Attachment 3

Project Justification

North Cal-Neva Resource Conservation and Development Council, Inc.

Project Summary Table

Table 4 – 2014 IRWM Drought Solicitation Project Summary Table				
Drought Project Element		South Fork Irrigation District Infrastructure Upgrade	Ash Valley Ranch Irrigation Infrastructure Efficiency Project	Restoring Hydrologic Function in South Ash Valley
D.1	Provide immediate regional drought preparedness	√	√	√
D.2	Increase local water supply reliability and the delivery of safe drinking water			
D.3	Assist water suppliers and regions to implement conservation programs and measures that are not locally cost-effective			
D.4	Reduce water quality conflicts or ecosystem conflicts created by the drought	√	√	√
IRWM Project Element				
IR.1	Water supply reliability, water conservation, and water use efficiency	√	√	
IR.2	Stormwater capture, storage, clean-up, treatment, and management			
IR.3	Removal of invasive non-native species, the creation and enhancement of wetlands, and the acquisition, protection, and restoration of open space and watershed lands			√
IR.4	Non-point source pollution reduction, management, and monitoring			
IR.5	Groundwater recharge and management projects		√	√
IR.6	Contaminant and salt removal through reclamation, desalting, and other treatment technologies and conveyance of reclaimed water for distribution to users			
IR.7	Water banking, exchange, reclamation, and improvement of water quality			
IR.8	Planning and implementation of multipurpose flood management programs			
IR.9	Watershed protection and management		√	√
IR.10	Drinking water treatment and distribution			
IR.11	Ecosystem and fisheries restoration and protection			√

PROJECT DESCRIPTION

Project 1: Ash Valley Ranch Irrigation Infrastructure Efficiency Project
The project will conserve water by increasing the efficiency of an agricultural irrigation system. Two pumps will be upgraded and a piped delivery system installed.
Implementing Agency/Organization: Pit Resource Conservation District

Project 1: Ash Valley Ranch Irrigation Infrastructure Efficiency Project
The proposed project is located on the Ash Valley Ranch, a cattle operation in Adin, CA. The project proposal involves upgrading two diesel pumps currently installed in agricultural wells to electric pumps and the replacement of two miles of old, inefficient ditch water delivery system (estimated 25% loss) with a state-of-the-art piped delivery system. This will require running an electrical line underground for 1.5 miles from an existing power line to get power to the two new electric pump locations. The antiquated water delivery system currently loses large amounts of water due to seepage. The water from the wells has been used for over half a century to irrigate a native grassland/wetland pasture that is grazed by ranch livestock and provides a high quality seasonal resource for an abundance of wildlife species including the state threatened Sandhill crane.

The project will help alleviate the drought impact(s) identified in Attachment 2 as follows. The project will provide improved efficiency of groundwater used for irrigation which is currently the only source of irrigation water as reservoir supplies have dried up. The project will immediately result in water savings of 25% percent as water loss to evaporation and leakage will be minimized. In addition, less water will be pumped from the Ash Valley Groundwater Basin resulting in conservation of this important resource for both drinking and agricultural water use. ***By conserving groundwater the project will contribute to maintaining a sustainable water supply and increase reliability of the Ash Valley water supply during water shortages.***

The combination of antiquated diesel pumping plants and inefficient and seeping water delivery systems results in increased energy consumption to pump additional water. This project will result in an increase in water use efficiency by reducing water loss and a decrease in energy consumption because less water will need to be pumped and the new electric pumps will be much more efficient than the antiquated diesel pumps. Reduced water loss will result in less pumping within the wells which will sustain the life of the pumps. In addition, by converting the well pumps from diesel to electric, the project will result in a significant reduction in Greenhouse Gas (GHG) emissions and significant reduction in cost to operate the Ash Valley Ranch cattle operation.

Significant benefits to surface water quality will also be achieved. Water tends to stagnate in irrigation ditches resulting in a reduction of dissolved oxygen and increased temperatures. Water in ditches attracts livestock, which trample the ditches adding sedimentation and fecal matter to the water stream. A piping system will reduce these impacts resulting in improved surface water quality and in better quality water reaching the meadow/pasture.

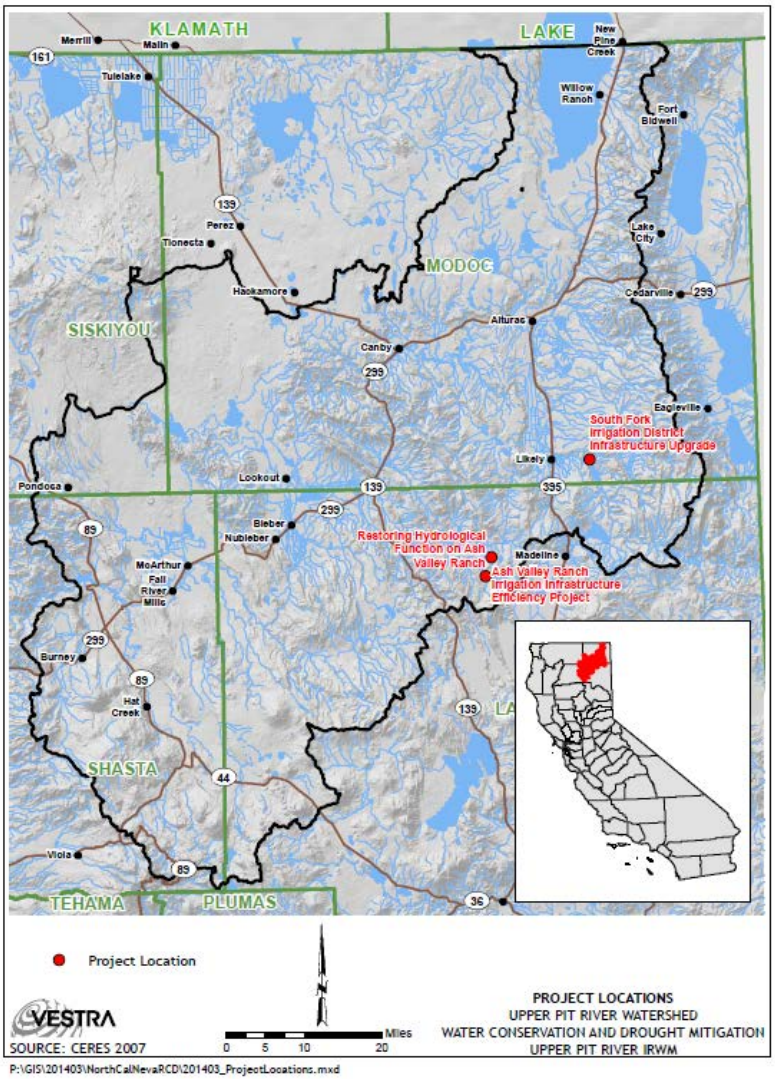
The project can be considered as three of the four eligible drought project types. The project will provide immediate regional drought preparedness by:

- Promoting water conservation. The project will result in significant conservation of water as water loss is reduced.
- Improving landscape and agricultural irrigation efficiencies.
- Achieving long term reduction of water use as the improved irrigation system will be maintained.
- Managing the Ash Valley groundwater basin more efficiently by reducing the amount of water extracted for irrigation.

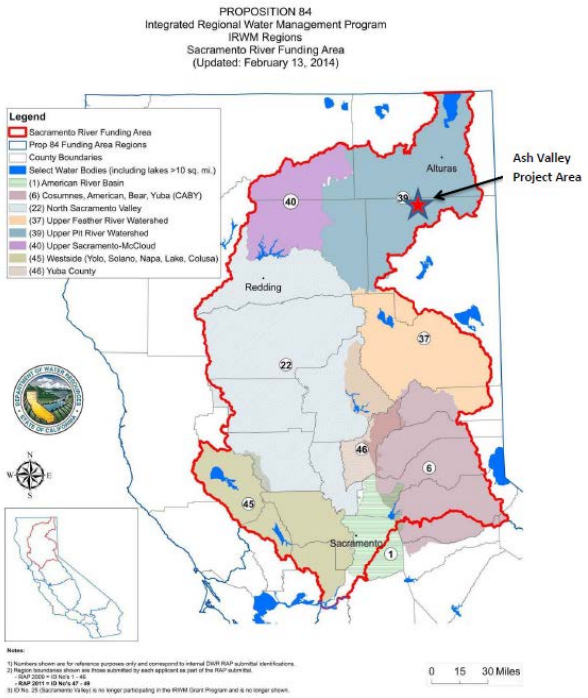
In addition, the project will reduce water quality conflicts or ecosystem conflicts created by the drought. The ongoing drought has depleted and reduced wetlands that have been utilized by waterfowl more often pre drought, including the state listed/threatened sand hill crane. Efficient use of irrigation water will help restore wetlands needed by waterfowl.

Expedited funding for the project is needed to provide sufficient water for agricultural operations without further compromising valuable groundwater resources. Surface water resources that have previously been relied upon for continued production have dried up as a result of the drought. Increasing the efficiency of the current irrigation system will minimize water use and increase water conservation.

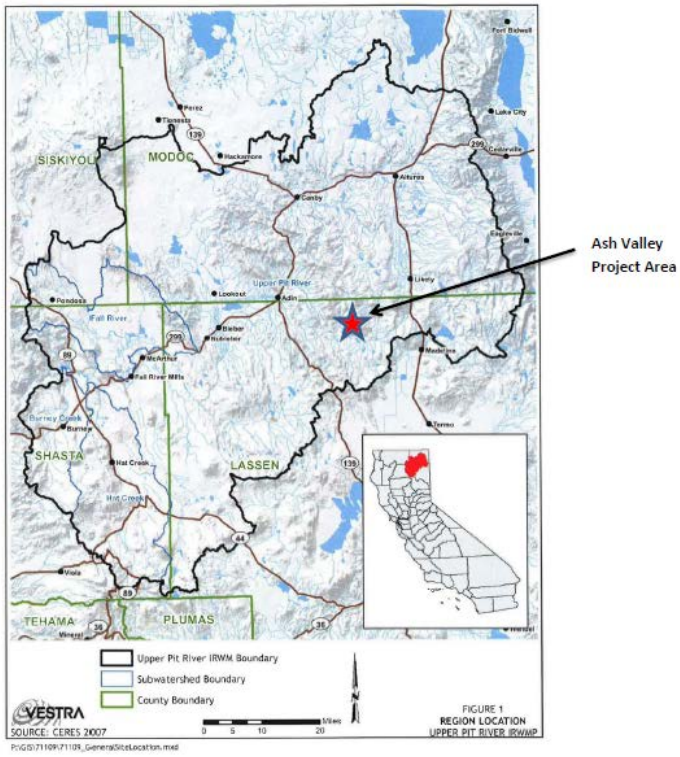
Regional Map



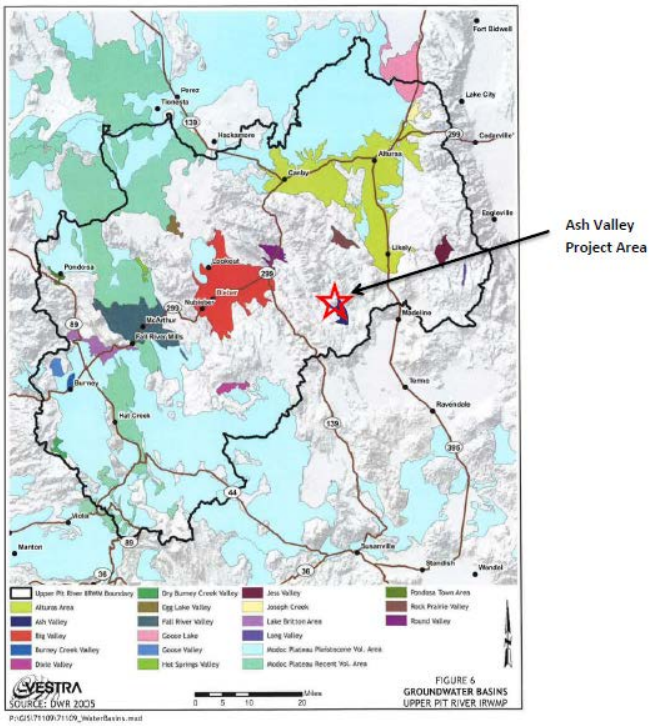
Project Map



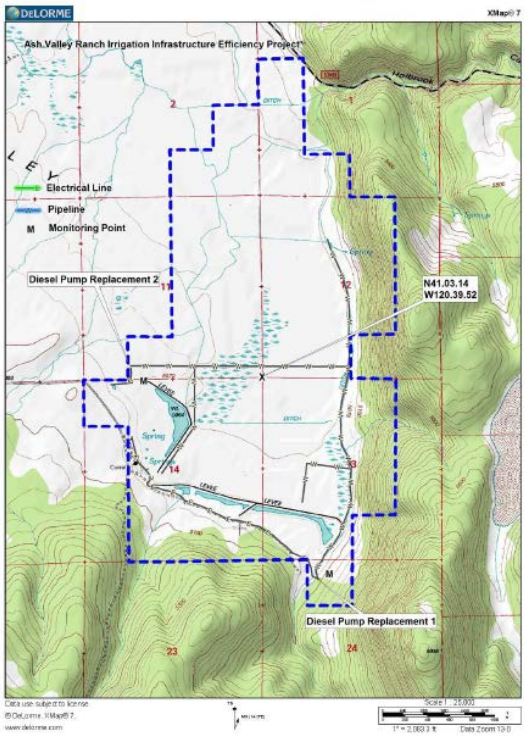
Attachment 3 Figure 1: Regional map with Integrated Regional Water Management (IRWM) regional boundaries and Ash Valley project location shown with a red star ★. The Ash Valley project area is located within the Upper Pit River Watershed of the Sacramento River Funding Area.



Attachment 3 Figure 2: Upper Pit River Integrated Regional Water Management (IRWM) boundary. The Ash Valley project area is shown with a red star ★.

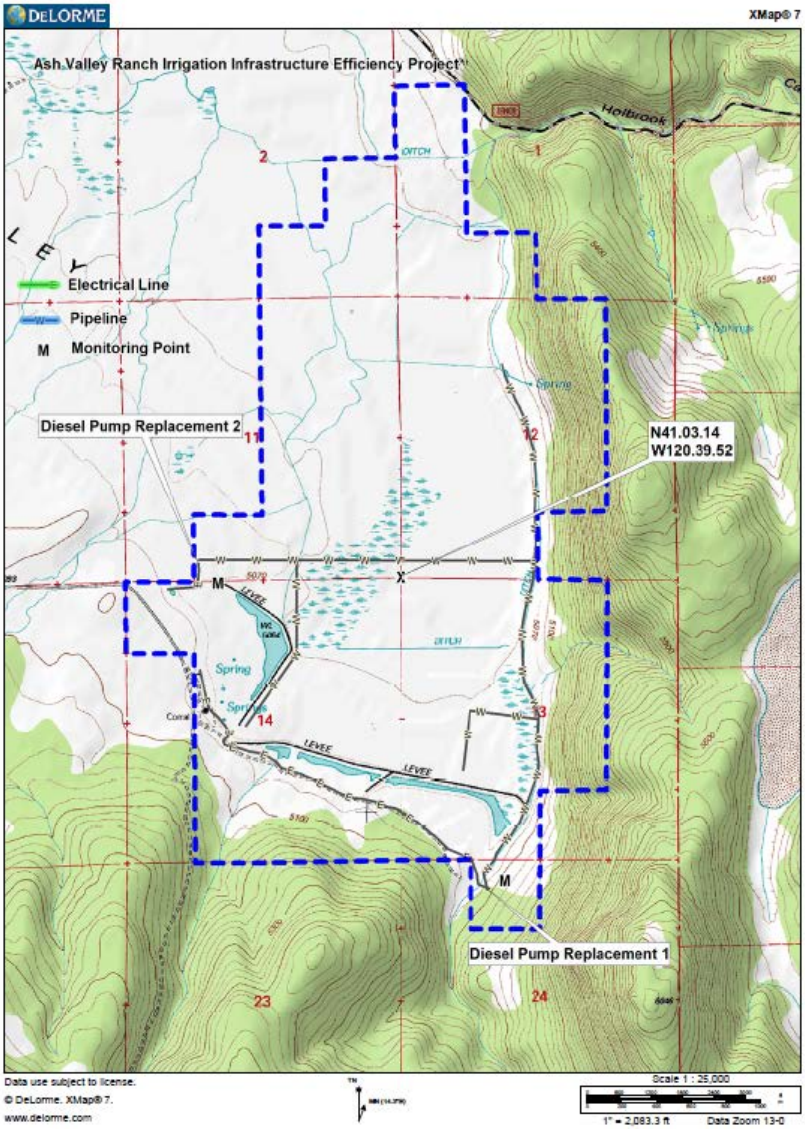


Attachment 3 Figure 3: Upper Pit River Integrated Regional Water Management (IRWM) area. The Ash Valley project area is shown with a red star overlying the affected Ash Valley Groundwater Basin.



Attachment 3 Figure 4: Topographic map of Ash Valley Ranch Irrigation Infrastructure Efficiency project area illustrating the project's geographical location and the surrounding work boundaries, facilities of the project, the water resources that will be affected, and proposed monitoring locations.

Project A – Monitoring Points Map



PROJECT PHYSICAL BENEFITS See Tables 5.1 through 5.4 of Excel Spreadsheets

Benefits of the **Ash Valley Ranch Irrigation Infrastructure Efficiency Project** detailed in Table 5 (There is a copy of Table 5 for each of the 3 benefits):

1. Amount of water saved. 1,000 acre feet of water will be saved annually as a result of the project. This is an estimated savings of 25% over current water use of 4,350 acre feet annually.
2. Amount of energy saved. Estimated energy conservation is 800 MMBtu annually or a 75% reduction.
3. Greenhouse gas emissions avoided. The diesel engines run for a total of 6,000 hrs annually. Diesel used annually is 8,000 gallons. The current Greenhouse gas emissions of the 2 diesel engines are 180,000 lbs of CO2 per year. After the conversion to electric, the CO2 emissions associated with the electric motors will be 66,000 lbs. This project will reduce greenhouse gas emissions by 114,000 lbs of CO2 per year.
4. Annual cost savings of $9, 184.

Table 5.1 – Annual Project Physical Benefits			
Project Name: Ash Valley Ranch Irrigation Infrastructure Efficiency Project Type of Benefit Claimed: Amount of water saved Units of the Benefit Claimed : acre feet per year Additional Information About this Benefit:			
(a)	(b)	(c)	(d)
	Physical Benefits		
Years of Project Life	Without Project	With Project	Change Resulting from Project (b) – (c)
25	0	1,000	25,000 acre feet over a 30-year project lifespan
Comments: Projected water savings from groundwater resources can go up when not in drought conditions. If Spooner Reservoir has water in it, then the demand on the ag wells is reduced. The "Irrigation Water Savings Calculator" tool, a model used throughout California by NRCS and by State agencies was used to calculate the estimated water used and water saved. The web soil survey tool was used to gather necessary soils information needed to calculate water use and savings			

Table 5.2 – Annual Project Physical Benefits			
Project Name: Ash Valley Ranch Irrigation Infrastructure Efficiency Project Type of Benefit Claimed: Energy Conservation Units of the Benefit Claimed : MMBtu Additional Information About this Benefit_____			
(a)	(b)	(c)	(d)
	Physical Benefits		
Years of Project Life	Without Project	With Project	Change Resulting from Project (b) – (c)
25	0	800 per year	24,000 Mbtu over over a 30-year project lifespan
Comments: Utilized the COMET-Farm Quick Energy Tool (Colorado State) to estimate energy conservation.			

Table 5.3 – Annual Project Physical Benefits			
Project Name:Ash Valley Ranch Irrigation Infrastructure Efficiency Project Type of Benefit Claimed:Greenhouse gas emissions avoided Units of the Benefit Claimed : Lbs of Carbon equivalent (includes N2O and CH4) per year Additional Information About this Benefit			
(a)	(b)	(c)	(d)
	Physical Benefits		
Years of Project Life	Without Project	With Project	Change Resulting from Project (b) – (c)
25	0	114,000	3,420,000 lbs CO2 over the life of the project
Comments: Carbon reduction takes into consideration the carbon footprint of electricilty being generated. Utilized the COMET-Farm Quick Energy Tool (Colorado State) to estimate greenhouse gas emissions. The diesel engines run for a total of 6,000 hrs annually. Diesel used annually is 8,000 gallons. The current Greenhouse gas emissions of the 2 diesel engines is 180,000 lbs of CO2 per year. After the conversion to electric, the CO2 emissions associated with the electric motors will be 66,000 lbs. This project will reduce greenhouse gas emissions by 114,000 lbs of CO2 per year.			

Table 5.4 – Annual Project Physical Benefits			
Project Name: Ash Valley Ranch Irrigation Infrastructure Efficiency Project Type of Benefit Claimed: Annual Cost Savings Units of the Benefit Claimed : Dollars Additional Information About this Benefit_____			
(a)	(b)	(c)	(d)
	Physical Benefits		
Years of Project Life	Without Project	With Project	Change Resulting from Project (b) – (c)
25	0	$9, 184	$275,520 over a 30-year project lifespan
Comments: Projected cost savings is based on current market value of off road diesel and current KWH prices from surprise valley electric.			

TECHNICAL ANALYSIS OF PHYSICAL BENEFITS CLAIMED

Technical basis of the project

Replacing diesel motors with electric motors is proven technology; as is replacing earth ditches with pipelines. Diesel motors are inefficient and dirty compared to electric motors and pipes do not lose any water to seepage or evaporation. Estimated water savings from NRCS estimation tools are 1,000 ac-ft, a 25% reduction. Estimated energy conservation from COMET (Colorado State) is 800 MMBtu or a 75% reduction. Although not detailed in Table 5 surface water quality will also be improved as water currently flowing in 3.2 miles of stagnant open ditch that is contaminated with animal waste will no longer flow through the ranch and into the irrigated pasture.

Recent and historical conditions that provide background for benefits to be claimed

Ash Valley Ranch has relied on water stored in the ranch owned Spooner Reservoir for a major portion of its pasture irrigation needs. The ongoing drought has eliminated all water from this source causing the ranch to be totally dependent on ground water from two irrigation wells and an antiquated, inefficient, ditch water delivery system. The pumping of more ground water in to the inefficient ditch system has increased the amount of water losses due to evaporation and seepage. The increased use of diesel motors for pumping has also increased carbon out puts and pollution.

The current drought conditions have significantly highlighted the inefficiencies of open ditch delivery systems. Historically open ditches have had an estimated loss of 40% due to evaporation, deep percolation, and leaks. Degraded water quality is another factor associated with open ditches. Surface ditches warm water because they are shallow, and in many cases, they develop leaks

that blow out and contribute sediment (turbidity) to surface water. Another issue with most ditch delivery systems is their inability to deliver the amount of water needed to efficiently flood irrigate. Closed flood systems eliminate losses and allow control; the correct amount of water is applied to the desired area and the conserved water is left in the river for aquatic habitat and ecosystem functions.

Estimates of without project conditions

Without project excess water and energy will continue to be used. Water will be warmed in surface ditches; water quality may be impacted by ditch blowouts.

Description of methods used to estimate physical benefits

The "Irrigation Water Savings Calculator" tool, a model used throughout California by NRCS and by State agencies was used to calculate the estimated water used and water saved. The web soil survey tool was used to gather necessary soils information needed to calculate water use and savings. The COMET-Farm Quick Energy Tool was used to estimate the greenhouse gas emissions and energy savings. Greenhouse gas reductions were calculated as follows: The diesel engines run for a total of 6,000 hrs annually. Diesel used annually is 8,000 gallons. The current Greenhouse gas emissions from the 2 diesel engines are 180,000 lbs of CO2 per year. After the conversion to electric, the CO2 emissions associated with the electric motors will be 66,000 lbs. This project will reduce greenhouse gas emissions by 114,000 lbs of CO2 per year. Projected cost savings is based on current market value of off road diesel and current KWH prices from surprise valley electric.

Identification of all new facilities, policies, and actions required to obtain the physical benefits.

New lines and transformers may be required to bring required volume of electricity to the pumping site. Pipeline will need to be trenched and installed. New motors will be installed at existing pumping plant.

Description of any potential adverse physical effects

Surface ditches do provide some function as groundwater recharge and habitat for wetland plants and animals that pipelines do not. However, the loss of these ditch functions will be greatly outweighed by the benefits of their replacement to energy conservation, water conservation, water quality improvements, and greenhouse gas emission reductions.

Cost Effective Analysis: see table 6

Table 6 – Cost Effective Analysis Project name: Ash Valley Ranch Irrigation Infrastructure Efficiency Project	
Question 1	Types of benefits provided as shown in Table 5 : The Ash Valley Ranch irrigation System Improvement project will save 30,000 acre feet of water or 9,775,542,956 gallons. This water that is being saved is currently coming from groundwater sources. The water saved will be available for other beneficial uses. By converting the diesel engines to electric, over 3.5 million pounds of Carbon will not enter the atmosphere. The project lifespan in Table 5 will last well beyond 30 years. If and when the electric motors fail, they will be replaced with newer more efficient motors, thus continuing the reduction of carbon being released into the atmosphere. The current state of our atmosphere is always a topic of discussion and these projects should be done whenever possible.
Question 2	Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified? Yes If no, why? If yes, list the methods (including the proposed project) and estimated costs. We considered the use of solar-powered pumps but the cost of a solar array to power the pumps needed to irrigate 840 acres would be prohibitively expensive. We also considered converting from a flood irrigation system to a system that would use 4 center pivots. We would still need to convert the inefficient ditch delivery system to a pipeline and an estimated cost of $85,000 per pivot we felt the additional cost would not be a realistic option. Our pipeline/flood delivery system could be converted for center pivot use in the future if the landowner was able to get cost share assistance from NRCS or other partners in the future. Another reason to stay with flood irrigation is the loss of current ground under irrigated production. Center pivots irrigate in a circular pattern and when in square fields, you have corners that are not irrigated. These corners are then not producing and can be difficult to manage separately from the rest of the irrigated field. Often the corners transition to dry land type species including many undesirable and invasive weeds. These corners can be irrigated as well, but requires additional buried mainline and either hand line or wheel line sprinklers. It was also considered to convert from flood irrigation to a wheel line sprinkler system. Similar to the center pivot option, buried mainline would be required to facilitate this system. Again, the pipeline system being proposed could in the future be converted for use in a sprinkler system. A single wheel line can irrigate up to 20 acres, so a minimum of 42 wheel lines would be required. These wheel lines could operate on 12 sets and therefore, every wheel line would need to be moved every 12 hours. In order to move a wheel line, the water needs to be shut off which requires shutting off the pumps. Water in the wheel lines drains out due to lack of pressure. Once all wheel lines have been moved, the pumps are turned back on and it takes around 10 minutes for the pressure to increase enough to seat all the gaskets. There is a large amount of water that is lost when moving wheel lines(40,000 gallons). Wheel lines can be efficient when conditions are right. They are very inefficient when the wind blows. As the pressurized water is sprayed in the air, the wind redirects much of the irrigation water to unintended locations. There is also substantial water lost to the atmosphere in evaporation. The center pivots are not impacted as mush by the wind as the water is projected downward and at much lower pressures. The cost of purchasing wheel lines is also fairly expensive. Each wheel line costs between $11,000 - $12,000. Total cost for wheel lines would run around $500,000.
Question 3	If the proposed project is not the least cost alternative, why is it the preferred alternative? The proposed project is the least-cost option and lends itself to transition into a pivot or a wheel lines irrigation system in the future. The proposed project is proven to work and will immediately benefit the crop and natural resources.
Comments:	

Project 2: Restoring Hydrologic Function in South Ash Valley
The project will restore hydrologic function to an agricultural area by removing invasive juniper. Groundwater recharge will increase. Stream water quality and quantity will improve.
Implementing Agency/Organization: Pit Resource Conservation District

Project 2: Restoring Hydrologic Function in South Ash Valley
The goal of this project is to restore watershed functions (capture, storage of water in soil, and beneficial release) within a working landscape in the South Ash Valley Watershed at the headwaters of Ash Creek, a tributary to the Pit River, in Lassen County. This will be accomplished through the landscape-scale removal of invasive western juniper (*Juniperus occidentalis*) on 5,500 acres of wet meadow and sagebrush steppe habitat. 1,800 acres have been completed to date and BLM is currently soliciting bids for 300-400 acres. The proposed project will occur on approximately 1,000 acres of BLM Managed land on the Ash Valley Ranch, approximately 24 miles southwest of Adin, CA, in Lassen County. Additional partnerships are being developed to treat the balance of the project acres.

Not only has western juniper replaced native plant communities but it has also degraded the hydrologic cycle in invaded rangelands. Juniper canopies intercept greater quantities of precipitation than native grass and shrub communities leaving less water to infiltrate the soil. In addition, studies have shown that a mature juniper can transpire huge quantities of water on a daily basis. It is an evergreen, and thus also has the capacity to further deplete soil moisture by transpiring when native grasses and deciduous shrubs are dormant. The combination of less water entering the soil and strong ability of western juniper to extract and transpire water means that little water has a chance to percolate beneath the root zone. Therefore, invasion of western juniper on large areas that were once primarily grassland has strong implications for recharge of aquifers. It is a common occurrence to have seeps and springs stop flowing in conjunction with increases in juniper cover. These impacts are particularly damaging during dry climatic cycles such as the one currently being endured in California.

The project will help alleviate the drought impact(s) identified in Attachment 2 as follows. Removing western juniper will help alleviate the drought impacts experienced in the past several years by reducing water lost by interception, transpiration, and storage by an invasive species. This will make more water available for native plant communities in support of wildlife and agriculture. In addition, greater quantities of water will reach below the root zone and contribute to the recharge of the Ash Valley Groundwater Basin. ***Therefore, the project will contribute to maintaining a sustainable water supply and increase reliability of the Ash Valley water supply during water shortages.*** Furthermore, the project will demonstrate the effectiveness of juniper removal on restoring hydrologic function with the following measurable outcomes:

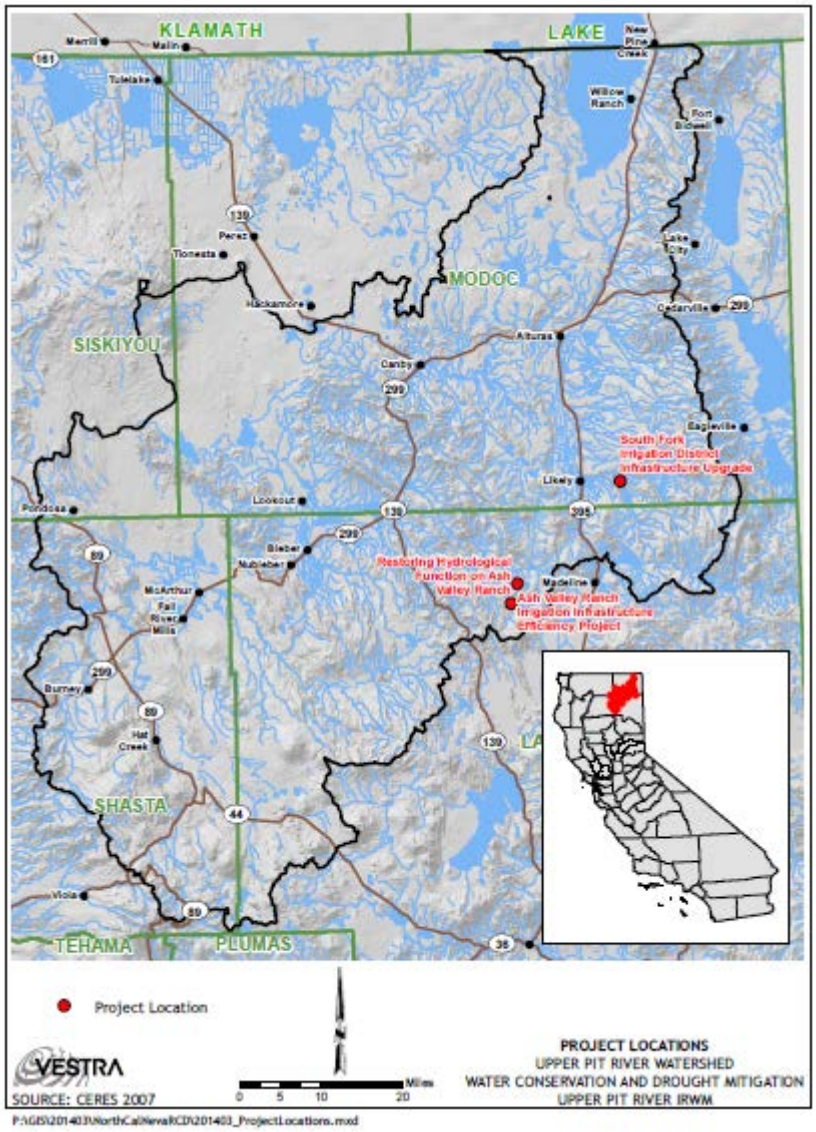
- Restoration of hydrologic function including increased soil moisture levels, ground water replenishment, and spring flow during the growing season
- Restoration of historic drought-resilient plant communities to the landscape including increased production of perennial grasses on rangeland and decreased bare ground
- Reduced overland flow and soil erosion
- Increased water abundance in support of agriculture and wildlife

The project can be considered as three of the four eligible drought project types. The project will provide immediate regional drought preparedness by restoring the Ash Valley watershed through the removal of invasive western juniper from areas that it has not historically occupied. This will help restore ecosystem hydrological function and thus increase the amount of water available for livestock and wildlife needs. In addition, a restored watershed will increase the amount of water available for groundwater recharge.

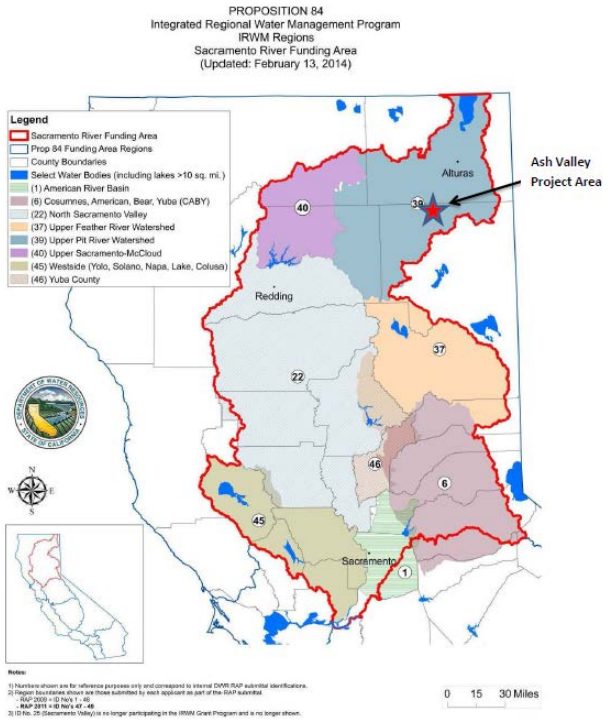
The project will also reduce water quality conflicts or ecosystem conflicts created by the drought. Western juniper removal and montane meadow and adjacent upland restoration treatments have been documented to restore hydrological function. Even under drought regimes such as that currently experienced in California, restoration treatments have been documented to increase spring flows, making water available for livestock and wildlife usage. The restoration of wet montane meadow sites is critical to livestock operations and dependent wildlife.

Expedited funding for the project is needed to aid in providing livestock water, which is also utilized by wildlife, and increase forage for livestock and wildlife that has been severely depleted by the current drought.

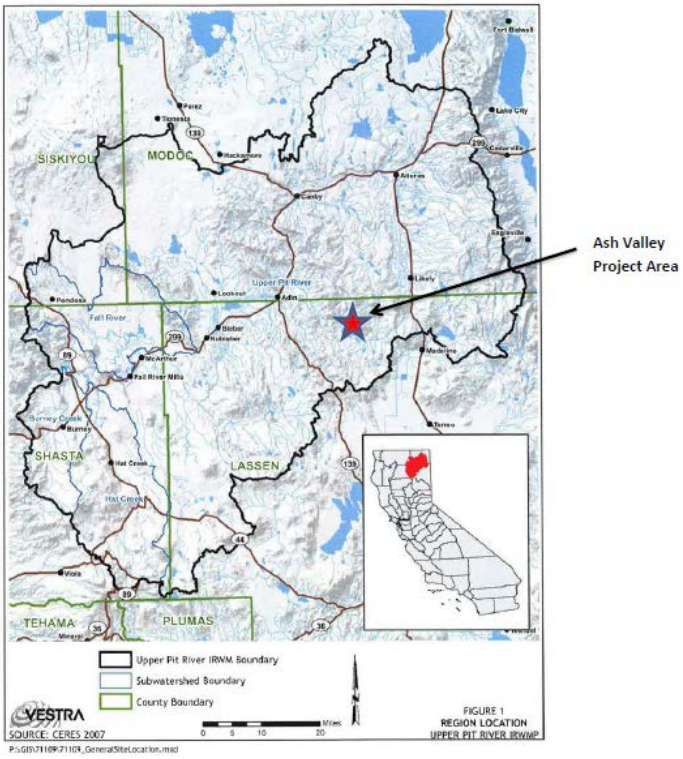
Regional Map



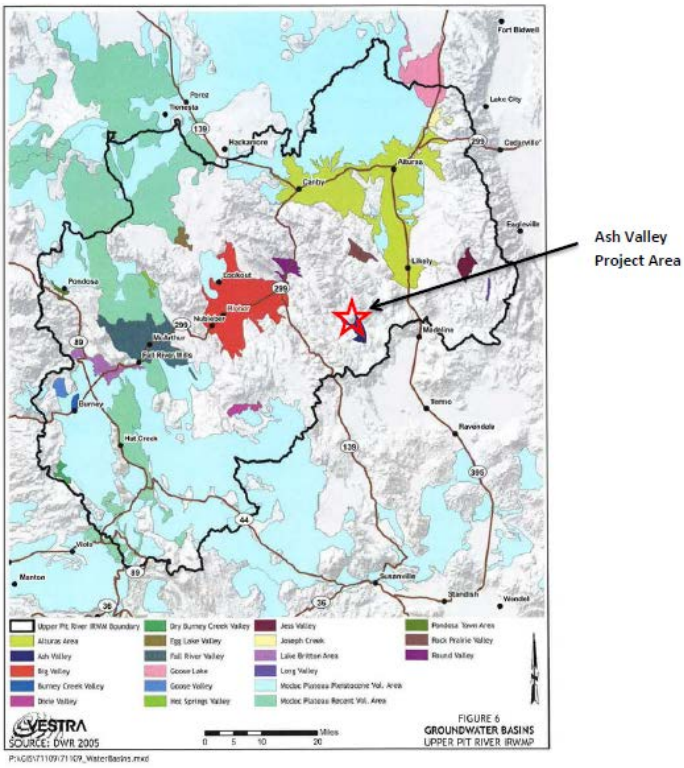
Project Maps



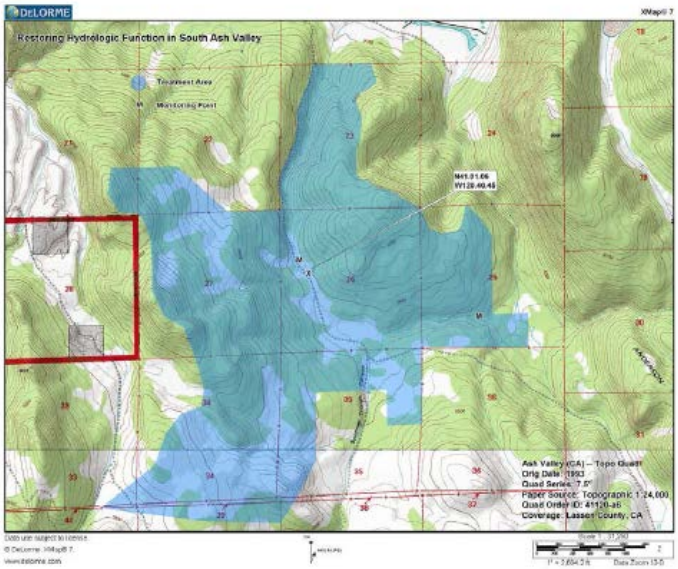
Attachment 3 Figure 1: Regional map with Integrated Regional Water Management (IRWM) regional boundaries and Ash Valley project location shown with a red star ★. The Ash Valley project area is located within the Upper Pit River Watershed of the Sacramento River Funding Area.



Attachment 3 Figure 2: Upper Pit River Integrated Regional Water Management (IRWM) boundary. The Ash Valley project area is shown with a red star ★.

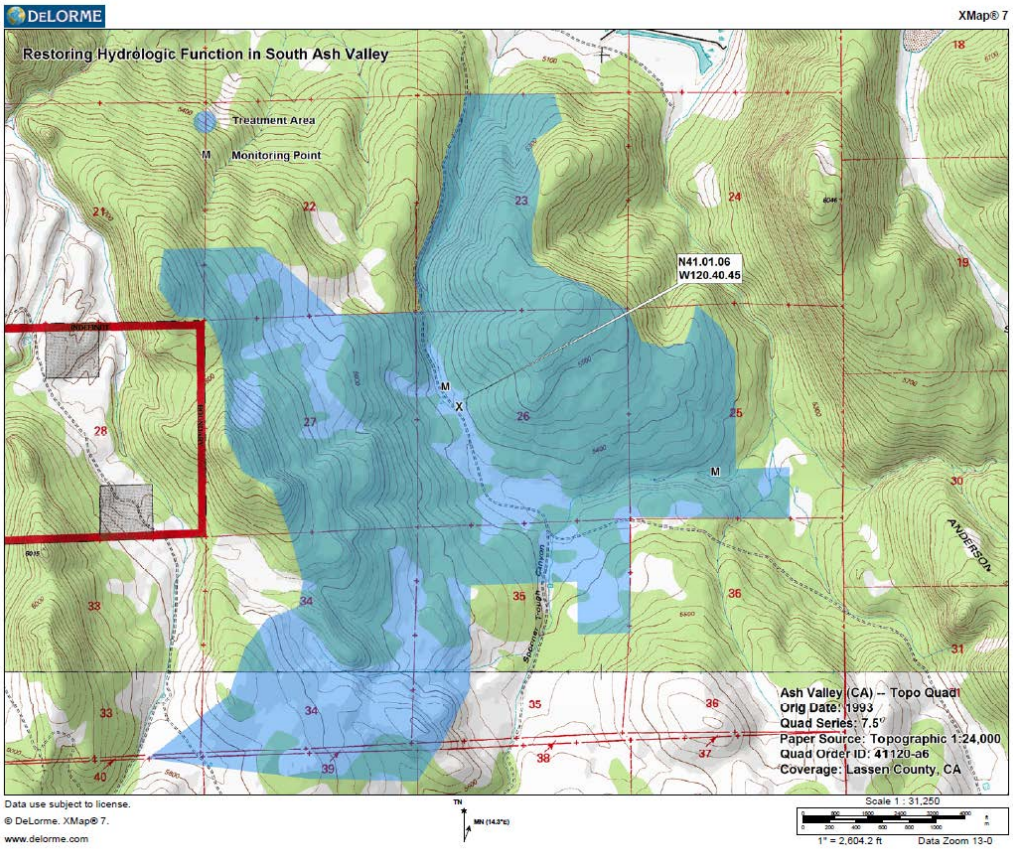


Attachment 3 Figure 3: Upper Pit River Integrated Regional Water Management (IRWM) area. The Ash Valley project area is shown with a red star overlying the affected Ash Valley Groundwater Basin.



Attachment 3 Figure 4: Topographic map of Restoring Hydrologic Function in South Ash Valley project area illustrating the project's geographical location and the surrounding work boundaries, facilities of the project, the water resources that will be affected, and proposed monitoring locations.

Project B – Monitoring Points Map



PROJECT PHYSICAL BENEFITS See Tables 5.1 through 5.5 of Excel Spreadsheets

Benefits of the **Restoring Hydrologic Function in South Ash Valley Project** detailed in Table 5

1. Increased precipitation available for groundwater recharge and forage production
2. Restoration of historic drought-resilient native plant communities to the landscape to support agriculture and wildlife
3. Increased forage production
4. Kilowatt hours of energy produced from harvested biomass
5. Acres of land with reduced wildfire hazard

Additional benefits that will accrue from the project but that are not quantified in Table 5 include:

- Restoration of hydrologic function including increased deep soil moisture levels, ground water replenishment, and spring flow during the growing season
- Reduced overland flow and soil erosion

Table 5.1 – Annual Project Physical Benefits			
Project Name: Restoring Hydrologic Function in South Ash Valley			
Type of Benefit Claimed: Increased precipitation available for groundwater recharge and forage production			
Units of the Benefit Claimed : inches per year			
Additional Information About this Benefit:			
(a)	(b)	(c)	(d)
	Physical Benefits		
Years of Project Life	Without Project	With Project	Change Resulting from Project (b) – (c)
30	0	8	240" of precipitation over a 30-year project lifespan
Comments: The percentage of rain and snow intercepted by the canopy has been shown to be equivalent to the percentage of juniper canopy cover (e.g. a juniper canopy of 20 percent equates to an interception of about 20 percent of the precipitation the site receives). Canopy cover in project area ranges from 40% to 70%. The mean annual precipitation is about 15-20 inches. For purposes of this analysis we assume a conservative estimate of canopy cover (40%) and precipitation (15 inches annually) for an annual savings of 6 inches of precipitation. For our analysis we have chosen to use a very conservative measure of water savings to juniper transpiration by limiting water loss to the months when evergreen juniper is still transpiring, albeit at low levels, and native grasses and deciduous shrubs are dormant. We have chosen to use an estimate of 1.5" of water used by juniper during the months of January through May. This is based on modelling of transpiration rates for a similar site.			

Table 5.2 – Annual Project Physical Benefits			
Project Name: Restoring Hydrologic Function in South Ash Valley			
Type of Benefit Claimed: Restoration of historic drought-resilient native plant communities to the landscape to support agr			
Units of the Benefit Claimed : acres			
Additional Information About this Benefit:			
(a)	(b)	(c)	(d)
	Physical Benefits		
Years of Project Life	Without Project	With Project	Change Resulting from Project (b) – (c)
30	0	1,000	1,000 acres total will be restored by the project
Comments: The proposed treatment area is 1,000 acres and drought-resistant plant communities will be restored to the entire project area. These native plant communities are adapted to low moisture conditions and can continue to provide valuable forage even in drought years.			

Table 5.3 – Annual Project Physical Benefits			
Project Name: Restoring Hydrologic Function in South Ash Valley			
Type of Benefit Claimed: Forage Production			
Units of the Benefit Claimed : Pounds/acre			
Additional Information About this Benefit: This benefit is based on vegetative production other than juniper.			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014			
2015	500	750	250
2016	500	1000	500
2017	500	1250	750
2018	500	1500	1000
2019-2054	500	1500	Average 1,000/yr for a total of 35,000
Total forage production			37500
Comments: The project assumes a maximum increase of 1,000 pounds of forage production per acre after juniper removal beginning four years after project completion and continuing into the future. If 60% of this forage is utilized by animals this equates to 600 lbs per acre. Over the 1,000 acres of the proposed project, that is 1,000,000 lbs of additional forage produced and 600,000 pounds of additional forage utilized per year once maximum growth has been achieved. Project life of the project is dependant upon maintenance. Juniper will start to encroach after a 20 year period. The juniper will continue to grow and spread until it reaches current density. Project has plans for maintenance therefore project benefit with last for an undetermined amount of time.			

Table 5.4 – Annual Project Physical Benefits Project Name: Restoring Hydrologic Function in South Ash Valley Type of Benefit Claimed: Kilowatt hours of energy produced from harvested biomass Units of the Benefit Claimed : killowatts Additional Information About this Benefit:			
(a)	(b)	(c)	(d)
	Physical Benefits		
Years of Project Life	Without Project	With Project	Change Resulting from Project (b) – (c)
30	0	14,000,000	14,000,000 will be produced by the project
Comments: Based on previous projects we can assume that the project will produce approximately 14 bone dry tons of wood chips per acre. Each bone dry ton of chips yields approximately 1,000 kilowatts of energy. Assuming that 1,000 acres will be treated the project will result in 14,000,000 kilowatts of renewable energy produced.			

Table 5.5 – Annual Project Physical Benefits Project Name: Restoring Hydrologic Function in South Ash Valley Type of Benefit Claimed: Acres of land with reduced wildfire hazard Units of the Benefit Claimed : acres Additional Information About this Benefit:			
(a)	(b)	(c)	(d)
	Physical Benefits		
Years of Project Life	Without Project	With Project	Change Resulting from Project (b) – (c)
30	0	1,000	1,000 acres will treated by the project
Comments: Wildfire hazard will be reduced on all 1,000 acres of the project area.			

TECHNICAL ANALYSIS OF PHYSICAL BENEFITS CLAIMED

Technical basis of the project

Juniper canopies intercept greater quantities of precipitation than native grass and shrub communities leaving less to infiltrate the soil. In addition, studies have shown that, under ideal conditions, a mature juniper can transpire huge quantities of water on a daily basis (Bedell et al. 1993[1]). It is an evergreen, and thus also has the capacity to further deplete soil moisture by transpiring when native grasses and deciduous shrubs are dormant. The combination of less water entering the soil and strong ability by western juniper to extract and transpire water means that little water has a chance to drain beneath the root zone. Therefore, invasion of western juniper on large areas that were once primarily grassland has strong implications for recharge of aquifers. It is a common occurrence to have seeps and springs stop flowing in conjunction with increases in juniper cover. (Thurow and Hester 1997[2])

However, removal of juniper has been shown to result in the reversal of these adverse effects. Removing juniper immediately decreases water lost to interception and juniper transpiration. Researchers at the University of Oregon have demonstrated how these water savings affect groundwater and spring flow. For example, in one study conducted by the University of Oregon, underground wells located in a watershed where juniper was removed were shown to keep water 45 more days each year compared to wells in an untreated watershed. Spring flow in the treated watershed increased from 30 gallons per minute to 40 gallons per minute. Most importantly, the difference in flow was maintained into the late season from mid-July through September when drought effects are greatest (Deboot et al. 2008)[3].

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[1] Bedell, T.E., L.E.Eddleman, T. Deboodt, and C. Jacks. 1993. Western Juniper. Its impact and Management in Oregon. Oregon State University Extension Service. EC1417 **Page 6** of 15pp.

[2] Thurow T.L. and J. W. Hester. 1997. How an increase or reduction in juniper cover alters rangeland hydrology. Juniper Ecology and Management 1997 Juniper Symposium Proceedings. **Page 7** of 17.

[33] Deboodt, T.L., M.P. Fisher, J.C. Buckhouse, John Swanson. 2008. Monitoring Hydrological Changes Related to Western Juniper Removal: A Paired Watershed Approach. **Page 229** of pages 227-232 *in* Webb, R.M.T., and Semmens, D.J., eds., 2009, Planning for an uncertain future—Monitoring, integration, and adaptation. Proceedings of the Third Interagency Conference on Research in the Watersheds: U.S. Geological Survey Scientific Investigations Report 2009-5049, 292 pp.

While these studies suggest that more water is percolating deep enough to recharge the groundwater, to our knowledge, there are no published studies that have attempted to quantify water movement downward through the soil profile. In the spring of 2013 we installed passive capillary lysimeters in paired watersheds at Ash Valley Ranch to compare water movement below the rooting zone in a watershed where juniper was removed in the fall and winter of 2013/14 and a control watershed where juniper was not removed. Our preliminary results show much greater water movement into deep soil layers in the treatment watershed as compared to the control watershed (see Figure 1). The difference between the control and treatment watersheds in Figure 1 reflects the rain and snow intercepted and evaporated by the juniper canopy in the control watershed, and water taken up by juniper during the mild winter and spring of 2014 when native grasslands were dormant. These water savings are quantified below.

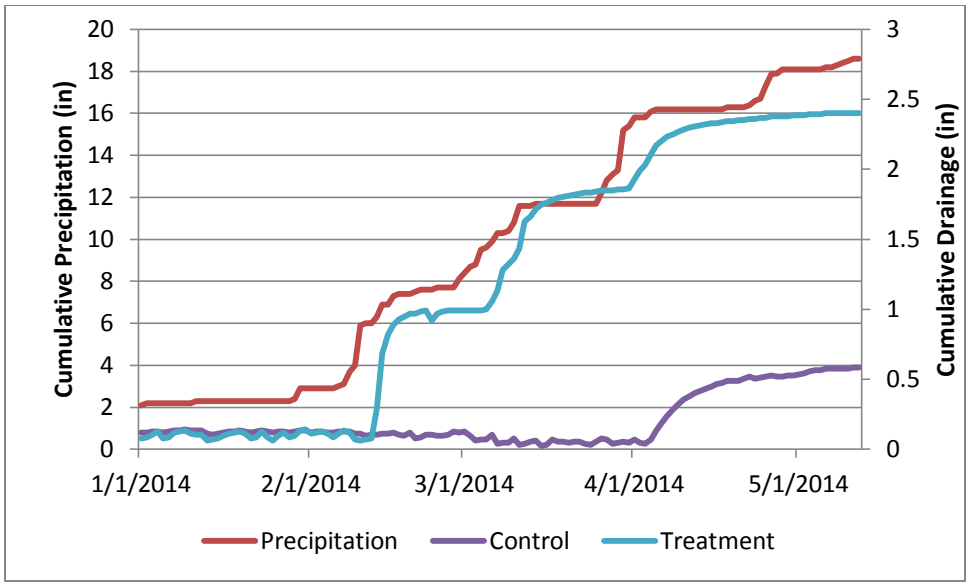

Figure 1: Cumulative precipitation and drainage through the soil profile to a depth of 58 inches in lysimeters installed in a watershed where western juniper was removed (Treatment) and a similar watershed where western juniper was not removed (Control).

Juniper encroachment results in a suite of additional adverse effects to impacted ecosystems (reviewed in the 2007 publication, Western Juniper Management: A Field Guide[4]). - Increasing juniper dominance on a site results in the die-off of shrubs and a reduction or die-off of native grasses and forbs. The ensuing loss of shrubs, grasses, and forbs reduces species richness and diversity and results in a loss of habitat value (cover, forage) for many wildlife species as well as a loss of forage for livestock. The loss of species diversity diminishes the function of the basic ecological processes of nutrient cycling and energy flow. - Juniper encroachment into sage grouse habitat provides perches for avian predators, often causing sage grouse to abandon the area. Sediment loads from areas dominated by juniper are much greater than those dominated by native sagebrush steppe or grassland vegetation[5].

Juniper encroachment also greatly increases the risk of wildfire. Overly dense juniper and eastside pine stands in the project area have also created fuel loads that increase the risk for high-intensity wildfire around private property, as identified in the Lassen County Community Wildfire Protection Plan (Lassen County Fire Safe Council, Inc., 2006[6]). The California Department of Forestry and Fire Protection has identified locations within the project area where the abundance of fuels and environmental conditions (topography, vegetation, and climate) are ripe for catastrophic fire. Catastrophic fires, generally referred to as stand-replacement fires, are problematic for

[4] CSR Natural Resources Consulting, Inc. 2007. Western Juniper Management: A Field Guide. Oregon Watershed Enhancement Board Western Juniper Management Effectiveness Monitoring Phase II Final Report. **Pages 4-6** of 88pp. Available at: http://www.oregon.gov/OWEB/MONITOR/docs/Juniper_PhaseII_report.pdf).

[5] Bedell, T.E., L.E.Eddleman, T. Deboodt, and C. Jacks. 1993. Western Juniper. Its impact and Management in Oregon. Oregon State University Extension Service. EC1417 **Page 5** of 15pp.

[6] Available at: http://www.co.lassen.ca.us/govt/dept/county_clerk/Agenda/MG9387/AS9405/AI9669/DO9903/2.PDF

watersheds as they cause severe erosion due to loss of vegetation, sediment loading in rivers and streams, reduced retention of water in the upper watershed, poor air quality, loss of forage and rangeland, loss of timber, and loss of wildlife habitat.

Recent and historical conditions that provide background for benefits to be claimed

The current drought has degraded the hydrological function of montane meadow and sagebrush steppe ecological sites on Ash Valley Ranch, the primary locations for cattle grazing and watering. The area is also critical habitat for upland game species such as sage grouse, mule deer and pronghorn antelope. The drought impact has been further exacerbated by the recent establishment of invasive western juniper into these ecological sites, sites that have not been historically occupied by juniper. The combined impacts of drought and the conversion of montane meadow and sagebrush steppe sites to juniper woodlands has caused springs to dry up, eliminating livestock and wildlife watering sources, and plant communities to decline, reducing feed stocks. The drought caused depletion of native plant communities has also disrupted the overall hydrologic cycle, decreasing the amount of water infiltrating the soil and thereby reducing aquifer recharge.

Estimates of without-project conditions

Without the project none of the physical benefits will be realized. Western juniper will continue to expand in the region. Trees on site will continue to grow, and therefore, use more water. Native drought-resistant ecosystems will be further degraded and groundwater will be further depleted.

Description of methods used to estimate physical benefits.

Increased precipitation available for groundwater recharge and forage production

It would be difficult to estimate the reduction in total evapotranspiration associated with removing juniper without extensive monitoring and modelling. However, it is less difficult to provide a robust estimate of water lost to evapotranspiration from water that is intercepted and evaporated from the canopy and water that is transpired by juniper during the time of year when native grasses and deciduous shrubs are dormant. The percentage of rain and snow intercepted by the canopy has been shown to be equivalent to the percentage of juniper canopy cover (e.g. a juniper canopy of 20 percent equates to an interception of about 20 percent of the precipitation the site receives). Furthermore, precipitation through-fall (i.e. water reaching the soil surface through the tree canopy) generally occurs only after rain events of 0.30 inches or more[7]. Canopy cover in project area ranges from 40% to 70%. The mean annual precipitation is about 15-20 inches. For purposes of this analysis we assume a conservative estimate of canopy cover (40%) and precipitation (15 inches annually) for an annual savings of 6 inches of precipitation. It is estimated that juniper stands can use up to 44% of annual precipitation[8] and modelled estimates of annual water use by western juniper stands in stands having 81 trees per acre greater than 6" in diameter per acre under non-limited water conditions are as high as 19.5" of water per year[9]. Within the project site, over 100 trees per acre are greater than 6" in diameter suggesting that a great deal of the water available for plant growth is used by these trees. For our analysis we have chosen to use a very conservative measure of water savings to juniper transpiration by limiting water loss to the months when evergreen juniper is still transpiring, albeit at low levels, and native grasses and deciduous shrubs are dormant.

We have chosen to use an estimate of 1.5" of water used by juniper during the months of January through May. This is based on modelling of transpiration rates for a similar site[10]. Although this is likely to be an underestimate of water use by juniper during the cool season at the project site it illustrates the potential of western juniper to significantly alter watershed value and site productivity. Furthermore the amount of water taken up by juniper during years with mild winters such as that experienced in 2013/14 is greater than in colder years and further amplifies the impact of juniper on available soil moisture during the forage growing season.

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[7] CSR Natural Resources Consulting, Inc. 2007. Western Juniper Management: A Field Guide. Oregon Watershed Enhancement Board Western Juniper Management Effectiveness Monitoring Phase II Final Report. **Page 4** of 88pp. Available at: http://www.oregon.gov/OWEB/MONITOR/docs/Juniper_PhaseII_report.pdf).

[8] Angell, R. F. and R.F. Miller, Richard F. 1994. Simulation of leaf conductance and transpiration in western Juniper. Forest Science. Volume 40(1). **Page 21** of 21-24.

[9] Bedell, T.E., L.E.Eddleman, T. Deboodt, and C. Jacks. 1993. Western Juniper. Its impact and Management in Oregon. Oregon State University Extension Service. EC1417 **Page 6** of 15pp.

[10] Angell, R. F. and R.F. Miller, Richard F. 1994. Simulation of leaf conductance and transpiration in western Juniper. Forest Science. Volume 40(1). **Page 21** of 21-24

Restoration of historic drought-resilient native plant communities to the landscape to support agriculture and wildlife
The proposed treatment area is 1,000 acres and drought-resistant plant communities will be restored to the entire project area. These native plant communities are adapted to low moisture conditions and can continue to provide valuable forage even in drought years. Furthermore, biologists and other natural resource professionals agree that invasive juniper reduces habitat values for sage grouse, mule deer, elk and sandhill cranes, all of which rely on understory shrubs, grasses and forbs for forage and hiding cover.

Increased forage production
Juniper control is visually obvious, but the greatest benefits are with respect to water. With available water in the soil profile, desirable native plant species germinate and grow. Underneath juniper at the soil surface and just below are thousands upon thousands of native plant seeds. They are sitting there waiting for the available resources to begin their life cycle. When water is available, plants will grow. Following juniper removal, the existing plants and seeds in the soil thrive without the competition of juniper. Production of desirable range species will increase every year until the desirable plants themselves are competing for resources. At this point the production of desirable or palatable range species is greatest. For the project analysis this is assumed to be four years after project implementation. (The increase in production over 1 ½ acres is enough to support a cow or 1 animal unit (AU) for one month). The project assumes a maximum increase of 1,000 pounds of forage production per acre after juniper removal beginning four years after project completion and continuing into the future. If 60% of this forage is utilized by animals this equates to 600 lbs per acre. Over the 1,000 acres of the proposed project, that is 1,000,000 lbs of additional forage produced and 600,000 pounds of additional forage utilized per year once maximum growth has been achieved. During these drought conditions every bit of water is critical. If available water is being taken up by desirable plant species rather than juniper, then benefits to cattle and wildlife will accrue.

Kilowatt hours of energy produced from harvested biomass
Based on previous projects we can assume that the project will produce approximately 14 bone dry tons of wood chips per acre. Each bone dry ton of chips yields approximately 1,000 kilowatts of energy. Assuming that 1,000 acres will be treated the project will result in 14,000,000 kilowatts of renewable energy produced.

Acres of land with reduced wildfire hazard
Wildfire hazard will be reduced on all 1,000 acres of the project area.

Identification of all new facilities, policies, and actions required to obtain the physical benefits
Western juniper will need to be removed from approximately 1,000 acres to obtain the physical benefits outlined in this proposal. Treatment of additional acres would result in additional benefit.

Description of any potential adverse physical effects
No wildlife species is considered a juniper obligate although many bird and small mammal species feed on juniper berries. Although large herbivores such as deer and antelope may use stands of juniper for thermal cover, juniper provides minimal food resources. Both digestibility and levels of available protein are low in western juniper. Increased western juniper dominance across the landscape will result in a decline in browse resources.

COST EFFECTIVE ANALYSIS **see Table 6**

Table 6 – Cost Effective Analysis Project name: Restoring Hydrologic Function in South Ash Valley	
Question 1	Benefits of the Restoring Hydrologic Function in South Ash Valley Project detailed in Table 5 1. Increased precipitation available for groundwater recharge and forage production 2. Restoration of historic drought-resilient native plant communities to the landscape to support agriculture and wildlife 3. Increased forage production 4. Kilowatt hours of energy produced from harvested biomass 5. Acres of land with reduced wildfire hazard
Question 2	Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified? NO
	If no, why? The only alternative to restoring the drought damage ecosystem is to remove the invasive western juniper that has compromised the hydrological function of the landscape, which when combined with the drought, is causing springs and seeps to dry up. This has eliminated livestock and wildlife watering and forage resources. Herbicide and burning are alternative means to cutting to kill the juniper but because of their potential adverse environmental effects these alternative methodologies were not considered.
	If yes, list the methods (including the proposed project) and estimated costs.
Question 3	If the proposed project is not the least cost alternative, why is it the preferred alternative? Provide an explanation of any accomplishments of the proposed project that are. The proposed project is the least cost alternative.
Comments:	

Project 3: South Fork Irrigation District Infrastructure Upgrade
This project upgrades sections of distribution ditches where there is significant water lost by the removal and replacement of 5100 feet of metal pipe.
Implementing Agency/Organization: Central Modoc Resource Conservation District

Project 3: South Fork Irrigation District Infrastructure Upgrade
How the project will help alleviate the drought impact(s)
The project will reduce the amount of water that is lost and wasted in the irrigation infrastructure. Two areas have been identified for upgrading, the diversion ditch pipeline and the flume pipeline. This will make the water diversion ditch to the reservoir more efficient and reduce the amount of water lost by frequent bank overflow each year. The project will also make the water being delivered by the master ditch more efficient by replacing the flume pipeline reducing the amount of water lost by the numerous leaks in the old pipeline. Efficiency is improved by reducing the amount of water lost before it reaches the irrigated fields. This upgrade also makes the amount of water to be delivered more sustainable during drought periods.

Diversion ditch pipe – This portion of the proposed project consists of removing of 4100 feet of pipe and replacing it with plastic ditch liner. The diversion ditch, which carries water to west Valley Reservoir, was dug in 1933. During the construction phase, the ditch had to go through a rocky rim area. A 40" corrugated steel pipeline was to get through the rocky rim area. A considerable amount of water would be lost each day through the rocks. At the time this ditch was being constructed, the laying of metal pipe was about the only option they had to get water to West Valley Reservoir. The diversion permit only allows water to be diverted to West Valley Reservoir only from Oct 30 to April 15. This is the period of coldest weather and highest runoff events. Since its construction, debris and ice dams clogging the pipe kept being a problem. When the pipe clogs water flows over the canal bank and down into the National Forest and is lost. Keeping a close vigil on the situation and clearing the pipe as soon as possible seemed to be the only solution to this problem. Access to this area is not always easy at this time of year. Loss of water varies each year but estimates would be from 65 to 130 ac ft/year. At the present time, the solution to this problem is to remove the 4,100 feet of pipe and replace with plastic ditch liner to prevent loss of water out the bottom or sides of the ditch. This section of ditch will become an open ditch eliminating ice and debris dams.

Flume pipe – The project involves the removal of 1000 feet of metal 36"D corrugated pipe and replace with plastic pipe. The original flume was constructed in 1867 and was made of wood. In 1945 the wood flume was taken out and replaced with the present metal pipe. Over the years numerous leaks in the pipe have occurred. Most are occurring along the bottom of the pipe at joints that are rusting out, some by falling rocks hitting the pipe and a few suspect rifle shot holes. The amount of water being lost is estimated to range from 500 to 600 ac ft /season.

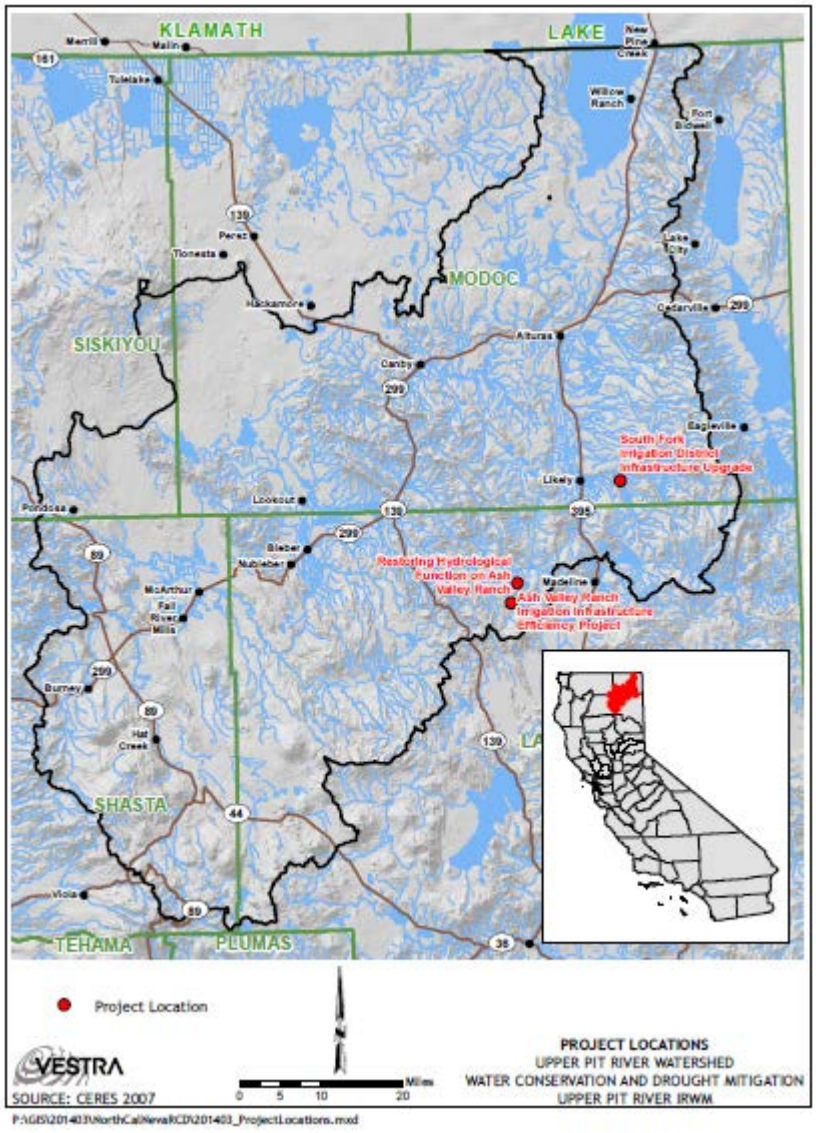
How many Eligible Drought Project Types does this project meet?

Provide immediate regional drought preparedness
This project improves immediate drought preparedness by reducing the wasteful water loss which is occurring each year. The loss of water in the infrastructure will be reduced as soon as the project is completed. The proposed project will contribute to a more sustainable and reliable water delivery system. This project improves agricultural irrigation efficiencies by correcting problems in the infrastructure which contributes to annual loss of water. The first step in making an agricultural irrigation system more efficient is to reduce or eliminate any unnecessary loss of water. The second step is to make the water go further through recycling or more efficient by improving the hydrology of the irrigated field. This project also addresses the long term preparedness because the project has at least a 15 year life expectancy.

Reduce water quality conflicts or ecosystem conflicts created by the drought
As mentioned in attachment two, flood irrigation systems and wetland sites are all part of the same water system. As agricultural irrigation water is reduced so is the water to many of the wetland areas. This will result in some wet meadows being dryer than normal and some wetland areas drying up completely. The controversy between water for agricultural needs or water for the wetland ecosystem becomes more of an issue as more of these critical site dry up. Having more efficient irrigation system will, in part, help reduce this controversy. The wet meadow and wetland areas influenced by this project are estimated at about 3,000 acres. These estimates are based on the National Wetlands Inventory maps for this area.

Why expedited funding is needed.
During normal years, the water flow from the River is more than adequate to meet the irrigation demands of the District. The loss of water was not greatly noticed. Now with the extended drought period we are experiencing, any loss of water is a critical issue. The annual revenue the District receives does not provide them the opportunity to take on such a project. This funding is needed at this critical time to make changes that will improve the efficiency of the irrigation infrastructure. This project can't be completed any time in the near future without this funding.

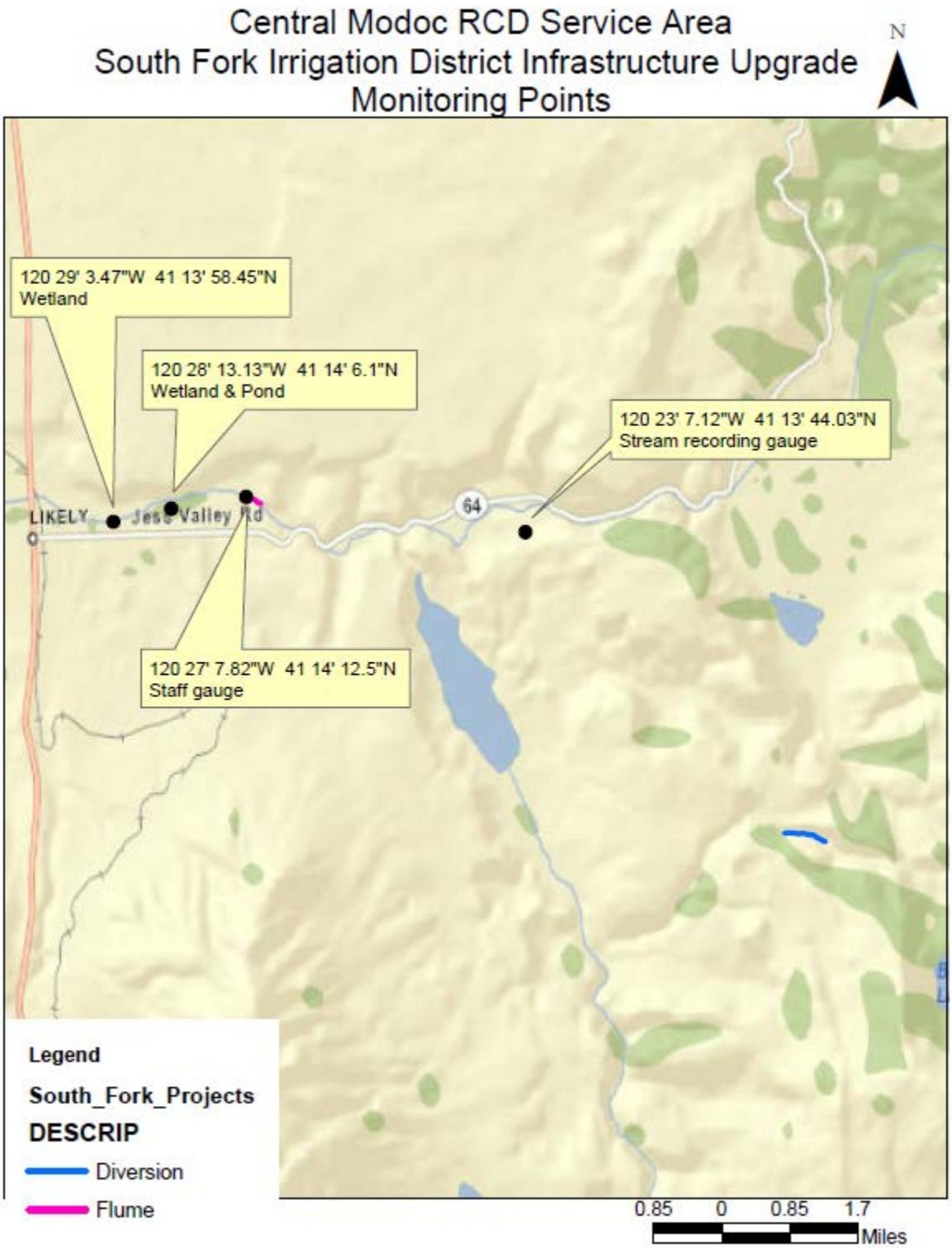
Regional Map:



Project Maps:

South Fork Irrigation
Upgrade Projects
N
Legend
South_Fork_Projects
DESCRIP
Diversion
Flume
3,250 0 3,250 6,500
Feet

Project C: Photo Monitoring Points



PROJECT PHYSICAL BENEFITS See Tables 5.1 through 5.3of Excel Spreadsheets

Table 5.1 – Annual Project Physical Benefits			
Project Name: South Fork Irrigation District Infrastructure Upgrade			
Type of Benefit Claimed: _Amount of water saved by stopping distribution ditch waste			
Units of the Benefit Claimed: acre feet/year			
Additional Information About this Benefit: The ac ft/year is the amount prevented from being lost from leaks and			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
Diversion ditch pipe removal			
15	23,400	23,500	100
Flume pipe replacement			
20	2,000	2,550	550
Last Year of Project Life			
Comments: The figures in the table are based on flow measurements from a staff gage and an automatic recording flow meter. Flow measurements and scheduled ditch inspections will be used to monitor the desired benefits. Column d represents the water saved each year.			

Table 5.2 – Annual Project Physical Benefits			
Project Name: South Fork Irrigation District Infrastructure Upgrade			
Type of Benefit Claimed: _Amount of wetland acres maintained by stopping distribution ditch waste			
Units of the Benefit Claimed: acres			
Additional Information About this Benefit: The acres are the amount prevented from being lost due to lack of water.			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	3000	3000	0
2015	3,000	3,000	0
2016	2970	3000	-30
2017	2,940	3,000	-60
Last Year of Project Life			
Comments: The figures in the table represent the amount of acres lost without the project. The benefits with the project maintain the current status of wetland habitat. Column d represents the loss without the project. The benefit analysis is for only 4 years. To many variables effect the wetland habitat. It would not be reasonable to predict benefits longer than this period, although the life of the project is for a longer period.			

Table 5.3 – Annual Project Physical Benefits			
Project Name: South Fork Irrigation District Infrastructure Upgrade			
Type of Benefit Claimed: _Amount of pond habit maintained as a result of preventing the loss of water,__			
Units of the Benefit Claimed: Number of ponds_____			
Additional Information About this Benefit: The benefit is based on preventing the loss of pond habitat.___			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	4	4	0
2015	4	4	0
2016	3	4	-1
2017	2	4	-2
Last Year of Project Life			
Comments: The figures in the table represent the amount of pond habitat lost without the project. The benefits with the project maintain the current status of pond habitat. Column d represents the loss without the project. The benefit analysis is for only 4 years. To many variables effect the pond habitat. It would not be reasonable to predict benefits longer than this period, although the life of the project is for a longer period.			

TECHNICAL ANALYSIS OF PHYSICAL BENEFITS CLAIMED

The primary benefit is the prevention of lost irrigation water due to problems in the main ditch infrastructure, which will be measured in acre feet per irrigation year. The technical basis of the project is based on expert opinion and local knowledge of the irrigators in the District. Experts from the local NRCS and Central Modoc RCD offices along with the water master have all looked at the present situation. This effort resulted in suggestions that formed the basis of the proposed project. Local knowledge from users in the District provided information on the frequency and duration of water overflowing the banks and leaking from the pipe. Knowledge of resent and historical events provided the basis for the frequency and duration of water loss. The amount of water loss is based on flow measurement records along with estimates from local people using the irrigation water. Estimates of without project conditions would result in the same loss of benefits as described above. Any future projects that might be planned would not have any impact on the water being lost in the ditch infrastructure. The other projects would have an impact on water use after it leaves the main distribution ditches. The physical benefits were estimated by using stream flow information from stream staff gauges and an automatic recording stream flow gauge. Local knowledge from irrigators in the District was used to estimate the average water flow being lost or wasted in the main ditch infrastructure. No new facilities, polices, and actions are required to obtain the estimated physical benefits identified as a result of this project. No potential adverse physical effects have been identified. The proposed project will eliminate an adverse impact from the present situation by stopping overflow and leakage from sections of the main ditches.

The secondary benefits are sustaining the wet-meadow and wetland habitats and providing shallow flooded areas for migrating birds. This benefit will be measured in acres of wet-meadow and wetlands, which is estimated at about 3,000 acres within the South Fork District. The initial basis for this estimate is based on National Wetlands Inventory maps and local experts. As mentioned in Attachment 2, flood irrigation and wetland areas are all a part of the same system. What benefits the field irrigation will also provide positive benefits to the wet-meadow and wetland areas.

COST EFFECTIVE ANALYSIS **see Table 6**

Table 6 – Cost Effective Analysis Project name: The South Fork Irrigation District Infrastructure Upgrade_____	
Question 1	Types of benefits provided as shown in Table 5 - Reduce the amount of water being lost in acre feet per year, reduce the amount of wetland habitat loss, and reduce the amount of pond habitat lost due to the drought.
Question 2	Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified? Yes
	If no, why?
	If yes, list the methods (**including the proposed project**) and estimated costs. Diversion ditch upgrade - remove pipe and replace with concrete - $78,400(material cost only) Diversion ditch upgrade - **remove pipe/replace plastic ditch liner** - $19,600 (material only) Flume pipe upgrade - remove pipe and replace with metal pipe - $35,200(material cost only) **Flume pipe upgrade - remove pipe and replace with plastic pipe** - $30,400(material cost only)
Question 3	If the proposed project is not the least cost alternative, why is it the preferred alternative? Provide an explanation of any accomplishments of the proposed project that are different from the alternative project or methods.
Comments: Since this proposed project involves making improvements to an existing project, very few options are available. The main option is the use of materials to replace the existing pipe. Comparisons were made between concrete and ditch liners and metal pipe and plastic pipe. Labor costs were comparable in price. The main controlling factor was material used. The proposed project is the least	