

# Alpine Hydrology of Phoenix Spring and Lake Fork of the Rio Hondo, Taos Ski Valley, NM

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The Phoenix Spring complex currently provides the entire municipal water supply for the Village of Taos Ski Valley, NM, and is one of the primary sources of stream flow in the upper reaches of the Lake Fork of the Rio Hondo. Water is also diverted during winter low-flow conditions for snow making by Taos Ski Valley, Inc. A field investigation was initiated in 2016 to develop a conceptual model of the alpine hydrology of the groundwater and surface water systems. This investigation included collection of precipitation samples and discrete intervals of the snowpack for tritium and stable isotope analyses, installation of piezometers and water level monitoring upgradient of the Phoenix Spring complex, sampling of springs, piezometers and Williams Lake for general chemistry, tritium, and stable isotopes, and gaging of stream flows.

Phoenix Spring is situated at an elevation of 10,310 ft in the Lake Fork valley, a north-to-northwest-trending glacial valley draining the Williams Lake cirque and Wheeler Peak. The Lake Fork Valley is underlain by glacial deposits including rock glacier and thick valley bottom till. Recharge occurs both in Williams Lake Cirque and along the Lake Fork Valley, with snowmelt and monsoonal precipitation infiltrating directly into the highly permeable glacial deposits. No surface water flow leaves the cirque; instead groundwater discharges further down the valley through springs and directly to the Lake Fork. Phoenix Spring discharges at a location where the width of glacial deposits narrows between a bedrock constriction formed by Precambrian gneiss and schist. Spring discharge ranges from a low of 200-300 gallons per minute (gpm) or less from December through April to a high of over 1000 gpm in June and July. The Lake Fork above Phoenix spring is an intermittent stream that flows during spring runoff in response to discharge from South Fork Lake Fork and East Fork Lake Fork springs. These springs both discharge at a rate up to several cubic feet per second (cfs) during peak spring runoff, but are typically dry by August of each year. The Lake Fork is a gaining stream from its origin at the Phoenix Spring to the confluence with the North Fork. Below this confluence the Rio Hondo is a gaining reach to the USGS gaging station at Valdez.

Preliminary analysis of  $d^{18}O$ - $d^2H$  data indicate a greater contribution to recharge from summer monsoonal precipitation than has been found in previous studies, although recharge is still dominated by winter precipitation. Tritium data from springs are within the range of tritium concentrations indicative of a modern recharge source. Precipitation data and water levels measured in piezometers in September, 2017 show that shallow groundwater is recharged by monsoonal precipitation events with an approximate two-week lag time. Preliminary study results indicate that winter precipitation is the predominant component of recharge to Phoenix Spring, with a significant component of summer monsoonal precipitation.

## Keywords:

alpine hydrology, geochemistry, stable isotopes, mountain recharge, stream gaging

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