Conservation of surface and ground water in a Western watershed experiencing rapid loss of irrigated agricultural land to development

A research, extension and education project funded by the U.S. Department of Agriculture Cooperative State Research, Education, and Extension Service—National Integrated Water Quality Program (NIWQP).

Project Number: CALR-2008-03643

Project Director: Rob Van Kirk, Department of Mathematics, Humboldt State University, Arcata, CA

Fiscal Year 2010 Annual Report: November 29, 2010

Outputs
The primary outputs of the second year were data collection and analysis, model formulation, and dissemination of information to watershed stakeholders and decision-makers.

Activities
Three graduate students completed their second year in master’s degree programs in Environmental Systems (Mathematical Modeling and Environmental Engineering) and Environment and Community. Project faculty mentored the students on campus and in the field. During the summer, the students lived in the study watershed in Idaho, where they finished collection of physical and sociologic data begun in 2009. Additional data were compiled from existing water resources and land use databases.

The physical science team developed a model to estimate a water budget for the watershed’s surface irrigation system. Water budget components include diversion, canal evaporation, transpiration from canal riparian areas, seepage to ground water, and delivery to fields. The centerpiece of this model is daily calculation of each of these components for each of the watershed’s 40 major canal systems. The canal system has been digitized and incorporated into a groundwater model domain. Model features estimated from GIS and satellite images were validated with field observations and aerial reconnaissance from small aircraft.

The social science team conducted over 50 formal interviews with watershed stakeholders and decision-makers representing the primary groups identified during the project’s first year: “traditional” agricultural water users, “new” water users such as landscaping managers in resort developments and residents in newly built subdivisions, organizations devoted to fish/wildlife/environmental conservation, water managers, and land use planners. The team also quantified the amount of previously irrigated land that has been converted to non-agricultural use and investigated the types of water rights transfers that accompany such conversions.
Events
The project team organized and led the annual day-long field trip sponsored by the Henry’s Fork Watershed Council in July. The field trip illustrated the primary hydrologic and sociological components of the project through site visits to streams, irrigation systems, new subdivisions, and important areas of groundwater emergence (springs). Agency personnel, irrigators, project team members, and water-use consultants gave on-site presentations, and the project team provided a handout of detailed maps and graphs to each participant. Over 50 people attended the field trip, including state legislators and staff representing U.S. Senate and House members.

Products
Website: http://humboldt.edu/henrysfork, which includes the field trip handout.

Dissemination
We presented a poster at the Land and Sea Grant National Water Conference in February. We presented information to the Henry’s Fork Watershed Council at its March meeting and at the July field trip. The project director gave formal presentations at the annual conference of the Yellowstone Business Partnership, to a technical team at the U.S. Bureau of Reclamation’s regional office in Boise, and at a seminar series sponsored by The Nature Conservancy.

Outcomes/Impacts
During the project’s first year, the primary outcome was change in knowledge among members of the research team. During the second year, we have expanded the scope of this knowledge to watershed stakeholders and decision-makers.

Aquifer recharge incidental to irrigation is a major component of the watershed’s hydrology. The canal system was built at the turn of the 20th century by small canal companies to divert water from streams and deliver it to fields. Originally, all of the canals were unlined structures with high seepage, and most canals remain in their original form. Prior to the 1970s, irrigation water was applied directly to the ground via flooding or furrows, but almost all irrigation has been converted to more efficient sprinkler application, thus decreasing the amount of irrigation-dependent recharge from its mid-20th century peak. Diversion of water from streams, recharge to aquifers, and re-emergence of this water at springs has transformed snowmelt-dominated hydrologic regimes into more stable, groundwater-dominated hydrologic regimes. This has created a large water supply for domestic use, a more stable supply for irrigators who divert water down-gradient from other canals, and extensive spring/wetland systems that support fish and wildlife resources. However, the groundwater-dominated system generally favors introduced fish species over native species, and hydrologic alteration is a factor limiting recovery of increasingly rare cutthroat trout, the only trout species native to the watershed.

Conversion of irrigated land to non-agricultural uses could reduce the amount of water diverted from streams and delivered through canals, thereby reducing groundwater and associated resources but potentially increasing streamflow. Because most recharge incidental to irrigation occurs through canal seepage, we are focusing on the fate of canals as land use changes. Generally, as land has changed
ownership and use, usage of water tied to that land has also been transferred, and the new owners use this water—delivered in existing canals—to irrigate landscaping or small pastures. However, management of canal systems has become more complex as large parcels of land irrigated by a single landowner are replaced by large numbers of small parcels. The water transfer mechanism that has the greatest potential to provide continuity in canal operation and maintenance is one in which the water rights remain with the canal company, and new landowners are issued shares in the company. Because Idaho Water Law does not prioritize instream flow, conversion of land to non-agricultural uses does not provide an easy mechanism for transferring water to instream uses. However, mechanisms such as leasing through the State Water Bank and the establishment of local water banks geared toward instream flows have been used to restore water to some streams in Idaho.

Any change in current management of the canal system will have consequences for groundwater supply, spring/wetland ecosystems, down-gradient irrigators, and surface hydrology. Our research will provide tools to identify and quantify these consequences and inform future decisions about land and water use.

**Publications**

None

**Participants**

**Senior Personnel**

Rob Van Kirk, Project Director: Performed administrative functions, supervised graduate students during field season, presented information at Henry’s Fork Watershed Council meeting and field trip and at other regional venues, performed technical aspects of hydrologic modeling and analysis. Thesis advisor to Kimberly Peterson.

J. Mark Baker and Yvonne Everett, Co-directors. Supervised formal stakeholder interview process, analyzed interview data, and interpreted land use data. Thesis advisors to Lora Liegel.

Brad Finney, Co-director. Supervised technical aspects of ground-water modeling, performed field observations of the irrigation system, attended field trip. Thesis advisor to Brian Apple.

Steve Steinberg, Co-director. Maintained project web site, provided technical guidance to graduate students regarding GIS analysis.

Steve Trafton, Henry’s Fork Foundation. Co-facilitated meetings of Henry’s Fork Watershed Council, provided field area logistical support, assisted in arranging stakeholder interviews.

Amy Verbeten, Friends of the Teton River. Organized Henry’s Fork Watershed Council field trip, assisted in arranging stakeholder interviews, attended Henry’s Fork Watershed Council meetings, provided field area logistical support.
Dale Swenson, Fremont-Madison Irrigation District. Co-facilitated meetings of Henry’s Fork Watershed Council, provided field area logistical support, assisted in arranging stakeholder interviews, attended Watershed Council field trip.

**Graduate Students**
Kimberly Peterson: Completed second year of master’s program, collected field data, analyzed streamflow data, developed hydrologic model components, attended field trip.

Brian Apple: Completed second year of master’s program, collected field data, compiled and analyzed groundwater data, developed hydrologic and groundwater model components, attended field trip.

Lora Liegel: Completed second year of master’s program, conducted formal stakeholder interviews, analyzed land use and interview data, presented results to the Henry’s Fork Watershed Council on the field trip.

**Partner Organizations**
Project team includes nongovernmental organizations in watershed; personnel from these organizations and roles/activities are listed above.

**Collaborators and contacts**
A formal collaboration was established with the U.S. Bureau of Reclamation (USBR), which has initiated a two-year study of water supply and options for increasing availability of water for irrigation in the Henry’s Fork Watershed. To minimize duplication of effort and to maximize the resources available to the USBR to evaluate potential management alternatives, the Henry’s Fork Watershed Council facilitated the collaboration between our project and the USBR. Our project will provide the water budget and analysis of supply and use in the watershed, and the USBR will then use these data as the basis for its evaluation of alternatives. This collaboration will substantially increase the utility and application of our results.

**Training or professional development**
Graduate students received training in research techniques. Lora Liegel delivered a presentation on the Watershed Council field trip.

**Target Audiences**
The primary target audiences of the project are water management agencies, irrigators, developers, state/county/municipal decision-makers and planners, and conservation groups within the watershed. Secondary audiences targeted thus far include interested watershed residents who are not directly involved in water management, water use, or land and water conservation. The larger water resources research and management community outside of the study area will be targeted during third year of the project.
**Efforts**
The Watershed Council field trip was the primary activity through which we delivered science-based knowledge to watershed stakeholders. Most of our extension and outreach efforts will be conducted during the project’s third and final year, when the scientific results will be finalized.

**Project Modifications**
In the original project proposal, we had planned to employ a seasonal outreach/education assistant to design and implement extension and outreach activities in the watershed. However, because our research results are not yet final, we have deferred these activities until the project’s third year. This winter, we will recruit an advanced undergraduate student as an outreach/education assistant and employ this person in the watershed during summer 2011. The assistant will be supervised by Amy Verbeten, one of the senior project personnel based in the watershed.