March, 2013

MONTANA BUREAU OF MINES AND GEOLOGY

Ground Water Investigation Program

In Montana, groundwater is essential for safe drinking water supplies and for economic growth. On average, approximately 272,000,000 gallons (835 acre-feet) are extracted from Montana's aquifers every day. In many areas of the State, groundwater is the only reliable year-round source of water for household use and for livestock. Groundwater is also widely used for irrigated agriculture and for lawns and gardens. In some settings, groundwater withdrawals could directly affect senior water-rights holders, stream flows, the availability of irrigation water, and the health of aquatic ecosystems. Efficient water management in these areas requires a well-founded understanding of the groundwater systems.

In 2009 the Montana State Legislature established the Ground Water Investigation Program (GWIP) within the Montana Bureau of Mines and Geology (MBMG) to conduct detailed groundwater investigations in those areas with the most serious concerns. Over 40 projects have been nominated to date and prioritized by the Groundwater Steering Committee. Eleven investigations have been initiated. Each investigation is expected to take from 1 to 3 years to complete.

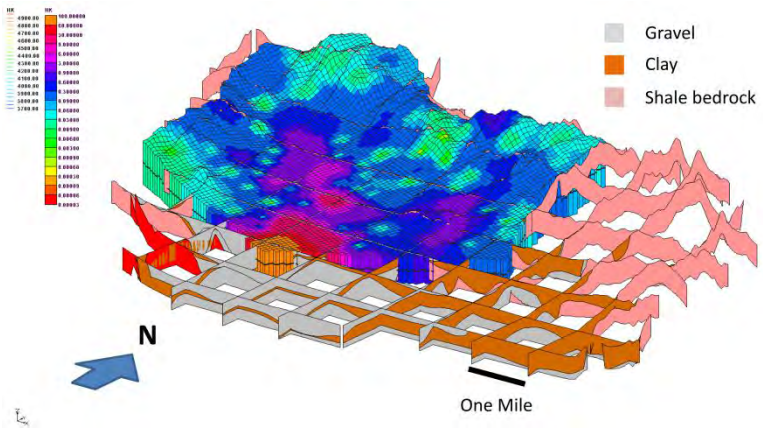
Results of each study will include a detailed report describing the hydrogeologic system of the area and interpreting stresses on the aquifers. A comprehensive set of data will be archived for public access. These products will provide a more detailed understanding of the groundwater system and tools which can then be used by regulators, senior water-rights holders, new water-rights applicants, and other stakeholders, to make informed water management decisions and to help anticipate hydrogeologic effects from stresses.

Completed Investigations

1) North Hills area, Helena—Increased subdivision development in this area raises concerns about declining water levels, and the possibility of degraded water quality. (MBMG Open-File Reports 610 and 628).

2) Scratchgravel Hills, Helena—Increased subdivision development is creating concerns about groundwater depletion and water-quality impacts.(Reports in final review)

3) Fox Hills-Bakken --Preliminary data collection effort in response to increasing water demands in northeastern Montana.



Computer modeling is used to evaluate potential future stresses on aquifers, such as a hypothetical subdivision.

Visit our web page:
http://www.mbmg.mtech.edu/gwip/gwip.asp

Current Investigations

4) Lower Beaverhead River, Dillon—The current increase in the number of high-volume irrigation wells has raised concerns regarding stream depletion and impacts to senior water-rights holders.(Reports in review)

5) Four Corners area—Conversion from irrigated agriculture to high-density residential land use has raised concerns about changes in water quality, water availability, and effects on surface water.

6) Florence—Higher population density has increased the demand on the aquifer and raised the possibility of groundwater degradation.

7) Stevensville—The feasibility of using groundwater to supplement surface water for irrigation will be investigated.

8) Belgrade-Manhattan—Increased development of shallow groundwater may lower the water table and impact surface water availability and quality.

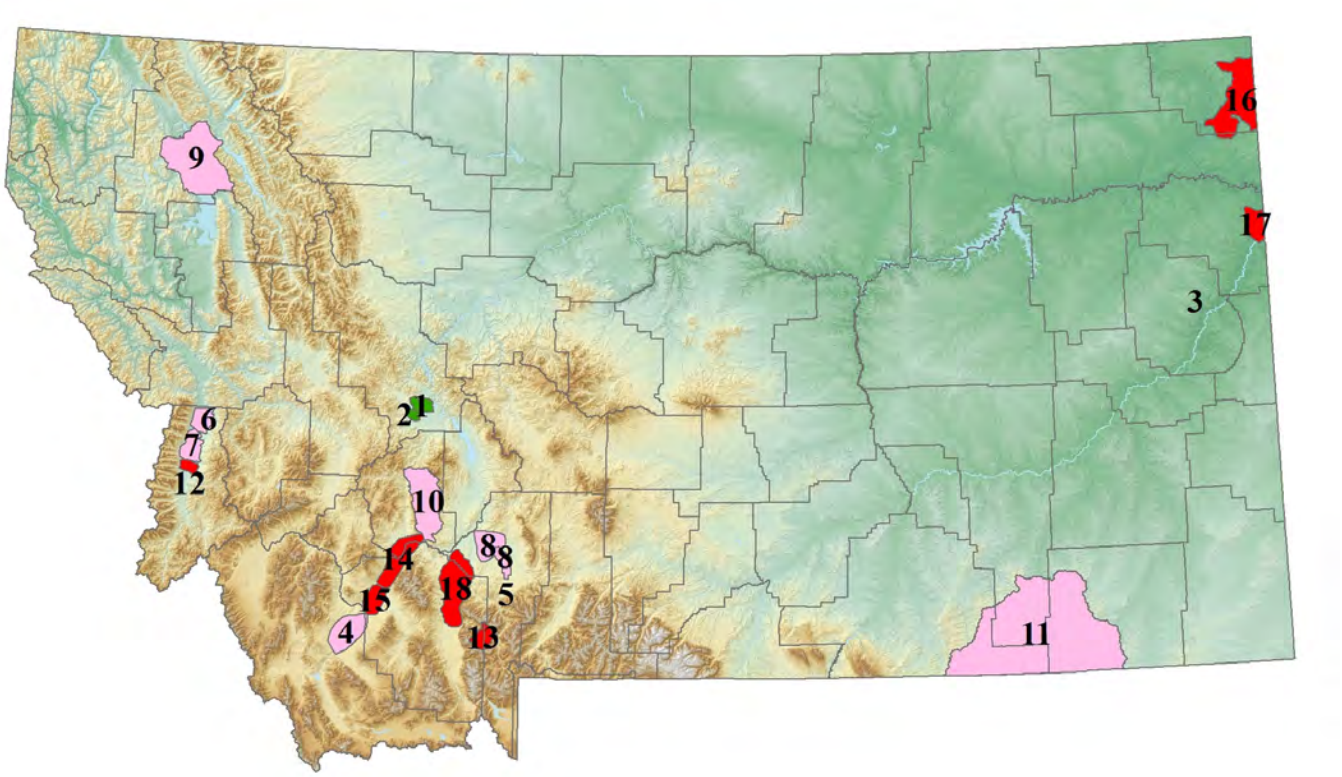
9) Flathead Valley Deep Confined Aquifer—Increased groundwater utilization, and localized water-level declines, have raised concerns about the long-term sustainability of the aquifer and the possibility of degradation to groundwater and surface-water quality.

10) Boulder River Valley—Groundwater availability for subdivision development and the potential to use the aquifer as a storage reservoir will be investigated.

11) Coalbed Methane (CBM)—Development of CBM in the Powder River Basin has raised concerns regarding aquifer depletion and mobilization of salts.

Scheduled Investigations

12) Hamilton
13) Big Sky
14) Upper Jefferson River
15) Beaverhead to Twin Bridges
16) Clear Lake aquifer
17) Buried river channel aquifer (Sydney)
18) Madison Valley Ennis to Three Forks

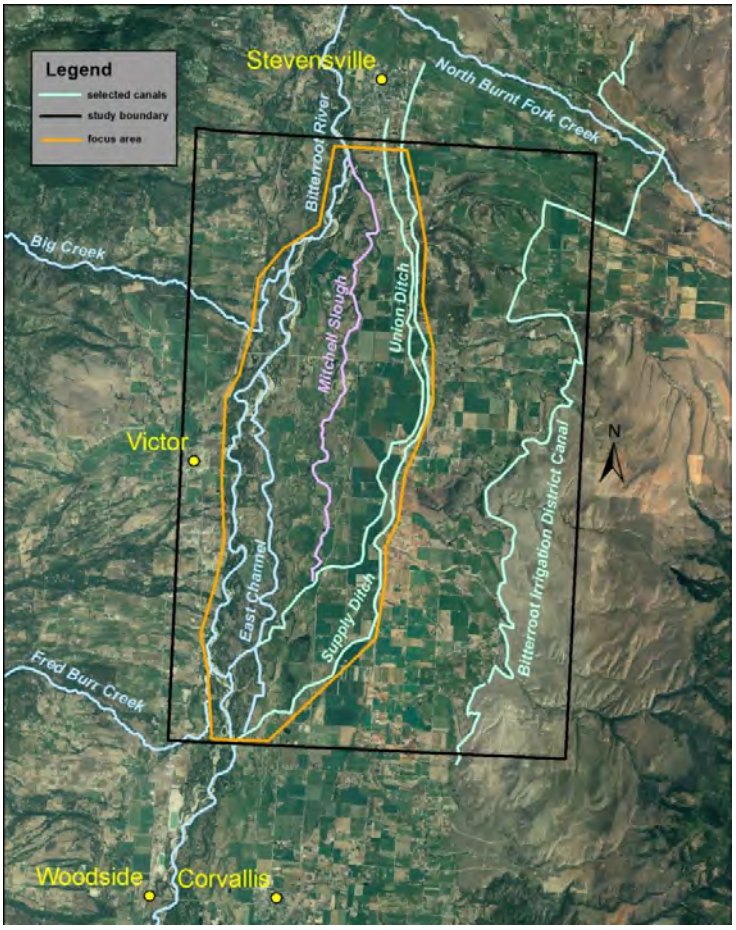


Completed GWIP investigations are in green, current investigations are pink and scheduled work is red.

GWIP PROJECT AREA:

STEVENSVILLE SHALLOW AQUIFER INVESTIGATION, RAVALLI COUNTY

The Stevensville Shallow Aquifer Investigation area, located in the Bitterroot Valley, will address concerns raised by irrigators about the expense and practicality of maintaining current diversion and distribution. One option the irrigators may consider in the future is moving some water diversions from surface water to groundwater wells. This investigation will provide them with the information needed to consider this option. Six irrigation canals divert water from a reach of the Bitterroot River locally called the East Channel. Approximately 3,500 acres, including some of the most productive farmland in the Bitterroot Valley, are irrigated from this source. During the past several decades, irrigators have maintained flow into the Channel by excavating a canal from the main Bitterroot River to the East Channel. Construction and regular maintenance of the canal is necessary because the main river channel is migrating westward. The canal is presently about 3,000 feet in length and is being extended each year. There is significant concern among irrigators that maintenance of the canal will not technically or economically be feasible in the near future.



The study will focus on the area lying between the Union Ditch and the main channel of the Bitterroot River beginning at the headgate and extending north (downstream) near the town of Stevensville. Two large irrigation systems, the Supply and the Bitterroot Irrigation District, are located above the Union Ditch.

This project will evaluate the scientific feasibility of using groundwater to supplement or replace irrigation water that is currently supplied by water diverted from the East Channel. Irrigation needs supplemented by groundwater may provide a more reliable source of irrigation water, particularly during droughts, and leave more surface water in the streams during periods when low flows are detrimental to fish and wildlife. A numerical groundwater model will be developed and used to evaluate various scenarios of groundwater use. This project is nearly ideal in terms of gaining a better understanding of groundwater-surface water interactions, a major goal of GWIP.

The products of this investigation will include an interpretive report and a groundwater flow model. These publicly available products will provide land owners and public agencies with scientific information to help make data-driven water management decisions about how proposed changes in irrigation activities may affect groundwater and surface water in the area.

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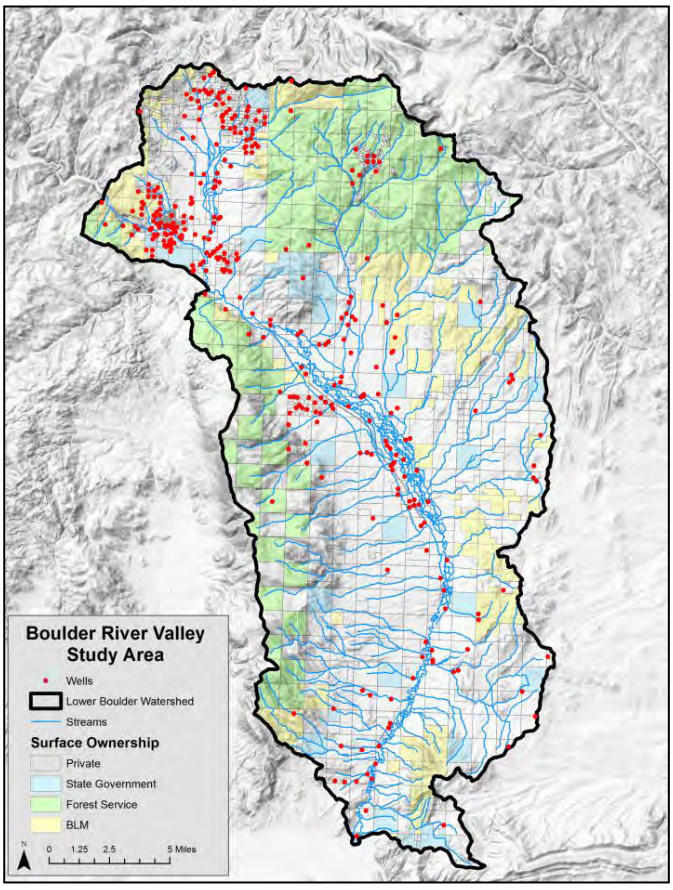
GWIP PROJECT AREA:

Boulder River Valley

The Montana Bureau of Mines and Geology (MBMG) Groundwater Investigations Program (GWIP) is conducting a groundwater study of the Boulder River Valley.



It is believed that the alluvial aquifer of the Boulder River provides baseflow to the river. In its current state, the Boulder River often runs dry in the late summer, eliminating the ability to irrigate, even for senior-water rights holders. As such, there are concerns that continued groundwater development in the watershed will adversely impact senior-water rights holders. This GWIP study examines the flux of water between the alluvium and the river, the magnitude of impacts that would be expected from existing and potential housing developments in the watershed, and the potential for increasing water availability throughout the year. Water quality samples will also be collected from groundwater and surface waters in the study area.

This is a two year study, running from July 1, 2011 to June 30, 2013. The area of study is the Lower Boulder River Watershed from Boulder to Cardwell (USGS Watershed 1002000605), with focus on the alluvial aquifer along the Boulder River.

In the initial phase of the project, wells were wells were inventoried and surface-water sites (including on irrigation ditches) were established as part of a monitoring network. Additional wells are being installed where more data are needed, such as upland bedrock areas and alongside the Boulder River.

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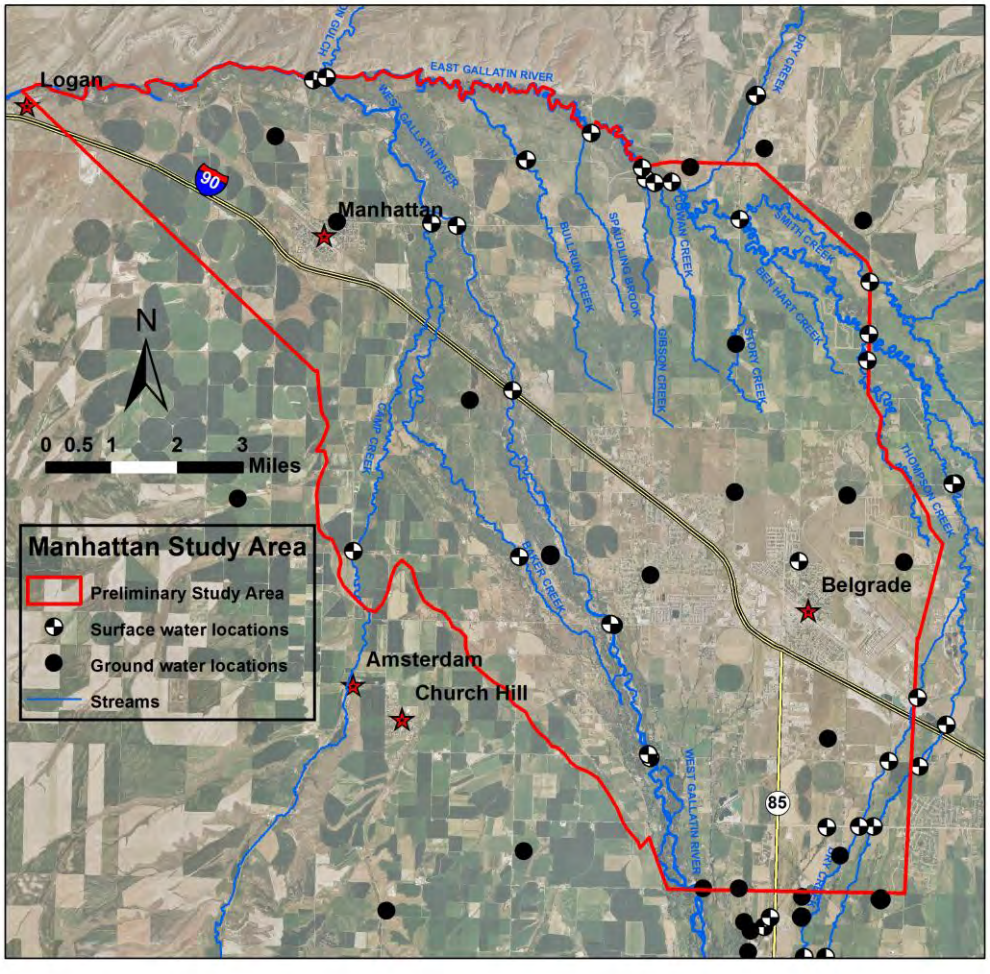
GWIP Project Area:

Belgrade-Manhattan, Gallatin County



The Montana Bureau of Mines and Geology (MBMG) Groundwater Investigations Program (GWIP) is conducting a groundwater study of the Manhattan-Belgrade area.

Two study areas were combined to comprehensively examine the similar geology and issues of the lower Gallatin Valley. This combination will increase efficiency and facilitate modeling of this area, which includes the hydrologic outlet for the basin. Work in the Belgrade area was begun in 2009 and in Manhattan in 2012. Expected completion date for this united effort is spring of 2014.

New development, both rural and municipal has increased water demand throughout this area. Some rural residents report decreased flows in spring-fed streams that are tributaries of the East Gallatin River. The area is intensely irrigated although land use and irrigation methods are changing.

Questions include:

- Can the groundwater resource support increased municipal and agricultural use?
- Has development upstream and upgradient of Manhattan caused changes in local hydrology?
- What are the long-term effects of development and changing irrigation methods?

In order to provide more accurate descriptions of the geology, hydrologic properties of the aquifers, available water supplies and the effects of stresses on the groundwater and surface water in the Manhattan-Belgrade study area, GWIP has been installing stream-gauging stations and measuring stream flows at many locations along the Gallatin, East Gallatin and major tributaries. We have added new wells to the groundwater monitoring network. Test wells have been installed at four locations throughout the study area. These test sites will be used to conduct long-term aquifer tests to generate detailed data for use in computer models of the study area. A numerical groundwater model will be constructed to simulate the observed hydrogeologic conditions and to evaluate the response of the groundwater system to specific stresses, such as new wells or municipal systems. The final products will include a publicly available interpretive report and a groundwater computer model. If you're interested in participating or would like more information please contact:

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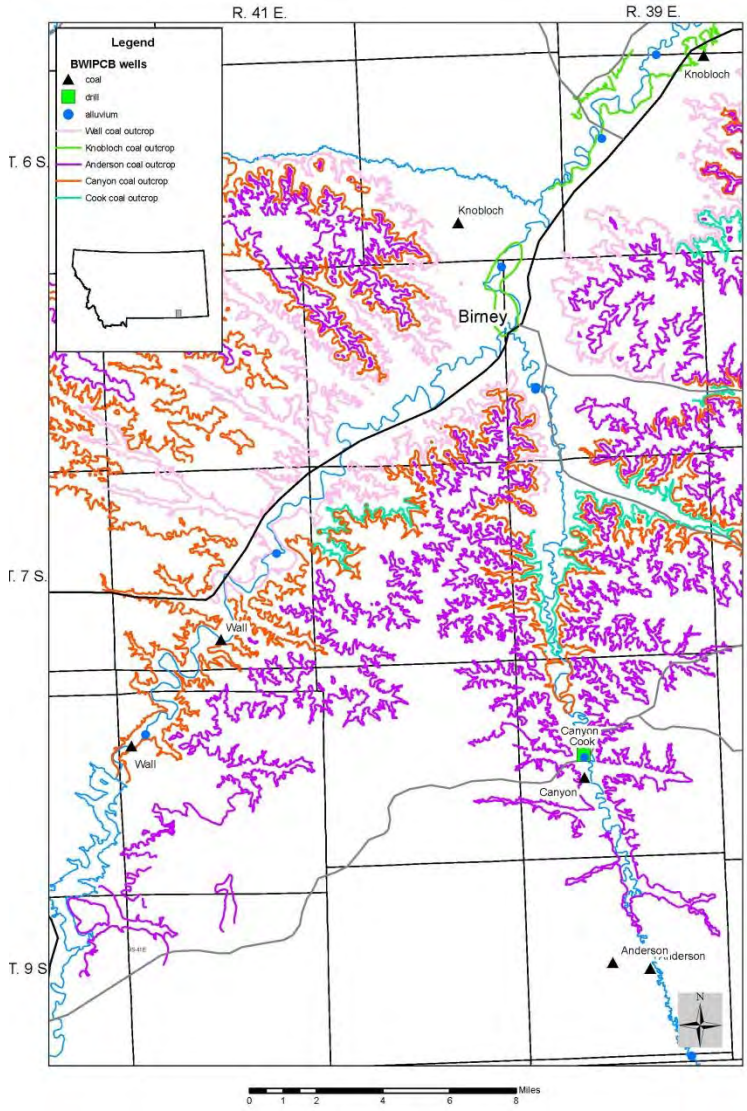
GWIP Project Area:

COAL AQUIFER BASEFLOW TO POWDER RIVER BASIN STREAMS

Coalbed methane production requires the extraction of large quantities of groundwater from coal aquifers; aquifers that provide baseflow to streams and are used throughout the region for domestic and stock purposes. Groundwater withdrawal during CBM production, up-gradient from where the produced coal seam subcrops to streams, has the potential to reduce baseflow to those streams. The volume of water contributed by coal seams to surface drainages in the Powder River Basin is unknown, which has created an environment of discord between the many water users in both Montana and Wyoming. The presence or magnitude of impact to coal aquifers is difficult or impossible to show without a better understanding of the relationship between coal aquifers and surface streams in the Powder River Basin.



Isotopes of carbon and strontium have been shown to effectively fingerprint the groundwater contribution to surface water in the Powder River Basin. Geochemical parameters will be combined with traditional in-stream flow measurements to identify – and perhaps quantify – the contribution to Powder River Basin streams from coal aquifer baseflow. Samples and flow rate measurements were taken during the lowest point in the stream hydrograph to maximize the proportional contribution of groundwater to the surface water hydrograph. Wells completed in the targeted coals near outcrop were sampled.

The ability to quantify the impact to surface water from up-gradient energy development will aid in the acquisition of the necessary permits that will allow the energy producers to use the coproduced water for beneficial purposes, rather than treat it as a waste product. Defining and quantifying the relationship between the coal aquifers and streams will allow stakeholders to have science-based discussions of best management practices.

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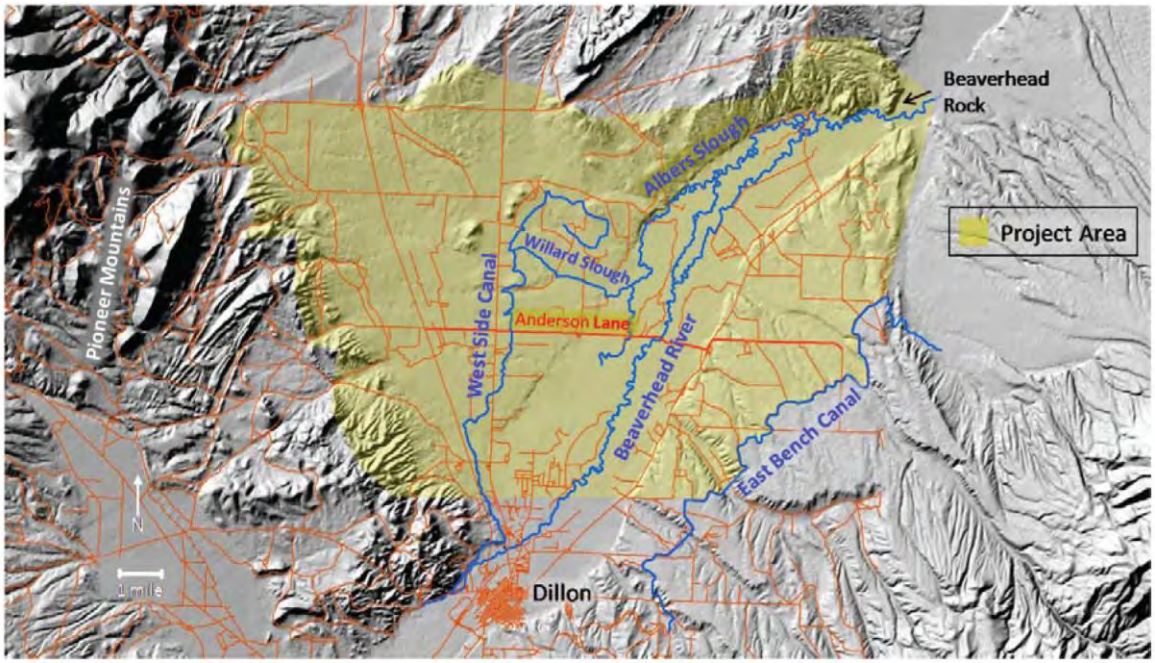
GWIP PROJECT AREA:

LOWER BEAVERHEAD RIVER WEST, BEAVERHEAD & MADISON COUNTIES



The Lower Beaverhead River-West project area extends from Dillon to Beaverhead Rock. The mainstay of the economy in this area is agriculture, which is supported by groundwater and surface-water irrigation. The Beaverhead River basin has been closed to new surface-water appropriations since 1993. Groundwater permit applications must include a hydrogeologic assessment that evaluates whether the proposed appropriation will result in a net depletion of surface water. If so, the application must be accompanied by aquifer recharge or mitigation plans.

Irrigation needs are primarily met by the Clark Canyon Reservoir and the Beaverhead River, which supply the East Bench Canal, West Side Canal, and ditches throughout the valley. As a result of drought and increasing irrigation demands, there has been an increase in high-volume production wells since the mid-1990s. Applications for well permits have resulted in conflicts between senior and junior groundwater and surface-water rights holders. A primary concern is that groundwater withdrawals will result in stream depletion by inducing flow away from the stream or by capturing stream recharge.

This investigation provides more detailed hydrogeologic information in order to better understand the effects of pumping high-capacity wells on groundwater and surface water. Data collection included well drilling, aquifer testing, water-chemistry sampling, and monitoring groundwater and surface water. A numerical groundwater model was developed to predict impacts of groundwater development on the Beaverhead River and its tributaries. The final products will be a publicly available report, several web-based project maps, and the groundwater model. GWIP results will provide land owners and regulatory personnel with scientific information to help make informed water management decisions that provide a balance between further development and protection of water resources.

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http://www.mbmg.mtech.edu/gwip/gwip.asp

GWIP Staff

News

Current Projects

Completed Projects

Scheduled Projects

Online Data Access

Nominating and Ranking

Supporting Documents

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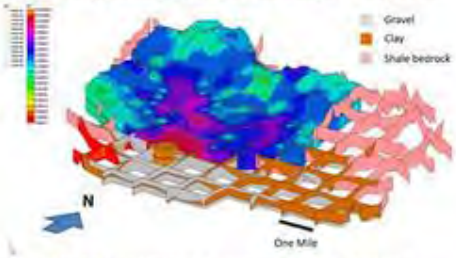
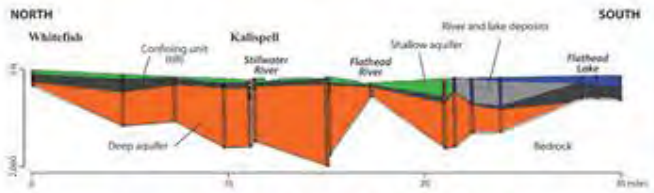


In 2009, the Montana State Legislature established the Ground Water Investigation Program (GWIP) within the Montana Bureau of Mines and Geology (MBMG) to conduct detailed groundwater investigations in specific areas with the most serious concerns. Over 40 projects have been nominated and prioritized by the Groundwater Steering Committee. Seven investigations were initiated in 2009. Five additional areas were selected to begin during 2011 and 2012. Each investigation is expected to take from 1 to 3 years to complete.

The results of each study will include a detailed report describing the hydrogeologic system of the area and a comprehensive set of data. These products are intended to provide a more detailed understanding of the groundwater system and tools which can then be used by regulators, senior water-rights holders, new water-rights applicants, and other stakeholders, to make informed water management decisions and to help anticipate hydrogeologic effects from changes in land use.



Cross section of aquifers in the Flathead River valley