Attachment 8.1 – Supporting Documents

Water Quality and Other Expected Benefits

Madera Region – IRWM Implementation Grant Application

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Attachment 8.1, Project B – Ash Slough Arundo Eradication and Sand Removal

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Project B – Ash Slough Arundo Eradication and Sand Removal

This project will have a substantial impact on the ecosystem and habitat of the Ash Slough targeted area, particularly the 90 acres which will be treated for the current severe Arundo infestation. It is not possible for the project proponent to quantify the benefit of this impact or its dollar value. But such benefits can be qualitatively established based on assessment of current conditions and scientifically accepted information on the ecosystem impacts of such infestations.

a. Without Project Physical Conditions: According to the National Biological Information Infrastructure (NBII) & IUCN/SSC Invasive Species Specialist Group (ISSG), *Arundo donax* is one of the 100 'world's worst' invaders. Dense populations of *Arundo donax* affect riversides and stream channels, compete with and displace native plants, interfere with flood control, and are extremely flammable increasing the likelihood and intensity of fires. Arundo may establish an invasive plant-fire regime as it both causes fires and recovers from them 3-4 times faster than native plants. It is also known to displace and reduce habitats for native species including the Least Bell's Vireo (Vireo bellii), a state and federally endangered species. Its long, fibrous, interconnecting root mats of giant reed form a framework for debris behind bridges, culverts, and other structures that can affect their function and disturb ecosystems. With its rapid growth rate, estimated 2-5 times faster than native competitors, and vegetative reproduction, it is able to quickly invade new areas and form pure stands. Once established, Arundo has the ability to outcompete and completely suppress native vegetation, reduce habitat for wildlife, and inflict drastic ecological change (Benton *et al*, 2006; McWilliams, 2004; Ambrose and Rundel, 2007; Rieger & Keager, 1989). (see Attachment 8.2, page 3)

The physical condition in question – the infestation of Arundo - can be viewed in Attachment 8.2, page 9 – photos of Arundo in Ash Slough.

b. With Project Physical Conditions: The acreage of Arundo that will be eradicated is estimated based on the average width of the slough (including inner and outer banks, since Arundo often spreads out to the surrounding lands (see Attachment 8.2, page 7 – photos of Arundo*)*. The width of Ash Slough within the target area ranges from 350 to 650 feet but is conservatively estimated at 300 ft. *(*See Attachment 8.2, page 13 – County GIS map of Ash Slough) Arundo infestations can range in density from the entire slough width to sparse patches. For purposes of determining acreage we are assuming an average 1/2 of the slough is infested (150 feet). That leads to a figure of 90 acres (150 x 5280 x 5 = 5,280,000/43560[1] = 90.9 acres). Clearly this figure is an estimate, and this lack of reliable quantitative documentation makes it difficult to put a dollar value to these habitat benefits. The first year benefit of 50 acres is based on experience with previous Arundo eradication projects where approximately 50 – 60% of the Arundo is killed from the first year treatment and approximately 90% is killed after the second year treatment.

[1] 43560 = number of square feet/acre

c. Methods used to estimate without and with project conditions. The methods used to estimate the change in ecosystem restoration value with Arundo eradication is based on standard protocols for Arundo treatment. (see Attachment 6.2, page 3).

d. Description of local, regional, and statewide benefits. The majority of the ecosystem restoration benefit is local to the area treated. Eradication of Arundo prevents its downstream spread, however downstream waterways are already infested with Arundo and this project will not have a significant benefit unless this infestation should be eradicated in the future, at which time the benefit will consist of reduction in danger of re-infestation.

e. Beneficiaries. *Arundo* grows so thickly that it chokes out habitat for birds and mammals. Since it lacks a canopy, it also reduces waterway shading leading to hotter water temperatures, which can harm habitat for insects. Increasing the acreage of native vegetation will result in a net increase in habitat, both for migratory and resident species.

Several special status species are likely to benefit from habitat enhancement and *Arundo* control on the site. Restoration of riparian areas can improve the habitat for the following species:

- Western Yellow-billed cuckoo (*Coccyzus americanus occidentalis*), a federal candidate species
- Southwestern willow flycatcher (*Empidonax traillii extimus*) a state and federally endangered species
- Least Bell's vireo (*Vireo bellii pusillus*), a state and federally endangered species
- Swainson's hawk (*Buteo swainsonii*), a state threatened species.

(see Attachment 3.2, page 71)

It is difficult in most cases to set a dollar value for habitat restoration. This has led us not to claim financial benefits from the improvement in habitat. However, there will be an undeniable qualitative benefit to the target area.

f. When benefits will be received. Table 16 starts the benefits in 2012. The actual treatment will start in 2011, however it is not until the next spring that the benefits are obtained, when native vegetation can grow into the space left from the effectively treated Arundo.

g. Uncertainty associated with the benefits. There is uncertainty as to the exact percentage of Arundo that will be eradicated in each of the three treatment years. In the long run, however, this will make very little difference since maintenance of the project will eradicate any small stands of Arundo which remain or re-grow after the treatment period.

h. Adverse effects. The proposed treatment is standard for Arundo infestations in waterways. (see Attachment 8.2, page 3) The treatments will follow the requirements of the 1602 Stream Bed Alteration Permit, which protects nesting birds, desirable vegetation, and other desirable ecosystem characteristics. (see Attachment 5.2, page 3)

Table 16 - Water Quality and Other Expected Benefits

(All benefits should be in 2009 dollars)

Project: Project B - Ash Slough Arundo Eradication and Sand Removal Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit (Units)	Without Project	With Project	Change Resulting from Project (e) – (d)	Unit $ Value (1)	Annual $ Value (f) x (g) (1)	Discount Factor (1)	Discounted Benefits (h) x (i) (1)
2012	ecosystem restoration	acres	0	50	50		$0	1.000	$0
2013	ecosystem restoration	acres	0	80	80		$0	0.943	$0
2014	ecosystem restoration	acres	0	90	90		$0	0.890	$0
2015	ecosystem restoration	acres	0	90	90		$0	0.890	$0
2016	ecosystem restoration	acres	0	90	90		$0	0.890	$0
2017	ecosystem restoration	acres	0	90	90		$0	0.890	$0
Project Life	ongoing		0	90	90			…	
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) Transfer to Table 20, column (f), Exhibit F: Proposal Costs and Benefits Summaries									

Comments: The estimated project life is 50 years, however after the initial year the benefits will be the same - ecosystem restoration in 90 acres - so the additional rows have not been added to the chart.

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

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Attachment 8.1, Project C – Cottonwood Creek, Dry Creek, and Berenda Creek Arundo Eradication and Sand Removal

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Project C – Cottonwood, Dry and Berenda Creek Arundo Eradication and Sand Removal

I. Narrative of the Project's Expected Water Quality Benefits

This project will have a substantial impact on the ecosystem and habitat of Cottonwood Creek, Berenda Creek, and Dry Creek target areas, particularly the 300 acres which will be treated for the current severe Arundo infestation. It is not possible for the project proponent to quantify the benefit of this impact or its dollar value. But such benefits can be qualitatively established based on assessment of current conditions and scientifically accepted information on the ecosystem impacts of such infestations.

The *Arundo* infestation and excessive sedimentation cause a number of water quality issues. The project will benefit water quality the following ways:

- Improved flood flows through this area will reduce the amount of erosion and improve water quality. In addition, removal of invasive plant species will allow for native vegetation to establish itself and provide food and cover for wildlife, particularly species of concern. Increasing wildlife habitat, increasing water availability, reducing erosion, and enhancing water quality will meet the program's goal of Ecosystem Restoration.

- MID's proposal also meets the Statewide Priority **"Protect Surface Water Quality and Groundwater Quality".** By removing sediment and Arundo, which are currently choking these three creeks, flooding potential is minimized. By reducing the amount of flooding that will occur surface water quality will be protected because when flood flows retreat from upper elevations, they carry with them invasive plant seed, sediment, nutrients, and other harmful elements.

- Arundo provides little shade for animals and little protection from the weather. The lack of canopy allows sunlight to raise the water temperature, additionally reducing the quality and quantity of habitat for fish and rapid evaporation of water resources.

The measure of these benefits cannot be effectively estimated, so they are not included on Table 16.

a. Without Project Physical Conditions According to the National Biological Information Infrastructure (NBII) & IUCN/SSC Invasive Species Specialist Group (ISSG), *Arundo donax* is one of the 100 'world's worst' invaders. Dense populations of *Arundo donax* affect riversides and stream channels, compete with and displace native plants, interfere with flood control, and are extremely flammable increasing the likelihood and intensity of fires. *A. donax* may establish an invasive plant-fire regime as it both causes fires and recovers from them 3-4 times faster than native plants. It is also known to displace and reduce habitats for native species including the Least Bell's Vireo (Vireo bellii), a state and federally endangered species. Its long, fibrous, interconnecting root mats of giant reed form a framework for debris behind bridges, culverts, and other structures that can affect their function and disturb ecosystems. With its rapid growth rate, estimated 2-5 times faster than native competitors, and vegetative reproduction, it is able to quickly invade new areas and form pure stands. Once established, *A. donax* has the ability to outcompete and completely suppress native vegetation, reduce habitat for wildlife, and inflict drastic ecological change (Benton *et al*, 2006; McWilliams, 2004; Ambrose and Rundel, 2007; Rieger & Keager, 1989). (see Attachment 8.3, page 3)

The physical condition in question – the infestation of Arundo - can be viewed in Attachment 8.2-2 – photos of Arundo in Cottonwood Creek.

<u>b. With Project Physical Conditions</u> Arundo infestations can range in density from the entire creek's width to sparse patches. For purposes of determining acreage we are assuming an average width of 150' of Arundo infestation and that is over 17 miles of creek. That leads to a figure of approximately 300 acres (17 miles x 5280'/mile x 150' = 13,464,000/43560 square feet/acre = 309.1 acres). This estimate was based on the most current aerial photography available. It is difficult in most cases, to set a dollar value for habitat restoration. This has led us not to claim financial benefits from the improvement in habitat. However, there will be an undeniable qualitative benefit to the target area.

<u>c. Methods used to estimate without and with project conditions</u> The methods used to estimate the change in ecosystem restoration value with Arundo eradication is based on standard protocols for Arundo treatment.

<u>d. Description of local, regional, and statewide benefits</u> The majority of the ecosystem restoration benefit is local to the area treated. Eradication of Arundo prevents its downstream spread, however downstream waterways are already infested with Arundo and this project will not have a significant benefit unless this infestation should be eradicated in the future, at which time the benefit will consist of reduction in danger of re-infestation.

<u>e. Beneficiaries</u> *Arundo* grows so thickly that it chokes out habitat for birds and mammals. Since it lacks a canopy, it also reduces waterway shading leading to hotter water temperatures, which can harm habitat for insects. Increasing the acreage of native vegetation will result in a net increase in habitat, both for migratory and resident species.

Several special status species are likely to benefit from habitat enhancement and *Arundo* control on the site. Restoration of riparian areas can improve the habitat for the following species:

- Western Yellow-billed cuckoo (*Coccyzus americanus occidentalis*), a federal candidate species
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- Least Bell's vireo (*Vireo bellii pusillus*), a state and federally endangered species
- Swainson's hawk (*Buteo swainsonii*), a state threatened species.

It is difficult in most cases to set a dollar value for habitat restoration. This has led us not to claim financial benefits from the improvement in habitat. However, there will be an undeniable qualitative benefit to the target area.

f. When benefits will be received. Table 16 starts the benefits in 2012. The actual treatment will start in 2011, however it is not until the next spring that the benefits are obtained, when native vegetation can grow into the space left from the effectively treated Arundo.

g. Uncertainty associated with the benefits. There is uncertainty as to the exact percentage of Arundo that will be eradicated in each of the three treatment years. In the long run, however, this will make very little difference since maintenance of the project will eradicate any small stands of Arundo which remain or re-grow after the treatment period.

h. Adverse effects. The proposed treatment is standard for Arundo infestations in waterways. (see Attachment 8.3, page 3). The treatments will follow the requirements of the 1602 Stream Bed Alteration Permit, which protects nesting birds, desirable vegetation, and other desirable ecosystem characteristics.

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Table 16 - Water Quality and Other Expected Benefits (All benefits should be in 2009 dollars) Project: Project C - Cottonwood, Dry, and Berenda Creek Arundo Eradication and Sand Removal									
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit (Units)	Without Project	With Project	Change Resulting from Project (e) – (d)	Unit $ Value (1)	Annual $ Value (f) x (g) (1)	Discount Factor (1)	Discounted Benefits (h) x (i) (1)
2012	Ecosystem Restoration	Acres	0	194	194		$0	0.840	$0
2013	Ecosystem Restoration	Acres	0	300	300		$0	0.792	$0
2014	Ecosystem Restoration	Acres	0	300	300		$0	0.747	$0
2015	Ecosystem Restoration	Acres	0	300	300		$0	0.705	$0
2016	Ecosystem Restoration	Acres	0	300	300		$0	0.665	$0
Project Life	Ongoing	Acres	0	300	300		$0	…	$0
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) Transfer to Table 20, column (f), Exhibit F: Proposal Costs and Benefits Summaries									**$0**
Comments: The estimated project life is 50 years, however after the initial year the benefits will be the same - ecosystem restoration in 309 acres - so the additional rows have not been added to the chart.									

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

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Attachment 8.1, Project D – Root Creek In-Lieu Groundwater Recharge

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Project D – Root Creek In-Lieu Groundwater Recharge

The Root Creek In-Lieu Groundwater Recharge Project will offer water quality benefits and a reduction in groundwater pumping costs in the greater regional area from raised groundwater levels. The water quality benefits are difficult to quantify in economic terms, but they are discussed qualitatively below. The impact to groundwater pumping costs was quantified and is a major economic benefit of the project.

<u>Reduction in Groundwater Pumping Costs</u>

<u>Power Savings</u>
The proposed project will reduce groundwater pumping costs in the surrounding area by importing surface water that will reduce groundwater pumping demands, thus causing groundwater levels to rise.

<u>With and Without Project</u>
With the project groundwater levels will rise in the surrounding area. Without the project groundwater levels will probably continue to decline at the historical rate of at least 3 feet per year.

<u>Quantification of Benefits</u>
The benefits can be quantified by two methods: 1) Monitoring groundwater level changes; and 2) Calculating groundwater level changes based on surface water deliveries. RCWD plans to employ both methods. RCWD already has a comprehensive District-wide groundwater level monitoring program. The District prepares groundwater contour maps and can estimate the annual change in groundwater depth. This will be compared to historical trends to determine the impact from the project. RCWD will also calculate the change in groundwater level based on the surface water deliveries and avoided groundwater pumping.

<u>Area Benefitted</u>
The beneficiaries will be the residential, municipal and agricultural well pumpers in the area surrounding the project. Over time the benefitted area could include tens of square miles. The benefits will accrue throughout the life of the project, or 50 years. The benefits will also be cumulative and increase over time.

<u>Certainty of Analysis</u>
There is a fairly high certainty that these power saving benefits will be realized. As long as the surface water is delivered, there will be a reduction in groundwater pumping. The benefits could be lost if surrounding areas increase groundwater pumping, but this is unlikely since most of the area is already fully developed for agriculture and already pumps groundwater. Benefits could also be lost if the groundwater flowed out of the area. However, if this occurred it would still ultimately benefit other water users in the Central Valley. Nevertheless, to be conservative, it was assumed that the groundwater rise occurring each year lasts for only five years. In other

words, within five years the groundwater contributing to the rise in levels is either pumped or flows out of the area. This provides a conservative estimate of the power savings benefits.

Benefit Calculations

The power savings benefits are presented in Tables 16 at the end of this section. The annual power savings are estimated to be about $121,000/year. The calculations and assumptions used are provided in Attachment 8.4, page 3. The same methodology for estimating power savings was successfully used in a 2010 USBR grant application for the Delano- Earlimart Irrigation District's Turnipseed Recharge Basin.

Non-quantifiable Economic Benefits

Other economic benefits will be realized from the higher groundwater levels. These could include less need to install new wells since well yields will increase with a higher water column. Also, there will be less need to deepen wells or lower pump bowls since the historical groundwater level decline will be partially arrested. These benefits are difficult to quantify accurately so they are not included in the economic analysis. Since these benefits are not included, the economic benefit claimed is considered conservative.

Groundwater Quality Benefits

The proposed project will help improve groundwater quality by: 1) Helping to maintain groundwater levels in an area that shows a decline in groundwater quality with depth, and 2) Importing cleaner surface water that will mix with and improve the quality of the groundwater.

Groundwater Quality versus Depth

The proposed Root Creek In-Lieu Groundwater Recharge project is critically necessary because of degrading groundwater quality in southeastern Madera County. Currently the only potable water supply for the community of Rolling Hills (population approximately 1,700) is local groundwater. However, this normally reliable supply has been found to be in jeopardy. The groundwater elevations in the area have been declining for years. This has forced this community to begin leasing an existing agricultural well from a nearby landowner within Root Creek Water District (the District). Recent studies on water supply and quality have shown that the quality of local groundwater degrades with increasing depth to groundwater.

In the most recent water quality investigation for the District, water samples were obtained from 15 wells. The wells that were sampled are shown in Attachment 8.4, page 7. Well locations were chosen so that groundwater from a broad area of the District was tested, including both shallow and deep wells. A copy of the test results is included in Attachment 8.4, page 11. Contaminants such as manganese, arsenic, and heterotrophic plate count (indicative of slime forming organisms) were shown to be limiting to the usefulness of this supply at certain depths. Manganese concentrations in water from four wells (17, 129, 156, and 182) ranged from 0.16 to 0.63 mg/1, exceeding the recommended maximum contaminant level for drinking water of 0.05 mg/l.

An intended goal of the project is to avoid groundwater table depths greater than 365 feet. This depth is where degrading groundwater quality will begin to limit deliveries to the communities of Rolling Hills. In 2009, groundwater depths in Rolling Hills were approximately 300 feet. If the project is implemented, it will help to maintain existing groundwater levels and could prevent the need for installing treatment facilities or finding a new water supply for Rolling Hills.

<u>Importing Clean Surface Water</u>
San Joaquin River water will be diverted for the project. This water originates in the Sierra Nevada Mountains and has excellent quality for irrigation or municipal use. As previously stated, certain areas in and near the project have groundwater quality problems. Approximately 10 -15% of the imported surface water will percolate and mix with the groundwater, thus improving its overall quality.

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Table 16 - Water Quality and Other Expected Benefits

(All benefits should be in 2009 dollars)

Project: Project D - Root Creek In-Lieu Groundwater Recharge

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value (1)	(h) Annual $ Value (f) x (g) (1)	(i) Discount Factor (1)	(j) Discounted Benefits (h) x (i) (1)
2009	Power Savings				0		$0	1.000	$0
2010	Power Savings				0		$0	0.943	$0
2011	Power Savings				0		$0	0.890	$0
2012	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.840	$101,968
2013	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.792	$96,141
2014	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.747	$90,678
2015	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.705	$85,580
2016	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.665	$80,724
2017	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.627	$76,112
2018	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.592	$71,863
2019	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.558	$67,736
2020	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.527	$63,973
2021	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.497	$60,331
2022	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.469	$56,932
2023	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.442	$53,654
2024	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.417	$50,620
2025	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.394	$47,828
2026	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.371	$45,036
2027	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.350	$42,487
2028	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.331	$40,180
2029	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.312	$37,874
2030	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.294	$35,689
2031	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.278	$33,746
2032	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.262	$31,804
2033	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.247	$29,983
2034	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.233	$28,284
2035	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.220	$26,706
2036	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.207	$25,128
2037	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.196	$23,792
2038	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.185	$22,457
2039	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.174	$21,122
2040	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.164	$19,908
2041	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.155	$18,815
2042	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.146	$17,723
2043	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.138	$16,752
2044	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.130	$15,781
2045	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.123	$14,931
2046	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.116	$14,081
2047	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.109	$13,232
2048	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.103	$12,503
2049	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.097	$11,775
2050	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.092	$11,168
2051	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.087	$10,561
2052	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.082	$9,954
2053	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.077	$9,347
2054	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.073	$8,861
2055	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.069	$8,376
2056	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.065	$7,890
2057	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.061	$7,405
2058	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.058	$7,041
2059	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.055	$6,676
2060	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.052	$6,312
2061	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.049	$5,948
2062	Power Savings	$/AF	0	6,100	6,100	$19.9	$121,390	0.046	$5,584
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) Transfer to Table 20, column (f), Exhibit F: Proposal Costs and Benefits Summaries									$1,709,050

Comments: See attached spreadsheet for methodology on how costs savings from rising groundwater levels were calculated .

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

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Attachment 8.1, Project E – Sierra National Forest Fuel Reduction

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Project E – Sierra National Forest Fuels Reduction Project

The Sierra National Forest Fuels Reduction Project serves a dual purpose: reducing fuel loads and ecological restoration. The proposed treatments will result in the significant preservation of water quality, aquatic habitat, terrestrial habitat, and long-term ecological restoration. By reducing fuel loads and horizontal and lateral continuity of fuels, this project will reduce the spread, severity, and intensity of wildfires. By reducing stand density and opening up the canopy, the treatments will restore structural heterogeneity to the forest and improve ecological processes.

I. Without Project Physical Conditions

The proposed project is intended to protect and restore the hydrologic and ecologic functions of the forest. Therefore, the without project conditions are a combination of the existing conditions and the effects that could be expected in the event of a wildfire. The occurrence, size, and effects of a wildfire depend on several variables, including fuel type and loading, weather conditions at the time of the fire, slope and aspect of the land, antecedent conditions of the fuels, and the ability for firefighting personnel to either extinguish or manage the wildfire. Complex fire modeling is required to accurately predict the size and character of a fire. This type of modeling was not performed for this proposal. Rather, existing studies and geospatial information, and some simple runoff and erosion modeling is used.

a. Water Quality

The Water Quality Control Plan for The Sacramento River Basin and The San Joaquin River Basin (Basin Plan) identify water quality objectives for the project area. The water quality indicators specifically identified in the Basin Plan are Bacteria, Biostimulatory Substances, Chemical Constituents, Color, Dissloved Oxygen (DO), Floating Material, Mercury, Methylmercury, Oil and Grease, pH, Pesticides, Radioactivity, salinity, sediment, settleable material, suspended materials, taste and odor, temperature, toxicity, and turbidity. Of these indicators, sediment, DO, temperature, and turbidity could be affected by the proposed project or the occurrence of wildfire. These four indicators are also very important to aquatic organisms. Excessive fine sediments in rivers can destroy spawning habitat, smother eggs, fill in foraging pools, and result in an overall loss of habitat. Loss of canopy cover by fire can increase water temperatures and decreases DO. Temperature effects can last for decades until enough canopy cover is reestablished to provide the necessary shading.

The Madera IRWMP identifies Microbiological Contaminants (i.e. Giardia, Cryptosporidium, and Legionella) and disinfection byproducts (DBPs) as the major contaminants of concern for the San Joaquin River in the foothill/mountain area. DBPs are related to levels of Total Organic Carbon (TOC) in the raw water prior to treatment. For the Fresno River, the major concern reported was massive algae blooms in Hensley Lake (located approximately 35 miles downstream of the project). Algae blooms are of a concern due to reduced desirability of water related activites and health hazards associated with contact recreation, as well as potentially lethal effects on other aquatic life. Algae blooms can result from excessive nutrients (nitrogen and phosphorous) delivered from the watershed in solution and attached to sediments. The *Fresno River Nutrient Reduction Plan* concluded that these algae blooms were a result of in-lake processes and not from excessive nutrients from the Fresno River. Through increased erosion and introduction of ash during the first flush of the watershed after a fire, nutrient levels in the Fresno River could be expected to increase, possibly exacerbating the algae problem although how long these affects would last and how they would affect in-lake processes is not known

Post fire erosion and sediment delivery depends on the soil burn severity (which includes measures of soil cover, presence or absence of fine roots in the surface soil, and fire effects on soil structure), as well as the spatial pattern of moderate to high burn severity patches in relation to drainages. The California Department of Forestry and Fire Protection (CDF) has produced a geospatial layer of predicted post-fire erosion based on the Revised Universal Soil Loss Equation (RUSLE), existing land cover, and fuel models (CDF 2004). Based on the CDF geospatial layer, the average post-fire erosion in the project areas ranges from 3.6 to 34.9 tons/acre/year (see attachment 8.5, page 3). Grave/Yard, Swortzel, Topping, and Walker Mine all have mean values of less than 10 tons/acre/year. However, the mean here is deceiving as they all have pockets of erosion potential that are in excess of 25 tons/acre/year. It is in these pockets that treatments would take place since these are areas of high fuel loading and dense vegetation. The CDF values generally agree with values estimated with the Water Erosion Prediction Project (WEPP) model (see attachment 8.5, page 7), which calculates an average erosion and sediment delivery between 4.37 and 28.05 tons/acre for moderate and high burn severity.

For purposes of benefits claimed in Table 16, it is assumed that under the without project condition, the number of acres not treated in any given year will potentially burn at a moderate to high severity and will produce between 4.37 and 28.05 tons/acre. The average value of 16.21 tons/acre is used in Table 16. Routing of this sediment through the drainage system was not attempted. However, the production of this sediment from the burned hillsides will impact both downstream systems from fines that are flushed through the drainage network, and local aquatic habitat from in-channel deposition and storage. Increased sediment delivered downstream to Oakhurst, Bass Lake, and North Fork could result in increased costs of treatment to remove sediment and nutrients flushed off the hillsides. These costs were not estimated for this proposal.

Other water quality parameters considered but not quantified are temperature and pH. Transient short-term increase in pH can be expected as a result of ash washing off the hillslopes into local streams and aquatic habitat.

Attachment 8.5, page 13 shows the mapped habitat of Special Status aquatic species in the Madera IRWMG area within USFS lands. For the without project condition, the potential for fire and sediment to affect these habitat cannot be directly determined without extensive fire behavior modeling. At a minimum, the habitat within the project areas could be degraded as a result of increased erosion and sedimentation, increased temperatures due to loss of canopy cover, and short-term changes on water pH as a result of ash. In addition, high sediment loads in post-fire flood conditions have a much higher shear stress than clearer water flows. These floods and debris flows can rip out channel banks and riparian vegetation, resulting in channel widening and lower residual pool depths, further impairing aquatic habitat.

b. Ecosystem Restoration

The without project condition does not result in any ecosystem restoration or habitat protection. The proposed actions are to take place within overstocked plantations and areas of high fuel loading. These areas are currently low-functioning ecosystems. Attachment 3.5, page 17 shows the mapped distribution of Special Status terrestrial habitat. Protected Activity Centers (PACs) are areas that are buffered around known locations of species activity.

c. Recreation and Public Access

The Sierra National Forest (SNF) is an area of high recreational demand. The variety of landforms, elevations, climate, vegetation, and natural and man-made attractions make it rank among the top of all National Forests for recreational use (USDA-FS 1991). Demand for recreation was estimated to be 1.6 million visitor days in 1985 and projected to hit 2.1 million visitor days by 2015 (USDA-FS 1991). The SNF is bordered by two National Parks and three other National Forests. During peak recreational times, the SNF receives overflow from both Yosemite National Park and Sequoia and Kings Canyon National Park. Several reservoirs in the area also have recreational facilities that contribute to the high recreation use of the SNF. Accelerated in-filling of reservoirs is not an uncommon result of large high-severity wildfires.

II. With Project Physical Conditions

a. Water Quality

Fuel reduction activities will provide protection to water quality and aquatic habitat in the Madera IWMG region. The goal of fuel reduction projects is to bring the fuel loads down to a level where either natural or prescribed fire will burn at low intensities. At this level of burn, much of the duff and litter layer remains intact and soil hydrologic function is only minimally disrupted. WEPP model results show that at low intensity burns, sediment and erosion will increase from 0.08 tons/acre to 1.15 tons/acre (see Attachment 8.5, page 7). This is much less than the moderate to high burn rates of 4 to 28 tons/acre and represents a significant protection to water quality and aquatic habitat. In Table 16, it is assumed that areas treated will burn at a low intensity.

b. Ecosystem Restoration

SNF plantations were created by clear-cutting and planting trees at high density. The high density of planting was performed so that natural seedling mortality and future thinning would result in stand densities of mature trees that are optimal for the site conditions. These plantations are young even-aged stands with little structural heterogeneity. This type of management was efficient and economical during a time when timber production drove the management of these lands. The 2004 SNFPM ROD directs the Sierra Nevadan forests (including the Sierra National Forest) to move these plantations towards old forest characteristics:

"Where young plantations (generally Pacific Southwest Region size classes 0x, 1x, 2x) are included within area treatments, apply the necessary silvicultural and fuels treatments to: (1) accelerate the development of key habitat and old forest characteristics, (2) increase stand heterogeneity, (3) promote hardwoods, and (4) reduce risk of loss to wildland fire" (USDA-FS, 2004, pg 49).

Forest thinning and prescribed underburning create greater forest heterogeneity by partially opening the forest overstory canopy, in portions of the forest, to allow greater sunlight penetration to the forest floor. This in-turn promotes greater tree species ages as well as promotes greater herbaceous and shrub growth and age classes particularly through the first 10-20 years following treatments. This increased diversity of micro-site niches is essential for many small mammals and bird species that rely on habitats with greater sunlight penetration, and those species in-turn may provide forage for larger species, such a Pacific fisher, marten, spotted owls, and goshawks. A forest with a high degree of heterogeneity provides diversity of micro-site conditions needed by a diversity of wildlife for forage and cover.

The proposed project will result in increase vigor and resilience of the forest and long-term ecological restoration of over 3,000 acres of thinning and fuel reductions. The actual amount of habitat protected from severe wildfire depends on several factors including weather, existing conditions, and the type of treatment, but exceeds the boundaries of the actual treatment areas (Martinson and Omi 2003, Omi and Martinson 2007, Skinner et al 2004, and Stratton 2004).

d. Recreation and Public Access

There are no expected differences as a result of the project.

III. Methods Used to Estimate without- and with-project conditions

The following benefits are listed in Table 16 and were estimated as follows:

Water Quality – The results of the WEPP modeling are used to estimate tons/acre of sediment delivery based on the assumption that a wildfire will start and burn through the project areas. Since this is a relative comparison, no attempt was made to predict the location and size of fire.
For each year in Table 16, the number of acres treated was assumed to burn at a low intensity for the with-project condition, and at a moderate to high intensity for the without-project condition.

Ecological Restoration – The number of acres treated in each year are considered to have gone through restoration activities.

Aquatic Habitat Protection – No attempt was made to model how far downstream sediment and debris would be transported to affect aquatic habitat areas. Nor was there any fire behavior modeling performed. Therefore, habitat that is within the project area boundaries are considered protected from wildfire under the with-project conditions. For simplicity, all aquatic habitats are considered together, rather than on a species by species basis. On an annual basis, the acres of habitat protected are scaled by the proportion of planned treatment acres completed in that year. For example, there were 815 acres treated in 2009 out of a total of 4655. Total aquatic habitat in the project areas is 4,976 acres. Therefore, the 2009 aquatic habitat protection was 4976*(815/4655) = 871 acres of aquatic habitat protected.

Terrestrial Habitat Protection – Terrestrial habitat protection was determined in the same manner as aquatic habitat protection. For the Pacific Fisher, only areas with a probability greater than 60% were considered.

Other – see below

IV. Potential Other Benefits

A significant potential other benefit is the reduction the in the cost of fire suppression. Fire and suppression modeling for the Dinky Forest Landscape Restoration Program (USDA-FS 2010), showed that similar treatments in similar terrain and vegetation type would reduce fire suppression costs from approximately $344 per acre, to $133 per acre. The fire size frequency analysis used for Flood Reduction Benefits calculations (see Attachment 9.5, page 3) indicates a 50% annual probability of a fire of 657 acres. Therefore, in table 16, the benefit is in dollars per acre and the “unit value” was set to 0.50 * 657 = 328.5.

V. Distribution of local, regional, and statewide benefits

The water quality benefits are local to regional scale benefits. A healthy hydrologically functioning forest will continue to produce high quality water to all the local and regional water users. Ecological restoration and habitat protection will benefit users of the Forest as well as the plant and animal species that inhabit them. Visitors to the forest are from all over the state and nation. These benefits are national in scale.

VI. Identification of beneficiaries

Beneficiaries of this project include downstream water users in the cities of Oakhurst, Madera, North Fork, Bass Lake, and other visitors to the area. Aquatic and terrestrial species that will benefit from the project include the Pacific Fisher, Spotted Owl, Great Grey Owl, Goshawk, Foothill Yellow-Legged Frog, Western Pond Turtle, Mountain Yellow-Legged Frog, California Red-Legged Frog, and various species of fish that are used for game in the area waters.

VII. When the benefits will be realized

The protection of habitat and water quality from the proposed project will be realized immediately after treatment and will last between 10 and 20 years when future fuels reductions will need to take place. However, this can then be accomplished through the use of low-intensity prescribed fire at a much reduced cost indefinitely. Benefits listed in Table 16 are already realized for areas that have been treated since 2009. Ecosystem restoration will take longer. Once the canopies are opened up and the densities reduced, the time to develop micro-niche habitats and to attract a variety of wildlife that can be used as forage for larger predator species could be 10-20 years.

VIII. Uncertainty associated with the benefits

The size, intensity, and affects of the wildfire were not modeled and if they were it is expected that models of this nature would have large errors. The WEPP model has a known error of 50%, which is typical for complex physically based models. For this reason, these benefits were only quantified as a gross estimate. However values from the WEPP model and CDF maps are within the same order of magnitude, lending credibility to the estimates.

IX. Adverse Impacts

Mastication has little chance of adversely impacting water quality or other resources. The excavator walks on top of a bed of already shredded material, preventing soil compaction and disturbance. Small areas of less than 20 ft^2 of disturbance can be expected in areas where the machine turns on its tracks. These will have little impact on the soil hydrologic function.
The largest potential for adverse impact is during the dozer piling of slash. Poor operators can cause significant soil disturbance and remove too much ground cover. Forest Service Best Management Practices (BMPs) and contract requirements are used to minimize these impacts by limiting slopes on which dozers can operate to less than 35%, requiring operations on dry

ground, and by requiring contractors and operators to repair areas of excessive disturbance. Wildlife is protected through the use of Limited Operating Periods (LOPs) which operations to be conducted at times when noise would not cause a nuisance.

X. References

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Table 16 - Water Quality and Other Expected Benefits

(All benefits should be in 2009 dollars)

Project: E. Sierra National Forest Fuels Reduction

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit Value (1)	(h) Annual $ Value (f) x (g) (1)	(i) Discount Factor (1)	(j) Discounted Benefits (h) x (i) (1)
2009	WQ(S)	tons/acre	16.21	1.15	-15.06		$0		$0
	ER	acres	0	815	815		$0		$0
	AHP	acres	0	871	871		$0		$0
	THP	acres	0	3951	3951		$0		$0
	FS	$/acre	344	133	-211	328	-$69,208	1.000	-$69,208
2010	WQ(S)	tons/acre	16.21	1.15	-15.06		$0		$0
	ER	acres	0	290	290		$0		$0
	AHP	acres	0	310	310		$0		$0
	THP	acres	0	1406	1406		$0		$0
	FS	$/acre	344	133	-211	328	-$69,208	0.943	-$65,263
2011	WQ(S)	tons/acre	16.21	1.15	-15.06		$0		$0
	ER	acres	0	360	360		$0		$0
	AHP	acres	0	385	385		$0		$0
	THP	acres	0	1745	1745		$0		$0
	FS	$/acre	344	133	-211	328	-$69,208	0.890	-$61,595
2012	WQ(S)	tons/acre	16.21	1.15	-15.06				
	ER	acres	0	1150	1150				
	AHP	acres	0	1229	1229				
	THP	acres	0	5576	5576				
	FS	$/acre	344	133	-211	328	-$69,208	0.840	-$58,135
2013	WQ(S)	tons/acre	16.21	1.15	-15.06				
	ER	acres	0	1150	1150				
	AHP	acres	0	1229	1229				
	THP	acres	0	5576	5576				
	FS	$/acre	344	133	-211	328	-$69,208	0.792	-$54,813
2014	WQ(S)	tons/acre	16.21	1.15	-15.06				
	ER	acres	0	890	890				
	AHP	acres	0	951	951				
	THP	acres	0	4315	4315				
	FS	$/acre	344	133	-211	328	-$69,208	0.747	-$51,698
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) Transfer to Table 20, column (f), Exhibit F: Proposal Costs and Benefits Summaries									**-$360,712**

Comments:

1. The numbers in this table represent avoided cost, and are therefore negative. In order to make this consistent with the benefits from other projects, these number are represented in Table 20 as a positive number.

2. Abbreviations: WQ(S) - Water Quailty (sediment); ER - Ecological Restoration; AHP - Aquatic Habitat Protected; THP - Terrestial Habitat Protected; FS - Fire Suppression Costs

(1)unit value is the size of a 50% annual chance fire multiplied by the probability (0.5)

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