Let's Talk Water – BARCASS Discharge Estimates

By Dr. Mike Strobel

Last week, I discussed how the USGS-DRI Ground-Water Study (BARCASS) would examine the recharge side of the water budget for basins in White Pine County. This week, I will discuss the approach for studying the discharge side of the equation.

As a review, the water budget for any basin consists of

Inflow (recharge) = Outflow (discharge) + or – Change in Storage

As we discussed last week, recharge consists of infiltration of precipitation into the aquifers. Another contribution of inflow to a basin is the ground-water inflow from adjacent basins. Discharge is the water removed from the ground-water system of a particular basin by evapotranspiration (ET), pumpage, and ground-water flow out of the basin to another basin.

By far, the largest component for natural discharge for many basins in Nevada is ET. This is the water that is lost either by direct evaporation from shallow water tables or lakes and streams, and water transpired (taken up and released to the atmosphere) by plants. In fact, the majority of precipitation that reaches land surface in Nevada is ultimately lost to ET and neither infiltrates into the ground-water system or runs off as streamflow. It is only that water that becomes ground water or streamflow that needs to be considered in estimates of discharge.

For example, estimates of ET for the mountain blocks around Ruby Valley are about 82-89 percent of the annual precipitation, or about 346,000 to 371,000 acre-feet of water per year. ET from the alluvial slopes in Ruby Valley is about 11.96 inches per year, or about 183,000 acre-feet per year. ET from phreatophytic vegetation in Ruby Valley is estimated to be about 18.71 inches per year, or about 169,600 acre-feet per year (David Berger, USGS, written communication). Depending on the depth to water and climatic conditions, the amount of discharge due to ET from other basins in eastern Nevada may be less than or greater than that measured in Ruby Valley.

In order to make estimates for discharge for specific basins, BARCASS will quantify streamflow, springflow, pumpage, and ground-water ET. One of the difficulties in making these measurements is that there is much interaction between the different components. For example, streamflow can be made up of runoff from precipitation and from springflow (or ground water). Water in a stream can be affected by ET, natural inflow to the ground water, and induced inflow to the ground water from pumpage.

Streamflow is assessed from making discharge measurements at various locations along a channel. Increases in streamflow along a reach may indicate springflow or baseflow contributions to the stream, which would be part of the ground-water discharge estimate for a basin. In addition, water samples from the streams and ground, as well as from soil

cores and plant stems can be analyzed for isotopes in order to identify the source of the water (ground water versus surface water).

Springflow measurements (present and historic) will be compiled and estimates of ground-water discharge for each basin will be completed. Approximately 60 springs will be sampled in order to determine source water to the springs.

Pumpage will be estimated using available data in the State of Nevada reports on Ground-Water Pumpage Inventories. In places where there are not available data, estimates of agricultural irrigation will be made using satellite images of irrigated acreage, estimates of crop application rates, and any additional information from well logs and water-use permits.

One of the most complicated factors to assess will be ET from ground-water discharge areas. Field measurements of ET for different vegetation covers and climatic conditions will be collected using different methods. One method involves the use of domes and these measurements provide a measure of ET for different plant types and densities. A second method involves determining ET from energy-budget calculations using either eddy-covariance or Bowen-ratio methods. The eddy-covariance and Bowen-ratio methods will establish ET estimates for three different plant-density communities for an 18-month period. The information from both methods can then be applied over entire basins using remote sensing (satellite images) of plant distribution and density, and estimates of temporal and mean-annual ET can be calculated.

Once we have developed estimates for the various discharge components for each basin, we can compare these to our estimates for recharge and see how they balance out. Between the two components, we will be able to make estimates of the overall water budget for each basin of study.

If you have questions about measuring discharge, please contact me via the Ely Times or at mstrobel@usgs.gov. Next week, I will discuss the ground-water flow portion of the BARCASS. One additional note: As I have mentioned in the past, the previous articles of Let's Talk Water have been combined into a book entitled Water in Nevada. In the coming weeks, we will release this book as a pdf on the USGS and NWRA websites so that anyone can download the files. Also, the book will be released soon as a paper version. I will inform readers of this column when the book is published and available.