.

### 1. Passive-use value associated with increases in salmon populations

**Relevant change.** Through improvements in habitat and fish passage, the project would increase the fish populations of Coho and steelhead. The project would create habitat sufficient for salmon to produce 15 additional redds. Assuming a smolt survival rate of 36 smolts per redd, project proponents expect the project to increase populations of Coho and steelhead by 540 fish per year.

**Evidence for demand and value.** Several studies have attempted to estimate the passive use value of increases in salmon and steelhead populations among households in California and neighboring states. Passive use value, in this case, refers to the benefit individuals derive from knowing that healthy salmon and steelhead populations exist, regardless of their intent to directly interact with salmon and steelhead through fishing or some other means. In general, these studies have estimated households' average willingness to pay to implement policies that would increase salmon and steelhead populations.

At the per fish level, these studies reveal that households are willing to pay only fractions of a penny for increases in salmon populations. When summed across a region, however, the total value Californians are willing to pay for increases in fish populations can become several thousands of dollars per fish. With about 12.4 million households in California, two studies that have estimated willingness to pay values for increases in salmon and steelhead populations suggest that Californians, in total, would be willing to pay these values per fish per year (in 2012

dollars): $497 (Olsen, Richards, and Scott 1991) and $4,351 (Loomis 1996). In eliciting willingness to pay estimates from respondents, these studies told respondents that hypothetical policies would increase salmon populations by 2.5 million and 300,000, respectively. To reduce the risk that we overestimate this benefit, we employ a value of $500 per fish per year as a rough estimate of the benefit of increases in salmon populations. The total annual undiscounted value of increases in salmon populations is about $270,000.

There is additional evidence of specific local demand for habitat restoration and increased salmon populations on West Weaver Creek. For example, the Weaverville Community Forest, a partnership between the Bureau of Land Management, the U.S. Forest Service, and the TCRCD manages federal land in the Weaverville basin as a community forest. In its mission it is to uphold several values, one of which is habitat restoration.

**Timing and duration.** Project proponents expect to complete construction of habitat restoration by November of 2014. To reduce the risk that we overestimate this benefit, we assume the project begins conferring benefits related to passive-use values associated with increases in salmon populations in 2015. These benefits likely would increase over time, as restoration matures, and would persist over the long run (at least 50 years).

**Beneficiaries.** The beneficiaries of this benefit are the people of California who value the continued existence of aquatic wildlife and habitat, particularly critical habitat for Chinook salmon, Coho salmon, and steelhead.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of increased salmon populations would also affect the economic benefit estimate described here. There is also uncertainty associated with the marginal economic value of increases in fish populations described above. The results from the studies listed above depend crucially on survey methodology and public perceptions on the current state of salmonid populations. Of the studies listed, three were conducted in the Pacific Northwest, which may over or underestimate Californians' willingness to pay for salmon.

All studies we reviewed found that the willingness to pay per fish for an increase in salmon populations decreases as the hypothetical increase in salmon stocks increases. In all cases however, the increases in population were several degrees of magnitude larger than the increases expected by this project. The projects would yield small potential increases in salmon populations, relative to the size of existing populations. There is no data in the literature measuring respondents' willingness to pay for population increases in the scope of the project. If the marginal value per fish of increases in salmon populations diminishes as the size of the project becomes very small, the value of salmon may lie at the lower end of the range presented above. If the value per additional fish resulting from the projects resembles the upper end of the range, we have likely underestimated the true value of this benefit.

## 2. Avoided costs associated with reduced probability of sediment deposition

**Relevant change.** The project would benefit the Trinity River through reduced channel erosion and increased floodplain fine sediment sequestration. Reduced channel erosion will be accomplished though in-channel step-pool/riffle-pool structures that cover the eroding exposed bedrock, stabilize in-channel substrate, and reduce in-channel scour through more regular connection to the adjacent floodplain. Increased sequestration of fine sediment will occur by integrating riparian vegetation and roughness elements into a more frequently inundated floodplain. Project proponents expect the project would reduce Willow Creek's fine sediment yield to Trinity River by 24 tons per year.

**Evidence for demand and value.** Economic studies have examined and monetized some of the benefits that materialize when excessive sediment does not impair streams, rivers, estuaries, and the marine environment. A study conducted by the U.S. Department of Agriculture identified 13 types of benefits associated with decreasing sediment (Hansen and Ribaudo 2008). For each benefit, the researchers modeled the potential value associated with reducing sediment, per ton, for each county across the country. For our analysis, we apply the average value for the counties in the Trinity watershed, $9.11 per ton, to estimate the benefits derived from the prevention of sediment deposition. Included in this value are the regional benefits associated with the impacts of sediment on:

- Water-based recreation – cleaner fresh water recreation
- Irrigation ditches and channels – reduced cost of removing sediment and aquatic plants from irrigation channels
- Road drainage ditches – less damage to and flooding of roads
- Municipal water treatment – lower sediment-removal costs for water treatment plants
- Flood damage – reduced flooding and damage from flooding
- Marine fisheries – improved catch rates for marine commercial fisheries
- Marine recreational fishing – improved catch rates for marine recreational fishing
- Municipal and industrial water use – reduced damages from salts and minerals dissolved from sediment
- Steam power plants – reduced plant growth on heat exchangers
- Soil productivity – reduced losses in soil productivity
- Dust cleaning – decrease in cleaning due to reduced wind-borne particulates.
- Reservoir services – less sediment in reservoirs
- Navigation – shipping industry avoidance of damages from groundings

The annual undiscounted value of the avoided costs related to sediment reduction is $219.

Moreover, the Trinity River, Upper Middle Assessment Area, is a listed 303(d) impaired water body for sedimentation and siltation. The Trinity River Total Maximum Daily Load, approved in 2001 by the EPA, indicates sediment from Weaver and Rush Creek watersheds, which includes West Weaver Creek, need to be reduced by 42 percent combined. Should this project reduce

specific costs for landowners in complying with the TMDL, it would confer additional benefits not quantified here.

**Timing and duration.** Project proponents expect the project begins conferring benefits related reduced channel erosion and increased floodplain fine sediment sequestration in 2015. These benefits would persist over the long run (at least 50 years).

**Beneficiaries.** The beneficiaries of this benefit are the wide array of downstream users associated with each of the benefits listed above. To some extent, these beneficiaries include the general public, municipal water treatment operators and their ratepayers, irrigators, recreationalists, downstream property owners, and fishermen.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of reduced sedimentation would also affect the economic benefit estimate described here. For example, the actual rate of sediment deposition is dependent on water year type, sediment yields, location and roughness of the flood prone surface, among other factors.

At least three major factors suggest that the value of sediment we use underestimates the true value of the sediment-reduction benefits. First, the value does not reflect many potential benefits, such as the goods and services derived from potential impacts on wetlands and endangered species. Second, the estimates of sediment erosion that the projects would reduce are based on current sediment erosion rates. Climate change is expected to increase the frequency and intensity of storm events, which would likely increase the rate of sediment erosion absent the projects (Madsen and Figdor 2007). If future sediment erosion rates exceed current rates, the without-project sediment erosion is likely to increase, and thus, the expected benefit of each project's sediment control activities is likely to be an underestimate. Third, this estimate does not anticipate increases in value that occur over time. We anticipate that the value of sediment-reduction benefits will increase, relative to the general price index, but have not accounted for this increase in our calculations. To the extent that this project also helps avoid future costs related to TMDL compliance, we have also underestimated the value of this benefit.

### 3. Enhanced and increased riparian habitat

**Relevant change.** While there have been no terrestrial or aquatic surveys conducted in this area over the past 20 years, anecdotal evidence suggests there is no habitat functionality outside the narrow strip of riparian trees lining the channel. The site is underlain by relic hydraulic mine debris and was twice hit by recent fire, which means it is essentially barren with poor soil for vegetation establishment. Currently, the only plant that grows in this riparian area is coyote brush. Within the riparian corridor at the project site, the channel is predominantly exposed bedrock. There are no undercut banks and very few pools. Those that do exist are scoured into bedrock and provide little to no refuge.

The project would restore .8 acres of riparian habitat to full functionality. Raising the channel bed, along with willow baffle roughness elements will increase deposition of fine sediment and help improve the soil for establishment of riparian/upland woody species. Restoration would increase the riparian function from 0 to 100 percent as it matures over a 15-year period. Once the restoration reaches year 15, we assume the function would persist for the long-run, at least 50 years.

**Evidence for demand and value.** Data are insufficient to delineate specific impacts of the project's restoration efforts on the ecosystem services provided by this area of riparian habitat. Thus, instead we employ a value that accounts for people's willingness to pay for the flow of goods and services from an acre of forested riparian habitat. In 2009, researchers conducted several meta-analyses estimating various use and nonuse values associated with forestland. In estimating the passive use value of forestland, the researchers compiled data from 23 relevant studies (Chiabai et al. 2009). Their results identify per-acre estimates for passive use values by geographic region and forest biome. For our analysis, we use the passive use value associated with North American forestland in the cool coniferous biome, $125 per acre per year. At full maturity, the annual undiscounted benefit would be $100.

**Timing and duration.** Project proponents expect to complete construction of habitat restoration by November of 2014. To reduce the risk that we overestimate this benefit, we assume the project begins conferring benefits related to enhanced and increased riparian habitat in 2015. These benefits likely would increase over time, as restoration matures, and would persist over the long run (at least 50 years).

**Beneficiaries.** The beneficiaries of this benefit are the residents nearby and individuals in California who value the continued existence of riparian habitat in the state.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of increased riparian habitat acreage and functionality would also affect the economic benefit estimate described here. The value described above estimates society's total willingness to pay for fully-restored forest land in cool coniferous forests in North America. Insofar as this estimate considers only passive use values, it likely underestimates the total economic value of riparian and other forest-based restoration because direct users of the restored habitat likely are willing to pay more for its restoration. It also likely underestimates the value because, as human populations and incomes grow in California, the marginal value of forest land probably will increase, as will the value of restoration efforts. Because we found no reliable estimate of the rate of increase, we did not fold this increase into our estimates. For these reasons, it seems reasonable to conclude that the value estimates derived in the past underestimate, perhaps substantially, the true value of future increases in fully-restored riparian and other forest habitat.

Table 15.1-636 – Annual Benefit: Increases in Salmon Population
(All benefits should be in 2012 dollars)

Project: 636 -Trinity County Resource Conservation District, West Weaver Creek - Channel and Floodplain Rehabilitation

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Increase in Salmon pop | fish | 0 | 0 | 0 | $ 500.00 | $ - | 1.000 | $ - |
| 2013 | Increase in Salmon pop | fish | 0 | 0 | 0 | $ 500.00 | $ - | 0.943 | $ - |
| 2014 | Increase in Salmon pop | fish | 0 | 0 | 0 | $ 500.00 | $ - | 0.890 | $ - |
| 2015 | Increase in Salmon pop | fish | 0 | 54 | 54 | $ 500.00 | $ 27,000.00 | 0.840 | $ 22,669.7 |
| 2016 | Increase in Salmon pop | fish | 0 | 108 | 108 | $ 500.00 | $ 54,000.00 | 0.792 | $ 42,773.1 |
| 2017 | Increase in Salmon pop | fish | 0 | 162 | 162 | $ 500.00 | $ 81,000.00 | 0.747 | $ 60,527.9 |
| 2018 | Increase in Salmon pop | fish | 0 | 216 | 216 | $ 500.00 | $ 108,000.00 | 0.705 | $ 76,135.7 |
| 2019 | Increase in Salmon pop | fish | 0 | 270 | 270 | $ 500.00 | $ 135,000.00 | 0.665 | $ 89,782.7 |
| 2020 | Increase in Salmon pop | fish | 0 | 324 | 324 | $ 500.00 | $ 162,000.00 | 0.627 | $ 101,640.8 |
| 2021 | Increase in Salmon pop | fish | 0 | 378 | 378 | $ 500.00 | $ 189,000.00 | 0.592 | $ 111,868.8 |
| 2022 | Increase in Salmon pop | fish | 0 | 432 | 432 | $ 500.00 | $ 216,000.00 | 0.558 | $ 120,613.3 |
| 2023 | Increase in Salmon pop | fish | 0 | 486 | 486 | $ 500.00 | $ 243,000.00 | 0.527 | $ 128,009.4 |
| 2024 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.497 | $ 134,181.7 |
| 2025 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.469 | $ 126,586.5 |
| 2026 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.442 | $ 119,421.3 |
| 2027 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.417 | $ 112,661.6 |
| 2028 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.394 | $ 106,284.5 |
| 2029 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.371 | $ 100,268.4 |
| 2030 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.350 | $ 94,592.8 |
| 2031 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.331 | $ 89,238.5 |
| 2032 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.312 | $ 84,187.3 |
| 2033 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.294 | $ 79,422.0 |
| 2034 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.278 | $ 74,926.4 |
| 2035 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.262 | $ 70,685.3 |
| 2036 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.247 | $ 66,684.2 |
| 2037 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.233 | $ 62,909.6 |
| 2038 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.220 | $ 59,348.7 |
| 2039 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.207 | $ 55,989.3 |
| 2040 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.196 | $ 52,820.1 |
| 2041 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.185 | $ 49,830.3 |
| 2042 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.174 | $ 47,009.7 |
| 2043 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.164 | $ 44,348.8 |
| 2044 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.155 | $ 41,838.5 |
| 2045 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.146 | $ 39,470.3 |
| 2046 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.138 | $ 37,236.1 |
| 2047 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.130 | $ 35,128.4 |
| 2048 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.123 | $ 33,140.0 |
| 2049 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.116 | $ 31,264.2 |
| 2050 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.109 | $ 29,494.5 |
| 2051 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.103 | $ 27,825.0 |
| 2052 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.097 | $ 26,250.0 |
| 2053 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.092 | $ 24,764.1 |
| 2054 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.087 | $ 23,362.4 |
| 2055 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.082 | $ 22,040.0 |
| 2056 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.077 | $ 20,792.5 |
| 2057 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.073 | $ 19,615.5 |
| 2058 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.069 | $ 18,505.2 |
| 2059 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.065 | $ 17,457.7 |
| 2060 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.061 | $ 16,469.6 |
| 2061 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.058 | $ 15,537.3 |
| 2062 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.054 | $ 14,657.9 |
| 2063 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.051 | $ 13,828.2 |
| 2064 | Increase in Salmon pop | fish | 0 | 540 | 540 | $ 500.00 | $ 270,000.00 | 0.048 | $ 13,045.4 |
| | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | | | $ 2,907,141.2 |

Comments: This calculation assumes salmon populations would increase linearly for the first 10 years following the project's completion.

Table 15.2-636 – Annual Benefit: Reduced Sediment Deposition
(All benefits should be in 2012 dollars)

Project: 636 -Trinity County Resource Conservation District, West Weaver Creek - Channel and Floodplain Rehabilitation

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Reduced Sediment | tons | 0 | 0 | 0 | $ 9.11 | $ - | 1.000 | $ - |
| 2013 | Reduced Sediment | tons | 0 | 0 | 0 | $ 9.11 | $ - | 0.943 | $ - |
| 2014 | Reduced Sediment | tons | 0 | 0 | 0 | $ 9.11 | $ - | 0.890 | $ - |
| 2015 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.840 | $ 184 |
| 2016 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.792 | $ 173 |
| 2017 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.747 | $ 163 |
| 2018 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.705 | $ 154 |
| 2019 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.665 | $ 145 |
| 2020 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.627 | $ 137 |
| 2021 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.592 | $ 129 |
| 2022 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.558 | $ 122 |
| 2023 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.527 | $ 115 |
| 2024 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.497 | $ 109 |
| 2025 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.469 | $ 103 |
| 2026 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.442 | $ 97 |
| 2027 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.417 | $ 91 |
| 2028 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.394 | $ 86 |
| 2029 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.371 | $ 81 |
| 2030 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.350 | $ 77 |
| 2031 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.331 | $ 72 |
| 2032 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.312 | $ 68 |
| 2033 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.294 | $ 64 |
| 2034 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.278 | $ 61 |
| 2035 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.262 | $ 57 |
| 2036 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.247 | $ 54 |
| 2037 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.233 | $ 51 |
| 2038 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.220 | $ 48 |
| 2039 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.207 | $ 45 |
| 2040 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.196 | $ 43 |
| 2041 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.185 | $ 40 |
| 2042 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.174 | $ 38 |
| 2043 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.164 | $ 36 |
| 2044 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.155 | $ 34 |
| 2045 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.146 | $ 32 |
| 2046 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.138 | $ 30 |
| 2047 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.130 | $ 28 |
| 2048 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.123 | $ 27 |
| 2049 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.116 | $ 25 |
| 2050 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.109 | $ 24 |
| 2051 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.103 | $ 23 |
| 2052 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.097 | $ 21 |
| 2053 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.092 | $ 20 |
| 2054 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.087 | $ 19 |
| 2055 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.082 | $ 18 |
| 2056 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.077 | $ 17 |
| 2057 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.073 | $ 16 |
| 2058 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.069 | $ 15 |
| 2059 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.065 | $ 14 |
| 2060 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.061 | $ 13 |
| 2061 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.058 | $ 13 |
| 2062 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.054 | $ 12 |
| 2063 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.051 | $ 11 |
| 2064 | Reduced Sediment | tons | 0 | 24 | 24 | $ 9.11 | $ 218.64 | 0.048 | $ 11 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 3,067 |

Comments:

Table 15.3-636 – Annual Benefit: Enhanced Riparian Habitat
(All benefits should be in 2012 dollars)

Project: 636 -Trinity County Resource Conservation District, West Weaver Creek - Channel and Floodplain Rehabilitation

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Riparian Habitat | Functional Acres | 0 | 0 | 0 | $ 125.00 | $ - | 1.000 | $ - |
| 2013 | Riparian Habitat | Functional Acres | 0 | 0 | 0 | $ 125.00 | $ - | 0.943 | $ - |
| 2014 | Riparian Habitat | Functional Acres | 0 | 0 | 0 | $ 125.00 | $ - | 0.890 | $ - |
| 2015 | Riparian Habitat | Functional Acres | 0 | 0.05 | 0.05 | $ 125.00 | $ 6.67 | 0.840 | $ 6 |
| 2016 | Riparian Habitat | Functional Acres | 0 | 0.19 | 0.19 | $ 125.00 | $ 23.33 | 0.792 | $ 18 |
| 2017 | Riparian Habitat | Functional Acres | 0 | 0.32 | 0.32 | $ 125.00 | $ 40.00 | 0.747 | $ 30 |
| 2018 | Riparian Habitat | Functional Acres | 0 | 0.45 | 0.45 | $ 125.00 | $ 56.67 | 0.705 | $ 40 |
| 2019 | Riparian Habitat | Functional Acres | 0 | 0.59 | 0.59 | $ 125.00 | $ 73.33 | 0.665 | $ 49 |
| 2020 | Riparian Habitat | Functional Acres | 0 | 0.72 | 0.72 | $ 125.00 | $ 90.00 | 0.627 | $ 56 |
| 2021 | Riparian Habitat | Functional Acres | 0 | 0.85 | 0.85 | $ 125.00 | $ 106.67 | 0.592 | $ 63 |
| 2022 | Riparian Habitat | Functional Acres | 0 | 0.99 | 0.99 | $ 125.00 | $ 123.33 | 0.558 | $ 69 |
| 2023 | Riparian Habitat | Functional Acres | 0 | 1.12 | 1.12 | $ 125.00 | $ 140.00 | 0.527 | $ 74 |
| 2024 | Riparian Habitat | Functional Acres | 0 | 1.25 | 1.25 | $ 125.00 | $ 156.67 | 0.497 | $ 78 |
| 2025 | Riparian Habitat | Functional Acres | 0 | 1.39 | 1.39 | $ 125.00 | $ 173.33 | 0.469 | $ 81 |
| 2026 | Riparian Habitat | Functional Acres | 0 | 1.52 | 1.52 | $ 125.00 | $ 190.00 | 0.442 | $ 84 |
| 2027 | Riparian Habitat | Functional Acres | 0 | 1.65 | 1.65 | $ 125.00 | $ 206.67 | 0.417 | $ 86 |
| 2028 | Riparian Habitat | Functional Acres | 0 | 1.79 | 1.79 | $ 125.00 | $ 223.33 | 0.394 | $ 88 |
| 2029 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.371 | $ 37 |
| 2030 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.350 | $ 35 |
| 2031 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.331 | $ 33 |
| 2032 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.312 | $ 31 |
| 2033 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.294 | $ 29 |
| 2034 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.278 | $ 28 |
| 2035 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.262 | $ 26 |
| 2036 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.247 | $ 25 |
| 2037 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.233 | $ 23 |
| 2038 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.220 | $ 22 |
| 2039 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.207 | $ 21 |
| 2040 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.196 | $ 20 |
| 2041 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.185 | $ 18 |
| 2042 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.174 | $ 17 |
| 2043 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.164 | $ 16 |
| 2044 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.155 | $ 15 |
| 2045 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.146 | $ 15 |
| 2046 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.138 | $ 14 |
| 2047 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.130 | $ 13 |
| 2048 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.123 | $ 12 |
| 2049 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.116 | $ 12 |
| 2050 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.109 | $ 11 |
| 2051 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.103 | $ 10 |
| 2052 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.097 | $ 10 |
| 2053 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.092 | $ 9 |
| 2054 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.087 | $ 9 |
| 2055 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.082 | $ 8 |
| 2056 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.077 | $ 8 |
| 2057 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.073 | $ 7 |
| 2058 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.069 | $ 7 |
| 2059 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.065 | $ 6 |
| 2060 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.061 | $ 6 |
| 2061 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.058 | $ 6 |
| 2062 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.054 | $ 5 |
| 2063 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.051 | $ 5 |
| 2064 | Riparian Habitat | Functional Acres | 0 | 0.8 | 0.8 | $ 125.00 | $ 100.00 | 0.048 | $ 5 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 1,398 |

Comments: Riparian habitat begins to improve in 2015, but habitat takes time to grow back. We assume this takes 15 years in this case and so there is a linear increase from 2015-2029

## Section D3. Project Costs

The present value of the project's costs, which would occur between 2012 and 2014, is $493,370 in 2012 dollars, discounted at a 6-percent annual rate. These costs would fund labor, planning, equipment, and materials necessary to implement the project.[23]

| Table 19-636 – Annual Costs of Project<br>(All costs should be in 2012 Dollars)<br><br>Project: 636 -Trinity County Resource Conservation District, West Weaver Creek - Channel and Floodplain Rehabilitation | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Initial Costs Grand Total Cost from Table 7 (row (i), column (d)) | Adjusted Grant Total Cost | 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 | $ 239,500.00 | | | | | | | $ 239,500 | 1.000 | $ 239,500 |
| 2013 | $ 25,800.00 | | | | | | | $ 25,800 | 0.943 | $ 24,340 |
| 2014 | $ 257,900.00 | | | | | | | $ 257,900 | 0.890 | $ 229,530 |
| Total Present Value of Discounted Costs (Sum of column (j))<br>Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries | | | | | | | | | | $ 493,370 |
| Comments: | | | | | | | | | | |

[23] We have distributed the costs outlined Table 7 across the project's implementation period based on the expected timing and phasing described in the Work Plan. Actual distribution of costs during this period may differ somewhat.

## 206. *Humboldt Bay Municipal Water District*, Ranney Collectors 1 & 1A Lateral Replacement

### Conditions Without the Project

Humboldt Bay Municipal Water District (HBMWD) provides wholesale treated water to municipal customers through 7 water agencies that provide water to about 87,000 people (about 60 percent of Humboldt County's population).

HBMWD's water collection system draws from the aquifer below the Mad River. The HBMWD recharges the aquifer through water releases in the summer and fall from seasonal flows stored in Ruth Lake, approximately 60 miles upstream of the water collection system. Ruth Lake was designed to provide 75 million gallons per day (MGD), and the District maintains water rights, which support that. Releases from Ruth Lake also help support several species of salmonid on the 60-mile section of the Mad River, which is water-quality impaired for temperature, and has historically gone dry during the summer.

Installed almost 50 years ago, HBMWD's water collection system is aging, and its capacity to produce water has declined. Without the project, project proponents estimate that all of the laterals would progressively fail within the next 20 years, reducing water supply reliability for HBMWD's customers and resulting in emergency operations and maintenance costs for the HBMWD. With ongoing use of the existing system, engineering studies have shown that HBMWD's regular operation and maintenance costs associated with pumping, treatment, and overall system operation would be higher than with new collectors. Ultimately, the collectors would become unusable, requiring HBMWD to replace them at a later date, after incurring extensive costs to keep the deteriorating system running.

Without the project, water treatment costs would also increase. After it pumps and collects water, HBMWD treats the water to state and federal drinking water standards: chlorine is added, and during the winter, HBMWD processes the water at its turbidity reduction facility. As the collection system has aged, HBMWD has had to increase the flow velocity to maintain the same flow rate and volume production, which picks up more sediment and increases the turbidity of the water. Without the project, HBMWD would have to expand the turbidity reduction facility, incur increasing treatment costs, and operate it longer during the year.

If the water collection system were to fail or no longer be able to provide the current rate of water consumption, it is likely that the District would reduce its releases from Ruth Lake. This could cause HBMWD to lose a portion of its water right from Ruth Lake, which would likely trigger a small decrease in the District's releases from Ruth Lake. This would result in lower flows to 60 miles of the river, which may have an adverse effect on aquatic species and recreational kayakers, rafters, and anglers during the low-flow summer months.

### Conditions With the Project

With the project, HBMWD would replace all the laterals in the existing water collection system. The existing laterals consist of 12-inch diameter pipes that are punched with approximately 1-inch diameter

holes. The new laterals consist of spiral wound well screens with over four times the available flow per foot than the existing screens. This higher flow area would allow more water through into the caissons at lower flow velocities, which would mobilize less sediment and reduce turbidity in the water pumped from the collectors.

Maintaining the integrity and capacity of the water collection system would allow HBMWD to avoid constructing an alternate water supply. It would also secure HBMWD's water right and allow it to continue to release the same amount of water from Ruth Lake, maintaining the flow regime in the Mad River. This is especially important during the late summer and fall months, when the releases augment low flows and benefit salmonids and recreational water users.

The project would not affect the net quantity of water extracted in the long-run.

## Section D2. Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient information to quantify in monetary terms does not exist. Table 12-206 identifies the non-monetized benefits the project would likely generate.

Table 12-206 – Non-monetized Benefits Checklist
*Humboldt Bay Municipal Water District*, Ranney Collectors 1 & 1A Lateral Replacement

| *No.* | *Will the proposal…* | *Response*[1] |
|---|---|---|
| | **Community/Social Benefits** | |
| 1 | Provide education or technology benefits? | No |
| 2 | Provide social recreation or access benefits? Protect instream flows for recreation | Yes |
| 3 | Help avoid, reduce or resolve various public water resources conflicts? | No |
| 4 | Promote social health and safety? | No |
| 5 | Have other social benefits? | No |
| | **Environmental Stewardship Benefits** | |
| 6 | Benefit wildlife or habitat in ways that were not quantified in Attachment 7? Protect passive-use value associated with increases in salmon populations | Yes |
| 7 | Improve water quality in ways that were not quantified in Attachment 7? | No |
| 8 | Reduce net emissions in ways that were not quantified in Attachment 7? | No |
| 9 | Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4? | No |
| | **Sustainability Benefits** | |
| 10 | Improve the overall, long-term management of California groundwater resources? Reduced localized impacts to aquifer | Yes |
| 11 | Reduce demand for net diversions for the regions from the Delta? | No |
| 12 | Provide a long-term solution in place of a short-term one? | No |
| 13 | Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources? | No |
| 14 | Improve water supply reliability in ways not quantified in Attachment 7? Reduced risk of shortage to HBMWD customers during periods of peak demand | Yes |
| 15 | Other (If the above listed categories do not apply, provide non-monetized benefit description)? | No |

Notes: [1] A "no" response may mean the project does not produce this benefit, or it may mean the benefit is already quantified in Attachment 7, or monetized directly under Section D3 below.

## 2. Provide social recreation or access benefits: Protect instream flows for recreation

**Relevant change.** Without the project, if the collectors slowly failed, HBMWD would likely decrease its releases from Ruth Lake. With the project, HBMWD would improve the production capacity of its laterals, avoiding having to reduce diversions from Ruth Lake. This would protect the existing levels of flows in 60 miles of the river. This would protect the existing levels of flows in 60 miles of the river.

**Evidence for demand and value.** Recreationists, including kayakers, rafters and fisherman, use the Mad River extensively for recreational purposes. Protecting late-summer flows in the Mad River would avoid adverse impacts to recreational values in several ways:

- Protecting the quality of the recreational experience for kayakers, rafters and fishermen who already visit the area, by maintaining instream flows.
- Reducing the likelihood that low-flow conditions deteriorate to the point that recreational boaters and anglers would go elsewhere, at greater cost and potentially diminished experience.

Quantifying the extent to which any of these effects would occur is difficult, given that data about current recreational use of this area are not collected in a systematic way.

Another source of value comes from people who haven't actually used the Mad River, but are willing to pay to have the option of using it at some point in the future, if they choose. Data are not available to determine if this "option value" is an important component of the value of the River's instream flows, but given that it is a popular destination for various types of recreationalists, it is plausible that this would be a source of value.

**Timing and duration.** Project proponents expect to complete lateral installation within six months of the start date, in March of 2013. Without the project, HBMWD would have reduced flows to the Mad River when the first lateral fails, likely within 10-15 years. We assume the project would begin to confer benefits related to recreation in 2028. These benefits would persist for the lifespan of the project, 50 years.

**Beneficiaries.** Anyone who recreates or visits the area, or who would value the opportunity to recreate or visit the area at some point in the future would benefit from the recreational aspects of the project.

**Sources of uncertainty.** The value of recreation and tourism associated with the increased instream flows to Mad River depend on the demand from potential recreationalists, as well as the characteristics of the supply of recreational opportunities in the area. Both of these variables have the potential to change over time and affect the value of the instream flows.

### 6. Benefit wildlife or habitat: Protect passive-use value associated with increases in salmon populations

**Relevant change.** Without the project, if the collectors slowly failed, HBMWD would likely decrease its releases from Ruth Lake. With the project, HBMWD would improve the production capacity of its laterals, avoiding having to reduce diversions from Ruth Lake. This would protect the existing levels of flows in 60 miles of the river. This would protect the existing levels of flows in 60 miles of the river. The Mad River serves as habitat for salmonids. Lower flows during already low-flow summer and fall period would have the potential to diminish survival rates for salmon and impact population levels.

**Evidence for demand and value.** Individuals derive value from increases in salmon and steelhead populations in two ways: some (e.g., recreational anglers and commercial fishermen) directly interact with salmon and steelhead populations and derive benefit by catching and consuming the fish, others (including some from the former group) derive value from the fish solely based on the salmon and steelhead's existence. Studies have shown that regardless of direct interaction with fish populations, many Californians hold a positive willingness to pay to ensure the long-term survival of salmon and steelhead (Pate and Loomis 1997).

Several studies have attempted to estimate the passive use value of increases in salmon and steelhead populations among households in California and neighboring states. Passive use value, in this case, refers to the benefit individuals derive from knowing that healthy salmon and steelhead populations exist, regardless of their intent to directly interact with salmon and steelhead through fishing or some other means. In general, these studies have estimated households' average willingness to pay to implement policies that would increase salmon and steelhead populations. At the per fish level, these studies reveal that households are willing to pay only fractions of a penny for increases in salmon populations. When summed across a region, however, the total value Californians are willing to pay for increases in fish populations is considerable. Applying the results of two studies that have estimated willingness to pay values for increases in salmon and steelhead populations suggest that Californians, in total, would be willing to pay between $497 (Olsen, Richards, and Scott 1991) and $4,351 (Loomis 1996) per fish.[24]

**Timing and duration.** Project proponents expect to complete lateral installation within six months of the start date, in March of 2013. Without the project, HBMWD would have reduced flows to the Mad River when the first lateral fails, likely within 10-15 years. We assume the project would begin to confer benefits related to salmon populations in 2028. These benefits would persist for the lifespan of the project, 50 years.

[24] This is based on about 12.4 million households in California (U.S. Census Bureau 2007-2011).

**Beneficiaries.** The beneficiaries of this benefit are the people of California who value the continued existence of aquatic wildlife and habitat, particularly critical habitat for Chinook salmon, Coho salmon, and steelhead.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of increased salmon populations would also affect the economic benefit estimate described here. There is also uncertainty associated with the marginal economic value of increases in fish populations described above. The results from the studies listed above depend crucially on survey methodology and public perceptions on the current state of salmonid populations. Of the studies listed, three were conducted in the Pacific Northwest, which may over or underestimate Californians' willingness to pay for salmon.

### 10. Improve the overall, long-term management of California's groundwater resources: Reduced localized impacts to aquifer

The project would improve groundwater quality by spreading out groundwater production and recharge areas. The new laterals will be placed in a currently underutilized portion of the Holocene aquifer near Essex. The overall water quality would be enhanced because water flow per area is reduced by increasing the total production area, effectively spreading the aquifer recharge over a larger area.

We monetize the benefits in several ways that benefit HBMWD directly: reduced operations and maintenance costs associated with treatment (Monetized benefit # 3) and avoided costs associated with turbidity reduction facility (Monetized benefit # 1). To the extent that the project induces changes in groundwater use that protect the resource for other users, it would produce additional benefits related to promoting the long-term management of California's groundwater resources.

### 14. Improve water supply reliability: Reduced risk of shortage to HBMWD customers during periods of peak demand

**Relevant change.** The project would ensure an adequate supply of water for HBMWD's customers. Without the project, if a lateral fails, the capacity of the collector would decrease by roughly 0.5 MGD. Given that customer usage has already reached peak production levels during the summer months, any decrease in capacity would translate directly into disruption of service to the customers, particularly during summer months.

**Evidence for demand and value.** While sufficient data are unavailable to quantify this benefit, research suggests that households prefer non-drought conditions to drought conditions and are willing to pay for increased water supply and water reliability. Research conducted for the California Urban Water Agencies found that households were willing to pay, on average, $213 per year to avoid a 10-percent shortage once every three years and $222 per year to avoid a 30-percent shortage once every thirty years (Barakat & Chamberlin, Inc. 1994).

**Timing and duration.** This project would being conferring benefits related to improved water supply reliability when the first lateral would have failed in the baseline conditions, but after construction is complete. Project proponents have not calculated the annual probability of a lateral failing, but note both laterals would likely fail within 20 years without the project. We assume, therefore, that the project confers this benefit, with a 10 percent annual probability, beginning in 2014 and persisting for the lifespan of the project, 50 years.

**Beneficiaries.** The beneficiaries of this benefit are the 87,000 customers of the Humboldt Bay Municipal Water District.

**Sources of uncertainty.** The value of this benefit would depend on the degree to which a lateral failure actually requires the HBMWD to curtail water delivery to some or all of its customers. How customers experience supply interruptions determines how much they are willing to pay to avoid them. Small, infrequent disruptions are less costly than larger shortages, but if lots of customers experience small disruptions versus only a few experiencing larger shortages, the value of avoiding small, infrequent distributions may be greater. The distributional effects of this benefit would be especially important to consider.

## Section D3. Monetized Benefits Analysis

The present value of the monetized benefits in 2012 dollars, discounted annually at 6 percent over the relevant lifespan of each component of the project (described for each benefit below), is $1,739,142. The calculations for each monetized benefit are shown in Tables 15-1 through 15-3, 16-1 and 16-2, at the end of this section.

### 1. Avoided costs associated with an expansion of the Turbidity Reduction Facility (TRF)

**Relevant change.** Without the project the existing laterals would likely fail in a progressive manner. The existing holes in the laterals would rust through and expand, allowing sand and gravels to migrate into the laterals and increase the turbidity of the water withdrawn from the collectors. HBMWD designed the existing turbidity reduction facility (TRF) to address the existing turbidity of the water withdrawn. As turbidity increases, at some point, the existing TRF would no longer have sufficient capacity to handle the increased turbidity. At the point that the TRF facility reaches capacity, HBMWD would need to expand the current facility.

**Evidence for demand and value.** Project proponents estimate an expansion of the Turbidity Reduction Facility would cost $5 million. While there is no formal engineering report to support this cost, the estimate is based on the original construction cost of the facility and the best expert judgment of the system operators. As there may be several reasons, independent of this project, for HBMWD to expand the TRF, we attribute 50 percent of the cost of the expansion to this project.

**Timing and duration.** HBMWD would avoid the cost of expanding the TRF at some point in the future, based on the failure of the laterals. HBMWD expects this would occur after the failure of

a portion of the laterals, which it estimates within 10-15 years. We assume this avoided cost would occur 15 years in the future, in 2027.

**Beneficiaries.** The beneficiaries of this benefit are the HBMWD and its ratepayers.

**Sources of uncertainty.** The uncertainty related to this benefit depends on the probability of the laterals failing, the year in which they would fail under baseline conditions, and the costs associated with an expansion of the turbidity reduction facility, should that need to occur.

### 2. Avoided costs associated with replacing Collectors 1 & 1A

**Relevant change.** Without the project, the existing laterals would likely fail in a progressive manner. When either a sufficient number of laterals partially fail, so the District would not be able keep up with increased turbidity even with an expanded turbidity reduction facility, or if a sufficient number completely fail and need to be sealed, it would not longer be economically viable to keep the existing Collectors in service. The District would then replace the Collectors 1 & 1A in a similar manner to the project proposed under this application.

**Evidence for demand and value.** Project proponents estimate the cost of replacing Collectors 1 & 1A, including engineering, permitting, and construction, is $1.6 million dollars. Although the costs to replace Collectors 1 & 1A in the future after complete failure may be more expensive, we use the same project cost as proposed in this application.

**Timing and duration.** HBMWD would avoid the cost of replacing the collectors after they failure completely. HBMWD expects this occur within 20 years. Thus, we assume this avoided cost would occur 20 years in the future, in 2033.

**Beneficiaries.** The beneficiaries are the Humboldt Bay Municipal Water District and its ratepayers.

**Sources of uncertainty.** The uncertainty related to this benefit depends on the probability of the laterals failing, the year in which they would fail under baseline conditions, and the costs associated with replacing the collectors at the point of complete failure. It is likely that the current project costs underestimate the cost of replacing the collectors after complete failure in 2033.

### 3. Avoided costs associated with water treatment

**Relevant change.** Prior to reaching the capacity failure point, the operational costs of the existing TRF would increase to deal with the increased turbidity. HBMD would need to purchase additional chemicals to deal with increased turbidity and operate the TRF longer during the year, incurring additional costs. Moreover, if a lateral failed, the capacity of the collector would decrease by roughly 0.5 MGD and turbidity will further increase in the collector, resulting in additional turbidity treatment costs. Project proponents estimate the project would reduce water treatment costs by 10 percent, or about 5 gallons of alum per day for 180 days.

**Evidence for demand and value.** Project proponents estimate current water treatment costs are $2 per gallon of alum. Given the assumptions on timing below, the project would confer an annual, undiscounted benefit related to reduced water treatment costs of $1,800.

**Timing and duration.** The project would avoid these water treatment costs 180 days per year, after construction of the laterals is complete at the end of 2013. We therefore assume the project would begin to confer these benefits in 2014. These benefits would persist until the District would have expanded its TRF under baseline conditions, which we assume would occur in 2027.

**Beneficiaries.** The beneficiaries of this benefit are the Humboldt Bay Municipal Water District and its ratepayers.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of increased water treatment would also affect the economic benefit estimate described here. Additional uncertainty related to this benefit depends on the costs associated with water treatment in the baseline conditions.

### 4. Avoided costs associated with reduced energy use

**Relevant change.** The project would reduce energy use by reducing pumping as a result of a higher water levels in the collector. Also the lateral collectors are approaching their maximum supply capacity and are energy inefficient. Improvements to Collectors 1 & 1A would reduce the energy needed to supply water by 6 million gallons per day, for most of the year.

**Evidence for demand and value.** Assuming a cost of $10 per million gallons pumped, 6 million gallons, and 280 days per year, the annual cost savings of energy pumping is $16,800.

**Timing and duration.** The project would avoid costs related to energy use after construction of the laterals is complete at the end of 2013. We therefore assume the project would begin to confer this benefit in 2014. These benefits would persist until the District would have replaced the laterals in the without project conditions, which we assume is 20 years.

**Beneficiaries.** The beneficiaries of this benefit are the Humboldt Bay Municipal Water District and its ratepayers.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of increased water treatment would also affect the economic benefit estimate described here. Additional uncertainty related to this benefit depends on the costs associated with energy use in the baseline conditions.

## 5. Avoided costs of climate change from reduced carbon emissions

**Relevant change.** Project proponents estimate the project would reduce $CO_2$ emissions by 25.7 tons per year. These savings would occur as a result of reduced energy use described in monetized benefit #3 (avoided costs associated with reduced energy use), above.

**Evidence for demand and value.** The International Panel on Climate Change has identified anthropogenic greenhouse gas emissions as the main contributor of global warming and climate change. Carbon dioxide emissions have received the most attention as they account for the majority of these emissions – 77 percent in 2004 (IPCC 2007). Expected impacts of climate change include decreased ecosystem resilience, increased extinction rates, fluctuations in cropland productivity, increased erosion and flooding in coastal areas, and decreased availability of clean drinking water. These impacts could result in the displacement of hundreds of millions of people, increased morbidity, and irreversible damages to critical life-support systems within the environment (IPCC 2007).

Economists use the social cost of carbon to estimate the value of changes in greenhouse gas emissions. The social cost of carbon represents "the full global cost today of emitting an incremental unit of carbon at some point of time in the future, and it includes the sum of the global cost of the damage it imposes on the entire time it is in the atmosphere." (Shaw 2009) There are currently over 200 different estimates of the social cost of carbon. One review of the literature found values ranging from about $7 to $111 per ton of carbon dioxide equivalent ($2007) (Shaw 2009). Another analysis suggests increasing the social cost of carbon, in real terms, by 2–3 percent per year to reflect the rising damages from climate change (Nordhaus 2008).

California's cap-and-trade system for carbon provides one such estimate of the social cost of carbon. The cap-and-trade system, which took effect January 1, 2012, allots credits through auctions. The second such auction on February 19, 2013 elicited bids that ranged from $10.71-$50.01, with a mean and median price of $14.71 and $12.56, respectively (California Air Resources Board 2012). The cap-and-trade market, however, only applies to large producers of carbon and producers are allowed to offset up to 8 percent of carbon emissions.[25] Thus, while this range of costs for carbon is well within the broader range of costs, this market is not the appropriate mechanism for determining the cost of carbon beyond the cost for large producers.

For this analysis, we use a value of $13 per ton of carbon dioxide equivalent sequestered to represent the social cost of carbon. We inflate this value by 2.5 percent per year, in real terms, to reflect the rising damages from climate change. The annual, undiscounted value of this

[25] These projects may currently include, and may only include forestry, urban forestry, dairy manure digesters, and the destruction of ozone depleting substances. California Environmental Protection Agency - Air Resources Board. Air Resources Board sets stage for carbon offset projects. December 14, 2012.

benefit is therefore $334 in the first year in which benefits occur, increasing at a real rate of 2.5 percent per year.

**Timing and duration.** The project would avoid costs related to energy use after construction of the laterals is complete at the end of 2013. We therefore assume the project would begin to confer benefits related to avoided costs of climate change in 2014. These benefits would persist until the District would have replaced the laterals in the without project conditions, which we assume is 20 years.

**Beneficiaries.** The beneficiaries of this benefit are all residents of California.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of increased carbon dioxide sequestered would also affect the economic benefit estimate described here. If the true cost of carbon dioxide lies closer to the upper or lower end of the range we presented above, our unit value would represent an under or overestimate.

Table 15.1-206 – Annual Benefit: Water Treatment
(All benefits should be in 2012 dollars)

Project: 206 - Humboldt Bay Municipal Water District, Ranney Collectors 1 & 1A Lateral Replacement

| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
|---|---|---|---|---|---|---|---|---|---|
| Year | Type of Benefit | Measure of Benefit (Units) | Without Project | With Project | Change Resulting from Project (e) – (d) | Unit $ Value | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Avoided water treatment | gallons | 0 | 0 | 0 | $ 2.00 | $ - | 1.000 | $ - |
| 2013 | Avoided water treatment | gallons | 0 | 0 | 0 | $ 2.00 | $ - | 0.943 | $ - |
| 2014 | Avoided water treatment | gallons | 0 | 900 | 900 | $ 2.00 | $ 1,800.00 | 0.890 | $ 1,602 |
| 2015 | Avoided water treatment | gallons | 0 | 900 | 900 | $ 2.00 | $ 1,800.00 | 0.840 | $ 1,511 |
| 2016 | Avoided water treatment | gallons | 0 | 900 | 900 | $ 2.00 | $ 1,800.00 | 0.792 | $ 1,426 |
| 2017 | Avoided water treatment | gallons | 0 | 900 | 900 | $ 2.00 | $ 1,800.00 | 0.747 | $ 1,345 |
| 2018 | Avoided water treatment | gallons | 0 | 900 | 900 | $ 2.00 | $ 1,800.00 | 0.705 | $ 1,269 |
| 2019 | Avoided water treatment | gallons | 0 | 900 | 900 | $ 2.00 | $ 1,800.00 | 0.665 | $ 1,197 |
| 2020 | Avoided water treatment | gallons | 0 | 900 | 900 | $ 2.00 | $ 1,800.00 | 0.627 | $ 1,129 |
| 2021 | Avoided water treatment | gallons | 0 | 900 | 900 | $ 2.00 | $ 1,800.00 | 0.592 | $ 1,065 |
| 2022 | Avoided water treatment | gallons | 0 | 900 | 900 | $ 2.00 | $ 1,800.00 | 0.558 | $ 1,005 |
| 2023 | Avoided water treatment | gallons | 0 | 900 | 900 | $ 2.00 | $ 1,800.00 | 0.527 | $ 948 |
| 2024 | Avoided water treatment | gallons | 0 | 900 | 900 | $ 2.00 | $ 1,800.00 | 0.497 | $ 895 |
| 2025 | Avoided water treatment | gallons | 0 | 900 | 900 | $ 2.00 | $ 1,800.00 | 0.469 | $ 844 |
| 2026 | Avoided water treatment | gallons | 0 | 900 | 900 | $ 2.00 | $ 1,800.00 | 0.442 | $ 796 |
| 2027 | Avoided water treatment | gallons | 0 | 900 | 900 | $ 2.00 | $ 1,800.00 | 0.417 | $ 751 |
| | | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | $ 15,784 |

Comments: Project proponents estimate the project would reduce water treatment costs by 10 percent over the baseline or 5 gallons per day and that current water treatment costs are $2/day for each of 180 days per year

Table 15.2-206 – Annual Benefit: Energy Use Reduction

(All benefits should be in 2012 dollars)

Project: 206 - Humboldt Bay Municipal Water District, Ranney Collectors 1 & 1A Lateral Replacement

| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
|---|---|---|---|---|---|---|---|---|---|
| Year | Type of Benefit | Measure of Benefit (Units) | Without Project | With Project | Change Resulting from Project (e) – (d) | Unit $ Value | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Energy to Pump Water | million gallons | 0 | 0 | 0 | $ 10.00 | $ - | 1.000 | $ - |
| 2013 | Energy to Pump Water | million gallons | 0 | 0 | 0 | $ 10.00 | $ - | 0.943 | $ - |
| 2014 | Energy to Pump Water | million gallons | 0 | 1680 | 1680 | $ 10.00 | $ 16,800.00 | 0.890 | $ 14,952 |
| 2015 | Energy to Pump Water | million gallons | 0 | 1680 | 1680 | $ 10.00 | $ 16,800.00 | 0.840 | $ 14,106 |
| 2016 | Energy to Pump Water | million gallons | 0 | 1680 | 1680 | $ 10.00 | $ 16,800.00 | 0.792 | $ 13,307 |
| 2017 | Energy to Pump Water | million gallons | 0 | 1680 | 1680 | $ 10.00 | $ 16,800.00 | 0.747 | $ 12,554 |
| 2018 | Energy to Pump Water | million gallons | 0 | 1680 | 1680 | $ 10.00 | $ 16,800.00 | 0.705 | $ 11,843 |
| 2019 | Energy to Pump Water | million gallons | 0 | 1680 | 1680 | $ 10.00 | $ 16,800.00 | 0.665 | $ 11,173 |
| 2020 | Energy to Pump Water | million gallons | 0 | 1680 | 1680 | $ 10.00 | $ 16,800.00 | 0.627 | $ 10,541 |
| 2021 | Energy to Pump Water | million gallons | 0 | 1680 | 1680 | $ 10.00 | $ 16,800.00 | 0.592 | $ 9,944 |
| 2022 | Energy to Pump Water | million gallons | 0 | 1680 | 1680 | $ 10.00 | $ 16,800.00 | 0.558 | $ 9,381 |
| 2023 | Energy to Pump Water | million gallons | 0 | 1680 | 1680 | $ 10.00 | $ 16,800.00 | 0.527 | $ 8,850 |
| 2024 | Energy to Pump Water | million gallons | 0 | 1680 | 1680 | $ 10.00 | $ 16,800.00 | 0.497 | $ 8,349 |
| 2025 | Energy to Pump Water | million gallons | 0 | 1680 | 1680 | $ 10.00 | $ 16,800.00 | 0.469 | $ 7,876 |
| 2026 | Energy to Pump Water | million gallons | 0 | 1680 | 1680 | $ 10.00 | $ 16,800.00 | 0.442 | $ 7,431 |
| 2027 | Energy to Pump Water | million gallons | 0 | 1680 | 1680 | $ 10.00 | $ 16,800.00 | 0.417 | $ 7,010 |
| 2028 | Energy to Pump Water | million gallons | 0 | 1680 | 1680 | $ 10.00 | $ 16,800.00 | 0.394 | $ 6,613 |
| 2029 | Energy to Pump Water | million gallons | 0 | 1680 | 1680 | $ 10.00 | $ 16,800.00 | 0.371 | $ 6,239 |
| 2030 | Energy to Pump Water | million gallons | 0 | 1680 | 1680 | $ 10.00 | $ 16,800.00 | 0.350 | $ 5,886 |
| 2031 | Energy to Pump Water | million gallons | 0 | 1680 | 1680 | $ 10.00 | $ 16,800.00 | 0.331 | $ 5,553 |
| 2032 | Energy to Pump Water | million gallons | 0 | 1680 | 1680 | $ 10.00 | $ 16,800.00 | 0.312 | $ 5,238 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 176,846 |

Comments: Energy savings from a reduced pumping of 6 million gallons of water per day for each of 280 days per year.

Table 15.3-206 – Annual Benefit: Carbon Sequestration
(All benefits should be in 2012 dollars)

Project: 206 - Humboldt Bay Municipal Water District, Ranney Collectors 1 & 1A Lateral Replacement

| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
|---|---|---|---|---|---|---|---|---|---|
| Year | Type of Benefit | Measure of Benefit (Units) | Without Project | With Project | Change Resulting from Project (e) – (d) | Unit $ Value | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Reduced carbon emissions | tons | 0 | 0 | 0 | $ 13.00 | $ - | 1.000 | $ - |
| 2013 | Reduced carbon emissions | tons | 0 | 0 | 0 | $ 13.33 | $ - | 0.943 | $ - |
| 2014 | Reduced carbon emissions | tons | 0 | 25.7 | 25.7 | $ 13.66 | $ 351.01 | 0.890 | $ 312 |
| 2015 | Reduced carbon emissions | tons | 0 | 25.7 | 25.7 | $ 14.00 | $ 359.79 | 0.840 | $ 302 |
| 2016 | Reduced carbon emissions | tons | 0 | 25.7 | 25.7 | $ 14.35 | $ 368.78 | 0.792 | $ 292 |
| 2017 | Reduced carbon emissions | tons | 0 | 25.7 | 25.7 | $ 14.71 | $ 378.00 | 0.747 | $ 282 |
| 2018 | Reduced carbon emissions | tons | 0 | 25.7 | 25.7 | $ 15.08 | $ 387.45 | 0.705 | $ 273 |
| 2019 | Reduced carbon emissions | tons | 0 | 25.7 | 25.7 | $ 15.45 | $ 397.14 | 0.665 | $ 264 |
| 2020 | Reduced carbon emissions | tons | 0 | 25.7 | 25.7 | $ 15.84 | $ 407.07 | 0.627 | $ 255 |
| 2021 | Reduced carbon emissions | tons | 0 | 25.7 | 25.7 | $ 16.24 | $ 417.25 | 0.592 | $ 247 |
| 2022 | Reduced carbon emissions | tons | 0 | 25.7 | 25.7 | $ 16.64 | $ 427.68 | 0.558 | $ 239 |
| 2023 | Reduced carbon emissions | tons | 0 | 25.7 | 25.7 | $ 17.06 | $ 438.37 | 0.527 | $ 231 |
| 2024 | Reduced carbon emissions | tons | 0 | 25.7 | 25.7 | $ 17.48 | $ 449.33 | 0.497 | $ 223 |
| 2025 | Reduced carbon emissions | tons | 0 | 25.7 | 25.7 | $ 17.92 | $ 460.56 | 0.469 | $ 216 |
| 2026 | Reduced carbon emissions | tons | 0 | 25.7 | 25.7 | $ 18.37 | $ 472.07 | 0.442 | $ 209 |
| 2027 | Reduced carbon emissions | tons | 0 | 25.7 | 25.7 | $ 18.83 | $ 483.88 | 0.417 | $ 202 |
| 2028 | Reduced carbon emissions | tons | 0 | 25.7 | 25.7 | $ 19.30 | $ 495.97 | 0.394 | $ 195 |
| 2029 | Reduced carbon emissions | tons | 0 | 25.7 | 25.7 | $ 19.78 | $ 508.37 | 0.371 | $ 189 |
| 2030 | Reduced carbon emissions | tons | 0 | 25.7 | 25.7 | $ 20.28 | $ 521.08 | 0.350 | $ 183 |
| 2031 | Reduced carbon emissions | tons | 0 | 25.7 | 25.7 | $ 20.78 | $ 534.11 | 0.331 | $ 177 |
| 2032 | Reduced carbon emissions | tons | 0 | 25.7 | 25.7 | $ 21.30 | $ 547.46 | 0.312 | $ 171 |
| Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | | | | | | | | $ 4,462 |

Comments: The value of reduced carbon emissions is assumed to be $13/ton in 2012 and increases by 2.5% per year, in real terms, thereafter.

| Table 16.1-206 – Annual Costs: Turbidity Reduction Facility<br>(All avoided costs should be in 2012 dollars)<br>Project: 206 - Humboldt Bay Municipal Water District, Ranney Collectors 1 & 1A Lateral Replacement | | | | | | |
|---|---|---|---|---|---|---|
| | Costs | | | | Discounting Calculations | |
| (a) | (b) | (c) | (d) | (e) | (f) | (g) |
| Year | Alternative (Avoided Project Name): Turbidity Reduction Facility<br>Avoided Project Description: | | | | Discount Factor | Discounted Costs (e) x (f) |
| | Avoided Capital Costs | Avoided Replacement Costs | Avoided Operations and Maintenance Costs | Total Cost Avoided for Individual Alternatives (b) + (c) + (d) | | |
| 2012 | $ - | | | $ - | 1.000 | $ - |
| 2013 | $ - | | | $ - | 0.943 | $ - |
| 2014 | $ - | | | $ - | 0.890 | $ - |
| 2015 | $ - | | | $ - | 0.840 | $ - |
| 2016 | $ - | | | $ - | 0.792 | $ - |
| 2017 | $ - | | | $ - | 0.747 | $ - |
| 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 | $ 5,000,000.00 | | | $ 5,000,000.00 | 0.417 | $ 2,086,325 |
| | | | | | Total Present Value of Discounted Costs (Sum of Column (g)) | $ 2,086,325 |
| | | | | | (%) Avoided Cost Claimed by Project | 50% |
| | | | | | Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project (Total Present Value of Discounted Costs x % Avoided Cost Claimed by Project) | $ 1,043,163 |
| Comments: This project would be conferring benefits related to avoided costs associated with an expansion of the turbidity reduction facility after the first lateral would have failed in the baseline conditions, the existing facility reaches its capacity, but after construction of the project is complete (in 2014) | | | | | | |

| Table 16.2-206 – Annual Costs: Collectors 1 & 1A<br>(All avoided costs should be in 2012 dollars)<br>Project: 206 - Humboldt Bay Municipal Water District, Ranney Collectors 1 & 1A Lateral Replacement | | | | | | |
|---|---|---|---|---|---|---|
| | Costs | | | | Discounting Calculations | |
| (a) | (b) | (c) | (d) | (e) | (f) | (g) |
| Year | Alternative (Avoided Project Name): Collectors 1 & 1A<br>Avoided Project Description: | | | | Discount Factor | Discounted Costs (e) x (f) |
| | Avoided Capital Costs | Avoided Replacement Costs | Avoided Operations and Maintenance Costs | Total Cost Avoided for Individual Alternatives (b) + (c) + (d) | | |
| 2012 | $ - | | | $ - | 1.000 | $ - |
| 2013 | $ - | | | $ - | 0.943 | $ - |
| 2014 | $ - | | | $ - | 0.890 | $ - |
| 2015 | $ - | | | $ - | 0.840 | $ - |
| 2016 | $ - | | | $ - | 0.792 | $ - |
| 2017 | $ - | | | $ - | 0.747 | $ - |
| 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 | $ 1,600,000.00 | | | $ 1,600,000.00 | 0.312 | $ 498,888 |
| | | | | | Total Present Value of Discounted Costs (Sum of Column (g)) | $ 498,888 |
| | | | | | (%) Avoided Cost Claimed by Project | 1 |
| | | | | | Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project (Total Present Value of Discounted Costs x % Avoided Cost Claimed by Project) | $ 498,888 |
| Comments: This project would confer benefits related to avoided costs associated with replacing Collectors 1 & 1A after a sufficient number of laterals fail, but after construction of the project is complete (in 2014). | | | | | | |

## Section D3. Project Costs

The present value of the project's costs, which would occur between 2013 and 2015, is $1,470,164 in 2012 dollars, discounted at a 6-percent annual rate. These costs would fund labor, planning, equipment, and materials necessary to implement the project.[26]

| Table 19-206 – Annual Costs of Project<br>(All costs should be in 2012 Dollars)<br><br>Project: 206 - Humboldt Bay Municipal Water District, Ranney Collectors 1 & 1A Lateral Replacement | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Initial Costs Grand Total Cost from Table 7 (row (i), column (d)) | Adjusted Grant Total Cost | 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 | $ - | | | | | | | $ - | 1.000 | $ - |
| 2013 | $ 462,172 | | | | | | | $ 462,172 | 0.943 | $ 436,011 |
| 2014 | $ 1,014,468 | | | | | | | $ 1,014,468 | 0.890 | $ 902,873 |
| 2015 | $ 156,356 | | | | | | | $ 156,356 | 0.840 | $ 131,280 |
| Total Present Value of Discounted Costs (Sum of column (j))<br>Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries | | | | | | | | | | $ 1,470,164 |
| Comments: | | | | | | | | | | |

[26] We have distributed the costs outlined Table 7 across the project's implementation period based on the expected timing and phasing described in the Work Plan. Actual distribution of costs during this period may differ somewhat.

## 215. *Westhaven Community Services District*, Water Tank

### Conditions Without the Project

The Westhaven Community Services District (WCSD) provides water to approximately 450 residential customers, which represent 210 active household connections. The system relies on a single 100,000 gallon concrete storage tank with a metal roof supported by fir (wood) trusses that are in an advanced state of rot. An annual inspection in 2005 listed the condition of the tank roof as a "system or operational defect and/or potential health hazard—costly to correct—to be included in any long-range water improvement project." To temporarily mitigate the rot problem, the district runs ventilation fans to lower the humidity.

The roof has exceeded its lifespan. The deterioration of the trusses is such that a catastrophic event such as an earthquake or heavy winds could cause the roof to collapse. Without repair, it is highly likely the roof would fail in the next 5 years.

If the roof failed it would require about six months repair the existing tank and roof. In the interim, the District would issue a boil water order and provide bottled drinking water to its 450 users. After the initial cleanup, which would require several days, the District would keep the tank in service and provide non-potable water during construction of a new tank. While the tank was out of service, the District would supply the system directly from the gravity fed slow sand filter. During peak demand, the District would augment these supplies with untreated water directly from an open reservoir. Residents would be without a potable water source for the entire duration of construction of the replacement roof—six months—and without any water source for the duration of construction of the temporary roof—about five days.

### Conditions With the Project

The project would: (1) construct a new glass-lined steel 85,000 gallon storage tank adjacent to the existing concrete tank to allow the system to take the existing tank out of service and (2) replace the roof on the existing tank with a new free-span aluminum roof. The project would also construct a new ringwall foundation; install station piping connecting the new tank to the treated water effluent piping and connection to the existing outlet piping of the exiting storage tank; and install a cathodic protection system, tank floats and related controls. The new tank would operate in series with the existing tank.

### Section D2. Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient information to quantify in monetary terms does not exist. Table 12-215 identifies the non-monetized benefits the project would likely generate.

| Table 12-215 – Non-monetized Benefits Checklist<br>*Westhaven Community Services District*, Water Tank | | |
|---|---|---|
| *No.* | *Will the proposal…* | *Response*[1] |
| | **Community/Social Benefits** | |
| 1 | Provide education or technology benefits? | No |
| 2 | Provide social recreation or access benefits? | No |
| 3 | Help avoid, reduce or resolve various public water resources conflicts? | No |
| 4 | Promote social health and safety? Reduced levels of harmful pollutants in drinking water | Yes |
| 5 | Have other social benefits? | No |
| | **Environmental Stewardship Benefits** | |
| 6 | Benefit wildlife or habitat in ways that were not quantified in Attachment 7? | No |
| 7 | Improve water quality in ways that were not quantified in Attachment 7? Reduced levels of harmful pollutants in drinking water | Yes |
| 8 | Reduce net emissions in ways that were not quantified in Attachment 7? | No |
| 9 | Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4? | No |
| | **Sustainability Benefits** | |
| 10 | Improve the overall, long-term management of California groundwater resources? | No |
| 11 | Reduce demand for net diversions for the regions from the Delta? | No |
| 12 | Provide a long-term solution in place of a short-term one? | No |
| 13 | Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources? | No |
| 14 | Improve water supply reliability in ways not quantified in Attachment 7? Reduce risk of periodic shortages during peak demand associated with limited tank capacity | Yes |
| 15 | Other (If the above listed categories do not apply, provide non-monetized benefit description)? | No |

Notes: [1] A "no" response may mean the project does not produce this benefit, or it may mean the benefit is already quantified in Attachment 7, or monetized directly under Section D3 below.

## 4. Promote social health and safety: Reduce levels of harmful pollutants in drinking water

**Relevant change.** The rotting wood in the tank threatens the quality of the treated water inside, a public safety hazard. The District's water supply suffers from hazardous levels of Dibutyl phthalate (DBP) and it exceeds the minimum recommended halo-acetic acid (HAA5) concentration of 60 ppb. The District has recorded levels up to 400 ppb in its distribution system. With the project, the District would reduce the chlorine dose in the system, reducing the level of disinfection by-products of the chlorine. This would likely lower the District's levels of halo-acetic acid in the distribution system.

**Evidence for demand and value.** While we cannot quantify the costs associated with hazardous levels of DBP and haloacetic acids in the District's water system, the evidence suggests the costs to human health could be substantial, particularly over the long-term. Exposure to DBP and haloacetic acids in excess levels present a human health hazard. In 2006, California's voters added the plasticizer to their list of suspected teratogens—a drug or other substance capable of interfering with the development of an embryo fetus that may lead to birth defects or

developmental malformation—under California Proposition 65 (California Office of Environmental Health Hazard Assessment No date). The European Commission on Endocrine Disruption identified strong evidence that DBP is a human endocrine disruptor (EWG 2012).

According to the U.S. Environmental Protection Agency, people who drink water containing haloacetic acids in excess of the maximum content levels over a period of many years have an increased risk of cancer (EPA No Date). The California Department of Public Health has issued seven notices of violation regarding DBPs to the District. Every test for DBPs conducted by the District has resulted in a notice of violation.

**Timing and duration.** Project proponents expect to complete construction and repairs of the tank by October of 2015. We therefore assume benefits related to improved social health and safety would begin to accrue in 2016. The engineering lifespan of the project is 50-100 years, so we assume these benefits would accrue for at least 50 years.

**Beneficiaries.** The beneficiaries of this benefit are the customers of the Westhaven CSD. Westhaven CSD is entirely within a severely disadvantaged community.

**Sources of uncertainty.** This benefit is dependent on the project effectively reducing the amount of harmful pollutants in the water delivered to customer's taps.

### 7. Improve water quality: Reduced levels of harmful pollutants in drinking water

The rotting wood in the tank roof threatens the quality of the treated water, as described in non-monetized benefit #4, above. Repairing the roof would improve water quality and decrease treatment costs (quantified in monetary benefit #7).

### 14. Improve water supply reliability: Reduce risk of periodic shortages during peak demand associated with limited tank capacity

**Relevant change.** By constructing an additional tank, the District would have additional storage provided to help mitigate periodic shortages associated with the District's limited water supply capacity. Data are unavailable to quantify the duration and magnitude of these shortages or the number of customers affected.

**Evidence for demand and value.** While sufficient data are unavailable to quantify this benefit, research suggests that households are willing to pay for increased water supply and water reliability. Research conducted for the California Urban Water Agencies found that households were willing to pay, on average, $213 per year to avoid a 10-percent shortage once every three years and $222 per year to avoid a 30-percent shortage once every thirty years (Barakat & Chamberlin, Inc. 1994).

**Timing and duration.** Project proponents expect to complete construction and repairs of the tank by 2015. We therefore assume benefits related to avoided costs associated with improved

water supply reliability begin to accrue in 2016. The manufacturer's specified lifespan of the aluminum roof is 50 to 100 years, so we assume these benefits will accrue for 50 years.

**Beneficiaries.** The beneficiaries of this benefit are the customers of the Westhaven CSD. Westhaven CSD is entirely within a severely disadvantaged community.

**Sources of uncertainty.** Although anecdotal accounts suggest water shortages occur for customers of WCSD, data do not exist to properly describe what these are. Thus, to the extent that they actually have materialized and continue to be a problem without the project, this project would produce this benefit, and it could be substantial. If the current capacity issues are not translating into loss of service for customers, this benefit would be minimal. Even if problems aren't materializing now, if the risk exists in the future, the project could still produce this benefit.

## Section D3. Monetized Benefits Analysis

The present value of the monetized benefits in 2012 dollars, discounted annually at 6 percent over the relevant lifespan of each component of the project (described for each benefit below), is $236,588. The calculations for each monetized benefit are shown in Tables 15-1 through 15-7, 16-1, and 16-2, at the end of this section.

### 1. Avoided costs associated with issuing a boil water notice

**Relevant change.** If the roof catastrophically fails, the District's first action will be to issue a boil water order. This will involve sending repeated notices to each of the District's active household connections.

**Evidence for demand and value.** Project proponents anticipate the cost of issuing a boil water notice is approximately $300. This is a one-time cost. Given the annual probability of failure, the annual undiscounted value of this benefit is $60.

**Timing and duration.** Project proponents expect to complete construction and repairs by 2015. We therefore assume benefits related to avoided costs associated with catastrophic failure of the tank begin to accrue in 2014. The outside lifespan of the roof is 5 years. These benefits would persist until the tank would have failed, at the latest by 2017.

**Beneficiaries.** The beneficiaries of this benefit are the Westhaven CSD and its ratepayers. Westhaven CSD is entirely within a severely disadvantaged community.

**Sources of uncertainty.** The main source of uncertainty surrounding the value of this benefit is the probability of catastrophic failure of the roof. There is strong reason to believe the roof will fail within 5 years, if not sooner. The roof has exceeded its lifespan and the deterioration of the trusses is such that a catastrophic event such as an earthquake or heavy winds could cause the roof to collapse. If the tank's annual probability of failure is greater than 20 percent, we have

underestimated the true cost of this benefit, if it is less than 20 percent, we have overestimated it.

## 2. Avoided costs associated with bottled water purchases

**Relevant change.** If the roof catastrophically fails, the District's second action would be to provide its users with bottled drinking water. This is likely the only alternative for potable water supply; District does not have a backup supply and, without a storage tank, the District would have nowhere to store trucked in bulk water purchases. The District's 210 active household connections represent a population of approximately 450 to 500 people. We use the low-end of this range to reduce the risk that we overestimate this benefit.

**Evidence for demand and value.** The District estimates the costs of bottled water purchases for residents of Westhaven is $2 per gallon per person per day. Assuming each person requires one gallon of water per day, the District would pay approximately $27,000 per month to supply its customers with bottled water. Assuming the District would require six months to build and make a new tank fully operational, the total value of this benefit is $162,000. Given the annual probability of failure, the annual undiscounted value of this benefit is $32,400.

**Timing and duration.** Project proponents expect to complete construction and repairs by 2015. We therefore assume benefits related to avoided costs associated with catastrophic failure of the tank begin to accrue in 2015. The outside lifespan of the roof is 5 years. These benefits would persist until the tank would have failed, at the latest by 2017.

**Beneficiaries.** The beneficiaries of this benefit are the Westhaven CSD and its ratepayers. Westhaven CSD is entirely within a severely disadvantaged community.

**Sources of uncertainty.** The main source of uncertainty surrounding the value of this benefit is the probability of catastrophic failure of the roof. There is strong reason to believe the roof will fail within 5 years, if not sooner. The roof has exceeded its lifespan and the deterioration of the trusses is such that a catastrophic event such as an earthquake or heavy winds could cause the roof to collapse. If the tank's annual probability of failure is greater than 20 percent, we have underestimated the true cost of this benefit, if it is less than 20 percent, we have overestimated it.

## 3. Avoided costs associated with flushing the water system

**Relevant change.** If the roof catastrophically fails, while the District constructs a permanent replacement roof, it would supply the water system directly from the gravity fed slow sand filter. During peak demand the District would have to augment these flows with untreated, non-potable water directly from an open reservoir. Using this non-potable water source would require that the District flush and disinfect the entire distribution system and customers' plumbing and water heaters before reintroducing potable water again.

**Evidence for demand and value.** The District estimates the one-time, undiscounted cost of flushing and disinfecting District system is $20,000. The District estimates the one-time, undiscounted cost of flushing customers' water heaters $40,000. Given the annual probability of failure, the annual undiscounted value of this benefit is $12,000.

**Timing and duration.** Project proponents expect to complete construction and repairs by 2015. We therefore assume benefits related to avoided costs associated with catastrophic failure of the tank begin to accrue in 2016. The outside lifespan of the roof is 5 years. These benefits would persist until the tank would have failed, at the latest by 2017.

**Beneficiaries.** The beneficiaries of this benefit are the Westhaven CSD and its ratepayers. Westhaven CSD is entirely within a severely disadvantaged community.

**Sources of uncertainty.** The main source of uncertainty surrounding the value of this benefit is the probability of catastrophic failure of the roof. There is strong reason to believe the roof will fail within 5 years, if not sooner. The roof has exceeded its lifespan and the deterioration of the trusses is such that a catastrophic event such as an earthquake or heavy winds could cause the roof to collapse. If the tank's annual probability of failure is greater than 20 percent, we have underestimated the true cost of this benefit, if it is less than 20 percent, we have overestimated it.

### 4. Avoided costs associated with temporary loss of water supply

**Relevant change.** Depending on the extent of the collapse, it would take the District at least five days to return the system to non-potable service, during which residents would be completely without water. As a result, customers would bear additional costs related to a temporary loss of service, including traveling to do laundry and use a shower. The nearest community with a coin laundry is 9 miles from Westhaven.

**Evidence for demand and value.** Project proponents estimate cost the cost of traveling to the coin laundry facility is $10.00 per trip, including the cost of gas and laundry charges. If each household makes one trip to the laundry facility during the outage, the total, undiscounted value of this one-time avoided cost is $2,100. Given the annual probability of failure, the annual undiscounted value of this benefit is $420.

**Timing and duration.** Project proponents expect to complete construction and repairs by 2015. We therefore assume benefits related to avoided costs associated with catastrophic failure of the tank begin to accrue in 2016. The outside lifespan of the roof is 5 years. These benefits would persist until the tank would have failed, at the latest by 2017.

**Beneficiaries.** The beneficiaries of this benefit are the Westhaven CSD and its ratepayers. Westhaven CSD is entirely within a severely disadvantaged community.

**Sources of uncertainty.** The main source of uncertainty surrounding the value of this benefit is the probability of catastrophic failure of the roof. There is strong reason to believe the roof will

fail within 5 years, if not sooner. The roof has exceeded its lifespan and the deterioration of the trusses is such that a catastrophic event such as an earthquake or heavy winds could cause the roof to collapse. If the tank's annual probability of failure is greater than 20 percent, we have underestimated the true cost of this benefit, if it is less than 20 percent, we have overestimated it. There are other reasons to believe we have underestimate the true value of this benefit. We do not include travel costs related to showering or purchasing potable water for cooking, nor do we include the resident's opportunity cost of time. We also do not include the costs related to an inconvenience of a water outage, which are likely substantial. For these reasons it is very likely we have underestimated the value of this benefit, perhaps considerably.

### 5. Avoided costs associated with reduced water treatment

**Relevant change.** The District expects that as the wooden trusses deteriorate, increasing amounts of debris would fall into the treated water, necessitating increased chlorine dosing to keep the water safe to drink. By adding a second tank, the District would be able to reduce its chlorine dosing from 2 mg/l to slightly above 1 mg/l as a result of the increased contact time required for disinfection.

Also, by reducing the chlorine dose, the District hopes to reduce the levels of DBP formation the system is currently generating. This would also allow the District to cease water production during periods of heavy rainfall, which may lower the levels of dissolved organic carbon, a pre-cursor DBP formation, from being introduced into the system. The District would likely need to treat its water for DBPs; however, the installation of the new tank should reduce DBP concentrations, and consequently reduce the anticipated future treatment costs of removing them. We do not quantify this portion of the benefit.

**Evidence for demand and value.** The District estimates that by reducing its chlorine dosing from 2 mg/l to slightly above 1 mg/l, it would save approximately $1,000 in water treatment costs per year.

**Timing and duration.** Project proponents expect to complete construction and repairs of the tank by October of 2015. We therefore assume benefits related to improved social health and safety would begin to accrue in 2016. The engineering lifespan of the project is 50-100 years, so we assume these benefits would accrue for at least 50 years.

**Beneficiaries.** The beneficiaries of this benefit are the Westhaven CSD and its ratepayers. Westhaven CSD is entirely within a severely disadvantaged community.

**Sources of uncertainty.** The quantified portion of this benefit is based on standard treatment practices and is fairly certain. The unquantified portions of this benefit are highly uncertain, but could be much greater than the quantified benefit, especially as increasing regulations around DBP in drinking water emerge as research continues to strengthen the link between DBPs and health problems.

## 6. Avoided costs associated with reduced energy use

**Relevant change.** Under current conditions, the District must run a ventilation fan that circulates the air within the tank. Without the project, if the tank failed, the fan would not be needed any more. With the project, the District would replace the roof and eliminate the need for a fan. The fan requires 1,825 kWh of energy per year.

**Evidence for demand and value.** The District pays $0.20 per kWh for electricity. The total, undiscounted annual value of this avoided cost is $365.

**Timing and duration.** Project proponents expect to complete construction and repairs by 2015. We therefore assume benefits for avoided treatment costs would begin to accrue in 2016. The outside lifespan of the roof is 5 years, so without the project these benefits would have materialized by 2017, with an annual probability of 20 percent that the roof would have failed before 2017, translating to an 80 percent annual probability that the District would have continued to pay the costs until 2017.

**Beneficiaries.** The beneficiaries of this benefit are the Westhaven CSD and its ratepayers. Westhaven CSD is entirely within a severely disadvantaged community.

**Sources of uncertainty.** The main source of uncertainty surrounding the value of this benefit is the probability of catastrophic failure of the roof. There is strong reason to believe the roof will fail within 5 years, if not sooner. If the roof fails before 2017, the district would not run the fan anymore, and our benefit estimate would diminish slightly (the difference between running the fan to 2016 or 2017.

## 7. Avoided costs of climate change from reduced carbon emissions

**Relevant change.** By eliminating the need to run the ventilation fan, the project would reduce the energy demands of the water system, which would reduce net emissions of greenhouse gases. Using a conversion factor from EPA's Greenhouse Gas Calculator for electricity use in California, estimate that by reducing energy use by 1,825 kWh per year, the project would result in a reduction of 0.82 metric tons of emissions of $CO_2$e per year.

**Evidence for demand and value.** The International Panel on Climate Change has identified anthropogenic greenhouse gas emissions as the main contributor of global warming and climate change. Carbon dioxide emissions have received the most attention as they account for the majority of these emissions – 77 percent in 2004 (IPCC 2007). Expected impacts of climate change include decreased ecosystem resilience, increased extinction rates, fluctuations in cropland productivity, increased erosion and flooding in coastal areas, and decreased availability of clean drinking water. These impacts could result in the displacement of hundreds of millions of people, increased morbidity, and irreversible damages to critical life-support systems within the environment (IPCC 2007).

Economists use the social cost of carbon to estimate the value of changes in greenhouse gas emissions. The social cost of carbon represents "the full global cost today of emitting an incremental unit of carbon at some point of time in the future, and it includes the sum of the global cost of the damage it imposes on the entire time it is in the atmosphere." (Shaw 2009) There are currently over 200 different estimates of the social cost of carbon. One review of the literature found values ranging from about $7 to $111 per ton of carbon dioxide equivalent ($2007) (Shaw 2009). Another analysis suggests increasing the social cost of carbon, in real terms, by 2–3 percent per year to reflect the rising damages from climate change (Nordhaus 2008).

California's cap-and-trade system for carbon provides one such estimate of the social cost of carbon. The cap-and-trade system, which took effect January 1, 2012, allots credits through auctions. The second such auction on February 19, 2013 elicited bids that ranged from $10.71-$50.01, with a mean and median price of $14.71 and $12.56, respectively (California Air Resources Board 2012). The cap-and-trade market, however, only applies to large producers of carbon and producers are allowed to offset up to 8 percent of carbon emissions.[27] Thus, while this range of costs for carbon is well within the broader range of costs, this market is not the appropriate mechanism for determining the cost of carbon beyond the cost for large producers.

For this analysis, we use a value of $13 per ton of carbon dioxide equivalent sequestered to represent the social cost of carbon. We inflate this value by 2.5 percent per year, in real terms, to reflect the rising damages from climate change. The annual, undiscounted value of this benefit is therefore $10.72. Given the annual probability of failure, the annual undiscounted value of this benefit is $2.14.

**Timing and duration.** Project proponents expect to complete construction and repairs of the tank by 2015. We therefore assume benefits related to avoided costs associated with reduced energy use begin to accrue in 2016. This benefit would persist until the tank likely would have failed, by 2017.

**Beneficiaries.** The beneficiaries of this benefit are all residents of California.

**Sources of uncertainty.** The main source of uncertainty surrounding the value of this benefit is the probability of catastrophic failure of the roof. There is strong reason to believe the roof will fail within 5 years, if not sooner. If the roof fails before 2017, the district would not run the fan anymore, and our benefit estimate would diminish slightly (the difference between running the fan to 2016 or 2017. If the true cost of carbon dioxide lies closer to the upper or lower end of the range we presented above, our unit value would represent an under or overestimate.

[27] These projects may currently include, and may only include forestry, urban forestry, dairy manure digesters, and the destruction of ozone depleting substances. California Environmental Protection Agency - Air Resources Board. Air Resources Board sets stage for carbon offset projects. December 14, 2012.

## 8. Avoided costs associated with construction of a temporary roof

**Relevant change.** If the roof catastrophically fails, the District expects it could minimize costs by building a temporary roof, keeping the current tank in service to provide non-potable or questionably-potable water during construction of a replacement tank. This would involve removing the metal roof panels and upper truss components and covering the joists spanning the 35 X 52 foot perimeter with sheets of plywood and tarps.

**Evidence for demand and value.** The District estimates the total, undiscounted cost of construction of a temporary roof to bring the water supply in service is $6,500. This includes $5,000 for materials, assuming 35 sheets of plywood at a cost of $35 each and three 20'x40' tarps at cost of $100 each. Labor would cost an additional $5,000, assuming the construction would require a 4-person work crew and some equipment for five days. Given the annual probability of failure, the annual undiscounted value of this benefit is $1,300.

**Timing and duration.** Project proponents expect to complete construction and repairs by 2015. We therefore assume benefits related to avoided costs associated with catastrophic failure of the tank begin to accrue in 2016. The outside lifespan of the roof is 5 years. These benefits would persist until the tank would have failed, at the latest by 2017.

**Beneficiaries.** The beneficiaries of this benefit are the Westhaven CSD and its ratepayers. Westhaven CSD is entirely within a severely disadvantaged community.

**Sources of uncertainty.** The main source of uncertainty surrounding the value of this benefit is the probability of catastrophic failure of the roof. There is strong reason to believe the roof will fail within 5 years, if not sooner. The roof has exceeded its lifespan and the deterioration of the trusses is such that a catastrophic event such as an earthquake or heavy winds could cause the roof to collapse. If the tank's annual probability of failure is greater than 20 percent, we have underestimated the true cost of this benefit, if it is less than 20 percent, we have overestimated it.

## 9. Avoided costs associated with construction of a permanent replacement roof

**Relevant change.** If the roof fails, the District would have to disinfect the tank, replace the lining of the tank, and install a new roof on it.

**Evidence for demand and value.** Project proponents estimate the cost of disinfecting the tank are $5,000 and replacing the lining and installing a new roof would cost approximately $150,000. The total, undiscounted value of this benefit is therefore $155,000.

**Timing and duration.** Project proponents expect to complete construction and repairs by 2015. We therefore assume benefits related to avoided costs associated with catastrophic failure of the tank begin to accrue in 2016. The outside lifespan of the roof is 5 years. To reduce the risk

that we overestimate this benefit, we place the entire value of this avoided cost at the end of the 5 year time frame, in 2017.

**Beneficiaries.** The beneficiaries of this benefit are the Westhaven Community Services District and its ratepayers.

**Sources of uncertainty.** The main source of uncertainty surrounding the value of this benefit is the probability of catastrophic failure of the roof. There is strong reason to believe the roof will fail within 5 years, if not sooner. The roof has exceeded its lifespan and the deterioration of the trusses is such that a catastrophic event such as an earthquake or heavy winds could cause the roof to collapse. If the tank's annual probability of failure is greater than 20 percent, we have underestimated the true cost of this benefit, if it is less than 20 percent, we have overestimated it.

Table 15.1-215 – Annual Benefit: Avoided Cost of Issuing Boil Water Notice
(All benefits should be in 2012 dollars)

Project: 215 - Westhaven Community Services District, Water Tank

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Abated chance of issuing boil notice | Reduced probability | 0% | 0% | 0% | $ 300.00 | $ - | 1.000 | $ - |
| 2013 | Abated chance of issuing boil notice | Reduced probability | 0% | 0% | 0% | $ 300.00 | $ - | 0.943 | $ - |
| 2014 | Abated chance of issuing boil notice | Reduced probability | 0% | 20% | 20% | $ 300.00 | $ 60.00 | 0.890 | $ 53 |
| 2015 | Abated chance of issuing boil notice | Reduced probability | 0% | 20% | 20% | $ 300.00 | $ 60.00 | 0.840 | $ 50 |
| 2016 | Abated chance of issuing boil notice | Reduced probability | 0% | 20% | 20% | $ 300.00 | $ 60.00 | 0.792 | $ 48 |
| 2017 | Abated chance of issuing boil notice | Reduced probability | 0% | 20% | 20% | $ 300.00 | $ 60.00 | 0.747 | $ 45 |
| | | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | $ 196 |

Comments: In the event of roof failure, the cost of issuing a notice for the population to boil their water would be $300. Roof failure is likely to happen at some point in the next 5 years, which equates to a 20% annual probability of having to issue the boil water notice.

Table 15.2-215 – Annual Benefit: Bottled Water Purchases
(All benefits should be in 2012 dollars)

Project: 215 - Westhaven Community Services District, Water Tank

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Avoided Bottle Water Purchases | Reduced probaility | 0% | 0% | 0% | $ 162,000.00 | $ - | 1.000 | $ - |
| 2013 | Avoided Bottle Water Purchases | Reduced probaility | 0% | 0% | 0% | $ 162,000.00 | $ - | 0.943 | $ - |
| 2014 | Avoided Bottle Water Purchases | Reduced probaility | 0% | 0% | 0% | $ 162,000.00 | $ - | 0.890 | $ - |
| 2015 | Avoided Bottle Water Purchases | Reduced probaility | 0% | 20% | 20% | $ 162,000.00 | $ 32,400.00 | 0.840 | $ 27,204 |
| 2016 | Avoided Bottle Water Purchases | Reduced probaility | 0% | 20% | 20% | $ 162,000.00 | $ 32,400.00 | 0.792 | $ 25,664 |
| 2017 | Avoided Bottle Water Purchases | Reduced probaility | 0% | 20% | 20% | $ 162,000.00 | $ 32,400.00 | 0.747 | $ 24,211 |
| | | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | $ 77,079 |

Comments:In the event of roof failure, the cost of purchasing bottled water for all customers would be $162,000 ($1/bottle/person/day X 1 bottle X 450 people X 6 months X 30 days) . Roof failure is likely to happen at some point in the next 5 years, which equates to a 20% annual probability of having to purchase bottled water.

| Table 15.3-215 – Annual Benefit: Avoided Costs of Flushing the Water System<br>(All benefits should be in 2012 dollars)<br>Project: 215 - Westhaven Community Services District, Water Tank | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
| Year | Type of Benefit | Measure of Benefit (Units) | Without Project | With Project | Change Resulting from Project (e) – (d) | Unit $ Value | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Flushing district and customers' water heaters | Reduced probaility | 0% | 0% | 0% | $ 60,000.00 | $ - | 1.000 | $ - |
| 2013 | Flushing district and customers' water heaters | Reduced probaility | 0% | 0% | 0% | $ 60,000.00 | $ - | 0.943 | $ - |
| 2014 | Flushing district and customers' water heaters | Reduced probaility | 0% | 0% | 0% | $ 60,000.00 | $ - | 0.890 | $ - |
| 2015 | Flushing district and customers' water heaters | Reduced probaility | 0% | 20% | 20% | $ 60,000.00 | $ 12,000.00 | 0.840 | $ 10,075 |
| 2016 | Flushing district and customers' water heaters | Reduced probaility | 0% | 20% | 20% | $ 60,000.00 | $ 12,000.00 | 0.792 | $ 9,505 |
| 2017 | Flushing district and customers' water heaters | Reduced probaility | 0% | 20% | 20% | $ 60,000.00 | $ 12,000.00 | 0.747 | $ 8,967 |
| | | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | $ 28,548 |
| Comments: A catastrophic roof failure would require flushing the water heating systems of the district and of each household. Roof failure is likely to happen at some point in the next 5 years, which equates to a 20% annual probability of having to flush the system. | | | | | | | | | |

| Table 15.4-215 – Annual Benefit: Temporary Loss of Water Supply<br>(All benefits should be in 2012 dollars)<br>Project: 215 - Westhaven Community Services District, Water Tank | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
| Year | Type of Benefit | Measure of Benefit (Units) | Without Project | With Project | Change Resulting from Project (e) – (d) | Unit $ Value | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Avoided cost of travel to laundry and shower | Reduced probaility | 0% | 0% | 0% | $ 2,100.00 | $ - | 1.000 | $ - |
| 2013 | Avoided cost of travel to laundry and shower | Reduced probaility | 0% | 0% | 0% | $ 2,100.00 | $ - | 0.943 | $ - |
| 2014 | Avoided cost of travel to laundry and shower | Reduced probaility | 0% | 0% | 0% | $ 2,100.00 | $ - | 0.890 | $ - |
| 2015 | Avoided cost of travel to laundry and shower | Reduced probaility | 0% | 20% | 20% | $ 2,100.00 | $ 420.00 | 0.840 | $ 353 |
| 2016 | Avoided cost of travel to laundry and shower | Reduced probaility | 0% | 20% | 20% | $ 2,100.00 | $ 420.00 | 0.792 | $ 333 |
| 2017 | Avoided cost of travel to laundry and shower | Reduced probaility | 0% | 20% | 20% | $ 2,100.00 | $ 420.00 | 0.747 | $ 314 |
| | | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | $ 999 |
| Comments: A catastrophic roof failure would require flushing the water heating systems of the district and of each household. Roof failure is likely to happen at some point in the next 5 years, which equates to a 20% annual probability. The unit value is derived multiplying a one time $10 travel to and service fee at the nearest laundromat for each of the 210 households. | | | | | | | | | |

Table 15.5-215 – Annual Benefit: Reduced Water Treatment
(All benefits should be in 2012 dollars)

Project: 215 - Westhaven Community Services District, Water Tank

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Reduced water treatment costs | Avoided Cost | 0 | 0 | 0 | $ 1,000.00 | $ - | 1.000 | $ - |
| 2013 | Reduced water treatment costs | Avoided Cost | 0 | 0 | 0 | $ 1,000.00 | $ - | 0.943 | $ - |
| 2014 | Reduced water treatment costs | Avoided Cost | 0 | 0 | 0 | $ 1,000.00 | $ - | 0.890 | $ - |
| 2015 | Reduced water treatment costs | Avoided Cost | 0 | 0 | 0 | $ 1,000.00 | $ - | 0.840 | $ - |
| 2016 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.792 | $ 792 |
| 2017 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.747 | $ 747 |
| 2018 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.705 | $ 705 |
| 2019 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.665 | $ 665 |
| 2020 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.627 | $ 627 |
| 2021 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.592 | $ 592 |
| 2022 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.558 | $ 558 |
| 2023 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.527 | $ 527 |
| 2024 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.497 | $ 497 |
| 2025 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.469 | $ 469 |
| 2026 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.442 | $ 442 |
| 2027 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.417 | $ 417 |
| 2028 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.394 | $ 394 |
| 2029 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.371 | $ 371 |
| 2030 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.350 | $ 350 |
| 2031 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.331 | $ 331 |
| 2032 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.312 | $ 312 |
| 2033 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.294 | $ 294 |
| 2034 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.278 | $ 278 |
| 2035 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.262 | $ 262 |
| 2036 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.247 | $ 247 |
| 2037 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.233 | $ 233 |
| 2038 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.220 | $ 220 |
| 2039 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.207 | $ 207 |
| 2040 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.196 | $ 196 |
| 2041 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.185 | $ 185 |
| 2042 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.174 | $ 174 |
| 2043 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.164 | $ 164 |
| 2044 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.155 | $ 155 |
| 2045 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.146 | $ 146 |
| 2046 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.138 | $ 138 |
| 2047 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.130 | $ 130 |
| 2048 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.123 | $ 123 |
| 2049 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.116 | $ 116 |
| 2050 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.109 | $ 109 |
| 2051 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.103 | $ 103 |
| 2052 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.097 | $ 97 |
| 2053 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.092 | $ 92 |
| 2054 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.087 | $ 87 |
| 2055 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.082 | $ 82 |
| 2056 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.077 | $ 77 |
| 2057 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.073 | $ 73 |
| 2058 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.069 | $ 69 |
| 2059 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.065 | $ 65 |
| 2060 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.061 | $ 61 |
| 2061 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.058 | $ 58 |
| 2062 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.054 | $ 54 |
| 2063 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.051 | $ 51 |
| 2064 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.048 | $ 48 |
| 2065 | Reduced water treatment costs | Avoided Cost | 0 | 1 | 1 | $ 1,000.00 | $ 1,000.00 | 0.046 | $ 46 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 13,234 |

Comments: The existing tank volume requires more cholorine to achieve appropriate contact time. With the additional tank, the district would reduce the amount of chlorine it has to purchase to ensure safe drinking water. This benefit would persist for the life of the new tank, approximately 50 years.

| Table 15.6-215 – Annual Benefit: Reduction of Energy Usage<br>(All benefits should be in 2012 dollars)<br>Project: 215 - Westhaven Community Services District, Water Tank | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
| Year | Type of Benefit | Measure of Benefit (Units) | Without Project | With Project | Change Resulting from Project (e) – (d) | Unit $ Value | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Reduced energy expenditure | Probability | 20% | 20% | 0% | $ 365.00 | $ - | 1.000 | $ - |
| 2013 | Reduced energy expenditure | Probability | 20% | 20% | 0% | $ 365.00 | $ - | 0.943 | $ - |
| 2014 | Reduced energy expenditure | Probability | 20% | 20% | 0% | $ 365.00 | $ - | 0.890 | $ - |
| 2015 | Reduced energy expenditure | Probability | 20% | 20% | 0% | $ 365.00 | $ - | 0.840 | $ - |
| 2016 | Reduced energy expenditure | Probability | 20% | 100% | 80% | $ 365.00 | $ 292.00 | 0.792 | $ 231 |
| 2017 | Reduced energy expenditure | Probability | 20% | 100% | 80% | $ 365.00 | $ 292.00 | 0.747 | $ 218 |
| | | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | $ 449 |
| Comments: The district pays to run a dehumidifying fan to protect against further rot in the roof trusses. This cost would persist until the roof would have failed. Roof failure is likely to happen at some point in the next 5 years. This means that without the project, there is a 20% annual probability that the tank would fail and the district would install a new tank that would then confer this benefit. With the project, this benefit materializes in 2015. The annual electricity cost to run the fan is $365. | | | | | | | | | |

| Table 15.7-215 – Annual Benefit: Reduction of Carbon Emissions<br>(All benefits should be in 2012 dollars)<br>Project: 215 - Westhaven Community Services District, Water Tank | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| (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) | Reduction of C02E - tons | Unit $ Value | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Carbon Sequestration | Probability | 20% | 20% | 0% | 0.82 | $ 13.00 | $ - | 1.000 | $ - |
| 2013 | Carbon Sequestration | Probability | 20% | 20% | 0% | 0.82 | $ 13.33 | $ - | 0.943 | $ - |
| 2014 | Carbon Sequestration | Probability | 20% | 20% | 0% | 0.82 | $ 13.66 | $ - | 0.890 | $ - |
| 2015 | Carbon Sequestration | Probability | 20% | 20% | 0% | 0.82 | $ 14.00 | $ - | 0.840 | $ - |
| 2016 | Carbon Sequestration | Probability | 20% | 100% | 80% | 0.82 | $ 14.35 | $ 9.41 | 0.792 | $ 7 |
| 2017 | Carbon Sequestration | Probability | 20% | 100% | 80% | 0.82 | $ 14.71 | $ 9.65 | 0.747 | $ 7 |
| | | | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | $ 15 |
| Comments: The electricity use to run the fan produces carbon, which represents a cost to society. This cost would persist until the roof would have failed. Roof failure is likely to happen at some point in the next 5 years. This means that without the project, there is a 20% annual probability that the tank would fail and the district would install a new tank that would then confer this benefit. With the project, this benefit materializes in 2015. The avoided cost of emitting CO2E is $13 per ton, increasing by 2.5 percent per year in real terms. | | | | | | | | | | |

| Table 16.1-215 – Annual Avoided Costs: Construction of Temporary Roof<br>(All avoided costs should be in 2012 dollars)<br>Project: 215 - Westhaven Community Services District, Water Tank | | | | | | |
|---|---|---|---|---|---|---|
| | Costs | | | | Discounting Calculations | |
| (a) | (b) | (c) | (d) | (e) | (f) | (g) |
| Year | Alternative (Avoided Project Name): _____<br>Avoided Project Description: | | | | Discount Factor | Discounted Costs (e) x (f) |
| | Avoided Capital Costs | Avoided Replacement Costs | Avoided Operations and Maintenance Costs | Total Cost Avoided for Individual Alternatives (b) + (c) + (d) | | |
| 2012 | | $ - | | $ - | 1.000 | $ - |
| 2013 | | $ - | | $ - | 0.943 | $ - |
| 2014 | | $ - | | $ - | 0.890 | $ - |
| 2015 | | $ - | | $ - | 0.840 | $ - |
| 2016 | | $ - | | $ - | 0.792 | $ - |
| 2017 | | $ 325.00 | | $ 325.00 | 0.747 | $ 243 |
| | | | | | Total Present Value of Discounted Costs (Sum of Column (g)) | $ 243 |
| | | | | | (%) 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) | $ 243 |
| Comments: This represents the avoided cost to construct a temorary roof over the tank when the tank roof fails. | | | | | | |

| Table 16.2-215 – Annual Costs Avoided: Permanent Replacement Roof<br>(All avoided costs should be in 2012 dollars)<br>Project: 215 - Westhaven Community Services District, Water Tank | | | | | | |
|---|---|---|---|---|---|---|
| | Costs | | | | Discounting Calculations | |
| (a) | (b) | (c) | (d) | (e) | (f) | (g) |
| Year | Alternative (Avoided Project Name): _____<br>Avoided Project Description: | | | | Discount Factor | Discounted Costs (e) x (f) |
| | Avoided Capital Costs | Avoided Replacement Costs | Avoided Operations and Maintenance Costs | Total Cost Avoided for Individual Alternatives (b) + (c) + (d) | | |
| 2012 | | $ - | | $ - | 1.000 | $ - |
| 2013 | | $ - | | $ - | 0.943 | $ - |
| 2014 | | $ - | | $ - | 0.890 | $ - |
| 2015 | | $ - | | $ - | 0.840 | $ - |
| 2016 | | $ - | | $ - | 0.792 | $ - |
| 2017 | | $ 155,000.00 | | $ 155,000.00 | 0.747 | $ 115,825 |
| | | | | | Total Present Value of Discounted Costs (Sum of Column (g)) | $ 115,825 |
| | | | | | (%) 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) | $ 115,825 |
| Comments: This represents the cost to repair the tank roof and disinfect the tank when the tank roof fails. The district would have to do this when it ultimately fails. Although we estimate there is a 20 percent annual probability of the tank failing over the next five years, we place this avoided cost in 2017 to reduce the risk that we're overestimating the benefit. | | | | | | |

## Section D3. Project Costs

The present value of the project's costs, which would occur between 2012 and 2014, is $367,405 in 2012 dollars, discounted at a 6-percent annual rate. These costs would fund labor, planning, equipment, and materials necessary to implement the project.[28]

| Table 19-215 – Annual Costs of Project<br>(All costs should be in 2012 Dollars)<br><br>Project: 215 - Westhaven Community Services District, Water Tank | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Initial Costs<br>Grand Total Cost from Table 7<br>(row (i), column (d)) | Adjusted Grant Total Cost | Annual Costs (2) | | | | | | Discounting Calculations | |
| | | | Admin | Operation | Maintenance | Replacement | Other | Total Costs<br>(a) +…+ (g) | Discount Factor | Discounted Project Costs<br>(h) x (i) |
| Year | (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
| 2012 | $ 60,000.00 | | | | | | | $ 60,000.00 | 1.000 | $ 60,000 |
| 2013 | $ 15,000.00 | | | | | | | $ 15,000.00 | 0.943 | $ 14,151 |
| 2014 | $ 329,500.00 | | | | | | | $ 329,500.00 | 0.890 | $ 293,254 |
| Total Present Value of Discounted Costs (Sum of column (j))<br>Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries | | | | | | | | | | $ 367,405 |
| Comments: | | | | | | | | | | |

[28] We have distributed the costs outlined Table 7 across the project's implementation period based on the expected timing and phasing described in the Work Plan. Actual distribution of costs during this period may differ somewhat.

## 316. *California Land Stewardship Institute*, Fish Friendly Farming and Fish Friendly Ranching Environmental Certification in the Russian, Navarro, and Gualala River Watersheds

### Conditions Without the Project

California Land Stewardship implements the Fish Friendly Farming (FFF) and Fish Friendly Ranching (FFR) Environmental Certification Programs to increase the environmental values and functions on agricultural and grazing lands. The FFF program has implemented improvements on over 120,000 acres in five counties in conjunction with about 300 private owners in Sonoma, Solano, Napa and Mendocino Counties.

Grazing and irrigated agriculture in the Gualala, Russian and Navarro River watersheds generate fine sediment that erodes from pastures, cultivated land, roads and creeks. They may also generate chemical runoff from fertilizer and pesticide applications. Agricultural land uses also may contribute to higher water temperatures. Sediment, chemical runoff, and increased water temperatures reduce the quality of habitat in salmon-bearing streams.

Many of the agricultural lands in the Russian, Gualala and Navarro watersheds are owned and farmed by individuals with low incomes and limited means to implement the industry's best practices to minimize environmental damage to salmon-bearing streams. It is unlikely without the project that these operations would be able to invest in the necessary education and equipment to improve their farming and grazing practices. If future regulations require farmers and ranchers to meet more stringent requirements, they may not be able to maintain their operations at current levels, reducing employment opportunities for residents of disadvantaged communities.

### Conditions With the Project

With the project, the program would provide implementation funds for an additional 20,000 acres in the Russian, Gualala, and Navarro River watersheds for both grazing land and irrigated agriculture. The program would focus on lands in disadvantaged communities.

Under the program, CLSI and the participating farmers produce and implement a detailed, comprehensive Farm Conservation Plan using the FFF/FFR template. The plan includes the following activities:

- A review of all potential sources of fine sediment generation and delivery, including grazing and farm lands, roads, creek channels, and ditch erosion.
- An inventory of the potential for chemical runoff, all water supply facilities and their effects on habitat, and other features.
- An implementation of best management practices (BMPs). Some of these include: sediment source control, road and gully repair, water conservation and water efficiency, enhancement of riparian corridors through removal of invasive species and revegetation, and widening of riparian corridors.

For each of these BMPs, the farmer contributes part of the costs of implementation, while funding from CLSI and the FFF program contributes the remaining portion. For each benefit listed below, therefore, we scale the portion of benefits from the project by the percent of costs attributable to funding under this application.

Upon completion, the National Marine Fisheries Service, the Region 1 Water Quality Control Board, and the County Agricultural Commissioner certify the site. In order to maintain the certification, the rancher/grower must be recertified every five years.

## Section D2. Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient information to quantify in monetary terms does not exist. Table 12-316 identifies the non-monetized benefits the project would likely generate.

Table 12-316 – Non-monetized Benefits Checklist
*California Land Stewardship Institute*, Fish Friendly Farming and Fish Friendly Ranching Environmental Certification in the Russian, Navarro, and Gualala River Watersheds

| *No.* | *Will the proposal…* | *Response*[1] |
|---|---|---|
| | **Community/Social Benefits** | |
| 1 | Provide education or technology benefits? Enhanced human and social capital | Yes |
| 2 | Provide social recreation or access benefits? | No |
| 3 | Help avoid, reduce or resolve various public water resources conflicts? Increased water supply from conservation | Yes |
| 4 | Promote social health and safety? | No |
| 5 | Have other social benefits? | No |
| | **Environmental Stewardship Benefits** | |
| 6 | Benefit wildlife or habitat in ways that were not quantified in Attachment 7? Passive Use Value Associated with Salmon Habitat Enhancement | Yes |
| 7 | Improve water quality in ways that were not quantified in Attachment 7? Reduced costs of future TMDL compliance | Yes |
| 8 | Reduce net emissions in ways that were not quantified in Attachment 7? Enhanced carbon sequestration | Yes |
| 9 | Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4? | No |
| | **Sustainability Benefits** | |
| 10 | Improve the overall, long-term management of California groundwater resources? | No |
| 11 | Reduce demand for net diversions for the regions from the Delta? | No |
| 12 | Provide a long-term solution in place of a short-term one? | No |
| 13 | Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources? | No |
| 14 | Improve water supply reliability in ways not quantified in Attachment 7? | No |
| 15 | Other (If the above listed categories do not apply, provide non-monetized benefit description)? | No |

Notes: [1] A "no" response may mean the project does not produce this benefit, or it may mean the benefit is already quantified in Attachment 7, or monetized directly under Section D3 below.

## 1. Provide education or technology benefits: Enhanced human and social capital

**Relevant change.** The project would enhance the skills and knowledge of the farmers who participate in the FFF program through the comprehensive Farm Conservation Plans and the program's additional 24 workshops. These programs would build their expertise on best management practices, in some cases improving the economic efficiency and cost-effective management of farmland.

**Evidence for demand and value.** Drawing a cause-and-effect relationship between educational efforts and specific water-supply or water-quality outcomes is difficult, but there are several ways the project could produce tangible economic benefits through workshops:

- Increasing farmers' skills and understanding of technology may translate directly into increased earnings as the farmers develop practices that are more cost-effective, efficient, productive, or all three (depending on the mechanism this may or may not be a benefit from society's perspective).
- Bringing farmers together in a workshop environment may strengthen their relationships with each other, allowing them to transfer skills and information more efficiently in the future, which could lead to additional water-quality or environmental benefits achieved without additional outside support or effort.
- The opportunity to participate in a workshop may improve farmers' well-being directly, by providing an opportunity to do something they enjoy and would be willing to pay for, with or without the project.

It is impossible to quantify the value of this benefit in economic terms, although we likely have captured the indirect benefits on water-quality and the environment in some of the monetized effects, described below. The effects related to human and social capital building may be small, but subtle changes arising from education should not be dismissed. For example, interactions among community members in the context of this project may be brief, compared to all of the other interactions that go on day-to-day, but the effect combined with all of the other small effects may accumulate into measurable improvements in quality of life in the long run.

**Timing and duration.** The project would begin conferring benefits related to education and technology when CLSI begins conducting the workshops, likely in February of 2014. Assuming the participating farmers continue to use the knowledge they gain from the program throughout their careers, the project would confer these benefits over the professional lifetimes of each of the farmers.

**Beneficiaries.** The beneficiaries of this benefit are the growers in the Russian, Gualala and Navarro River watersheds who participate in the consultations, assessments, and implementation assistance, as well as the broader community of farmers who attend the workshops. These growers represent approximately 100 farms, of which many will be disadvantaged community members, who would not otherwise be able to afford to acquire these skills and knowledge.

**Sources of Uncertainty.** Without detailed program evaluations of educational efforts, it is difficult to predict when particular benefits to education, outreach, and public engagement activities might emerge and what their impact might be. The peer-reviewed literature on this topic is scant, and results from one study may not be broadly transferrable to other programs because specifics of program design, delivery, and audience may affect the level of benefits achieved.

### 3. Help avoid, reduce, or resolve various public water conflicts: Increased water supply from conservation

By reducing water use through water conservation BMP implementation, the project would ensure additional water is available for environmental beneficial uses, reducing potential future water conflicts. For a full description of the process by which the project confers a benefit related to increased instream flows, see monetized benefit #1 (increased instream flows for environmental purposes), below.

### 6. Benefit wildlife or habitat: Passive Use Value Associated with Salmon Habitat Enhancement

**Relevant change.** The project would benefit wildlife and habitat by removing invasive species, increasing instream flows, reducing sediment loading from numerous sources, revegetating and, if needed, widening creek corridors to allow for natural geomorphic processes. We quantify the benefits related to reduced sediment delivery in monetized benefit #2 and enhanced riparian habitat in monetized benefit #3. Some of these activities may also result in increased populations of special-status fish from improved fish passage. Data are unavailable to quantify the change in salmon populations, however.

**Evidence for demand and value.** Individuals derive value from increases in salmon and steelhead populations in two ways: some (e.g., recreational anglers and commercial fishermen) directly interact with salmon and steelhead populations and derive benefit by catching and consuming the fish, others (including some from the former group) derive value from the fish solely based on the salmon and steelhead's existence. Studies have shown that regardless of direct interaction with fish populations, many Californians hold a positive willingness to pay to ensure the long-term survival of salmon and steelhead (Pate and Loomis 1997).

Several studies have attempted to estimate the passive use value of increases in salmon and steelhead populations among households in California and neighboring states. Passive use value, in this case, refers to the benefit individuals derive from knowing that healthy salmon and steelhead populations exist, regardless of their intent to directly interact with salmon and steelhead through fishing or some other means. In general, these studies have estimated households' average willingness to pay to implement policies that would increase salmon and steelhead populations. At the per fish level, these studies reveal that households are willing to pay only fractions of a penny for increases in salmon populations. When summed across a

region, however, the total value Californians are willing to pay for increases in fish populations is considerable. Applying the results of two studies that have estimated willingness to pay values for increases in salmon and steelhead populations suggest that Californians, in total, would be willing to pay between $497 (Olsen, Richards, and Scott 1991) and $4,351 (Loomis 1996) per fish.[29]

**Timing and duration.** The project would implement BMPs within three years of the project start date, January 2014. We therefore assume the project would begin to confer benefits related to enhanced habitat in 2017. These benefits would last at least for the duration that the certification would last. It is likely that many farmers would continue to practice the BMPs, and many of the BMPs implemented during the first certification period would continue to provide benefits in the long-run, at least 50 years.

**Beneficiaries.** The beneficiaries of this benefit are the people of California who value the continued existence of aquatic wildlife and habitat, particularly critical habitat for Chinook salmon, Coho salmon, and steelhead.

**Sources of Uncertainty.** Uncertainty surrounds the degree to which the project would produce increases in salmon populations. A lack of data about baseline populations and lack of understanding about how the BMPs the projects would support would directly influence salmon populations underlie this uncertainty. There is also uncertainty associated with the economic value of avoiding losses to fish populations. The results from the studies listed above depend crucially on survey methodology and public perceptions on the current state of salmonid populations. Both studies listed above were conducted in the Pacific Northwest, which may over or underestimate Californians' willingness to pay for salmon.

### 7. Improve water quality: Reduced costs of future TMDL compliance

**Relevant change.** The project would reduce bacterial contamination by reducing the number of livestock using streams. Data are unavailable to estimate the amount, location, or timing of these reductions related to this project, but past experience with these BMPs suggest they would diminish the total load and potential risk of water contamination.

**Evidence for demand and value.** FFF is a recognized compliance program for TMDLs for fine sediment and excessive water temperatures, the primary listed pollutants in Sonoma and Mendocino counties. To the extent that this project reduces the costs for downstream users, either by lowering the levels of pollutants they must address prior to using the water, or lowering the baseline load of pollutants dischargers must treat before discharging water back to the river, it would produce benefits. The project may also have cumulative effects, combined with other efforts to reduce pollutants, that may affect the overall regulatory framework and associated compliance costs for users of the Gualala, Russian and Navarro River watersheds.

[29] This is based on about 12.4 million households in California (U.S. Census Bureau 2007-2011).

**Timing and duration.** The project would implement BMPs within three years of the project start date, January 2014. We therefore assume the project would begin to confer benefits related to enhanced habitat in 2017. These benefits would last at least for the duration that the certification would last. It is likely that many farmers would continue to practice the BMPs, and many of the BMPs implemented during the first certification period would continue to provide benefits in the long-run, at least 50 years.

**Beneficiaries.** Taxpayers, property owners, water users, and other stakeholders in the Gualala, Russian and Navarro River watersheds..

**Sources of Uncertainty.** The economic value associated with this benefit, while not quantifiable, is contingent on whether this project would reduce pollutants below a level that translates into cost savings. This is unlikely, but there is likely value associated with the project's contribution to an overall effort to reduce contamination below levels that trigger regulation and impose costs on other dischargers.

### 8. Reduce net emissions: Enhanced carbon sequestration

**Relevant change.** The project would increase carbon sequestration by requiring participating growers to use cover crops on bare areas on their properties. Cover crops increase soil organic matter content and soil productivity, sequestering carbon. Participating farmers will also replant native woody vegetation along their waterways. Data are unavailable to quantify the amount of carbon that these improvements would sequester.

**Evidence for demand and value.** The International Panel on Climate Change has identified anthropogenic greenhouse gas emissions as the main contributor of global warming and climate change. Carbon dioxide emissions have received the most attention as they account for the majority of these emissions – 77 percent in 2004 (IPCC 2007). Expected impacts of climate change include decreased ecosystem resilience, increased extinction rates, fluctuations in cropland productivity, increased erosion and flooding in coastal areas, and decreased availability of clean drinking water. These impacts could result in the displacement of hundreds of millions of people, increased morbidity, and irreversible damages to critical life-support systems within the environment (IPCC 2007).

Economists use the social cost of carbon to estimate the value of changes in greenhouse gas emissions. The social cost of carbon represents "the full global cost today of emitting an incremental unit of carbon at some point of time in the future, and it includes the sum of the global cost of the damage it imposes on the entire time it is in the atmosphere." (Shaw 2009) There are currently over 200 different estimates of the social cost of carbon. One review of the literature found values ranging from about $7 to $111 per ton of carbon dioxide equivalent ($2007) (Shaw 2009). Another analysis suggests increasing the social cost of carbon, in real terms, by 2–3 percent per year to reflect the rising damages from climate change (Nordhaus 2008).

**Timing and duration.** The project would implement BMPs within three years of the project start date, January 2014. We therefore assume the project would begin to confer benefits related to enhanced habitat in 2017. These benefits would last at least for the duration that the certification would last. It is likely that many farmers would continue to practice the BMPs, and many of the BMPs implemented during the first certification period would continue to provide benefits in the long-run, at least 50 years.

**Beneficiaries.** The beneficiaries of this benefit are all residents of California.

**Sources of Uncertainty.** All sources of uncertainty surrounding the estimate of increased carbon dioxide sequestered would also affect the economic benefit estimate described here. In particular, the estimate of carbon sequestration does not account for the expected mortality rates of the planted trees, the age of the trees at planting, or other environmental factors that could effect the total amount of sequestered carbon. To the extent that these factors reduce the amount of carbon sequestered by the project, we are overestimating the value of the project. However, because we are using a low estimate of the value of the social cost of carbon, it is likely that we are underestimating the real value of carbon sequestration from the project in the long run.

## Section D3. Monetized Benefits Analysis

The present value of the monetized benefits in 2012 dollars, discounted annually at 6 percent over the relevant lifespan of each component of the project (described for each benefit below), is $3,786,899. The calculations for each monetized benefit are shown in Tables 15-1, 15-2, and 15-3 at the end of this section.

### 1. Increased instream flows for environmental purposes

**Relevant change.** All FFF Farm Plans include information related to water use for irrigation and for frost control. Certified properties must include irrigation and frost control water use rates, whether they could potentially use wind machines, and whether they have valves in between each grape varietal and other water conservation BMPs. Project proponents estimate the average farm conducting improvement with frost control BMPs will reduce diversions by 100,000 gallons per year. With approximately 100 participating farms, the annual physical benefit associated with increased instream flows for environmental purposes is 307 acre-feet per year.

**Evidence for demand and value.** An economic analysis of water transactions between 1990 and 2003 found that the median price paid in California to acquire water for environmental purposes was $77 per acre-foot (Brown 2007). We use this value, to measure the value of additional water for instream flows to enhance ecosystems, water-quality, and salmon populations for all projects that would generate this benefit. The median value is a better estimator of the true willingness to pay for water supplies than the mean, insofar as some transactions exhibiting

extreme values are distorted by political and other factors. We estimate the annual, undiscounted value of this benefit is $23,639.

**Timing and duration.** The project would implement BMPs progressively over the three year program period (2014-2017). We assume the benefits would accrue in equal parts each year, reaching full implementation in 2017. The benefits would last at least for 10 years. It is likely that many farmers would continue to practice the BMPs, and many of the BMPs implemented during the first certification period would continue to provide benefits in the long-run, at least 50 years.

**Beneficiaries.** The beneficiaries of this benefit would include several groups of stakeholders including commercial fishermen and recreational anglers in both marine and freshwater fisheries, and the general public insofar as they value an increase in fish populations regardless of any potential future direct use or exposure to the impacted fish populations. It would also benefit other recreational users of water, such as kayakers and wildlife watchers, Californians who place a non-use value on maintaining sufficient instream flows for environmental purposes, and other water users, such as irrigators, who bear increased regulatory pressure and costs to increase instream flows by reducing their own use of water.

**Sources of Uncertainty.** The value we derive from the findings of Brown (2007) embodies the uncertainty inherent in the individual study as well as from applying results from past research to future conditions. There is, however, no obvious reason to conclude that the estimate systematically overestimates the true marginal value of water for environmental purposes in the North Coast region. As human populations and incomes grow in California, the marginal value of wild salmonid populations and other benefits derived from instream flows for environmental purposes is likely to increase, as will the value of stream flows that support their continued existence. Because we found no reliable estimate of the rate of increase, we did not fold this increase into our estimates. For these reasons, it seems reasonable to conclude that the value estimates we apply in this analysis underestimate—perhaps substantially—the true value of future increases in water supplies that would result from the projects. The recent implementation of AB 2121, the state's instream flow policy that applies to the North Coast region, creates additional regulatory pressure for maintaining or increasing instream flows, potentially further increasing the demand and associated willingness to pay for instream flows above these estimates. Finally, this benefit is likely underestimated to the extent that we do not include instream flow benefits beyond the first 10 years of when the project begins. It is entirely likely that farmers participating in the FFF program would sustain these practices as long as they manage their land.

## 2. Avoided costs associated with reduced sediment

**Relevant change.** FFF projects aim to improve water quality by reducing fine sediment delivery from irrigated agricultural lands and grazing lands with BMPs. They accomplish sediment reduction by reducing soil erosion from roads and livestock trails and incising creek channels,

farmed areas, grazed areas, legacy gullies, and other erosion sites. Project proponents estimate these activities will result in an average sediment load reduction of 4 tons per acre per year. Given the 20,000 additional acres the project would fund, we calculate the total BMP reduction associated with the expanded FFF activities is 80,000 tons per year.

**Evidence for demand and value.** Economic studies have examined and monetized some of the benefits that materialize when excessive sediment does not impair streams, rivers, estuaries, and the marine environment. A study conducted by the U.S. Department of Agriculture identified 13 types of benefits associated with decreasing sediment (Hansen and Ribaudo 2008). For each benefit, the researchers modeled the potential value associated with reducing sediment, per ton, for each county across the country. For our analysis, we apply the average value for the counties in the Russian, Gualala, and Navarro River watersheds, $8.98 per ton, to estimate the benefits derived from the prevention of sediment deposition. Included in this value are the regional benefits associated with the impacts of sediment on:

- Water-based recreation – cleaner fresh water recreation
- Irrigation ditches and channels – reduced cost of removing sediment and aquatic plants from irrigation channels
- Road drainage ditches – less damage to and flooding of roads
- Municipal water treatment – lower sediment-removal costs for water treatment plants
- Flood damage – reduced flooding and damage from flooding
- Marine fisheries – improved catch rates for marine commercial fisheries
- Marine recreational fishing – improved catch rates for marine recreational fishing
- Municipal and industrial water use – reduced damages from salts and minerals dissolved from sediment
- Steam power plants – reduced plant growth on heat exchangers
- Soil productivity – reduced losses in soil productivity
- Dust cleaning – decrease in cleaning due to reduced wind-borne particulates.
- Reservoir services – less sediment in reservoirs
- Navigation – shipping industry avoidance of damages from groundings

The annual undiscounted value of the avoided costs related to sediment reduction is $718,133.

**Timing and duration.** The project would implement BMPs progressively over the three year program period (2014-2017). We assume the benefits would accrue in equal parts each year, reaching full implementation in 2017. The benefits would last at least for 10 years. It is likely that many farmers would continue to practice the BMPs, and many of the BMPs implemented during the first certification period would continue to provide benefits in the long-run, at least 50 years.

**Beneficiaries.** The beneficiaries of this benefit are the wide array of downstream users associated with each of the benefits listed above. To some extent, these beneficiaries include the general public, municipal water treatment operators and their ratepayers, irrigators, recreationalists, downstream property owners, and fishermen.

**Sources of Uncertainty.** All sources of uncertainty surrounding the estimate of reduced sedimentation would also affect the economic benefit estimate described here. For example, the actual rate of sediment deposition is dependent on water year type, sediment yields, location and roughness of the flood prone surface, among other factors. See Attachment 7 for a full description of these biophysical sources of uncertainty.

At least three major factors suggest that the value of sediment we use underestimates the true value of the sediment-reduction benefits. First, the value does not reflect many potential benefits, such as the goods and services derived from potential impacts on wetlands and endangered species. Second, the estimates of sediment erosion that the projects would reduce are based on current sediment erosion rates. Climate change is expected to increase the frequency and intensity of storm events, which would likely increase the rate of sediment erosion absent the projects (Masden and Figdor 2007). If future sediment erosion rates exceed current rates, the without-project sediment erosion is likely to increase, and thus, the expected benefit of each project's sediment control activities is likely to be an underestimate. Third, this estimate does not anticipate increases in value that occur over time. We anticipate that the value of sediment-reduction benefits will increase, relative to the general price index, but have not accounted for this increase in our calculations.

Finally, this benefit is likely underestimated to the extent that we do not include reduced sediment deposition benefits beyond the first 10 years of when the project begins. It is entirely likely that farmers participating in the FFF program would sustain these practices as long as they manage their land.

### 3. Increased or enhanced riparian habitat

**Relevant change.** FFF projects assess and enhance existing riparian habitat by revegetating and widening creek corridors to allow for natural geomorphic processes. Project proponents estimate, based on the averages from their overall program, expansion of the FFF program will enhance 50 to 72 miles of perennial, seasonal, and ephemeral creeks. To reduce the risk that we overestimate this benefit, we use the low-end of this range in our calculations. Assuming the restoration is 20 feet wide, we estimate the project would provide an additional 120 acres of riparian habitat. We assume the existing habitat provides 50 percent functionality, and restoration would fully increase its function as it matures over a 15-year period. Once the restoration reaches year 15, we assume the function would persist for the long-run, at least 50 years.

**Evidence for demand and value.** Data are insufficient to delineate specific impacts of the project's restoration efforts on the ecosystem services provided by this area of riparian habitat. Thus, instead we employ a value that accounts for people's willingness to pay for the flow of goods and services from an acre of forested riparian habitat. In 2009, researchers conducted several meta-analyses estimating various use and nonuse values associated with forestland. In estimating the passive use value of forestland, the researchers compiled data from 23 relevant studies (Chiabai et al. 2009). Their results identify per-acre estimates for passive use values by geographic region and forest biome. For our analysis, we use the passive use value associated with North American forestland in the cool coniferous biome, $125 per acre per year. The annual undiscounted value of the increased riparian habitat is $37,875.

**Timing and duration.** The project would implement BMPs within three years of the project start date, January 2014. We therefore assume the project would begin to confer benefits related to enhanced habitat in 2017. These benefits likely would increase over time, as restoration matures, and would persist over the long run (at least 50 years).

**Beneficiaries.** The beneficiaries of this benefit are the residents nearby and individuals in California who value the continued existence of riparian habitat in the state.

**Sources of Uncertainty.** All sources of uncertainty surrounding the estimate of increased riparian habitat acreage and functionality would also affect the economic benefit estimate described here. The value described above estimates society's total willingness to pay for fully-restored forest land in cool coniferous forests in North America. Insofar as this estimate considers only passive use values, it likely underestimates the total economic value of riparian and other forest-based restoration because direct users of the restored habitat likely are willing to pay more for its restoration. It also likely underestimates the value because, as human populations and incomes grow in California, the marginal value of forest land probably will increase, as will the value of restoration efforts. Because we found no reliable estimate of the rate of increase, we did not fold this increase into our estimates. For these reasons, it seems reasonable to conclude that the value estimates derived in the past underestimate, perhaps substantially, the true value of future increases in fully-restored riparian and other forest habitat.

| Table 15.1-316 – Annual Benefit: Increased Instream Flows<br>(All benefits should be in 2012 dollars)<br>Project: 316 - California Land Stewardship Institute, Fish Friendly Farming and Fish Friendly Ranching Environmental Certification in the Russian, Navarro, and Gualala River Watersheds | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
| Year | Type of Benefit | Measure of Benefit (Units) | Without Project | With Project | Change Resulting from Project (e) – (d) | Unit $ Value | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Increased instream flows | acre-feet | 0 | 0 | 0 | $ 77.00 | $ - | 1.000 | $ - |
| 2013 | Increased instream flows | acre-feet | 0 | 0 | 0 | $ 77.00 | $ - | 0.943 | $ - |
| 2014 | Increased instream flows | acre-feet | 0 | 100 | 100 | $ 77.00 | $ 7,700.00 | 0.890 | $ 6,853 |
| 2015 | Increased instream flows | acre-feet | 0 | 200 | 200 | $ 77.00 | $ 15,400.00 | 0.840 | $ 12,930 |
| 2016 | Increased instream flows | acre-feet | 0 | 307 | 307 | $ 77.00 | $ 23,639.00 | 0.792 | $ 18,724 |
| 2017 | Increased instream flows | acre-feet | 0 | 307 | 307 | $ 77.00 | $ 23,639.00 | 0.747 | $ 17,664 |
| 2018 | Increased instream flows | acre-feet | 0 | 307 | 307 | $ 77.00 | $ 23,639.00 | 0.705 | $ 16,665 |
| 2019 | Increased instream flows | acre-feet | 0 | 307 | 307 | $ 77.00 | $ 23,639.00 | 0.665 | $ 15,721 |
| 2020 | Increased instream flows | acre-feet | 0 | 307 | 307 | $ 77.00 | $ 23,639.00 | 0.627 | $ 14,831 |
| 2021 | Increased instream flows | acre-feet | 0 | 307 | 307 | $ 77.00 | $ 23,639.00 | 0.592 | $ 13,992 |
| 2022 | Increased instream flows | acre-feet | 0 | 307 | 307 | $ 77.00 | $ 23,639.00 | 0.558 | $ 13,191 |
| 2023 | Increased instream flows | acre-feet | 0 | 307 | 307 | $ 77.00 | $ 23,639.00 | 0.527 | $ 12,458 |
| Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | | | | | | | | $ 143,029 |
| Comments: 307 acre-feet per year is for all 100 participating farms. Benefits woud likely persist for many years beyond the 10 years included here. | | | | | | | | | |

| Table 15.2-316 – Annual Benefit: Reduced Sediment Deposition<br>(All benefits should be in 2012 dollars)<br>Project: 316 - California Land Stewardship Institute, Fish Friendly Farming and Fish Friendly Ranching Environmental Certification in the Russian, Navarro, and Gualala River Watersheds | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
| Year | Type of Benefit | Measure of Benefit (Units) | Without Project | With Project | Change Resulting from Project (e) – (d) | Unit $ Value | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Reduced Sediment | tons | 0 | 0 | 0 | $ 8.98 | $ - | 1.000 | $ - |
| 2013 | Reduced Sediment | tons | 0 | 0 | 0 | $ 8.98 | $ - | 0.943 | $ - |
| 2014 | Reduced Sediment | tons | 0 | 26,666 | 26,666 | $ 8.98 | $ 239,460.68 | 0.890 | $ 213,119 |
| 2015 | Reduced Sediment | tons | 0 | 53,334 | 53,334 | $ 8.98 | $ 478,939.32 | 0.840 | $ 402,127 |
| 2016 | Reduced Sediment | tons | 0 | 80,000 | 80,000 | $ 8.98 | $ 718,400.00 | 0.792 | $ 569,040 |
| 2017 | Reduced Sediment | tons | 0 | 80,000 | 80,000 | $ 8.98 | $ 718,400.00 | 0.747 | $ 536,830 |
| 2018 | Reduced Sediment | tons | 0 | 80,000 | 80,000 | $ 8.98 | $ 718,400.00 | 0.705 | $ 506,444 |
| 2019 | Reduced Sediment | tons | 0 | 80,000 | 80,000 | $ 8.98 | $ 718,400.00 | 0.665 | $ 477,777 |
| 2020 | Reduced Sediment | tons | 0 | 80,000 | 80,000 | $ 8.98 | $ 718,400.00 | 0.627 | $ 450,733 |
| 2021 | Reduced Sediment | tons | 0 | 80,000 | 80,000 | $ 8.98 | $ 718,400.00 | 0.592 | $ 425,220 |
| 2022 | Reduced Sediment | tons | 0 | 80,000 | 80,000 | $ 8.98 | $ 718,400.00 | 0.558 | $ 400,867 |
| 2023 | Reduced Sediment | tons | 0 | 80,000 | 80,000 | $ 8.98 | $ 718,400.00 | 0.527 | $ 378,597 |
| Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | | | | | | | | $ 3,581,290 |
| Comments: Project proponents estimate these activities will result in an average sediment load reduction of 4 tons per acre per year. With 20,000 acres enrolled in the program, this would avoid sediment deposition of 80,000 tons per year. We value this at $8.98 per ton, which is the average value for reduced costs of sediment deposition for the Russian, Gualala, and Navarro River watersheds. | | | | | | | | | |

Table 15.3-316 – Annual Benefit: Enhanced Riparian Habitat

(All benefits should be in 2012 dollars)

Project: 316 - California Land Stewardship Institute, Fish Friendly Farming and Fish Friendly Ranching Environmental Certification in the Russian, Navarro, and Gualala River Watersheds

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Riparian Benefit | functional acres | 60 | 60 | 0 | $ 125.00 | $ - | 1.000 | $ - |
| 2013 | Riparian Benefit | functional acres | 60 | 60 | 0 | $ 125.00 | $ - | 0.943 | $ - |
| 2014 | Riparian Benefit | functional acres | 60 | 60 | 0 | $ 125.00 | $ - | 0.890 | $ - |
| 2015 | Riparian Benefit | functional acres | 60 | 60 | 0 | $ 125.00 | $ - | 0.840 | $ - |
| 2016 | Riparian Benefit | functional acres | 60 | 60 | 0 | $ 125.00 | $ - | 0.792 | $ - |
| 2017 | Riparian Benefit | functional acres | 60 | 64 | 4 | $ 125.00 | $ 500.00 | 0.747 | $ 374 |
| 2018 | Riparian Benefit | functional acres | 60 | 68 | 8 | $ 125.00 | $ 1,000.00 | 0.705 | $ 705 |
| 2019 | Riparian Benefit | functional acres | 60 | 72 | 12 | $ 125.00 | $ 1,500.00 | 0.665 | $ 998 |
| 2020 | Riparian Benefit | functional acres | 60 | 76 | 16 | $ 125.00 | $ 2,000.00 | 0.627 | $ 1,255 |
| 2021 | Riparian Benefit | functional acres | 60 | 80 | 20 | $ 125.00 | $ 2,500.00 | 0.592 | $ 1,480 |
| 2022 | Riparian Benefit | functional acres | 60 | 84 | 24 | $ 125.00 | $ 3,000.00 | 0.558 | $ 1,675 |
| 2023 | Riparian Benefit | functional acres | 60 | 88 | 28 | $ 125.00 | $ 3,500.00 | 0.527 | $ 1,844 |
| 2024 | Riparian Benefit | functional acres | 60 | 92 | 32 | $ 125.00 | $ 4,000.00 | 0.497 | $ 1,988 |
| 2025 | Riparian Benefit | functional acres | 60 | 96 | 36 | $ 125.00 | $ 4,500.00 | 0.469 | $ 2,110 |
| 2026 | Riparian Benefit | functional acres | 60 | 100 | 40 | $ 125.00 | $ 5,000.00 | 0.442 | $ 2,212 |
| 2027 | Riparian Benefit | functional acres | 60 | 104 | 44 | $ 125.00 | $ 5,500.00 | 0.417 | $ 2,295 |
| 2028 | Riparian Benefit | functional acres | 60 | 108 | 48 | $ 125.00 | $ 6,000.00 | 0.394 | $ 2,362 |
| 2029 | Riparian Benefit | functional acres | 60 | 112 | 52 | $ 125.00 | $ 6,500.00 | 0.371 | $ 2,414 |
| 2030 | Riparian Benefit | functional acres | 60 | 116 | 56 | $ 125.00 | $ 7,000.00 | 0.350 | $ 2,452 |
| 2031 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.331 | $ 2,479 |
| 2032 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.312 | $ 2,339 |
| 2033 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.294 | $ 2,206 |
| 2034 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.278 | $ 2,081 |
| 2035 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.262 | $ 1,963 |
| 2036 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.247 | $ 1,852 |
| 2037 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.233 | $ 1,747 |
| 2038 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.220 | $ 1,649 |
| 2039 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.207 | $ 1,555 |
| 2040 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.196 | $ 1,467 |
| 2041 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.185 | $ 1,384 |
| 2042 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.174 | $ 1,306 |
| 2043 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.164 | $ 1,232 |
| 2044 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.155 | $ 1,162 |
| 2045 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.146 | $ 1,096 |
| 2046 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.138 | $ 1,034 |
| 2047 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.130 | $ 976 |
| 2048 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.123 | $ 921 |
| 2049 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.116 | $ 868 |
| 2050 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.109 | $ 819 |
| 2051 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.103 | $ 773 |
| 2052 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.097 | $ 729 |
| 2053 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.092 | $ 688 |
| 2054 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.087 | $ 649 |
| 2055 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.082 | $ 612 |
| 2056 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.077 | $ 578 |
| 2057 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.073 | $ 545 |
| 2058 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.069 | $ 514 |
| 2059 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.065 | $ 485 |
| 2060 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.061 | $ 457 |
| 2061 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.058 | $ 432 |
| 2062 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.054 | $ 407 |
| 2063 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.051 | $ 384 |
| 2064 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.048 | $ 362 |
| 2065 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.046 | $ 342 |
| 2066 | Riparian Benefit | functional acres | 60 | 120 | 60 | $ 125.00 | $ 7,500.00 | 0.043 | $ 323 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 62,580 |

Comments: 120 acres of riparian habitat grows to full functionality over 15 years following the completion of the project in 2017.

## Section D3. Project Costs

The present value of the project's costs, which would occur between 2012 and 2023, is $824,649 in 2012 dollars, discounted at a 6-percent annual rate. These costs would fund labor, planning, equipment, and materials necessary to implement the project.[30] It also includes administrative and O&M costs to maintain the benefits of the project over 10 years.

These project costs do not include the farmer's portion of the cost to fully achieve the sediment reduction and instream flow benefits quantified in monetary terms. To achieve the water conservation benefits quantified in this project, project proponents estimate farmer costs would amount to about $4 million in capital and ongoing operations and maintenance costs. To achieve the sediment reduction benefits, the farmers' costs would depend on the type of sediment control BMPs used. Based on past projects, project proponents estimate average control costs per acre between $8 and $1,700, depending on the type of BMP implemented (e.g., cover crops and winterization, culvert replacement, rock erosion control, etc.). Assuming all farmers implement all soil retention BMPs on all 20,000 acres, the total additional cost would be $4 million to $34 million. For both instream flow and sediment benefits, total additional costs could be $8 million to $38 million.

The actual cost associated with these inputs is dependent on the site conditions and specific activities. Because each of these projects would likely yield many additional benefits to the farmers, which we are not accounting for in the benefits of this project, we do not include these additional costs in the total project costs. We, recognize, however, that to achieve the full set of benefits described above, the total costs would be somewhat higher than shown in Table 19-316, below.

[30] We have distributed the costs outlined Table 7 across the project's implementation period based on the expected timing and phasing described in the Work Plan. Actual distribution of costs during this period may differ somewhat.

Table 19-316 – Annual Costs of Project
(All costs should be in 2012 Dollars)

Project: 316 - California Land Stewardship Institute, Fish Friendly Farming and Fish Friendly Ranching Environmental Certification in the Russian, Navarro, and Gualala River Watersheds

| | Initial Costs Grand Total Cost from Table 7 (row (i), column (d)) | Adjusted Grant Total Cost | 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 | $ 255,000.00 | | $ - | $ - | $ - | | | $ 255,000 | 1.000 | $ 255,000 |
| 2013 | $ 232,000.00 | | $ - | $ - | $ - | | | $ 232,000 | 0.943 | $ 218,868 |
| 2014 | $ 222,500.00 | | $ 2,000.00 | $ 10,000.00 | $ 10,000.00 | | | $ 244,500 | 0.890 | $ 217,604 |
| 2015 | $ - | | $ 2,000.00 | $ 10,000.00 | $ 10,000.00 | | | $ 22,000 | 0.840 | $ 18,472 |
| 2016 | $ - | | $ 2,000.00 | $ 10,000.00 | $ 10,000.00 | | | $ 22,000 | 0.792 | $ 17,426 |
| 2017 | $ - | | $ 2,000.00 | $ 10,000.00 | $ 10,000.00 | | | $ 22,000 | 0.747 | $ 16,440 |
| 2018 | $ - | | $ 2,000.00 | $ 10,000.00 | $ 10,000.00 | | | $ 22,000 | 0.705 | $ 15,509 |
| 2019 | $ - | | $ 2,000.00 | $ 10,000.00 | $ 10,000.00 | | | $ 22,000 | 0.665 | $ 14,631 |
| 2020 | $ - | | $ 2,000.00 | $ 10,000.00 | $ 10,000.00 | | | $ 22,000 | 0.627 | $ 13,803 |
| 2021 | $ - | | $ 2,000.00 | $ 10,000.00 | $ 10,000.00 | | | $ 22,000 | 0.592 | $ 13,022 |
| 2022 | $ - | | $ 2,000.00 | $ 10,000.00 | $ 10,000.00 | | | $ 22,000 | 0.558 | $ 12,285 |
| 2023 | $ - | | $ 2,000.00 | $ 10,000.00 | $ 10,000.00 | | | $ 22,000 | 0.527 | $ 11,589 |
| Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries | | | | | | | | | | $ 824,649 |

Comments:

## 317. *California Land Stewardship Institute*, Russian River Watershed Agricultural Water Conservation & Water Supply Reliability Program

### Conditions Without the Project

Some farmers on the Russian River and its tributaries divert water to use for frost control. These diversions primarily occur during the spring months. The Russian River and its tributaries provide habitat for federally listed salmonid species (Coho, Chinook and steelhead), and these agricultural water diversions can rapidly reduce water flows to levels that are harmful to fish populations. This is especially problematic in dry years, and climate change may increase the frequency and severity of these conditions. In 2009, the National Marine Fisheries Service proposed a moratorium on using stream diversions for frost control (NMFS 2009). The California State Water Resources Control Board developed regulations that would regulate these diversions in 2011, but they were invalidated by the California court system in 2012. It is uncertain what will happen next, but the issue has not gone away.

The City of Ukiah's wastewater treatment plant (WWTP) produces effluent that it discharges into the Russian River. The City's permit from the NCRWQCB restricts the timing and amount of effluent that it is allowed to discharge. The effluent discharge needs often exceed the limits of the permit, especially at times of the year when flows in the Russian River are low. The City has invested in a system to treat the water to standards acceptable for agricultural use. It has developed a 20-year plan to find beneficial uses for the effluent, and frost protection programs are one of the potential uses.

### Conditions With the Project

This project would construct Phase 1 of the City of Ukiah's Master Plan Recycled Water Project, including a storage pond at the treatment plant, a distribution line from the plant to the farms, a new pump station at the plant, and two storage ponds and pump systems on private land. By investing in this infrastructure, it would allow the agricultural producers to avoid diverting 180 acre-feet from the Russian River. It would also help the City avoid discharging effluent into the river during times when it would violate the terms of its wastewater discharge permit.

### Section D2. Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient information to quantify in monetary terms does not exist. Table 12-317 identifies the non-monetized benefits the project would likely generate.

| Table 12-317 – Non-monetized Benefits Checklist<br>*California Land Stewardship Institute*,<br>Russian River Watershed Agricultural Water Conservation & Water Supply Reliability Program | | |
|---|---|---|
| *No.* | *Will the proposal…* | *Response*[1] |
| | **Community/Social Benefits** | |
| 1 | Provide education or technology benefits? | No |
| 2 | Provide social recreation or access benefits? | No |
| 3 | Help avoid, reduce or resolve various public water resources conflicts? Reduce conflict associated with frost control withdrawals | Yes |
| 4 | Promote social health and safety? | No |
| 5 | Have other social benefits? Contribute to reducing risk and associated cost of unauthorized discharges and the cost of conducting studies of effluent impact on the Russian River | Yes |
| | **Environmental Stewardship Benefits** | |
| 6 | Benefit wildlife or habitat in ways that were not quantified in Attachment 7? Passive-use value associated with protection of salmonid populations | Yes |
| 7 | Improve water quality in ways that were not quantified in Attachment 7? Reduce costs to downstream users by limiting discharge of regulated pollutants and maintaining instream flows | Yes |
| 8 | Reduce net emissions in ways that were not quantified in Attachment 7? | No |
| 9 | Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4? | No |
| | **Sustainability Benefits** | |
| 10 | Improve the overall, long-term management of California groundwater resources? | No |
| 11 | Reduce demand for net diversions for the regions from the Delta? | No |
| 12 | Provide a long-term solution in place of a short-term one? Using effluent to satisfy beneficial uses of scarce surface water supplies | Yes |
| 13 | Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources? | No |
| 14 | Improve water supply reliability in ways not quantified in Attachment 7? Enhance reliability of water supplies for frost control purposes | Yes |
| 15 | Other (If the above listed categories do not apply, provide non-monetized benefit description)? | No |

Notes: [1] A "no" response may mean the project does not produce this benefit, or it may mean the benefit is already quantified in Attachment 7, or monetized directly under Section D3 below.

## 3. Help avoid, reduce, or resolve various public water resources conflicts: Reduce conflict associated with frost control withdrawals

**Relevant change.** This project would demonstrate progress toward a solution for reducing withdrawals for frost protection from the Russian River.

**Evidence for demand and value.** NOAA Fisheries has officially expressed concern over the threat withdrawals for frost control pose to federally threatened and endangered salmonids in the Russian River. In 2009, it asked the State Water Board to take immediate action to protect salmonids from rapid drawdowns linked to agricultural withdrawals for frost control. The State Water Resources Control Board took action, initiating a rule making process in 2011 that would impose limits on agricultural withdrawals for frost control purposes (California State Water

Resources Control Board 2011). The regulation became effective in 2011, but in 2012, a judge determined the regulations violated California law (Kronick, Moskovitz, Tiedmann & Girard 2012). The issue continues to be contentious between state and federal regulators and the agricultural community. To the extent that the project demonstrates good faith on behalf of the agricultural community to find alternate sources of water for frost control, it would potentially help dissipate some of the conflict.

**Timing and duration.** The City of Ukiah and private land owners have already made progress toward developing this project, and this funding would help secure these investments. The project would be constructed in 2014. It would continue to produce benefits as long as the underlying conflict remains unresolved.

**Beneficiaries.** The beneficiaries would include the agricultural land owners who would reduce their diversions from the Russian River directly as a result of this project, the broader agricultural community, state and federal regulators, and other non-profit groups that have been engaged in finding a solution to the frost control withdrawal issues.

**Sources of Uncertainty.** The degree to which this project would confer these benefits depends on its effectiveness works, and how interested parties involved in this conflict perceive its effects: if they see it as an important part of the solution, it could produce large dividends. If they see it as a sideshow issue, serving private interests and not important to the broader evolution of this issue, it may not affect the level of conflict around this issue at all.

### 5. Other social benefits: Contribute to reducing risk and associated cost of unauthorized discharges and the cost of conducting studies of effluent impact on the Russian River

**Relevant change.** The City of Ukiah currently discharges about 4,000 acre-feet of effluent per year into the Russian River. This project would reduce the amount of discharge by a minimum of about 187 acre-feet per year, which is about 5 percent of its annual discharge.

**Evidence for demand and value.** The City of Ukiah must pay fines if it violates its discharge permit, which prohibits discharge into the Russian River during certain times of the year, when flows are insufficient to dilute the pollutants and temperature of the effluent. This project would not likely eliminate the need to make these unauthorized discharges or the associated fines. It would, however, incrementally reduce the risk of unauthorized discharges. Combined with other efforts to put effluent to beneficial use, it could help the City eliminate or significantly curb them over time, avoiding all or a large portion of the fines.

The City also conducts studies to demonstrate its discharges aren't adversely impacting the ecological conditions of the Russian River. These studies cost almost $400,000 in 2011-2012. To the extent that the project, together with other actions, reduces the effort the City puts toward these studies, it would provide a benefit.

These benefits are heavily dependent on threshold effects, and this project alone does not confer a direct benefit through reduced costs. It should be recognized as part of the solution in the long run.

**Timing and duration.** The City of Ukiah and private land owners have already made progress toward developing this project, and this funding would help secure these investments. The project would be constructed in 2014. It would help generate this benefit when and if other Phases of the effluent reduction program successfully reduce costs in the future.

**Beneficiaries.** The beneficiaries would include ratepayers of the City of Ukiah, which is a disadvantaged community (and parts of it are severely disadvantaged).

**Sources of Uncertainty.** The degree to which this project would confer these benefits depends on its effectiveness, and the extent to which it, in combination with other efforts, would avoid the City's need to conduct the studies.

### 6. Benefit wildlife or habitat: Passive-use value associated with protection of salmonid populations

**Relevant change.** A controversial report by NOAA Fisheries biologists suggests that frost control diversions have resulted in juvenile steelhead mortality in the past. This project would reduce diversions from the Russian River for frost control that may have contributed to a drop in river levels that could have adversely affected fish populations. Data are unavailable to determine how much effect these diversions alone would have on protecting fish habitat or reducing juvenile salmonid mortality.

**Evidence for demand and value.** Individuals derive value from salmon and steelhead populations in two ways: some (e.g., recreational anglers and commercial fishermen) directly interact with salmon and steelhead populations and derive benefit by catching and consuming the fish, others (including some from the former group) derive value from the fish solely based on the salmon and steelhead's existence. Studies have shown that regardless of direct interaction with fish populations, many Californians hold a positive willingness to pay to ensure the long-term survival of salmon and steelhead (Pate and Loomis 1997).

Several studies have attempted to estimate the passive use value of increases in salmon and steelhead populations among households in California and neighboring states. Passive use value, in this case, refers to the benefit individuals derive from knowing that healthy salmon and steelhead populations exist, regardless of their intent to directly interact with salmon and steelhead through fishing or some other means. In general, these studies have estimated households' average willingness to pay to implement policies that would increase salmon and steelhead populations. At the per fish level, these studies reveal that households are willing to pay only fractions of a penny for increases in salmon populations. When summed across a region, however, the total value Californians are willing to pay for increases in fish populations is considerable. Applying the results of two studies that have estimated willingness to pay values

for increases in salmon and steelhead populations suggest that Californians, in total, would be willing to pay between $497 (Olsen, Richards, and Scott 1991) and $4,351 (Loomis 1996) per fish.[31]

**Timing and duration.** The City of Ukiah and private land owners have already made progress toward developing this project, and this funding would help secure these investments. The project would be constructed in 2014, so benefits would begin to accrue in 2015. Its expected minimum lifespan with appropriate operation and maintenance is 30 years. It would help protect fish populations as long as it remains operational, at least through 2044.

**Beneficiaries.** The beneficiaries of this benefit are the people of California who value the continued existence of aquatic wildlife and habitat, particularly survival of steelhead.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of increased salmon populations would also affect the economic benefit estimate described here. The results from the studies listed above depend crucially on survey methodology and public perceptions on the current state of salmonid populations. Of the studies listed, three were conducted in the Pacific Northwest, which may over or underestimate Californians' willingness to pay for salmon.

### 7. Improve water quality. Reduce costs to downstream users by limiting discharge of regulated pollutants and maintaining instream flows

**Relevant change.** The project may improve water quality in the Russian River by reducing both diversions and discharges of wastewater. The Russian River is listed as impaired for pathogens and bacteria, sediment, and temperature (among other TMDLs) (NCWQCB 2012). These TMDLs require permitted dischargers to eliminate these pollutants from their effluent.

**Evidence for demand and value.** While the project likely would not likely have a quantifiable impact on the TMDL regulation or compliance efforts, the project could provide an incremental improvement in water quality that would reduce costs of future efforts associated with TMDL compliance. This could, cumulative with other actions, reduce the costs dischargers face in complying with TMDL limits. Data are unavailable to characterize the magnitude of the effect, but it would likely be small.

**Timing and duration.** The City of Ukiah and private land owners have already made progress toward developing this project, and this funding would help secure these investments. The project would be constructed in 2014, so benefits would begin to accrue in 2015. Its expected minimum lifespan with appropriate operation and maintenance is 30 years. Cumulatively with other projects, it could help address water quality challenges in the Russian River as long as it remains operational, at least through 2044.

[31] This is based on about 12.4 million households in California (U.S. Census Bureau 2007-2011).

**Beneficiaries.** The beneficiaries of this benefit would be the downstream dischargers to the Russian River and other users of the Russian River that care about its water quality.

**Sources of uncertainty.** This benefit is highly uncertain, as TMDL compliance costs are not well understood, and data are not available to help us understand the incremental effect the project would have on reducing regulated pollutants in the river.

### 12. Provide a long-term solution in place of a short-term one: Using effluent to satisfy beneficial uses of scarce surface water supplies

**Relevant change.** The project would implement the infrastructure required to turn effluent, a pollutant, into a resource that satisfies a current beneficial use of scarce surface water supplies in the Russian River.

**Evidence for demand and value.** This project solves two problems, providing a long-term solution for both. Without this project, both the City of Ukiah and the agricultural land owners would have continued to patch together short-term solutions or incur violations meant to discourage environmentally damaging practices. In the case of Ukiah, it could continue to percolate effluent during low flows, discharging extra when necessary to avoid system damage and incur fines. Not only is this discharged water not available to satisfy beneficial uses, it imposes environmental harm and raises the costs of operating the system by generating fines. In the case of the farmers, they could continue to withdraw water and wait until the regulatory entities settle on a set of rules that may or may not provide the farmers and the environment with an adequate solution. By acting proactively, both the City of Ukiah and the farmers would resolve uncertainty inherent in short-term solutions and benefit the environment in the long-run.

**Timing and duration.** The City of Ukiah and private land owners have already made progress toward developing this project, and this funding would help secure these investments. The project would be constructed in 2014, so benefits would begin to accrue in 2015. Its expected minimum lifespan with appropriate operation and maintenance is 30 years.

**Beneficiaries.** The beneficiaries of this benefit would be the agricultural land owners who would receive the City of Ukiah's treated effluent, the ratepayers of the City of Ukiah, which is a disadvantaged community (and parts of it are severely disadvantaged), and the citizens of California who care about the long-term environmental health of the Russian River watershed.

**Sources of uncertainty.** That the project would produce a solution that would be viable for the long-run is relatively certain. It is also relatively certain that the environmental problems the project is aiming to address are not short-term issues, and so the long-term solution would continue to generate benefits throughout its lifespan.

## 14. Improve water supply reliability. Enhance supply reliability for frost control purposes

**Relevant change.** The project would secure a permanent supply of water for two agricultural land owners who currently rely on withdrawals from the Russian River for water to support frost control. The project would provide a minimum of 187 acre feet per year to replace these withdrawals.

**Evidence for demand and value.** The two agricultural land owners who are participating in this project currently withdraw about 250 acre-feet of water from the Russian River for frost control each year. The state regulations (which have since been invalidated) threatened to curtail these withdrawals. Given the 2012 court decision and the federal government's continuing interest in protecting threatened and endangered salmonids in the Russian River, it is unlikely withdrawals would be permitted based on current practices indefinitely. By providing an alternative supply of water that is highly reliable (effluent will flow from the treatment plant as long as the residents of Ukiah continue to flush their toilets), these farmers would not face annual uncertainty about securing water for frost control.

By increasing the reliability of the water supply, this project provides a real, though difficult to measure, benefit to the farmers. If the farmers lost their right to withdraw water from the Russian River, no viable alternative supply would be available. During a freeze, it is possible that they could loose the entire value of their wine grape crops, estimated at about $2 million per year. Because crop loss is not certain and may not actually occur, depending on how the regulatory process resolves, we do not monetize the benefit in this way. But this value provides an illustration of the value to the farmers of securing a reliable source of water.

**Timing and duration.** The City of Ukiah and private land owners have already made progress toward developing this project, and this funding would help secure these investments. The project would be constructed in 2014, so benefits would begin to accrue in 2015. Its expected minimum lifespan with appropriate operation and maintenance is 30 years.

**Beneficiaries.** The beneficiaries of this benefit would be the agricultural land owners who would receive the City of Ukiah's treated effluent.

**Sources of uncertainty.** That the farmers would benefit from securing an alternative supply of water is relatively certain, given the regulatory uncertainty they now face. If the regulatory uncertainty resolves itself and farmers continue to be able to withdraw water from the Russian River indefinitely, the value of this benefit to the farmers would diminish. It is not clear how likely it is that the situation would resolve in a way that maintains the status quo, but based on current conditions and available information, it seems unlikely.

## Section D3. Monetized Benefits Analysis

The present value of the monetized benefits in 2012 dollars, discounted annually at 6 percent over the relevant lifespan of each component of the project (described below), is $176,020. The calculations for each monetized benefit are shown in Table 15-1, at the end of this section.

### 2. Increase in instream flows for environmental purposes

**Relevant change.** By providing farmers with a minimum of 187 acre feet of water per year to offset withdrawals from the Russian River, the project would ensure that water remains instream to benefit salmonid populations and other aquatic resources.

**Evidence for demand and value.** An economic analysis of water transactions between 1990 and 2003 found that the median price paid in California to acquire water for environmental purposes was $77 per acre-foot (Brown 2007). We use this value, to measure the value of additional water for instream flows to enhance ecosystems, water-quality, and salmon populations for all projects that would generate this benefit. The median value is a better estimator of the true willingness to pay for water supplies than the mean, insofar as some transactions exhibiting extreme values are distorted by political and other factors. We estimate the annual, undiscounted value of this benefit is $14,399 per year.

**Timing and duration.** The City of Ukiah and private land owners have already made progress toward developing this project, and this funding would help secure these investments. The project would be constructed in 2014, so benefits would begin to accrue in 2015. Its expected minimum lifespan with appropriate operation and maintenance is 30 years.

**Beneficiaries.** The beneficiaries of this benefit would be the citizens of California who care about the long-term environmental health of the Russian River watershed.

**Sources of Uncertainty.** The value of this benefit is dependent on the water that the farmers would have withdrawn remaining instream to protect environmental flows. Documentation that this would be the case is not available, so there is some uncertainty about whether it would materialize.

Table 15.1-317 – Annual Benefit: Increased Instream Flows for Environmental Purposes

(All benefits should be in 2012 dollars)

Project: 317 - California Land Stewardship Institute, Russian River Watershed Agricultural Water Conservation & Water Supply Reliability 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 | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Increased instream flows | acre-feet | 0 | 0 | 0 | $ 77.00 | $ - | 1.000 | $ - |
| 2013 | Increased instream flows | acre-feet | 0 | 0 | 0 | $ 77.00 | $ - | 0.943 | $ - |
| 2014 | Increased instream flows | acre-feet | 0 | 0 | 0 | $ 77.00 | $ - | 0.890 | $ - |
| 2015 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.840 | $ 12,064 |
| 2016 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.792 | $ 11,381 |
| 2017 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.747 | $ 10,737 |
| 2018 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.705 | $ 10,129 |
| 2019 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.665 | $ 9,556 |
| 2020 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.627 | $ 9,015 |
| 2021 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.592 | $ 8,505 |
| 2022 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.558 | $ 8,023 |
| 2023 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.527 | $ 7,569 |
| 2024 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.497 | $ 7,141 |
| 2025 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.469 | $ 6,736 |
| 2026 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.442 | $ 6,355 |
| 2027 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.417 | $ 5,995 |
| 2028 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.394 | $ 5,656 |
| 2029 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.371 | $ 5,336 |
| 2030 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.350 | $ 5,034 |
| 2031 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.331 | $ 4,749 |
| 2032 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.312 | $ 4,480 |
| 2033 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.294 | $ 4,226 |
| 2034 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.278 | $ 3,987 |
| 2035 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.262 | $ 3,762 |
| 2036 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.247 | $ 3,549 |
| 2037 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.233 | $ 3,348 |
| 2038 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.220 | $ 3,158 |
| 2039 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.207 | $ 2,980 |
| 2040 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.196 | $ 2,811 |
| 2041 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.185 | $ 2,652 |
| 2042 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.174 | $ 2,502 |
| 2043 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.164 | $ 2,360 |
| 2044 | Increased instream flows | acre-feet | 0 | 186.6 | 186.6 | $ 77.00 | $ 14,368.20 | 0.155 | $ 2,226 |
| | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | | | $ 176,020 |

Comments: This represents the benefit associated with leaving flows in the Russian River for environmental purposes. The projcet would offset a minimum of 186.6 acre-feet of flow each year, and we value this at $77 per acre-foot, based on the median price paid for water for environmental flows in California.

## Section D3. Project Costs

The present value of the project's costs, which would occur between 2012 and 2044, is $4,357,393 in 2012 dollars, discounted at a 6-percent annual rate. These costs would fund labor, planning, equipment, and materials necessary to implement the project. They also include additional administration, operation, and maintenance costs to keep the project operational through the 30-year expected lifespan.

Table 19-317 – Annual Costs of Project
(All costs should be in 2012 Dollars)

Project: 317 - California Land Stewardship Institute, Russian River Watershed Agricultural Water Conservation & Water Supply Reliability Program

| | Initial Costs Grand Total Cost from Table 7 (row (i), column (d)) | Adjusted Grant Total Cost | 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 | $ 156,220 | | $ - | $ - | $ - | $ - | $ - | $ 156,220 | 1.000 | $ 156,220 |
| 2013 | $ 23,175 | | $ 23,170 | $ 100,000 | $ 55,000 | $ - | $ - | $ 201,345 | 0.943 | $ 189,948 |
| 2014 | $ 1,312,004 | | $ 23,170 | $ 100,000 | $ 55,000 | $ - | $ - | $ 1,490,174 | 0.890 | $ 1,326,250 |
| 2015 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.840 | $ 184,019 |
| 2016 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.792 | $ 173,603 |
| 2017 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.747 | $ 163,777 |
| 2018 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.705 | $ 154,506 |
| 2019 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.665 | $ 145,761 |
| 2020 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.627 | $ 137,510 |
| 2021 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.592 | $ 129,726 |
| 2022 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.558 | $ 122,383 |
| 2023 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.527 | $ 115,456 |
| 2024 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.497 | $ 108,921 |
| 2025 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.469 | $ 102,755 |
| 2026 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.442 | $ 96,939 |
| 2027 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.417 | $ 91,452 |
| 2028 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.394 | $ 86,275 |
| 2029 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.371 | $ 81,392 |
| 2030 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.350 | $ 76,785 |
| 2031 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.331 | $ 72,439 |
| 2032 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.312 | $ 68,338 |
| 2033 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.294 | $ 64,470 |
| 2034 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.278 | $ 60,821 |
| 2035 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.262 | $ 57,378 |
| 2036 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.247 | $ 54,130 |
| 2037 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.233 | $ 51,066 |
| 2038 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.220 | $ 48,176 |
| 2039 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.207 | $ 45,449 |
| 2040 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.196 | $ 42,876 |
| 2041 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.185 | $ 40,449 |
| 2042 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.174 | $ 38,160 |
| 2043 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.164 | $ 36,000 |
| 2044 | | | $ 23,170 | $ 100,000 | $ 55,000 | $ 26,000 | $ 15,000 | $ 219,170 | 0.155 | $ 33,962 |
| | | | | | | | | Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries | | $ 4,357,393 |

Comments: These costs represent the initial capital costs to build the project, some of which have already been spent as of 2013. It also represents in the increased administration, operation, maintenance, and replacement costs to keep the recycled water distribution system and ponds operational through their 30-year expected lifespan.

## 523. *Gold Ridge Resource Conservation District*, Coastal Watersheds Enhancement Project

### Conditions Without the Project

Dutch Bill Creek, a tributary of the Russian River, has historically provided high quality habitat for both Coho salmon and steelhead. The Creek supported healthy populations until the populations crashed in the 1980s and 1990s, with few fish spawning in the stream after 2000. The last remaining wild juvenile Coho were observed during the summer of 2006. Since 2006 Dutch Bill Creek has been a priority site of juvenile Coho releases through the Russian River Coho Salmon Captive Broodstock Program. In fact, Dutch Bill Creek is one of only five tributaries to the Russian River identified the Russian River Coho Salmon Keystone Initiative as critical for near-term salmonid recovery.

However, there are generally two limiting factors to salmon recovery in Dutch Bill Creek: a lack of large wood and large-scale diversions. One of these diversions is for playing field irrigation at the Westminister Woods Camp and Conference Center. This diversion decreases streamflow by up to 0.3 cfs (which can amount to 100 percent of streamflow) over a period of several hours, on a frequency that varies between two and seven times per week.

The neighboring Salmon Creek watershed, while not 303(d) listed, also suffers from considerable sedimentation, water shortages, and riparian health impacts. Dairy farms along Salmon Creek are significant water users, which draw from sources, influencing riparian flows.

### Conditions With the Project

The project would implement large-scale water conservation measures and irrigation efficiency improvements on riparian properties along key reaches of Dutch Bill and Salmon Creeks. It would eliminate the Westminister Woods Camp diversion by implementing an off-channel water storage system at this site and implementing irrigation improvements and other water conservation efforts. It would construct a roof rainwater catchment system on a dairy operation along Salmon Creek, which would allow the dairy farm to reduce summer diversions from an alluvial well connected to Salmon Creek. The project would also involve instream habitat improvements and upland sediment source management. The project would enhance key salmon spawning and rearing reaches of Dutch Bill Creek.

Finally, the project would conduct public outreach and education of IRMP priorities and project implementation with at least two public meetings and/or community events; a workshop series to assist landowners in identifying small erosion problems; and a workshop on installing roof rain water catchment systems.

### Section D2. Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient information to quantify in monetary terms does not exist. Table 12-523 identifies the non-monetized benefits the project would likely generate.

| Table 12-523 – Non-monetized Benefits Checklist<br>*Gold Ridge Resource Conservation District*, Coastal Watersheds Enhancement Project | | |
|---|---|---|
| *No.* | *Will the proposal…* | *Response*[1] |
| | **Community/Social Benefits** | |
| 1 | Provide education or technology benefits? Enhanced human and social capital | Yes |
| 2 | Provide social recreation or access benefits? | No |
| 3 | Help avoid, reduce or resolve various public water resources conflicts? | No |
| 4 | Promote social health and safety? | No |
| 5 | Have other social benefits? Cultural-use value associated with increases in salmon populations | Yes |
| | **Environmental Stewardship Benefits** | |
| 6 | Benefit wildlife or habitat in ways that were not quantified in Attachment 7? | No |
| 7 | Improve water quality in ways that were not quantified in Attachment 7? | No |
| 8 | Reduce net emissions in ways that were not quantified in Attachment 7? | No |
| 9 | Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4? | No |
| | **Sustainability Benefits** | |
| 10 | Improve the overall, long-term management of California groundwater resources? | No |
| 11 | Reduce demand for net diversions for the regions from the Delta? | No |
| 12 | Provide a long-term solution in place of a short-term one? | No |
| 13 | Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources? | No |
| 14 | Improve water supply reliability in ways not quantified in Attachment 7? Create additional water supplies by capturing water during high flows for use during dry periods | Yes |
| 15 | Other (If the above listed categories do not apply, provide non-monetized benefit description)? | No |

Notes: [1] A "no" response may mean the project does not produce this benefit, or it may mean the benefit is already quantified in Attachment 7, or monetized directly under Section D3 below.

## 1. Provide education or technology benefits: Enhanced human and social capital

**Relevant change.** The project would conduct a minimum of two public tours on the Westminister Woods project site, including the water storage project and instream habitat improvements. Project proponents would also hold at least two public meetings and/or community events to present IRWM-funded and related activities, including discussions on instream flow and habitat, salmonid monitoring efforts, and sediment reduction. They would also conduct at least one workshop on the installation of roof rainwater catchment systems, including a site tour.

**Evidence for demand and value.** Drawing a cause-and-effect relationship between educational efforts and specific water-supply or water-quality outcomes is difficult, but there are several ways the project could produce tangible economic benefits through its education components:

- Outreach for this project may increase the public's understanding of and support or demand for future water conservation and watershed-enhancement projects. Increased community support for and participation in future public projects may make future restoration projects

easier to implement and less costly to complete, resulting in additional water quality and quantity benefits at lower cost to the community.

- The education efforts related to water conservation, may inspire homeowners to explore opportunities for practices water conservation on their own. Increased public interest and support for water conservation may generate more widespread and long-run improvements in water quality and water management in the region. These private efforts may in turn lower the public costs for managing water resources.

- Opportunities to participate in educational programs and restoration opportunities improve the well-being of people who choose to participate. These improvements may not result in water-supply or water-quality benefits directly, but they may better people's lives in other ways that have economic importance. Spending time outdoors may improve an individual's emotional and physical health, which constitutes an investment in human capital. Working with others in restoration efforts has the potential to strengthen the relationships among community members, which constitutes an investment in social capital. Both of these effects may contribute to an overall improvement in quality of life.

These effects may be small, but subtle changes arising from education should not be dismissed. For example, interactions among community members in the context of this project may be brief, compared to all of the other interactions that go on day-to-day, but the effect combined with all of the other small effects may accumulate into measurable improvements in quality of life in the long run. Similarly, staff who work with community members on watershed education attest that a public better educated about watershed issues generates dividends in future projects. The efforts of this project, in combination with other sustained efforts in the long run, likely will translate to economic benefits for the community that reach beyond this project.

**Timing and duration.** We assume the value of this benefit will begin to accrue when the outreach and education activities occur, between September 2014 and September 2016. These benefits would persist for the professional lifetimes of the participants.

**Beneficiaries.** The beneficiaries of this benefit are the community members and residents who participate in the public meetings and events. To the extent that these events promote water savings and improved water quality in the community, the beneficiaries may also include a broad group of residents in the region.

**Sources of Uncertainty.** The education benefits from the project would depend on the extent to which the project effectively delivers information through the educational programs for landowners and residents and, significantly, the extent to which these people apply their knowledge in ways that reduces future costs.

### 5. Have other social benefits: Cultural-use value associated with increases in salmon populations

**Relevant change.** By enhancing instream habitat and increasing instream flows, the project would enhance salmon habitat in critical stream reaches, increasing their populations. See our description of non-monetized benefit #6 (benefit wildlife and habitat: passive-use value associated with increases in salmon populations) below for a full description of the process by which these projects confer this benefit.

**Evidence for demand and economic value.** Unlike many Californians who ascribe a monetary willingness to pay to protect salmon, even if they never intend to directly fish or watch them, many Native Americans recognize the importance of salmon outside the cultural framework and economic terms western society often imposes (Malloy 1992). Accordingly, they reject the validity of applying a dollar value to fish that constitute a core element of their cultural and spiritual well-being. For this reason, we recognize the cultural significance that arises from the projects' improvements to salmonid populations and their habitat apart from the quantified passive-use value or other measures of economic benefits.

**Timing and duration.** Project construction of the Dutch Bill Creek Instream Habitat Enhancement would occur at the end of 2013 and the Westminister Woods Irrigation Water Storage Project would occur in 2014. We therefore assume benefits related to increases in salmon populations would begin to accrue in 2015. Benefits would persist for the lifespan of the project, 50 years.

**Beneficiaries.** The beneficiaries of this benefit would include members of Native American tribes – both within and outside of the region – who believe the continued existence of salmonid populations and their habitat is essential to cultural and spiritual well-being.

**Sources of uncertainty.** The value of this benefit depends on the uncertainty associated with the extent to the project confers a biophysical benefit that will result in increased salmon populations.

### 14. Improve water supply reliability: Create additional water supplies by capturing water during high flows for use during dry periods

**Relevant change.** The off-stream water storage projects would reduce water demand by first implementing water conservation and irrigation efficiency measures. In doing so, the projects would reduce seasonal extraction pressure on streams that are subject to potential future decreases in flow. By collecting rainwater or extracting water from streams during winter, when streamflows are higher, these projects also provide a buffer against climate change, increasing water supply security for participating landowners.

**Evidence for demand and value.** Water supplies during low-flow periods in the watersheds the project would affect are scarce, but more abundant during the fall, winter, and spring, when

water demands diminish. By providing capacity to store water, the project reduces the likelihood that people would experience unmet demands during times of the year when water is scarcer. Data are unavailable to quantify the extent to which demands are currently going unmet, or how well this project would satisfy those demands and increase reliability. However, research suggests that people value water reliability and are willing to pay to increase it. Research conducted for the California Urban Water Agencies found that households were willing to pay, on average, $213 per year to avoid a 10-percent shortage once every three years and $222 per year to avoid a 30-percent shortage once every thirty years (Barakat & Chamberlin, Inc. 1994).

**Timing and duration.** Project construction of the of-channel water storage would occur between in late 2016. We assume benefits related to improvements in water supply reliability would begin to accrue in 2017. Benefits would persist for the lifespan of the project, 20 years.

**Beneficiaries.** The beneficiaries of this benefit are the water users in the Russian River watershed.

**Sources of uncertainty.** To the extent that this project actually address unmet demands, it would confer this benefit. Significant uncertainty hampers our ability to fully describe the current characteristics (timing, frequency, duration) of shortages. If the project provides sufficient capacity to address them, it would produce benefits that are potentially quite valuable. If it is unable to reduce the current frequency, duration, or timing, the benefits would be smaller or non-existent.

## Section D3. Monetized Benefits Analysis

The present value of the monetized benefits in 2012 dollars, discounted annually at 6 percent over the relevant lifespan of each component of the project (described for each benefit below), is $1,468,806. The calculations for each monetized benefit are shown in Tables 15-1, 15-2, 15-3 at the end of this section.

### 1. Passive-use value associated with increases in salmon populations

**Relevant change.** The current limiting factors to salmon recovery in Dutch Bill Creek are a lack of large wood and periodic drops in summer streamflows. Other features of Dutch Bill Creek suggest it has a substantial capacity to support salmon populations(California Department of Fish and Game 2006). For example, much of the creek remains shaded under riparian cover, with sufficiently low water temperatures, dissolved oxygen, and macroinvertebrate populations. However, the Fish and Game survey determined a mean pool shelter rating of 21 (with 80 being desirable), and large wood provided only 15 percent of pool shelter in the inventoried reaches. The inventory report recommended that woody cover be increased in pool and flatwater habitat units along the entire stream.

Reductions in surface flow from irrigation diversions are also threatening juvenile salmonid survival in Dutch Bill Creek in a number of ways. Low flows disconnect pools, causing juveniles to

become stranded in pools with unsuitable habitat (lack of cover, high temperature, low dissolved oxygen), or cause pools to dry up completely. Moreover, surface flow is necessary to maintain sufficient dissolved oxygen rates in pools. Decreased pool water volume can also cause increased water temperatures and greater exposure to predators.

By addressing two remaining limiting factors to Coho survival in Dutch Bill Creek, the project would enhance salmon habitat in critical stream reaches, increasing their populations. Benefits of instream improvements to fish populations are difficult to quantify, as a number of complex factors affect salmonid populations. Project proponents estimate these improvements would increase juvenile survival rates in each year by 10 percent. According to the UCCE rearing and spawning surveys along Dutch Bill Creek, Westminster Woods is the primary site where broodstock fish are released. UCCE has base population numbers based on their current surveys and in 2012 observed 1,960 wild juvenile Coho salmon. From these estimates, we assume the project would increase fish populations by approximately 196 fish per year.

**Evidence for demand and value.** Individuals derive value from increases in salmon and steelhead populations in two ways: some (e.g., recreational anglers and commercial fishermen) directly interact with salmon and steelhead populations and derive benefit by catching and consuming the fish, others (including some from the former group) derive value from the fish solely based on the salmon and steelhead's existence. Studies have shown that regardless of direct interaction with fish populations, many Californians hold a positive willingness to pay to ensure the long-term survival of salmon and steelhead (Pate and Loomis 1997).

Several studies have attempted to estimate the passive use value of increases in salmon and steelhead populations among households in California and neighboring states. Passive use value, in this case, refers to the benefit individuals derive from knowing that healthy salmon and steelhead populations exist, regardless of their intent to directly interact with salmon and steelhead through fishing or some other means. In general, these studies have estimated households' average willingness to pay to implement policies that would increase salmon and steelhead populations. At the per fish level, these studies reveal that households are willing to pay only fractions of a penny for increases in salmon populations. When summed across a region, however, the total value Californians are willing to pay for increases in fish populations is considerable. Applying the results of two studies that have estimated willingness to pay values for increases in salmon and steelhead populations suggest that Californians, in total, would be willing to pay between $497 (Olsen, Richards, and Scott 1991) and $4,351 (Loomis 1996) per fish.[32] In eliciting willingness to pay estimates from respondents, these studies told respondents that hypothetical policies would increase salmon populations by 2.5 million and 300,000, respectively. To reduce the risk that we overestimate this benefit, we employ a value of $500 per fish per year as a rough estimate of the benefit of increases in salmon populations.

We estimate the annual, undiscounted value of this benefit is therefore $98,000.

[32] This is based on about 12.4 million households in California (U.S. Census Bureau 2007-2011).

There is evidence of substantial local demand for salmon restoration efforts that may also imply our economic and biophysical estimates represent underestimates. State and local agencies have prioritized Dutch Bill Creek for its strong potential for Coho salmon recovery. For example, *Russian River Coho Salmon Keystone Initiative* identifies the project tributaries as two of the five most critical for near-term salmon recovery (National Fish and Wildlife Foundation 2009). Similarly, the *Recovery Strategy for California Coho Salmon* identifies the watersheds' Guerneville hydraulic sub area one of the highest ranking sites for restoration and management potential in the Central California Coast Coho ESU (California Department of Fish and Game 2004). Likewise, the *Central California Coast Coho ESU Draft Recovery Plan* identified Dutch Bill Creek as one of only five tributaries in the Russian River watershed to be named a "Coho Recovery Core Watershed," critical for near-term Coho salmon recovery (NMFS, 2008A).

**Timing and duration.** Project construction of the Dutch Bill Creek Instream Habitat Enhancement would occur at the end of 2013. We assume benefits related to increases in salmon populations would begin to accrue in 2014. Benefits would persist for the lifespan of the project, 50 years.

**Beneficiaries.** The beneficiaries of this benefit are the people of California who value the continued existence of aquatic wildlife and habitat, particularly critical habitat for Chinook salmon, Coho salmon, and steelhead.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of increased salmon populations would also affect the economic benefit estimate described here. There is also uncertainty associated with the marginal economic value of increases in fish populations described above. The results from the studies listed above depend crucially on survey methodology and public perceptions on the current state of salmonid populations. Of the studies listed, three were conducted in the Pacific Northwest, which may over or underestimate Californians' willingness to pay for salmon.

All studies we reviewed found that the willingness to pay per fish for an increase in salmon populations decreases as the hypothetical increase in salmon stocks increases. In all cases however, the increases in population were several degrees of magnitude larger than the increases expected by this project. The projects would yield small potential increases in salmon populations, relative to the size of existing populations. There is no data in the literature measuring respondents' willingness to pay for population increases in the scope of the project. If the marginal value per fish of increases in salmon populations diminishes as the size of the project becomes very small, the value of salmon may lie at the lower end of the range presented above. If the value per additional fish resulting from the projects resembles the upper end of the range, we have likely underestimated the true value of this benefit.

## 2. Increase in instream flows for environmental purposes

**Relevant change.** By improving winter storage and implementing conservation, the project would significantly reduce summer diversions from Dutch Bill Creek. These reductions would

provide streamflow augmentation by an estimated 750,000 to 900,000 gallons per year to key reaches of Dutch Bill Creek. With the rainwater catchment system on the dairy farm, the project would also reduce summer diversions from Salmon Creek by approximately 1.25 to 1.5 million gallons per year. Using the low-ends of these estimates, we estimate the project would increase instream flows for environmental purposes in Salmon and Dutch Bill Creeks by approximately 2.25 million gallons or 6.9 acre-feet per year.

**Evidence for demand and value.** An economic analysis of water transactions between 1990 and 2003 found that the median price paid in California to acquire water for environmental purposes was $77 per acre-foot (Brown 2007). We use this value, to measure the value of additional water for instream flows to enhance ecosystems, water-quality, and salmon populations for all projects that would generate this benefit. The median value is a better estimator of the true willingness to pay for water supplies than the mean, insofar as some transactions exhibiting extreme values are distorted by political and other factors. We estimate the annual, undiscounted value of this benefit is $531.

**Timing and duration.** Project construction of the Dutch Bill Creek Instream Habitat Enhancement would occur at the end of 2013 and the Westminister Woods Irrigation Water Storage Project would occur in 2014. We therefore assume benefits related to increases in salmon populations would begin to accrue in 2015. Benefits would persist for the lifespan of the project, 50 years.

**Beneficiaries.** The beneficiaries of this benefit would include several groups of stakeholders including commercial fishermen and recreational anglers in both marine and freshwater fisheries, and the general public insofar as they value an increase in fish populations regardless of any potential future direct use or exposure to the impacted fish populations. It would also benefit other recreational users of water, such as kayakers and wildlife watchers, Californians who place a non-use value on maintaining sufficient instream flows for environmental purposes, and other water users, such as irrigators, who bear increased regulatory pressure and costs to increase instream flows by reducing their own use of water.

**Sources of Uncertainty.** The value of this benefit is dependent on the water that the farmers would have withdrawn remaining instream to protect environmental flows. Documentation that this would be the case is not available, so there is some uncertainty about whether it would materialize.

### 3. Avoided costs associated with reduced probability of sediment deposition

**Relevant change.** The project would reduce sediment delivery to Dutch Bill Creek by implementing three to four small-scale, landowner initiated sediment reduction projects. These sites each have an estimated sediment delivery volume of 100 cubic yards over 10 years

following project completion.[33] Using a conversion factor of 1.6 tons per cubic yard, we estimate these projects would reduce sediment delivery by 64 tons per year.

**Evidence for demand and value.** Economic studies have examined and monetized some of the benefits that materialize when excessive sediment does not impair streams, rivers, estuaries, and the marine environment. A study conducted by the U.S. Department of Agriculture identified 13 types of benefits associated with decreasing sediment (Hansen and Ribaudo 2008). For each benefit, the researchers modeled the potential value associated with reducing sediment, per ton, for each county across the country. For our analysis, we apply the average value for the Russian River watershed, $9.90 per ton, to estimate the benefits derived from the prevention of sediment deposition. Included in this value are the regional benefits associated with the impacts of sediment on:

- Water-based recreation – cleaner fresh water recreation
- Irrigation ditches and channels – reduced cost of removing sediment and aquatic plants from irrigation channels
- Road drainage ditches – less damage to and flooding of roads
- Municipal water treatment – lower sediment-removal costs for water treatment plants
- Flood damage – reduced flooding and damage from flooding
- Marine fisheries – improved catch rates for marine commercial fisheries
- Marine recreational fishing – improved catch rates for marine recreational fishing
- Municipal and industrial water use – reduced damages from salts and minerals dissolved from sediment
- Steam power plants – reduced plant growth on heat exchangers
- Soil productivity – reduced losses in soil productivity
- Dust cleaning – decrease in cleaning due to reduced wind-borne particulates.
- Reservoir services – less sediment in reservoirs
- Navigation – shipping industry avoidance of damages from groundings

The annual undiscounted value of the avoided costs related to sediment reduction is $634.

Finally, there are local sources of demand for sediment reduction in the watershed, buttressing the evidence for demand for this benefit and suggesting we may have underestimated the value in our calculation. The North Coast Regional Water Quality Control Board's sediment TMDL implementation strategy, *the Work Plan to Control Excess Sediment in Sediment Impaired Watersheds*, lists the Russian River and Estero Americano as priority watersheds and calls for the development of sediment control projects like the upland erosion control efforts proposed (NCRWQCB 2011).

[33] 10 cubic yards per project per year, or 40 cubic yards per year for this project component

**Timing and duration.** Landowner-initiated sediment reduction projects would occur in 2014. We assume benefits related to reductions in sediment deposition would begin to accrue in 2015. Benefits would persist for the lifespan of those projects, 10 years.

**Beneficiaries.** The beneficiaries of this benefit are the wide array of downstream users associated with each of the benefits listed above. To some extent, these beneficiaries include the general public, municipal water treatment operators and their ratepayers, irrigators, recreationalists, downstream property owners, and fishermen.

**Sources of uncertainty.** All sources of uncertainty surrounding the estimate of reduced sedimentation would also affect the economic benefit estimate described here. For example, the actual rate of sediment deposition is dependent on water year type, sediment yields, location and roughness of the flood prone surface, among other factors. See Attachment 7 for a full description of these biophysical sources of uncertainty.

At least four major factors suggest that the value of sediment we use underestimates the true value of the sediment-reduction benefits. First, the value does not reflect many potential benefits, such as the goods and services derived from potential impacts on wetlands and endangered species. Second, the estimates of sediment erosion that the projects would reduce are based on current sediment erosion rates. Climate change is expected to increase the frequency and intensity of storm events, which would likely increase the rate of sediment erosion absent the projects (Masden and Figdor 2007). If future sediment erosion rates exceed current rates, the without-project sediment erosion is likely to increase, and thus, the expected benefit of each project's sediment control activities is likely to be an underestimate. Third, this estimate does not anticipate increases in value that occur over time. We anticipate that the value of sediment-reduction benefits will increase, relative to the general price index, but have not accounted for this increase in our calculations.

Table 15.1-523 – Annual Benefit: Increased Salmonid Populations
(All benefits should be in 2012 dollars)

Project: 523 - Gold Ridge Resource Conservation District, Coastal Watersheds Enhancement Project

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Increased Salmon | fish | 0 | 0 | 0 | $ 500.00 | $ - | 1.000 | $ - |
| 2013 | Increased Salmon | fish | 0 | 0 | 0 | $ 500.00 | $ - | 0.943 | $ - |
| 2014 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.890 | $ 87,220 |
| 2015 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.840 | $ 82,283 |
| 2016 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.792 | $ 77,625 |
| 2017 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.747 | $ 73,231 |
| 2018 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.705 | $ 69,086 |
| 2019 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.665 | $ 65,176 |
| 2020 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.627 | $ 61,486 |
| 2021 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.592 | $ 58,006 |
| 2022 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.558 | $ 54,723 |
| 2023 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.527 | $ 51,625 |
| 2024 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.497 | $ 48,703 |
| 2025 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.469 | $ 45,946 |
| 2026 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.442 | $ 43,345 |
| 2027 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.417 | $ 40,892 |
| 2028 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.394 | $ 38,577 |
| 2029 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.371 | $ 36,394 |
| 2030 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.350 | $ 34,334 |
| 2031 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.331 | $ 32,390 |
| 2032 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.312 | $ 30,557 |
| 2033 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.294 | $ 28,827 |
| 2034 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.278 | $ 27,195 |
| 2035 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.262 | $ 25,656 |
| 2036 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.247 | $ 24,204 |
| 2037 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.233 | $ 22,834 |
| 2038 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.220 | $ 21,541 |
| 2039 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.207 | $ 20,322 |
| 2040 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.196 | $ 19,172 |
| 2041 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.185 | $ 18,087 |
| 2042 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.174 | $ 17,063 |
| 2043 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.164 | $ 16,097 |
| 2044 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.155 | $ 15,186 |
| 2045 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.146 | $ 14,326 |
| 2046 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.138 | $ 13,515 |
| 2047 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.130 | $ 12,750 |
| 2048 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.123 | $ 12,029 |
| 2049 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.116 | $ 11,348 |
| 2050 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.109 | $ 10,705 |
| 2051 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.103 | $ 10,099 |
| 2052 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.097 | $ 9,528 |
| 2053 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.092 | $ 8,988 |
| 2054 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.087 | $ 8,480 |
| 2055 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.082 | $ 8,000 |
| 2056 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.077 | $ 7,547 |
| 2057 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.073 | $ 7,120 |
| 2058 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.069 | $ 6,717 |
| 2059 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.065 | $ 6,337 |
| 2060 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.061 | $ 5,978 |
| 2061 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.058 | $ 5,639 |
| 2062 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.054 | $ 5,320 |
| 2063 | Increased Salmon | fish | 0 | 196 | 196 | $ 500.00 | $ 98,000.00 | 0.051 | $ 5,019 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 1,457,229 |

Comments: This benefit assumes an improvement of habitat that would support an additional 196 fish in Dutch Bill Creek.

Table 15.2-523 – Annual Benefit: Increased Instream Flows for Environmental Purposes
(All benefits should be in 2012 dollars)

Project: 523 - Gold Ridge Resource Conservation District, Coastal Watersheds Enhancement Project

| (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 | (h) Annual $ Value (f) x (g) | (i) Discount Factor | (j) Discounted Benefits (h) x (i) |
|---|---|---|---|---|---|---|---|---|---|
| 2012 | Increased instream flows | acre-feet | 0 | 0 | 0 | $ 77.00 | $ - | 1.000 | $ - |
| 2013 | Increased instream flows | acre-feet | 0 | 0 | 0 | $ 77.00 | $ - | 0.943 | $ - |
| 2014 | Increased instream flows | acre-feet | 0 | 0 | 0 | $ 77.00 | $ - | 0.890 | $ - |
| 2015 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.840 | $ 446 |
| 2016 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.792 | $ 421 |
| 2017 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.747 | $ 397 |
| 2018 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.705 | $ 375 |
| 2019 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.665 | $ 353 |
| 2020 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.627 | $ 333 |
| 2021 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.592 | $ 314 |
| 2022 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.558 | $ 297 |
| 2023 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.527 | $ 280 |
| 2024 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.497 | $ 264 |
| 2025 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.469 | $ 249 |
| 2026 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.442 | $ 235 |
| 2027 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.417 | $ 222 |
| 2028 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.394 | $ 209 |
| 2029 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.371 | $ 197 |
| 2030 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.350 | $ 186 |
| 2031 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.331 | $ 176 |
| 2032 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.312 | $ 166 |
| 2033 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.294 | $ 156 |
| 2034 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.278 | $ 147 |
| 2035 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.262 | $ 139 |
| 2036 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.247 | $ 131 |
| 2037 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.233 | $ 124 |
| 2038 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.220 | $ 117 |
| 2039 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.207 | $ 110 |
| 2040 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.196 | $ 104 |
| 2041 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.185 | $ 98 |
| 2042 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.174 | $ 93 |
| 2043 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.164 | $ 87 |
| 2044 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.155 | $ 82 |
| 2045 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.146 | $ 78 |
| 2046 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.138 | $ 73 |
| 2047 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.130 | $ 69 |
| 2048 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.123 | $ 65 |
| 2049 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.116 | $ 62 |
| 2050 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.109 | $ 58 |
| 2051 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.103 | $ 55 |
| 2052 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.097 | $ 52 |
| 2053 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.092 | $ 49 |
| 2054 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.087 | $ 46 |
| 2055 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.082 | $ 43 |
| 2056 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.077 | $ 41 |
| 2057 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.073 | $ 39 |
| 2058 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.069 | $ 36 |
| 2059 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.065 | $ 34 |
| 2060 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.061 | $ 32 |
| 2061 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.058 | $ 31 |
| 2062 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.054 | $ 29 |
| 2063 | Increased instream flows | acre-feet | 0 | 6.9 | 6.9 | $ 77.00 | $ 531.30 | 0.051 | $ 27 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | $ 7,427 |

Comments: This benefit assumes reduced diversions of 6.9 acre feet per year from Dutch Bill Creek, arising from a rainwater catchment system on a dairy farm, offstream storage during high flows for irrigation, and conservation practices.

| Table 15.3-523 – Annual Benefit: Avoided Sediment Deposition (All benefits should be in 2012 dollars) Project: 523 - Gold Ridge Resource Conservation District, Coastal Watersheds Enhancement Project | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
| Year | Type of Benefit | Measure of Benefit (Units) | Without Project | With Project | Change Resulting from Project (e) – (d) | Unit $ Value | Annual $ Value (f) x (g) | Discount Factor | Discounted Benefits (h) x (i) |
| 2012 | Reduced Sediment Deposits | tons | 0 | 0 | 0 | $ 9.90 | $ - | 1.000 | $ - |
| 2013 | Reduced Sediment Deposits | tons | 0 | 0 | 0 | $ 9.90 | $ - | 0.943 | $ - |
| 2014 | Reduced Sediment Deposits | tons | 0 | 0 | 0 | $ 9.90 | $ - | 0.890 | $ - |
| 2015 | Reduced Sediment Deposits | tons | 0 | 64 | 64 | $ 9.90 | $ 633.60 | 0.840 | $ 532 |
| 2016 | Reduced Sediment Deposits | tons | 0 | 64 | 64 | $ 9.90 | $ 633.60 | 0.792 | $ 502 |
| 2017 | Reduced Sediment Deposits | tons | 0 | 64 | 64 | $ 9.90 | $ 633.60 | 0.747 | $ 473 |
| 2018 | Reduced Sediment Deposits | tons | 0 | 64 | 64 | $ 9.90 | $ 633.60 | 0.705 | $ 447 |
| 2019 | Reduced Sediment Deposits | tons | 0 | 64 | 64 | $ 9.90 | $ 633.60 | 0.665 | $ 421 |
| 2020 | Reduced Sediment Deposits | tons | 0 | 64 | 64 | $ 9.90 | $ 633.60 | 0.627 | $ 398 |
| 2021 | Reduced Sediment Deposits | tons | 0 | 64 | 64 | $ 9.90 | $ 633.60 | 0.592 | $ 375 |
| 2022 | Reduced Sediment Deposits | tons | 0 | 64 | 64 | $ 9.90 | $ 633.60 | 0.558 | $ 354 |
| 2023 | Reduced Sediment Deposits | tons | 0 | 64 | 64 | $ 9.90 | $ 633.60 | 0.527 | $ 334 |
| 2024 | Reduced Sediment Deposits | tons | 0 | 64 | 64 | $ 9.90 | $ 633.60 | 0.497 | $ 315 |
| Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) | | | | | | | | | $ 4,150 |
| Comments: Sediment reduction from implementation of four small-scale landowner intiated sediment reduction projects. Value is the average value for the Russian River watershed. | | | | | | | | | |

## Section D3. Project Costs

The present value of the project's costs, which would occur between 2012 and 2014, is $1,237,269 in 2012 dollars, discounted at a 6-percent annual rate. These costs would fund labor, planning, equipment, and materials necessary to implement the project.[34]

| Table 19-523 – Annual Costs of Project (All costs should be in 2012 Dollars) Project: 523 - Gold Ridge Resource Conservation District, Coastal Watersheds Enhancement Project | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Initial Costs Grand Total Cost from Table 7 (row (i), column (d)) | Adjusted Grant Total Cost | 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 | $ 136,000 | | | | | | | $ 136,000 | 1.000 | $ 136,000 |
| 2013 | $ 593,750 | | | | | | | $ 593,750 | 0.943 | $ 560,142 |
| 2014 | $ 608,000 | | | | | | | $ 608,000 | 0.890 | $ 541,118 |
| Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries | | | | | | | | | | $ 1,237,259 |
| Comments: | | | | | | | | | | |

[34] We have distributed the costs outlined Table 7 across the project's implementation period based on the expected timing and phasing described in the Work Plan. Actual distribution of costs during this period may differ somewhat.

## Summary: Benefits and Costs of the NCRIWMP Proposal Package

Table 20, on the following page, summarizes the benefits and costs of the thirteen projects included in the Proposition 84, Round 2 NCRIWMP Proposal Package. Each row shows, for each project, the total present value of the monetizable project costs, total present value of the monetizable project benefits, and summarizes the non-monetizable benefits.

Many of the projects in this proposal package would produce benefits by enhancing ecosystem services. It is important to consider both the monetary and non-monetary benefits together when evaluating the economic efficiency of these projects. Our monetary estimates of environmental benefits likely underestimate the true value insofar as the studies on which we base the estimates have examined the value of specific ecosystem goods and services in isolation, overlooking the cumulative value provided to human society by the ecosystem as a whole. Both ecologists and economists have recognized the importance of the integrated, composite workings of ecosystems, but both disciplines have yet to develop reliable techniques for describing, let alone measuring their value (Millennium Ecosystem Assessment 2005). In effect, then, our estimates give only a partial view of the total value of improvements in environmental quality.

To further buttress our belief that our non-market estimates of value probably underestimate the true value of the potential benefits from protecting and enhancing the environment, we turn to the National Research Council's review of methods for valuing the goods and services produced by water-related ecosystems. Based on its assessment, the report concluded,

> "**There is a much greater danger of underestimating the value of ecosystem goods and services than over-estimating their value**. Under-estimation stems primarily from the failure to include in the value estimates all of the affected goods and services and/or all of the sources of value, or from use of a valuation method that provides only a lower bound estimate of value. In many cases, this reflects the limitations of the available valuation methods. Over-estimation, on the other hand, can stem from double-counting or from possible biases in valuation methods. However, it is likely that in most applications the errors from omission of relevant components of value will exceed the errors from over-estimation of the components that are included (National Research Council 2004, p. 242)."

We believe this conclusion applies in this instance: the likelihood that we have underestimated the benefits of the projects is far greater than the likelihood that we have overestimated them.

| Table 20 – Proposal Benefits and Costs Summary[1]<br>Proposal: North Coast IRWM | | | |
|---|---|---|---|
| **Project and Project Proponent** | **Total Present Value Monetized Costs** | **Total Present Value Monetized Benefits** | **Non-Monetized Benefits Summary** |
| 101 - Big Rock CSD Stabilize Water Storage Tank | $1,375,489 | $22,159,362 | 2. Social, recreation, or access benefits: Avoided loss of access and water service disruptions to facilities<br>4. Promote social health and safety: Avoid damage and harm from disrupted emergency services<br>5. Other social benefits: Avoided costs of emergency repairs<br>6. Benefit wildlife or habitat: Value of improving damage to salmonid habitat<br>7. Improve water quality: Avoided costs of sediment and debris loading |
| 320 - Mendocino RCD, Working Landscapes Riparian Enhancement Project | $369,908 | $73,976 | 1. Education or technology: Demonstrate effective best practices<br>2. Social recreation or access benefits: Enhance amenity values for recreationalists<br>5. Other social benefits: Cultural importance associated with increases in salmon populations<br>6. Benefit wildlife or habitat: Passive-use value associated with increases in salmon populations |
| 522 - Gualala River Sediment Reduction Program: Lower Rockpile Creek Planning Watershed | $469,330 | $543,091 | 2. Social recreation or access benefits: Enhance the value of sportfishing<br>5. Other social benefits: Cultural importance associated with increases in salmon populations<br>6. Benefit wildlife or habitat: Passive-use value associated with improved salmon populations |
| 421 - Siskiyou County Septage Pond Closure | $493,347 | $137,504 | 3. Avoid, reduce or resolve various public water resources conflicts: Remove a highly contentious and long standing source of pollution<br>4. Promote social health and safety: Reduce contact with bacteria and other pollutants<br>6. Benefit wildlife or habitat: Passive-use values associated with improved salmon populations<br>7. Improve water quality: Reduce risk of groundwater contamination<br>9. Provide other environmental benefits: Avoided costs by reducing regulated pollutants<br>10. Improve the overall, long-term management of California groundwater resources: Reduce risk of groundwater contamination<br>15. Other: Avoided costs associated with reduced fertilizer purchases |
| 739 - Karuk Tribe, Lower Mid-Klamath Habitat Protection-Road Decommissioning Implementation Project | $324,303 | $1,523,612 | 4. Promote social health and safety: Reduce risk from landslides<br>5. Have other social benefits: Cultural importance associated with increases in salmon populations<br>6. Benefit wildlife or habitat: Passive-use value associated with improved salmon populations<br>7. Improve water quality: Avoided costs by reducing regulated pollutants |
| 740 - Yurok Tribe, Restoration of Lower Klamath River Habitats | $1,125,250 | $877,161 | 1. Education or technology: Enhance public understanding of environmental issues<br>5. Other social benefits: Reduce wood piracy and Enhance cultural use value associated with increases in salmon populations<br>7. Improve water quality: Enhance use and non-use values of groundwater |
| 635 - Salyer Mutual Water Company, Distribution System and Hydrants | $193,724 | $375,769 | 4. Promote social health and safety: Reduce risk of fire damage and loss of life<br>7. Improve water quality: Reduce cost associated with boil water advisory |
| 636 - Trinity County RCD, West Weaver Creek - Channel and Floodplain Rehabilitation | $493,370 | $2,911,606 | 1. Education or technology: Demonstration of new monitoring methodology<br>5. Other social benefits: Cultural use values associated with increases in salmon populations<br>10. Improve the overall, long-term management of California groundwater resources: Enhance use and non-use values of groundwater |

| Table 20 – Proposal Benefits and Costs Summary[1]<br>Proposal: North Coast IRWM | | | |
|---|---|---|---|
| **Project and Project Proponent** | **Total Present Value Monetized Costs** | **Total Present Value Monetized Benefits** | **Non-Monetized Benefits Summary** |
| 206 - Humboldt Municipal Water District, Ranney Collectors 1 & 1A Lateral Replacement | $1,470,164 | $1,739,142 | 2. Social recreation or access benefits: Protect instream flows for recreation<br>6. Benefit wildlife or habitat: Protect passive-use value associated with increases in salmon populations<br>10. Improve the overall, long-term management of California groundwater resources: Reduced localized impacts to aquifer<br>14. Improve water supply reliability: Reduced risk of shortage to HBMWD customers during periods of peak demand |
| 215 - Westhaven CSD Water Tank | $367,405 | $236,588 | 4. Promote social health and safety: Reduced levels of harmful pollutants in drinking water<br>7. Improve water quality: Reduce levels of harmful pollutants in drinking water<br>14. Improve water supply reliability: Reduced risk of periodic shortage during peak demand associated with limited tank capacity |
| 316 - CLSI, Fish Friendly Farming & Ranching Environmental Certification in the Russian, Navarro, & Gualala River Watersheds | $824,649[2] | $3,786,899 | 1. Enhanced human and social capital<br>3. Avoid water resources conflicts: Increased water supply from conservation<br>6. Benefit wildlife or habitat: Passive use values for salmonid populations<br>8. Net emissions: Enhanced carbon sequestration |
| 317 - CLSI, Russian River Watershed Agricultural Water Conservation & Water Supply Reliability Program | $4,357,393 | $176,020 | 3. Help avoid public water resources conflicts: Reduce conflict associated with frost control withdrawals<br>5. Other social benefits: Contribute to reduced risk and cost of unauthorized discharges and cost of conducting studies of effluent impact<br>6. Other wildlife benefits: Passive use values associated with salmon populations<br>7. Improve water quality: Reduce costs to downstream users by limiting discharge of regulated pollutants<br>12. Provide long term solution in place of short term one: Using effluent to satisfy beneficial uses of scare surface water supplies<br>14. Improve water supply reliability: Enhance reliability of water supplies for frost control purposes |
| 523 - Gold Ridge RCD Coastal Watersheds Enhancement Project | $1,237,259 | $1,468,806 | 1. Provide education and technology benefits: Enhance human and social capital<br>5. Other social benefits: Cultural use value associated with enhanced salmonid populations<br>14. Improve water supply reliability: Create additional water supplies by capturing water during high flows for use during dry periods |
| **Total Proposal Package** | **$13,101,591** | **$36,009,536** | **Many non-monetized benefits**<br>**(see explanation in summary above regarding uncertainty in valuing environmental benefits)** |

Notes:[1]All projects were analyzed using the benefit-cost framework outlined Sections D2 and D3 of the Proposal Solicitation Package (DWR 2012). We did not use the cost-effectiveness framework outlined in Section D1, so we do not include that column in these summary results. We also did not conduct a flood benefits reduction analysis, as described in Section D4, so we omit that column as well.

[2]This cost does not include the farmers' share of the costs to implement the BMPs. Total costs to achieve stated benefits would be somewhat higher. See narrative for more information.

## References

Barakat & Chamberlin, Inc. 1994. The Value of Water Supply Reliability: Results of a Contingent Valuation Survey of Residential Customers. California Urban Water Agencies. August.

Brown, T.C. 2007. "The Marginal Economic Value of Streamflow from National Forests: Evidence from Western Water Markets." In: M. Furniss, C. Clifton, and K. Ronnenberg, eds. Advancing the Fundamental Sciences: Proceedings of the Forest Service National Earth Sciences Conference, San Diego, CA, 18-22 October 2004. Gen. Tech. Rep. PNW-GTR-689. Portland, OR: U.S. Forest Service, Pacific Northwest Research Station. p. 458-466. Updated to 2012 dollars using the update factors in table 14 of the *Implementation Package.*

California Air Resources Board. 2012. California Cap-and-Trade Program Implementation. Frequently Asked Questions. June 25, 2012

The California Department of Fish and Game. 2004. *Recovery Strategy for California Coho Salmon: Report to the California Fish and Game Commission*. Species Recovery Strategy 2004-1. February.

California Department of Fish and Game. 2006. *Stream Inventory Report.* April 14.

California Office of Environmental Health Hazard Assessment. No date. *Proposition 65 FAQ.* Accessed 17 March 2013, from: http://oehha.ca.gov/prop65/p65faq.html.

California State Water Resources Control Board. 2011. "Frost Protection Regulation." *Water Issues.* Retrieved March 22, 2013, from http://www.waterboards.ca.gov/waterrights/water_issues/programs/hearings/russian_river_frost/

Chiabai, A., C. Travisi, H. Dine, et al. 2009. *Economic Valuation of Forest Ecosystem Services' Methodology and Monetary Estimates.* Fondazione Eni Enrico Mattei Working Paper No. 2009. 12.

Crutchfield, S.R., J.C. Cooper, D. Hellerstein. 1999. *Benefits of Safer Drinking Water: The Value of Nitrate Reduction*. U.S. Department of Agriculture, Economic Research Service, Food and Consumer Economics Division. Agricultural Economic Report No. 752.

Environmental Working Group (EWG). 2012. *Dibutyl phthalate.* Accessed 17 March 2012, from: http://www.ewg.org/skindeep/ingredient/701929/DIBUTYL_PHTHALATE/.

Federal Emergency Management Agency (FEMA). 2009. *BCA Reference Guide.* June. Retrieved March 18, 2013, from

Giessow, J., J. Casanova, R. Leclerc, and D. Johnson. 2011. *Arundo donax: Distribution and Impact Report*. California Invasive Plant Council and California State Water Resources Control Board. March. Retrieved March 18, 2013, from http://www.cal-ipc.org/ip/research/arundo/Arundo%20Distribution%20and%20Impact%20Report_Cal-IPC_March%202011.pdf

Hansen, L. and M. Ribaudo. 2008. *Economic Measures of Soil Conservation Benefits*. U.S. Department of Agriculture, Economic Research Service, Technical Bulletin Number 1922.

Intergovernmental Panel on Climate Change (IPCC). 2007. Climate Change 2007: Synthesis Report. IPCC, Geneva, Switzerland.

Jackson, T. and N. Manji. 2007. *California Steelhead Fishing Report-Restoration Card*. State of California Resources Agency, Department of Fish and Game. July.

Klamath Riverkeeper. 2009. *Notice of Violation and Intent to Seek a Preemptory Writ of Mandate Ordering Siskiyou County to Immediately Act to Comply with its Mandatory Duties under Porter-Cologne Act Section 13260.* October 13.

Kleven, M. 2010. "Assessing Affordability." *The Source: Utility Enterprise Management.* Retrieved March 22, 2013, from http://www.ae2snexus.com/TheSource/2010/November/AssessingAffordability.htm

Kronick, Moskovitz, Tiedemann & Girard. 2012. *Judge Declares Russian River Frost Protection Regualtion Constitutionally Void.* September 27. Retrieved March 22, 2013, from http://www.jdsupra.com/legalnews/judge-declares-russian-river-frost-prote-53650/

Loomis, J. 1996. "Measuring the economic benefits of removing dams and restoring the Elwha River: Results of a contingent valuation survey." *Water Resources Research* 32(2): 441-447.

Mader, S. 2007. Climate Project: Carbon Sequestration and Storage by California Forests and Forest Products. Technical Memorandum prepared by CH2M Hill, Inc, on behalf of California Forests for The Next Century. 35 p.

Malloy, R.P. 1992. "Letters from the Longhouse: Law, Economics, and Native American Values." Wisconsin Law Review 1992: 1569.

Masden, T. and E. Figdor. 2007. *When it Rains, it Pours.* Environment America Research and Policy Center and Frontier Group.

Millennium Ecosystem Assessment. 2005. Ecosystems and Human Well-Being: Synthesis. Washington, DC.: Island Press.

National Fish and Wildlife Foundation. 2009. *Business Plan for the Russian River Coho.* March 24.

National Marine Fisheries Service. 2009. *Frost Protection and Salmonids: A threat assessment review and recommendations for future action.* National Oceanic and Atmospheric Administration.

National Research Council, Committee on Valuing Groundwater (CVG). 1997. *Valuing Groundwater: Economic Concepts and Approaches*. Water Science and Technology Board, Commission on Geosciences, Environment, and Resources, National Research Council. National Academy Press: Washington, D.C.

National Research Council, Committee on Assessing and Valuing the Services of Aquatic and Related Terrestrial Ecosystems. 2004. Valuing Ecosystem Services: Toward Better Environmental Decision-Making. Washington, D.C.: National Academies Press.

Nordhaus, W. 2008. *A Question of Balance: Weighing the Options on Global Warming Policies*. New Haven: Yale University Press.

Norgaard, K.M. 2005. *The Effects of Altered Diet on the Health of the Karuk People.* November. Retrieved March 18, 2013, from http://karuk.us/press/2005/Health%20Effects%20of%20Altered%20Diet.pdf

North Coast Regional Water Quality Control Board. 2009. *Letter to Siskiyou County.* October 7.

North Coast Regional Water Quality Control Board. 2011. *Work Plan to Control Excess Sediment.* Accessed 14 March 2013, from: http://www.waterboards.ca.gov/northcoast/water_issues/ programs/tmdls/sediment_workplan/

North Coast Regional Water Quality Control Board. 2012. *Russian River TMDLs*. Retrieved March 22, 2013, from http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/russian_river/

Olsen, D., J. Richards, and R. Scott. 1991. "Existence and sport values for doubling the size of Columbia River Basin salmon and steelhead runs." *Rivers* 2(1): 44-56.

Pate, J. and J. Loomis. 1997. "The effect of distance on willingness to pay values: a case study of wetlands and salmon in California." *Ecological Economics* 20(3): 199-207.

Reclamation. 2012. *Yurok Tribe Sociocultural/Socioeconomics Effects Analysis Report for the Secretarial Determination on Whether to Remove Four Dams on the Klamath River in California and Oregon*. Retrieved March 5, 2013. Available online, from: www.klamathrestoration.gov.

Schoenig, S. (ed.) 2005. *California Noxious & Invasive Weed Action Plan*. California Department of Food and Agriculture and California Invasive Weed Awareness Coalition. September.

Shaw, R. et al, 2009. *The Impact of Climate Change on California's Ecosystem Services*. August.

State of California. 2010. *Final Staff Report for the Klamath River Total Maximum Daily Loads (TMDLs) Addressing Temperature, Dissolved Oxygen, Nutrient, and Microcystin Impairments in California: The Proposed Site Specific Dissolved Oxygen Objectives for the Klamath River in California and the Klamath River and Lost Plains Implementation Plans.* North Coast Regional Water Quality Control Board. Santa Rosa, California.

Sun, H.S., J.C. Bergstrom, and J. Dorfman,. 1992. "Estimating the benefits of groundwater contamination control." *Southern Journal of Agricultural Economics.* December. Dollars updated to 2012 using the Consumer Price Index.

U.S. Census Bureau. 2005-2011. DP04 Selected Housing Characteristics. American Community Survey.

U.S. Census Bureau. 2007-2011. State and County QuickFacts. Data derived from Population Estimates, American Community Survey, Census of Population and Housing, State and County Housing Unit Estimates, County Business Patterns, Nonemployer Statistics, Economic Census, Survey of Business Owners, Building Permits, Consolidated Federal Funds Report. Retrieved March 18, 2013, from http://http://quickfacts.census.gov/qfd/states/06000.html

U.S. Environmental Protection Agency (EPA). No date. *Basic Information about Disinfection Byproducts in Drinking Water: Total Trihalomethanes, Haloacetic Acids, Bromate, and Chlorite.* Accessed 17 March 2013, from: http://water.epa.gov/drink/contaminants/basicinformation/disinfectionbyproducts.cfm.

U.S. Environmental Protection Agency, Office of the Administrator, Science Advisory Board. 2009. Valuing the Protection of Ecological Systems and Services: A Report of the EPA Science Advisory Board. Report No. EPA-SAB-09-012. May. Retrieved March 26, 2013, from http://yosemite.epa.gov/sab/sabproduct.nsf/WebBOARD/SAB-09-012/$File/SAB%20Advisory%20Report%20full%20web.pdf

U.S. Environmental Protection Agency (EPA). 2010. Guidelines for Preparing Economic Analyses. Report No. EPA 240-R-10-001. December.

U.S. Environmental Protection Agency (EPA). 2012. *Mortality Risk Valuation*. Accessed on 21 March 2013, from: http://yosemite.epa.gov/ee/epa/eed.nsf/pages/MortalityRiskValuation.html. Updated to 2012 dollars using the update factors in Table 14 of the *Implementation Package.*

U.S. Geological Survey. 2010. *Scientific Investigations Report Upper Klamath Basin*. April.