

NRCS Conservation Innovation Grant Final Performance Report 2012

Grantee: Meagher County Conservation District

Copies of the report may be obtained: U.S. Geological Survey Montana Water Science Center, 3162 Bozeman Ave., Helena, MT 59601. Digital copies of the reports will be available through the U.S. Geological Survey Montana Water Science Center website at <http://mt.water.usgs.gov/>. Current (3/2012) and published copies of the project reports will be submitted to the Meagher County Conservation District and DNRC.

Background:

Project history: The USGS entered into a cooperative agreement with the Meagher County Conservation District (MCCD) to install and operate a streamflow gaging station on the Smith River below Newlan Creek beginning in water year 2005 (gage operation began 10/1/2004). As drought conditions in the Smith River watershed were occurring, the MCCD board and USGS scientists met early in 2005 to discuss possible study options to address water management issues in the watershed. During these initial meetings, questions regarding the interaction of groundwater and surface water became the highest priority. The USGS then developed a study plan to examine the hydrology of the watershed with an emphasis on the understanding of the interaction of groundwater and surface water. The MCCD then actively searched for funding options, hired a grant writer, and applied for the Conservation Innovation Grant and the MT DNRC Reclamation and Development Grant. The MCCD signed a Joint Funding Agreement with the USGS to conduct a multi-year investigation of the watershed with the USGS contributing on the order of 40 percent of the project funds through their Cooperative Water Program.

This project was occurring and nearing completion while a second phase (phase II) of the investigation that was designed to examine the overall water budget was proposed and approved by the Montana legislature. Data collected as part of the second phase became important as part of the groundwater/surface-water interpretation. Therefore, product dates were pushed forward in order to incorporate additional data. The extension of deadlines resulted in a better product, with the addition of another report (overall data report) at no extra cost to the cooperator.

Project location: The Smith River watershed of Meagher and Cascade counties of west-central Montana. The primary area of focus encompassed approximately 1,200 mi² in the upper watershed above the Tenderfoot Creek drainage.

Project purpose: The primary project purpose was to use multiple lines of evidence to describe spatial and temporal interactions of groundwater and surface water within the upper Smith River watershed. The project also provided an increased understanding of the overall hydrologic system. The description of groundwater and surface-water interactions include: 1) generalized groundwater-flow direction, 2) the delineation of gaining (flow from the groundwater to the

stream) and losing (flow from the stream to the groundwater) reaches of the upper Smith River and selected tributaries, 3) quantification of gains and losses during different hydrologic conditions, 4) the relation between groundwater levels and stream stage, 5) hydraulic properties of the Quaternary alluvium, and 6) estimated water fluxes between surface water groundwater at modeled stream cross sections.

Results from this project will help state and federal agencies, along with the concerned public, understand the interaction of the groundwater and surface water, which is an important component when determining the allocation of water in the area. The data and information obtained from this investigation will help water managers and water users develop water management plans based on science. It will provide needed unbiased, scientific information to educate the public regarding water resource issues. Methods used in this study can be used to better understand other intermontane hydrologic systems throughout Montana and other Rocky Mountain states.

Project Implementation

This project was conducted through series of tasks as listed below -

Task 1. FY 2006-2011: Existing data compilation and review.

Task 2. FY 2006 – 2011: Installed and operated streamflow gaging stations on the Smith River near Eden and near Fort Logan (above Camp Baker), and continued to operate the Smith River gauging station below Newlan Creek –. Note: a fourth gauging station was in operation on the Smith River, but was not funded by this project. Data from all four gaging stations were utilized for this project.

Task 3. FY 2006: Initial reconnaissance of the Smith River.

Task 4. FY 2006 – FY 2007: Inventory and surveying of approximately 100 existing wells.

Task 5. FY 2007 – 2008: Synoptic stream-flow measurements. Stream flow was measured on the Smith River and selected tributaries at multiple locations over a short time period.

Task 6. FY 2007-2011: Groundwater levels were measured synoptically in a network of as many as 100 wells at the same time. The data from these synoptic measurements was used to determine where the Smith River or its tributaries were gaining or losing water from the groundwater system, the quantity of these gains and losses, and how these gains and losses varied with changing stream flow conditions.

Task 7. FY 2006-2008: Installation of 31 shallow wells.

Task 8. FY 2006-2010: Monitoring of water levels in wells and stream stage. Water levels and stream stage were measured monthly to continuously. Differences between water levels in wells and river stage indicated if water was moving from the river to the groundwater system or vice versa.

Task 9. FY 2007-2009: Temperature loggers were used to monitor stream-water, stream-bed water, and groundwater temperatures at selected locations in an attempt to quantify groundwater contributions to stream flow.

Task 10. FY 2006-2011: Generation of water-table and gain/loss maps. Four maps were produced showing the gaining and losing reaches of the Smith River and its tributaries based on streamflow, groundwater level, and temperature measurements. Water-table maps were generated based on the groundwater and stream elevations from the synoptic streamflow and water-level measurements.

Task 11. FY 2008: Water chemistry sample collection and analysis. Water chemistry samples were collected from surface-water sites during one of the seepage runs and from wells along inferred flow paths. The water chemistry data were used to detect areas where water from the groundwater system discharges to the Smith River.

Task 12. FY 2008-2010: Estimation of aquifer properties and streamflow gains and losses. Drillers' logs were evaluated in an attempt to delineate hydrologic units within the Tertiary and Quaternary sedimentary deposits on the basis of grain size and stratigraphic position. Well yield and drawdown information reported on drillers' logs were used to calculate specific yield and estimate horizontal hydraulic conductivity of various hydrologic units.

Task 13. FY 2008: Contract to drill exploration wells. Exploration wells were drilled at selected locations in an effort to determine the thickness of unconsolidated sediments within the central part of the upper Smith River watershed. An estimated \$30,000 was allocated for this task. Two wells were drilled.

Task 14. FY 2006-2012: Report writing, review and publication. The results of this study will be published in a US Geological Survey Scientific Investigations Report in the fourth quarter of FY12. The report will include the purpose and scope of this study, descriptions of previous studies and methods used to collect and analyze data, maps showing the altitude of the water table and gaining and losing reaches of the Smith River, interpretation of water-chemistry data, and gain and loss estimates from streamflow measurements and the model of the transport of heat in the groundwater flow system. Water-level, streamflow, and water-chemistry data collected by this project will be verified and will be stored in the USGS NWIS database. These data are accessible via the internet (<http://waterdata.usgs.gov/NWIS>). A second report, not originally proposed, will be published by the fourth quarter of FY12. It includes data collected as part of phase I and II of this study and will be available digitally on the internet.

Discussion and Results:

Specifically, results from this project indicate that groundwater and surface water are connected along the main stem Smith River and tributaries and that the interaction between the two changes dynamically spatially and temporally. Results from this project also added information regarding the overall hydrologic system including aquifer characteristics, groundwater-flow direction, and quantified streamflow at several locations through differing conditions.

Published copies of the USGS reports will be available in 2012.

Products:

Nilges and Caldwell, 2012, Hydrologic Data for an Investigation of the Smith River Watershed, Montana, through Water Year 2010; U.S. Geological Survey Open-File report

Caldwell and Eddy-Miller, 2012, Groundwater and Surface-Water Interaction within the Upper Smith River Watershed, Montana, 2006 -2010, U.S. Geological Survey Scientific Investigations Report