ATTACHMENT 4: PROJECT DESCRIPTION

Provide a complete, detailed description of the proposed project, including the goals of the project, needed facilities and their location, and the area covered. Maps are generally not required (also see Attachment 5), but can be very helpful in explaining the proposed project. Describe how the project supports the goals and objectives of the GWMP. Applicant must clearly explain the relevance of project to the GWMP.

Describe the quality and usefulness of the information that will be obtained using technically feasible methods. Include a discussion of data, technical methods, and analyses to be used. The level of detail should be sufficient to determine the technical feasibility of the proposed project.

Describe how the applicant collaborates with other local public agencies with regard to the management of the affected groundwater basin. Discuss and provide evidence that a process is or will be in place that informs groundwater users, stakeholders, and the general public about the project to be funded with the proposed grant and disseminates relevant reports and data. A stakeholder is an individual, group, coalition, agency or others who are involved in, affected by, or have an interest in the implementation of a specific program or project. Explain and document how federal and other State agencies will be contacted. Examples include workshops, regularly scheduled groundwater association meetings, public notices, informational mailings, and websites.

Explain how ongoing use of the products derived from the proposed project will be funded after grant funds are expended. Additional State grant funds to continue with the funded project should not be a consideration. Provide examples of how often and under what funding mechanism monitoring wells will continue to be monitored, models maintained and used in the future, automated monitoring equipment maintained, or data management systems be updated and maintained. Include a discussion of measures that will be used to evaluate data and mechanisms to adapt the data collection process as new information is obtained. For proposals to develop a GWMP, explain how the GWMP will be implemented and how it will be funded.

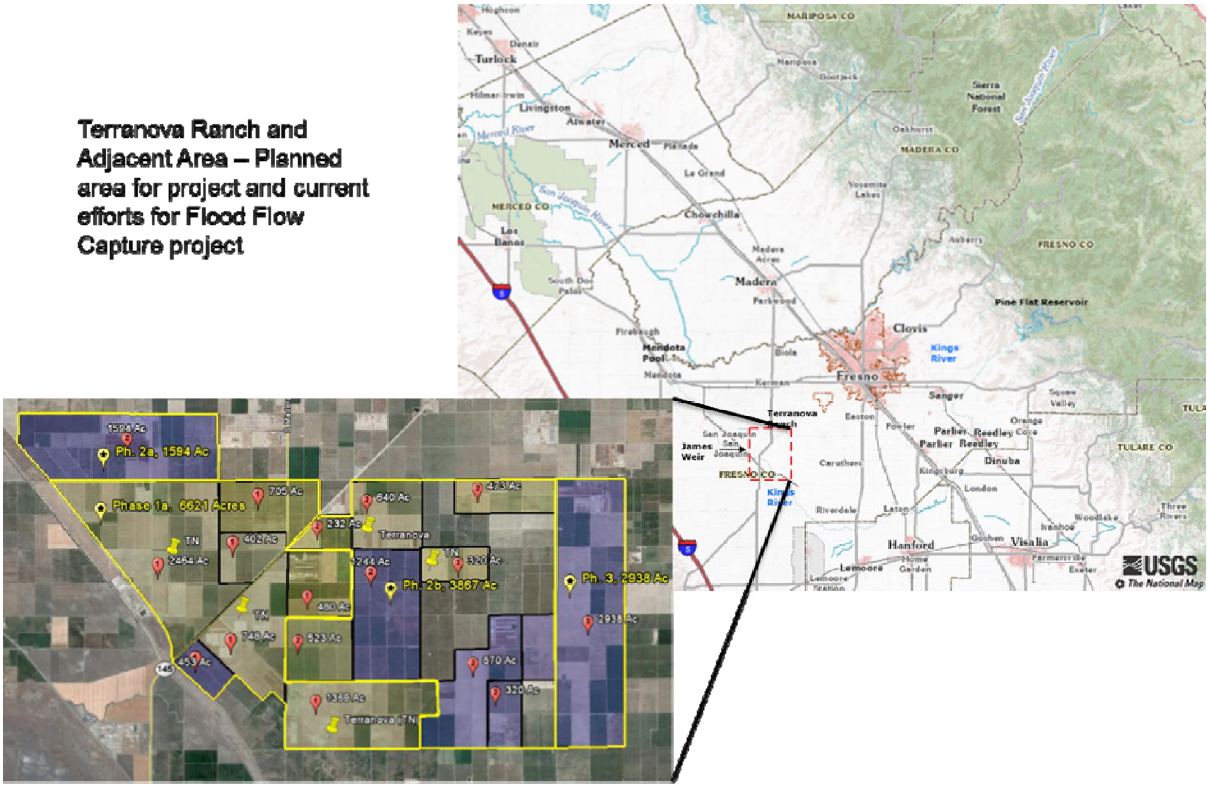
Overview

In the Kings River Basin, groundwater overdraft is a serious and chronic problem threatening the agricultural and economic sustainability of the region. Throughout the basin, surface water and groundwater are used to meet water demand. Annual surface water deliveries vary annually, ranging from about 300,000 to 1,500,000 ac-ft and averaging around 1,000,000 ac-ft[1]. In addition, 1,000,000 to 2,200,000 ac-ft of groundwater is pumped annually with an average of about 1,600,000 ac-ft. Agricultural demand as calculated from a consumptive use model and including recharge from irrigation inefficiencies is about 2,700,000 ac-ft annually (based on the Kings Basin Integrated Groundwater and Surface water Model or Kings IGSM). Natural groundwater recharge occurs from deep percolation from the east and south, and can also occur during "wet" (above average) water years when

[1] WRIME. 2007. Kings Basin Integrated Groundwater and Surface water Model (Kings IGSM). Model Development and Calibration. Prepared for Upper Kings Basin Water Forum, Kings River Conservation District, and City of Fresno in Coordination with California Department of Water Resources by Water Resources & Information Management Engineering, Inc. November 2007. http://www.krcd.org/water/ukbirwma/docs_rept.html

surface water is available to water rights holders as far downstream as Stinson or James Weirs on the North Fork of the Kings River, or during prolonged flood releases through the James Bypass/Fresno Sloughs. The imbalance between supply and demand has led to a long-term groundwater overdraft in the basin. The Kings IGSM calculates all sources of water to the Kings Basin including deep percolation from the east and south and estimates overdraft in the Kings Basin at about 160,000 ac-ft annually, with about 100,000 ac-ft overdrafted from the Lower Kings Basin and 60,000 overdrafted from the Upper Kings Basin.

This overdraft is most severe at Helm, CA adjacent to the James Weir. Pumped groundwater is the primary source of irrigation in this region, with standing water typically measured at 200 feet below the surface. The region is also within the well field of the James Irrigation District, which pumps water from east of the Kings River channel and transports it to irrigated lands to the west of the channel. Improvements in irrigation technology have allowed applications to match crop usage, but the high frequency of irrigation applications necessary for such systems place continual demands upon the unconfined aquifer. As a result, groundwater is over 200 feet below ground levels in this region.



To help mitigate this problem and to reduce downstream flood risks, DWR has awarded a Flood Corridor grant to KRCD and its partners to implement a Flood Flow Capture at Terranova Ranch, Helm, CA[2]. One goal of this Flood Corridor project is to capture flood flows in perpetuity from the Kings River

[2] McMullin On-Farm Flood Capture and Recharge Project

and apply them to large tracts of agricultural land to reduce downstream flood risks and simultaneously recharge groundwater. Based upon the findings of demonstration studies under a NRCS Conservation Innovation Grant (CIG), the DWR project promises a more flexible and cost-effective approach to capturing flood flows and recharging groundwater than is possible with more engineered solutions, by managing agricultural acres for the dual purposes of crop production and flood flow risk reduction.[3]

The DWR project should provide an approach for helping mitigate the severe and chronic groundwater overdraft in the Kings Basin. The CIG grant data suggest salts and nitrate in the upper soil layers are pushed down towards groundwater under flood flow recharge. However, over the long term high quality river flood flow water will improve groundwater quality[4] (Bachand et al., 2012). Wide adoption could potentially provide opportunities throughout California and elsewhere for a cost effective way to capture stormflows and mitigate groundwater overdraft in the face of climate change pressures (e.g., decreased snow period and volume; increased rain volumes; increased rain on snow events).

Despite the promise of the flood recharge approach, more information is needed with regard to understanding groundwater impacts. Broad adoption will require 1) more definitive answers with regard to groundwater water quality impacts and 2) an understanding of steps that can be taken for creating a sustainable groundwater future.

Goals and Objectives

This project's goals are to 1) quantify vadose zone impacts of capturing flood flows on agricultural lands; 2) quantify hydrologic and water quality fluxes to groundwater, and, 3) validate model results against groundwater data. Additional data to be obtained from this project is a Basin-wide understanding of groundwater levels and movements through the use of remote telemetry stations along an East-West transect of the Basin (roughly along Manning Ave in central Fresno County) and water quality measurements as part of the KRCD's management of the Long Term Irrigated Lands Regulatory Program for the Kings and Tulare Lake regions. Water level data will be incorporated into the CASGEM program as well.

Methods, Technical Data and Analyses

The methods proposed to be used in this work include installation of three dedicated monitoring wells between Raisin City and Helm, CA and implementation of an accompanying vadose zone / groundwater investigation utilizing the lithology, hydrologic and water quality data from these wells and root zone and deep vadose zone modeling.

[3] AGREEMENT NO.68-9104-0-128; Demonstrating Groundwater Recharge with Storm Flood Flows on Agricultural Lands using Best Management Practices to mitigate groundwater overdraft

[4] Bachand, P.A.M., W.R. Horwath, S.Roy, J. Choperena and D. Cameron. 2012. Project Report and data for NRCS CIG Groundwater Recharge project. In progress. Planned completion October 2012.

Monitoring Wells

The funded project will consist of the construction of three dedicated groundwater monitoring wells between Raisin City and Helm, CA on the Terranova Ranch. Previous work in the region conducted by the KRCD has shown that the confining "A" clay (located approximately 60 feet below the surface) is discontinuous within the region, which does allow for recharge potential in carefully selected sites. What the previous studies could not do, however, was accurately track the movement of water through the entire vadose zone. All the previous geologic work (conducted under the McMullin Recharge Studies and Lower Kings Basin Groundwater Recharge grants) was to a maximum depth of 100 ft. below the ground surface, far above the region's groundwater table. Rates of groundwater recovery from Kings River flood events (as measured by the time lag between river flow and groundwater recovery and the duration of recovery) and the rate of movement from regions of high groundwater levels into the depression remain unknown. Installation of the monitoring wells will provide data on the lithology throughout the vadose zone to the groundwater table, and will enable water quality and water elevation monitoring of groundwater in this highly impacted area.

Vadose zone / Groundwater Investigation

The vadose zone / groundwater investigation will be conducted by integrating 1-D models for the vadose zone with a field data collection effort focused on characterizing the upper 5 feet of the soil (the agronomically managed root zone) to provide data on the physical and chemical characteristics of the soils, and for calibration and validation of the model.

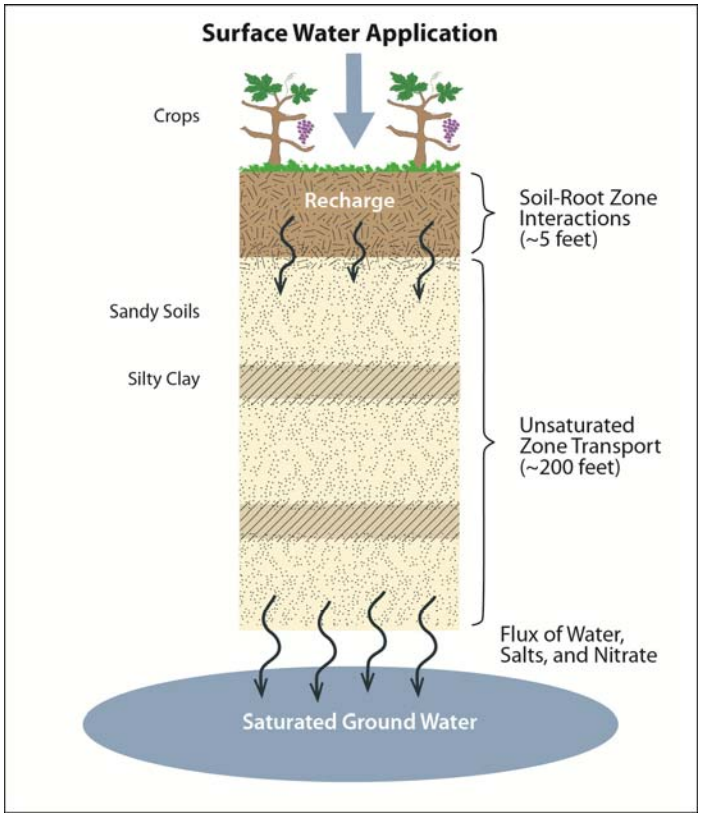
Model – 5 feet below ground surface to the vadose zone

The purpose of the vadose zone modeling will be to follow the movement of the nitrate and salts through the root zone to estimate constituent and hydrologic loading to the groundwater table (Figure 1). Numerical and analytical 1-D models will be used to simulate water quality changes and groundwater transport through the vadose zone from a depth of 5 feet below ground surface (bgs) to 200 feet bgs at the vadose zone / groundwater interface. This region of the vadose zone is relatively simple in comparison to the upper 5 feet where biogeochemical processes are driving nutrient and organic carbon cycling, hydrology is most variable, and the soils are agronomically managed for crops. Field data collected from that region will form the upper boundary of the modeling for the unsaturated zone. The model will be used to evaluate four scenarios: flood irrigation, over-irrigation, normal irrigation, and dry conditions for a range of typical soil conditions in a Monte Carlo framework for different cropping patterns. Soils data collected during well installation will be used to calibrate the model. The primary processes affecting nitrate and salt transport throughout this region are expected to be advection, dispersion, and to a lesser extent sorption. Adsorption coefficients and hydraulic conductivity will be directly measured in the laboratory on collected soils using standard methods. The

two modeling approaches to be tested, a 1-D analytical model and a 1-D numerical model of unsaturated zone transport, have different advantages. The advantage of the analytical model is that it requires less data and has a short run time. The benefit of using a numerical model is that it can handle multiple soil layers. Both models would use the flux out of the root zone as input to the model simulations.

Characterizing the upper vadose zone

The upper vadose zone, composed primarily of the root zone (0-5 feet), will be characterized through field sampling efforts. The objective of this characterization will be to provide inputs for the deeper vadose zone model.



This root zone is more challenging to effectively model due to complex nutrient, organic carbon and redox cycling, time-varying hydrology, and active agronomic management. Thus, nitrogen and salt cycling, retardation and transport will be determined through field sampling efforts that will include installation of soil moisture probes within the root zone, shallow soil cores collected throughout the year, measurements of surface hydrologic and constituent loading on the fields through direct measurement and through record keeping of agronomic practices. These techniques were successfully implemented during the NRCS CIG demonstration project with the primary goal of measuring infiltration rates and tracking salt transport. Thus, those data will be available to support this effort. However, efforts for this project will be broadened to include assessing nitrogen transport and cycling, investigation of precipitation and dissolution cycling of gypsum and magnesium sulfate (as a long-term source of salts), and assessment of potential changes in soil infiltration rates as a result of flood recharge efforts. Analyses used to interpret the data include hydrologic and mass flux budgets for the root zone using a Microsoft Access database; statistical analyses of differences and trends using ANOVA and regressions; and the development of simple empirical or analytical models.

These efforts are expected to occur over one full year in order to capture the complete annual cycles. Field sites will be selected to include different hydrologic management, soils and cropping patterns; and

to supplement data collected from the NRCS CIG demonstration project and the DWR Flood Corridor project. See integration section below.

Model Validation

The model will be validated in a number of ways. Field cores will be collected to 50 feet during the study using UC Davis's GeoProbe. The GeoProbe is a mobile soil corer that pulls intact cores to a depth of 50 feet. Soil and water quality data will be obtained for different hydrologic and cropping treatments and these data will be compared to findings from the model to enable adjustment of the model as needed. Reasons to adjust the model could include issues such as preferential flow paths or spatial variability.

The intended results from the model are quantify nitrate and salt fluxes reaching the water table under different recharge scenarios, the time frame of the transport from months to decades, and whether the sequence or duration of the scenarios influences the transport of nitrate and salts in soil. Sampling of the groundwater well network, comprised of new monitoring wells and existing production wells, will allow an opportunity to characterize groundwater trends both spatially and temporally. These data will help validate the model results through confirming flux trends and providing a mechanism for long-term validation of effects to groundwater from the adoption of the flood flow capture project in this area. These efforts are expected to occur over one full year to capture the complete annual cycle. Field sites will be selected to include different hydrologic management, soils and cropping patterns; and to supplement data collected from the NRCS CIG demonstration project and the DWR Flood Corridor project. This is further described in the integration section below.

Needed Facilities and Their Location

The proposed project will consist of the installation of a minimum of three new monitoring wells within the study area, completed to a depth of approximately 300 feet (up to 350 feet if possible) with full geologic evaluation as the drilling is conducted. This depth guarantees that (1) a complete geologic log is made from the surface to the water table and (2) that the data logger will remain completely submerged even in a prolonged period of dry conditions. These wells will be installed with approval of land owners and will ensure long-term access to groundwater data by KRCD. The completed wells will also allow for groundwater quality sampling, which is a concern for both the landowner and the Lower Kings Basin under its Groundwater Management Plan. The project will also use existing production wells in the region. The new monitoring wells and the existing production wells will enable groundwater tracking in the region through both high frequency and low spatial distribution (instrumented monitoring wells) and low frequency but high spatial distribution (all wells).

Integration, Collaboration and Outreach

The proposed project will be integrated with several past and current efforts as shown in Table 1: NRCS CIG grant, the newly funded DWR Flood Corridor project to implement flood flow capture on Terranova Ranch; KRCD's Remote Telemetry Project (RMT); and the network of CASGEM (California Statewide Groundwater Elevation Monitoring) wells that the KRCD reports on for the Kings River Basin. Integration with these projects is briefly described below.

NRCS CIG Grant

The NRCS CIG grant has been a demonstration project for quantifying infiltration rates that can be achieved through on-farm flood flow BMPs and for developing standard practices. The project will be completed in October 2012 and the final reporting will provide anticipated infiltration rates, a simple mass balance model for describing nitrate and salt losses from the vadose zone to the groundwater table, structural and non-structural management practices and an economic analyses. Data and/or samples from this project that will be integrated into this project include a NRCS soils map for Terranova Ranch; intact soil cores to a depth of up to 20 meters for three hydrologic regimes (flood recharge, over-irrigation, drip irrigation) with accompanying EC and soil moisture data; high frequency 15-minute soil moisture probe data (temperature, EC, % moisture by volume) for the root zone; and surface and pumped ground- water chemistry data. This project is near completion and has held field meetings and tours, and provided presentations in a variety of forums (e.g., NGWA annual conference, Lower Kings Basin JPA meeting). A final outreach effort will be provided at the completion of the project as either a manuscript for California Agriculture or a presentation to stakeholders in collaboration with NRCS Fresno.

DWR Flood Corridor Grant

The DWR Flood Corridor Grant (FCG) will implement flood flow capture onto the approximately 5,000 acre Terranova Ranch. Of this area, 1,500 acres will be used for capturing flood flows from December through May. This project will implement necessary conveyance infrastructure; provide flood easements on 375 acres; develop strategies for large-scale implementation of this program; and develop a JPA for further expansion to the neighboring farms for a total of 16,000 acres with about 5,000 being used for flood flow capture. The FCG-funded project will provide the necessary conveyance, tools and commitments for in perpetuity flood flow recharge for mitigating severe and chronic groundwater overdraft in the Kings Basin, and is expected to have profound effects on the groundwater basin, providing a means to infiltrate high quality Kings River flood flows to groundwater.

This proposed project will complement the FCG-funded project. The DWR FCG project will provide study sites, implementation of the flood corridor program, cooperating landowners and an in-perpetuity commitment for groundwater recharge. Data necessary for developing implementation strategies will be

collected under the DWR Flood Corridor grant; for validating flood recharge loading requirements for the DWR Flood Corridor project; and for quantifying total recharge achieved during flood flow capture efforts. This proposed project will augment that data collection effort by focusing on vadose zone effects and groundwater fluxes of salts and nitrate over time through the collection of field data and implementation of the 1-D model.

Outreach for this project will be led by our partner Sustainable Conservation and lead agency KRCD. Information is expected to be relevant to other areas in the Kings Basin, as well as other areas in the Central Valley where flashy flows in rivers make traditional engineering solutions for recharge, i.e., permanent recharge basins, impractical and expensive. This project will establish an outreach program to present the flood management and recharge opportunities being implemented by this program and will include a website, annual workshops and a newsletter. The project will also fund the creation of a Joint Powers Authority for long-term, committed, funded management of the Flood Flow Capture program.

KRCD Remote Telemetry Project (KRCD RMT)

This proposed project focuses on groundwater responses near Helm, Ca. This data set will be integrated into a larger scale data set being generated by the KRCD RMT project. This recently awarded project will use real time telemetry to monitor and report groundwater levels in existing dedicated monitoring wells within the Kings River Basin along a transect from Reedley to the Raisin City area along Manning Ave. During its term, this project will collect groundwater level data once per day at a resolution of 0.1 ft, allowing for development of hydrographs and quantifying seasonal and annual hydrologic responses that can be related to the current Kings Basin groundwater model. These data will be used to validate the KRCD groundwater basin model, and extend its understanding to better capture the groundwater trends and low and high frequency temporal responses in the highly affected area from Reedley to Raisin City.

Well data from the RMT project (and this project as well) will be made available in several ways. The RMT data will be included in the Annual Groundwater Report published by the KRCD (www.krcd.org). Moreover, summarized hydrograph data will be made available via the Internet and include monthly and annual summaries of changes in groundwater elevations at the different well locations. Integrating the RMT project with this proposed project will enable our team to interpret responses in groundwater under Terranova Ranch as a function of both local recharge and water management activities but also more regional hydrologic drivers (e.g., runoff, climate, groundwater gradients).

Integration into Basin-wide GWMP efforts and the CASGEM network

The completed wells from this project will allow for groundwater quality sampling, which is a concern for both the landowners and the Lower Kings Basin under its Groundwater Management Plan. The project will be integrated into other basin-wide efforts to monitor two groundwater trends, (levels and

movement) and groundwater quality, as mandated by the Lower Kings Basin GWMP and the upcoming groundwater requirements from the Regional Water Quality Control Board's pending General Order for Waste Discharge for the Tulare Lake Basin. Data generated from the water quality testing will be reported as required under the General Order to the Regional Board. The project will also be integrated into the CASGEM (California Statewide Groundwater Elevation Monitoring) wells. KRCD reports the Kings River Basin data for CASGEM. Wells from this proposed study and the RMT study will remain functional after the completion of the respective projects and will be incorporated into the GWMP and CASGEM efforts and shared with appropriate public agencies (e.g., irrigation districts, municipalities). Finally, the site locations will be GPS surveyed for location and elevation and integrated into the subsidence studies currently underway within the Basin. Subsidence information is to be published as part of the KRCD Groundwater Report as it is updated every 5 years or so.

Project Specific Outreach and Groundwater Management

As discussed above, this project will be integrated with a broad range of projects that each provide data to stakeholders:

- NRCS CIG project – California Ag article or NRCS forum
- DWR Flood Corridor project – workshops, newsletters, website
- KRCD RMT project – data summaries on the internet, KRCD Annual Groundwater Report
- GWMP and CASGEM efforts – KRCD Kings River Basin report to California, sharing data with public agencies (e.g., irrigation districts, municipalities), subsidence information as part of KRCD Groundwater Report, Regional Water Quality Control Board's pending General Order for Waste Discharge for the Tulare Lake Basin.

This project will integrate outreach efforts with the above efforts and incorporate findings into workshops and literature to specifically provide information on the fate and transport of nitrate and salts expected from On-Farm Flood Flow Capture BMPs and steps and practices to be taken to create a more sustainable groundwater supply.

Current groundwater efforts in the Kings Basin are primarily in place to characterize the basin, much of it regulatorily driven. This project's outreach efforts with regard to groundwater and its management will extend beyond the regulatory realm. The DWR Flood Corridor project is a novel and innovative approach towards a groundwater solution: integrating flood management into the management of agricultural lands to provide flexible and low cost conditions to capture highly variable flood flows to reduce flood risks and to recharge groundwater. The implementation of the DWR Flood Corridor project will have profound effects on the Kings Basin Groundwater basin by providing a means to infiltrate high quality river water to the groundwater table. The Flood Capture program will be self-funded and managed in the long-term through creation of a Joint Powers Authority.

As discussed earlier, broad adoption will require 1) more definitive answers with regard to groundwater water quality impacts and 2) an understanding of steps that can be taken for creating a sustainable groundwater future. The primary concern is what impact legacy salts and nitrate in the vadose zone will have on groundwater. This project specifically addresses these issues and will thus provide critical information for future decisions on approaches for managing groundwater here (and potentially in other areas of California) and for better understanding the opportunities and constraints with On-Farm Flood Flow Capture programs. All key players in the Kings Basin are involved with the above related studies so this project should be able to effectively leverage that network for effective outreach and to integrate findings from this study into regional and statewide discussions on groundwater management options. The information from this project is critical now for those related projects and will only become increasingly important under future climate change pressures.

Long-term Funding

After completion of the proposed project, wells will be monitored as part of KRCD's regular groundwater monitoring program, twice per year as a minimum as required by CASGEM. Continuing costs for the monitoring, analyzing and providing groundwater elevation data are paid as staff time by the KRCD (or other agency that may conduct monitoring of the well network). Water quality sampling is funded by the fees associated with the individual grower's membership in the Kings River Sub-Watershed of the Southern San Joaquin Valley Water Quality Coalition, the entity formed to perform the tasks required under the Regional Board's General Order.

Relevancy to Example Eligible Projects

This proposed project's integration with existing groundwater efforts addresses many of the examples provided in Table 1 of the Proposal Solicitation Package. This project provides data related to groundwater management; implements groundwater monitoring to support CASGEM and the GWMP; expands groundwater monitoring to include water quality; provides additional data on subsidence; and provides data to enhance groundwater mapping activities and to support the KRCD groundwater model. Importantly, this project will target a strategic location to understand the Kings River Groundwater Basin, focusing resources in the highly impacted region below Helm, CA. Finally, this project, in coordination with the NRCS CIG project and the DWR Flood Flow Capture project, will provide critical, important and new information and data for developing strategies for groundwater management; assessing high volume and relatively flexible recharge opportunities; provide 1-D models to help with understanding long-term impacts and thus improving groundwater management; enable an evaluation of water quality impacts under the Flood Flow Capture program; and provide information to integrate groundwater management with other management strategies, including managing farm waters.

Table 1. Project relevance to targeted example goals from PSP

		Proposed Project	Collaborative and Integrated Investigations		
			CIG Flood Recharge	DWR Flood Flow Capture	KRCD Remote Telemetry Grant
Groundwater Studies	Collect and evaluate data related to groundwater management	x	x	x	x
	Evaluate the potential for natural or artificial recharge or evaluate conjunctive use opportunities	x	x		
	Develop and calibrate a groundwater model to assist in managing groundwater resources	x			x
	Examine alternative methods of reducing the impact of high water tables				
	Evaluate the potential to deliver untreated water or treated wastewater for groundwater recharge				
	Perform aquifer tests				
	Gather information or perform studies for developing or improving groundwater management	x	x	x	x
Groundwater Monitoring, Mapping, and Data Reporting	Develop groundwater level monitoring and reporting program to support participation in the California Statewide Groundwater Elevation Monitoring (CASGEM) Program.	x			x
	Develop and implement monitoring programs to measure water quality and subsidence	x			x
	Install monitoring wells, extensometers, or other monitoring devices	x			x
	Install data loggers in wells at strategic locations	x			x
	Mapping of groundwater recharge areas	x		x	
Groundwater Management	Plan variations in amount and locations of pumping to better utilize the basin storage capacity	x			x
	Develop or expand a local or regional GWMP	x			x
	Evaluate alternatives to improve water supply reliability or to protect and improve water quality	x	x	x	
	Develop local or regional groundwater basin management objectives	x	x	x	
	Integrate groundwater management with other water management strategies	x	x	x	
	Well destruction to eliminate potential contaminant conduits				