Regional News

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Moab Groundwater Report

On March 8, 2004, 7 p.m., Kip Solomon and Phil Gardner of the University of Utah presented their findings on the hydrology of the Matheson Preserve shallow and deep aquifers, the underlying strata revealed by cores from wells drilled 150 feet deep, and water consumption. These findings, detailed below, oblige us to call into question two geohydrological models upon which governmental decision-making is being based:

1. The geohydrological model used by the Department of Energy in evaluating the environmental impacts of the Atlas uranium tailings pile reclamation options. In summary, Solomon and Gardner's data indicate that (A) a highly saline head of water is coming under the Atlas tailings, crossing under the river, and moving well under the Matheson in a deep aquifer flowing through alluvial gravel which is still present at the maximum depth of 150 feet cores were taken; (B) in these gravels next to the portal, at a depth of 24 feet carbon materials test as less than 100 years old and at 35' as 900 years old; (C) below the top 15-18 feet of silty river alluvial deposits, indicating slow water movement, the next 135' of gravels are all flood-scoured with no silty lenses, indicating recurring flood velocities capable of carrying rocks up to fifteen inches in diameter. It is physically impossible to have a bedrock "choke" at the portal and also have these flood velocities immediately upstream of it where current DOE models predict a stillwater lake forming during flood events.

2. The Downs & Kovacs water budget model for the Glen Canyon Group pristine groundwater aquifer: the assumption in that model that the production of the Glen Canyon Group aquifer is 13,300 acre-feet per annum and 9,530 acre-feet of that production is flowing underground down Spanish Valley and discharging into either the Matheson Wetlands or the Colorado River. In summary, Solomon and Gardner's data indicate that (A) they can account for only about 3,204 acre-feet of groundwater consumed in the Matheson by vegetation and evaporation; (B) they cannot find any outflow into the Colorado River through the Matheson from Spanish Valley in the shallow aquifer; (C) the chemical signature on the water in the Matheson does not match that of the Glen Canyon sandstone aquifer discharge, but instead appears to be "young" water from surface precipitation, irrigation outflow, and shallow flow from Mill and Pack Creeks. At most, 1,000 acre-feet of the Matheson water budget seems to come from the Glen Canyon aquifer, and its location indicates it is from Watercress and Skakel Springs behind the Grand Old Ranch House. (D) the flow in the deep aquifer under the Matheson preserve south of the Colorado River is highly saline water flowing under the river from the north; the center of the plume of saline water corresponds to the Moab Wash and Moab Fault orientation north of the river. In short, of the 9,530 acre feet of Glen Canyon aquifer outflow which is supposed to be flowing into or under the Matheson Preserve from the Spanish Valley valley fill aquifer, 8,530 acre-feet of it cannot be found. There are only two possible explanations for this:

Hypothesis 1: There is a deep gravel "drain" below 150 feet depth which is carrying water out of the Spanish Valley valley-fill aquifer under the Matheson and then beneath the surface water of the Colorado through the portal. There are currently no monitoring wells of sufficient depth to detect this "drain" if it exists.

Hypothesis 2: The water budget for the Glen Canyon sandstone aquifer is around 4770 acre-feet per annum, not 13,300 acre-feet per annum. If this is true, we are close to diverting the entire available output of this aquifer with the existing permitted water rights for the City of Moab and Grand Water Conservancy District culinary wells, and cannot develop more production from this aquifer to support future development.

I will discuss more detail of Solomon and Gardner's findings, and what we need to do in light of them, below.

In addition to Solomon and Gardner, attending the meeting were Sue Bellagamba of the Nature Conservancy; Jeff Freethey and Pat Lambert of the USGS; Laura Kamala of the Grand Canyon Trust; Barbara Morra of the Spanish

Valley Water and Sewer Improvement District Board; Richard Lance Christie, Grand County Water Planning Administrator; and Dr. LaRue Christie.

In the Downs and Kovacs water budget (2000), sources of water into the Spanish Valley acquifer system were 13,300 acre-feet outflow from the Glen Canyon sandstone aquifer, 730 acre-feet from precipitation in Spanish Valley, and 3,300 acre-feet leakage from Ken's Lake (this figure includes aquifer recharge from Pack Creek flow). This inflow was accounted for by 6,400 acre-feet diverted and consumed by culinary and irrigation uses; 1,400 acre-feet surface stream flow and vegetative evapotranspiration in Mill and Pack Creeks; and 9,530 acre-feet discharge into the Matheson/Colorado River at the foot of the valley. The 13,300 and 9,530 acre-feet numbers were estimates of low reliability; the other numbers are relatively certain.

In other regional water studies, reliable water budgets have only been established through accurate measurement of discharge from an aquifer system. For a variety of technical reasons, it is very difficult and expensive to accurately measure inputs into aquifers.

The Glen Canyon Group sandstone aquifer water has a geochemical "fingerprint" - low in tritium (<1), R/Ra helium isotope ratio <1, and stable isotope content indicating the water went into the aquifer at high elevations under cold conditions. The water in the Matheson wetlands in the shallow aquifer is high in tritium (3.1, 2.6, 15, 5.9, 4.7 were typical values in various test wells), has a high R/RA ratio, and does not contain the stable isotopes indicating high elevation, cold conditions at entry into the ground. There is a "plume" of water more like the Glen Canyon water on the NE side of the Matheson which I observe corresponds to the outflow of the Watercress and Skakel spring discharge.

Diane Pataki studied sap flow in cottonwoods in the Matheson under various salinity conditions. They ended up mapping five salinity zones in the Matheson: unhealthy Tamarisk (extremely saline), healthy Tamarisk, unhealthy native, healthy native vegetation, and open water/water vegetation. Evapotranspiration rates were calculated for each zone based on the vegetation there and the sap flow data. Saline conditions across the zones ranged from <1000 microSeimens/cm to over 3,000 average. Evapotranspiration is half that in 3,000 than in 1,000 saline. Total evapotranspiration/evaporation calculated was 3,204 acre-feet per annum.

The wells drilled to 150 feet depth encountered 15-18 feet of silty alluvium (indicating deposition by slow water) followed by cobbles and boulders to the 150 foot depth. There is a sharp transition between the top silty alluvium layer and the cobbles and boulders layer. There are no silty lenses in the cobbles and boulders, which can only have been deposited by swift-flowing current capable of carrying boulders to 15" size routinely. Wood was recovered from cores at 24 feet and 30 feet depth in the BL14 well just upstream of the portal and well back from the current edge of the river. The 24' sample was less than 100 years old and the 30' sample was 900 years old. This tells us that the river has repeatedly flooded at high velocity through an area 1.5 kilometers wide above the portal, and that the current has been swift enough to move 15"+ boulders as well as smaller cobbles, while carrying away anything smaller than about one inch in diameter. This flood cobble zone extends under the Atlas tailings and most of the Matheson. These floods have repeatedly occurred within the last thousand years - in other words, within historic times, and during them the river was scouring to at least 30 feet below today's surface. Since the same flood cobble and boulder formation extends to at least 150 feet depth, this means that the river was scouring at least 150 feet below its current bottom THROUGH THE PORTAL. If the portal had a bedrock sill, as the DOE hydrological models maintain, then the river could not scour below the top of this sill because the sill would slow down the flow of floodwater below the plane of the sill.

Re capping the Atlas tailings in place, with rip-rap armor to protect the cap against erosion from river flood, this kind of water velocity and scouring would make such armoring useless. Why? Because the river cuts down during flood events, and would undermine the armor and the tailings themselves, causing them to slough into the spate. It would make no difference if the rip-rap was composed of cement-filled greyhound buses; they would still roll off into the flood undercut. Kip Solomon said in light of these findings, leaving the tailings in place "should not even be on the table." As Moab mining engineer Mel Swanson said in 1989, the decision to cap the tailings in place is a decision to put the tailings into the Colorado River; Swanson said it would be cheaper and more honest to shove the tailings into the Colorado with bulldozers for eight years during high water. The environmental effect would be the same as capping in the long run. Solomon's findings confirm Swanson's observation.

The flow of water towards the Colorado is shallow. In the deeper hydraulic system in these cobbles, the water is highly saline, and the head is coming from the north (Moab Wash and Fault align with the center of the saline plume) under the river. As it comes under the Atlas tailings, the uranium concentration rises in a tongue which extends across the river in this saline water. The saline plume is fairly stagnant, so the uranium picked up from Atlas leachate is limited in its extent south of the river so far. Oxygen isotope "fingerprinting" of this water indicates it is not originally derived from either Mill Creek surface or Glen Canyon aquifer waters.

These findings underscore (1) the unfeasibility of a capping-in-place alternative for the Atlas tailings remediation. I've been dealing with this issue since 1989, and every bit of the geohydrology used by Atlas, the NRC, and now the DOE has turned out to be dead wrong. This appears to be yet another chapter in this sorry history. (2) the need to get a good study of the water budget of the Glen Canyon sandstone aquifer done so we know how much water can be supplied to culinary use by it.

Report by Phillip Gardner and Kip Soloman (with Addendum), University of Utah [8.3m PDF File]

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