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

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

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Outputs

As this was the first year of a three-year project, most of the outputs were related to training graduate students, collecting field data, and introducing ourselves and the project to watershed stakeholders. Stakeholder interaction included several public meetings we report under "Dissemination."

Activities

Three graduate students completed their first 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 collected data and interacted with stakeholders.

The physical science team measured discharge in irrigation canals and stream channels for the purpose of estimating gains from/losses to ground water. The team collected enough data to estimate 50 reach gains/losses. Additional measurements quantifying stream channel geometry will allow estimates to be made for another 55 stream reaches from existing discharge data. The team made visual observations of geology, springs, and canal returns along the Henry's Fork to identify locations and approximate amounts of ground- and surface-water returns to the river.

The social science team collected quantitative data on land development and met key stakeholders and decision-makers. The land development database includes all subdivisions in the study area that have been approved since 1970 and records information such as subdivision area, lot size, total number of lots, location, and water rights. These data will allow us to quantify the rate at which agricultural land is being developed and estimate water use characteristics of different types of development. Informal stakeholder meetings served to introduce the research team and project to key watershed stakeholders, who, in turn, provided suggestions on particular aspects of development and water management that are important to the local community.

Events

none

Products
Website: http://humboldt.edu/~henrysfk

Dissemination
We undertook three formal outreach activities designed to inform stakeholders of the project, encourage their participation, and allow them to express concerns about the project. In January, we presented an outline of the project to the Henry's Fork Watershed Council, co-facilitated by project partners Fremont-Madison Irrigation District and Henry's Fork Foundation. That meeting was held in Rexburg, the largest city in the watershed. The project received additional exposure both pre- and post-meeting in local newspapers. We presented this same information at January's Water Wise forum, part of a series of public forums sponsored by project partner Friends of the Teton River. This was held in Teton Valley, about 50 miles from Rexburg, to maximize the number of watershed stakeholders we reached in this initial effort. We delivered a shorter, technical presentation to the Watershed Council in March to build support for the project among irrigation companies and water management agencies and to request technical assistance from those entities.

Outcomes/Impacts
The primary outcome/impact during this first year was change in knowledge on the part of the research team. Through coursework and research experience, the graduate students gained knowledge of data collection and analysis techniques. Faculty and students increased their knowledge of water management and land development in the study area.

Field data, literature review, and stakeholder comments identify aquifer recharge incidental to irrigation as a major component of the watershed's hydrology. The canal system was built in the late 19th and early 20th centuries by small canal companies. Originally, all of the canals in the watershed were unlined, earthen structures with high permeability. Although a few canals have been replaced by pipelines, most remain in their original form. Prior to the 1970s, irrigation was applied by direct flooding or by raising the water table to the root zone with border ditches, providing additional recharge. During the 1970s and 1980s, most of the flood/border application was replaced with more efficient sprinkler application. The watershed's irrigation system diverts about 1.8 million acre-feet of the annual surface supply of 2.7 million acre-feet. Of the diverted amount, approximately 0.6 million acre-feet is recharged to aquifers via canal seepage, and an additional 0.3 million acre-feet was recharged during the era of flood application.

Based on this information, we identify four time periods that characterize hydrologic conditions in the agricultural areas of the watershed. 1) Pre-European: Most water moved through the watershed as surface flow in the major streams, supporting resources in riparian areas maintained by the annual snowmelt pulse. Aquifer recharge occurred from precipitation, which is very low in the agricultural areas of the watershed, and from stream channel seepage on Teton Range alluvial fans. 2) Flood irrigation: Withdrawal and delivery of water reduced stream flows and associated resources in many reaches but recharged local aquifers. This resulted in a shift away from riparian/surface flow-dominated systems toward spring/wetland systems and created a large supply of ground water for domestic use. 3) Current

condition: Increased irrigation efficiency has reduced demand on surface flow in some reaches but has also reduced aquifer recharge, resulting in lower water tables and decline in spring/wetland resources. 4) Possible future condition: Depending patterns of water use change, loss of irrigated land to development could result in lower water consumption, providing opportunities to restore stream flow and associated resources in some areas. However, any changes that reduces aquifer recharge (e.g., abandoning canals) could further reduce availability of ground water for domestic use at a time when demand for that use is increasing. Spring/wetland resources could continue to decline in some areas. Effects of decreased ground-water recharge could be exacerbated by climate change, especially if future climate includes larger extremes in droughts and floods. Our modeling will aim to quantify the hydrologic differences among these four scenarios, with emphasis on possible future conditions.

Publications

None

Participants

Senior Personnel

Rob Van Kirk, Project Director: Performed administrative functions (e.g., approved expenditures, ensured conformance with program guidelines, managed budget, submitted reports), supervised graduate students during summer field research season, presented information at Henry's Fork Watershed Council meetings and other stakeholder outreach activities, met with key watershed stakeholders, performed technical aspects of research related to hydrologic modeling. Thesis advisor to Kimberly Peterson.

J. Mark Baker, Co-director. Met with key watershed stakeholders, observed land development patterns in the field, compiled literature related to social science aspects. Primary thesis advisor to Lora Liegel.

Yvonne Everett, Co-director. Met with key watershed stakeholders, observed land development patterns in the field, compiled literature related to social science aspects. Co-thesis advisor to Lora Liegel.

Brad Finney, Co-director. Performed and supervised technical aspects of ground-water modeling. Thesis advisor to Brian Apple.

Steve Steinberg, Co-director. Supervised development of project web site.

Steve Trafton, Henry's Fork Foundation. Co-facilitated meetings of Henry's Fork Watershed Council, provided field area logistical support, arranged watershed stakeholder meetings.

Amy Verbeten, Friends of the Teton River. Arranged stakeholder meetings, organized education/outreach forum, 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, arranged watershed stakeholder meetings.

Graduate Students

Kimberly Peterson: Completed first year of master's degree program, performed field collection of hydrologic data, conducted data analysis.

Brian Apple: Completed first year of master's degree program, performed field collection of hydrologic data and compilation of existing ground-water data.

Lora Liegel: Completed first year of master's degree program, met with key watershed stakeholders, compiled land use database.

Partner Organizations

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

Collaborators and contacts

Informal collaboration was established with the Idaho Water Resources Research Institute at the University of Idaho. Planned collaborative work includes technical aspects of irrigation seepage/return flow models. Planned outputs include jointly authored paper on this subject.

Training or professional development

Graduate students received classroom and field training in research techniques. Kimberly Peterson delivered part of the project presentation at stakeholder meetings.

Target Audiences

The primary target audiences of the project are water management agencies, irrigators, developers, 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 the second and third years of the project.

Efforts

As this is the first year of a three-year project, we do not yet have science-based information derived from project activities to deliver to target audiences. Extension and outreach activities during year one consisted of making target audiences aware of the project rather than delivering scientific information to them.

Project Modifications

None.