

Water Research, Monitoring and Inventory in Montana Summer 2011

**Gretchen Rupp, Director
Montana University System Water Center**

Introduction

Many Montanans investigate our water resources. They range from the dozens of volunteers who check weather stations throughout the state daily, to scientists whose work garners prestigious awards nationally and internationally. The purpose of this report is to identify the types of water-investigation activities that are going on in Montana and the principle organizations involved. “Research” is defined herein as activity that generates new knowledge about the way the world works. Its results are published in peer-reviewed literature and applied both within and outside the boundaries of the state. “Monitoring” and “inventory” measure our water resources – amounts, flows, locations and characteristics. These are not trivial exercises; to characterize a large aquifer may require sophisticated modeling, for example. Ultimately, each of these activities – from routine water measurement to basic research - is vital to decision-making at all levels, from the individual household to state government and beyond.

Water Research

The powerhouses of water research are the two PhD-granting institutions, Montana State University and the University of Montana. There are about 100 faculty members and research associates at these institutions who conduct water research. In 2011, roughly \$30 million in water research is underway at the two universities (out of a combined research portfolio valued at \$170 million). The great majority of projects deal with natural science or engineering; relatively little work concerns social science, economics or policy. All projects have a student teaching-and-training component, and each year an estimated 200 undergraduate and graduate degrees are granted to students who have had intensive, direct water-research experience. A small number of highlights from the two universities are listed below, but many additional examples could be named. A number of individual faculty members lead research groups that have achieved international distinction.

University of Montana

The Flathead Lake Biological Station is a center of aquatic research that dates to 1899. Its original charter involved monitoring the condition of Flathead Lake, but the station now hosts investigators whose projects may take place anywhere from Lake County to Siberia. Research specialties include lake dynamics, water exchanges between streams and streambeds, and large-scale movement of salmonid populations.

The Numerical Terradynamic Simulation Group develops new approaches for landscape ecological and hydrological analyses, in order to understand how terrestrial vegetation responds to climate variability and influences energy, water and carbon cycles. The research is strongly based in computational process modeling, satellite remote sensing and GIS. A recently-completed project created a global dataset of evapotranspiration, that can be used to develop water budgets for individual river basins, as well as models of energy and carbon cycles.

Montana NSF EPSCoR is a collaborative program of UM and MSU, funded by the National Science Foundation, with the object of bolstering the state's research capacity. The program typically runs three large research projects at a time, at least one of which is water-related. The Large River Ecosystem project, examining the headwaters of the Columbia and Missouri Rivers, has just been completed. The Virtual Observatory and Ecological Informatics System project assembles an enormous amount of real-time data from field sensors such as buoys in Flathead Lake, to allow investigators to search for large-scale trends. Both of these projects include collaborators from Montana's tribal colleges.

Montana State University

MSU-Bozeman has a long history as a pre-eminent center for research on the physics of **snow and ice**. Scientists from three colleges concentrate in this field. Their work was greatly bolstered by the 2008 opening of the Subzero Laboratory, a facility that supports investigations in structural engineering, snow physics, subzero microbiology and other disciplines.

The Montana Cooperative Fishery Research Unit is a collaboration among the US Geological Survey, Montana State University and Montana Fish, Wildlife and Parks. Its research is designed to collect "useful and practical information needed to understand and manage fishery resources in the Rocky Mountains and northern Great Plains." In recent years many projects have focused on the habitat needs and restoration potential of native fishes.

The Center for Biofilm Engineering hosts research affiliates who investigate a wide range of topics related to the microbial communities that form on surfaces, including those inside drinking-water pipelines, those that control water quality in wetlands and those that influence groundwater chemistry.

The Thermal Biology Institute is also a university-wide organization, with investigators from five departments in three colleges. It conducts research on the "thermophiles" that live in the hot pools of Yellowstone Park. These organisms conduct their cellular affairs in unique ways that are potentially very useful in medical and engineering applications. For example, researchers are currently characterizing a complex of microorganisms adapted to hot, alkaline waters that may be suitable for degrading spilled herbicides and insecticides in soil and shallow groundwater.

Additional Water Research

Water research conducted by entities other than the two universities is typically very problem-focused. For example, a Montana Tech investigator is currently testing innovative methods to measure groundwater inflow to Georgetown Lake. The Gallatin Local Water Quality District is examining the widely-held assumption that septic leachate influences can be detected in groundwater in un-sewered areas. The USGS Montana Water Science Center is tracing the movement of a subsurface brine plume from the East Poplar Oil Field that jeopardizes the town of Poplar's drinking water. Researchers with the USGS Northern Rockies Science Center are developing methods to predict wetlands response to taking agricultural land out of the Conservation Reserve Program. The US Army Corps of Engineers completed a Cumulative Impacts Assessment for the upper Yellowstone, to inform its own and other management agencies' decisions. There are several other focused research projects underway, nearly all by public agencies or universities.

Water Monitoring and Inventory

Both special studies and ongoing monitoring are taking place throughout the state. State and federal agencies are the main organizations that monitor water and characterize particular water resources. The principal efforts are summarized below.

Special Studies

Hydrogeologists from the Montana Bureau of Mines & Geology (MBMG) are characterizing Montana's groundwater resources under the auspices of two state-funded programs. As authorized by the Groundwater Assessment Act of 1991, the **Groundwater Assessment Program** maps the distribution and documents the water quality and physical properties of the state's major aquifers. As of the end of 2010, 42 aquifer maps had been published. The **Ground Water Investigation Program** was established by the 2009 Legislature. This program more intensively investigates problem areas across the state, focusing initially on aquifers in closed basins. Seven studies have recently been completed, and, with funding from the 2011 Legislature, nine new groundwater problems have been nominated for work during the current biennium. A statewide steering committee establishes policy and coordinates both programs.

Other special studies currently underway include:

- Floodplain re-mapping – Federal Emergency Management Agency, with the DNRC
- Salinity monitoring in the Tongue River – USGS
- Site assessment prior to remediation – Natural Resource Damage Assessment Program, Montana Department of Justice
- Hazardous-waste site assessments – responsible parties, contractors and regulatory agencies
- Wetland mapping and amphibian surveys – Montana Natural Heritage Program

- Water quality characterization for establishing TMDLs and assessing Clean Water Act “use attainment” – Montana Department of Environmental Quality
- Groundwater pesticide testing – Montana Department of Agriculture.

Private organizations must characterize water resources prior to applying for permits for a variety of activities, among them developing new subdivisions, excavating gravel or filling new or amended water-rights claims in closed basins.

Ongoing Monitoring

Local, state and federal agencies monitor the quantity and quality of Montana water and make their data available to the public. The major long-term monitoring programs are listed below, by agency. It should be noted that no ongoing statewide program collects comprehensive water-quality data in a manner analogous to the information-rich streamflow and water-table-elevation measuring efforts.

- US Geological Survey – streamflow and some water quality; 125 sites currently report daily
- MBMG – water table elevations from more than 900 wells; water quality information from a subset of the wells – data are posted to the Ground Water Information Center
- Public water and wastewater utilities (>2000) – quality and flow of treated drinking water or wastewater
- National Weather Service – weather data and forecasting
- USDA Natural Resources Conservation Service – snowpack data, drought and streamflow forecasting
- USDI Bureau of Reclamation – AgriMet and reservoir data
- Montana DNRC – status of state-owned reservoirs
- Local water quality districts – monitoring of water-table elevations
- Northwest Power & Conservation Council – projection and analysis of water power resources in the Columbia Basin.

In addition, there are about 30 watershed groups in Montana that monitor local streams on a regular basis, as well as several dozen school groups. Some volunteer monitors have undergone rigorous training and make use of certified laboratories, such that their data are of high quality and could potentially be used for most purposes.