

**Montana Bureau of Mines and Geology (MBMG) – Groundwater Investigation Program (GWIP)
Helena Area GWIP Projects, North Hills and Scratchgravel Hills – Update July, 2011**

There are two GWIP projects in the Helena area, the North Hills project (GWIP Project Number 12) and Scratchgravel Hills project (GWIP Project Number 13). For the general descriptions of these projects, please see the Fact Sheets at the MBMG GWIP website. The link to the website is:

<http://www.mbmgs.mtech.edu/gwip/gwip-projects.asp>

Scroll down to projects 12 and 13, and near the top of each is a hyperlink for the Fact Sheet for that particular area.

This update lists contracts for both Helena area projects, followed by activities completed or underway for the each project.

**North Hills Pediment Focus Model
Schematic View**

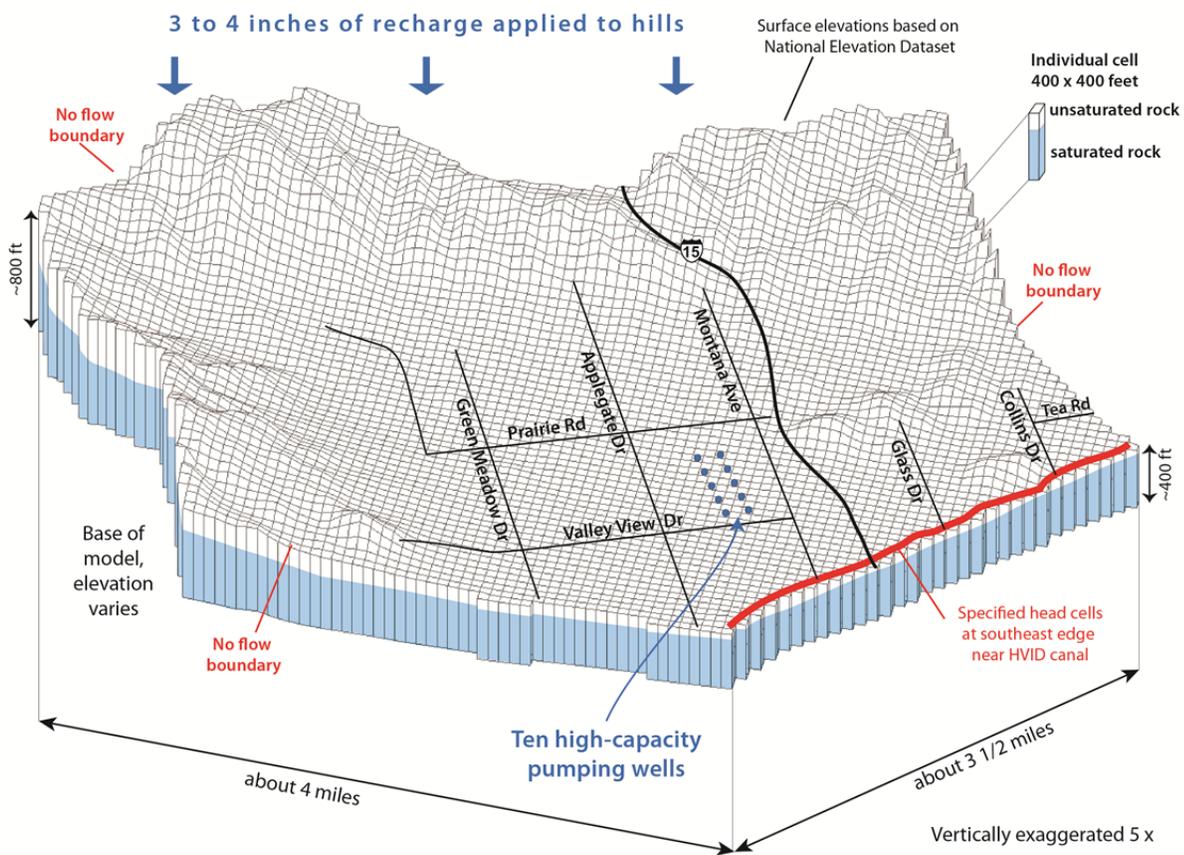


Figure 1. Schematic illustration of the Pediment Focus Model grid.

Helena area projects contracts:

Completed contracts:

- Phil Farnes – precipitation maps and consulting
- Patrick Faber – summaries of aquifer testing in the North Hills area
- MSE – installation of shallow peizometers along Silver Creek and Sevenmile Creek

- H and L Drilling – Aquifer test site drilling and well installation (Valley Excavating site)
- Diamond M Drilling: Exploratory drilling and aquifer tests at three wells along the Helena Valley Fault (Diamond Hill property)
- H and L Drilling – Aquifer test site drilling and well installation (Head Lane site on private land)
- Lindsay Drilling – Exploration and monitoring well installation at four locations in the North Hills area
- Lindsay Drilling – Exploration, monitoring, and aquifer test site well installations at three aquifer test sites in the Scratchgravel Hills on US Bureau of Land Management property
- Lindsay Drilling – Deep exploratory and test wells at two sites near the crest of the North Hills on state-owned land
- Isotech Laboratories – stable oxygen, hydrogen, sulfur, and nitrogen isotope analyses for water samples from area wells, streams, canals, and drain ditches
- University of Idaho METRIC evapo-transpiration calculations.
- Lewis and Clark County Water Quality Protection District (LCWQPD) – ¼ FTE Hydrogeologist and technician for monthly groundwater level monitoring
- H and L Drilling – Test well abandonment and aquifer test pump and generator rentals and installations
- Survey project wells – Robert Peccia and Associates
- Endocrine disrupter water quality sampling event – Columbia Analytical Services

North Hills Project Activities:

Began or re-instated monthly groundwater level monitoring at 26 wells, increased Lewis and Clark County Water Quality Protection District (LCWQPD) monitoring from quarterly to monthly at 4 wells, and collect monthly data for another 21 wells monitored monthly by LCWQPD. Eighteen wells were instrumented with continuous recorders.

Drilled replacement monitoring wells at two locations and installed a deep and shallow well pair near the north end of Glass Drive. Drilled and completed two sets of wells on state-owned land up near the divide, one near Interstate 15 and one in the hills northwest of Diamond Springs Gulch.

Installed a pumping well and four observation wells for aquifer testing near the Valley Excavating rock quarry and conducted a 5-day aquifer test at the test site.

Installed three wells near the Helena Valley Fault to examine hydrogeologic conditions in the subsurface in the vicinity of the fault and conducted numerous well and aquifer tests.

Drilled one well on an unmapped fault on private land and conducted a step-drawdown and 48-hour aquifer test, using pre-existing unused wells as observation wells.

Conducted a step-drawdown and 6-day aquifer test with existing, unused wells at the Panoramic Meadows Subdivision site north of Lake Helena.

Conducted step-drawdown tests and aquifer tests at test wells on two private property sites and two sites on state-owned lands near the divide.

Monitored and assisted with two privately conducted aquifer tests at a subdivision

Montana Tech Geophysics Department has conducted several resistivity surveys and a seismic survey on state and private land near and on both sides of Interstate 15 and completed gravity and magnetic surveys along Applegate Drive, Montana Avenue, and Prairie Road

Three sites along Silver Creek have been established for stream flow monitoring, and have been instrumented with data recorders, staff gages and shallow monitoring wells

Monitoring of stream flow at drains began in March 2010 at numerous sites, augmenting surface water flows measured by LCWQPD in Prickly Pear Creek, Ten Mile Creek, and Drain D2

Three major water quality sampling events were conducted in April, August, and October, 2010. These were conducted in cooperation with LCWQPD. GWIC project samples are being analyzed by the MBMG laboratory. Isotopes of certain elements are being analyzed by Isotech Laboratories, Inc. An additional limited event sampling for Organic Waste Chemicals (OWCs) was conducted in April, 2011. The OWC samples were analyzed by Columbia Analytical Services.

Crest gages have been installed with buried temperature recorder buttons in four sites in the North Hills area to measure the depth and durations of intermittent flows in selected drainages, and two rain gages are collecting precipitation data

Snow and water samples were collected in March 2010 for stable oxygen and hydrogen isotope analyses at various elevations

Aquifer test data from DNRC water rights records, the GWIC database, and from a summary from Helena area consultant Pat Faber have been compiled.

Area maps, aerial photos, and digital elevation models have been projected into the groundwater model coordinate system, which is the Montana State Plane system, North American Datum 1983, in feet

Well log data for hundreds of wells over 200 feet deep have been processed for display in a 3D graphics format in Groundwater Modeling System for use in developing the aquifer geometry for the groundwater model

All project sites were surveyed by Robert Peccia and Associates

Two groundwater models have been developed for the North Hills project. A larger-area model called the North Hills Area Model was developed for use in analyzing the water budget of the area and how groundwater extractions or other activities impact Lake Helena and the Missouri River. The North Hills Area Model approximately replicates the key elements of groundwater recharge and discharge in the study area.

The Pediment Focus Model is a smaller-area model that addresses the area of the North Hills pediment above the Helena Valley Canal where available observation well data is the densest, and where the concerns about groundwater extractions and observed drawdowns in the aquifer are the greatest. The purpose of this model is to provide for use in analyzing and predicting the impacts of various pumping schemes on the North Hills pediment above the Helena Valley Canal.

Both models may be used to evaluate the expected result of changes in recharge or discharge from the system, such as may be driven by droughts, wet years, changes in land use, and so forth. The Pediment Focus Model is a more refined model with a simpler water budget, while the North Hills Area Model has a more complex water budget that includes more uncertainty, especially in areas of the model where data is sparse.

For each of the models, there are two key products: a steady-state model and a transient model. For these applications, the steady-state model simulates average annual conditions for all elements of recharge and discharge. The steady-state models are used to evaluate the overall water budget and to use automated parameter estimation to generate optimal hydraulic conductivities (aquifer properties) for each cell. Transient

models use the aquifer properties of the steady-state models, and add the element of time. Transient models are able to simulate time-dependent stresses, such as seasonal irrigation and pumping activities. They may be used to simulate observed stresses and conditions, and to predict the impacts of differing stresses or conditions.

The North Hills Interpretive Report and the North Hills Groundwater Modeling Report are in internal review as of July 2011. The North Hills Technical Report has been assembled and prepared for review. Groundwater model files are being prepared for placement on CD's and on the website for use by the public. These files will be in several formats: native USGS MODFLOW file format, Groundwater Modeling System (GMS) format, and Groundwater Vistas format.

Scratchgravel Hills Project Activities:

Began or re-instated monthly groundwater level monitoring at 38 wells in cooperation with Lewis and Clark County Water Quality Protection District (LCWQPD). Nineteen wells instrumented with continuous recorders.

Five stream flow and shallow groundwater monitoring sites have been constructed and are being monitored by routine flow and water level measurements and various data logging instruments.

Installed two wells to augment two existing unused wells for an aquifer test near the intersection of Head Lane and Franklin Mine Road, and conducted a 5-day aquifer test

Complex geology in the vicinity of mapped faults was evaluated by a geologist from the Bureau's State Geologic Mapping program to ascertain conditions before drilling exploration and test wells

Seven exploration and test wells at three sites were installed on US Bureau of Land Management (BLM) land in the Scratchgravel Hills

Five constant rate aquifer tests have been conducted, two near the intersection of Head Lane and Franklin Mine Road, and several on BLM land north and west of the Head Lane area.

Three major water quality sampling events were conducted in April, August, and October 2010. These were conducted in cooperation with LCWQPD; GWIC project samples are being analyzed by the MBMG laboratory. Isotopes of certain elements are being analyzed by Isotech Laboratories, Inc. An additional limited event sampling for Organic Waste Chemicals (OWCs) was conducted in April, 2011. The OWC samples were analyzed by Columbia Analytical Services.

Crest gages have been installed with buried temperature recorder buttons at two sites in the Scratchgravel Hills area, and a rain gage is collecting precipitation data

Aquifer test data from DNRC water rights records, the GWIC database, and from a summary from Helena area consultant Pat Faber have been compiled

Area maps, aerial photos, and digital elevation models have been projected into the groundwater model coordinate system, which is the Montana State Plane system, North American Datum 1983, in feet.

All project sites were surveyed by Robert Peccia and Associates

Steady-state and transient groundwater flow models have been developed for the Scratchgravel Hills aquifer system. These models have been calibrated to existing groundwater level data and may be used to estimate the effects of various groundwater pumping scenarios on groundwater levels and the water budget in the aquifers.

The Scratchgravel Hills Interpretive Report is in internal review as of July 2011. The Scratchgravel Hills Technical Report and Groundwater Modeling Report have been assembled and prepared for review. Groundwater model files are being prepared for placement on CD's and on the website for use by the public. These files will be in several formats: native USGS MODFLOW file format, Groundwater Modeling System (GMS) format, and Groundwater Vistas format.