

Glen Canyon Dam Adaptive Management Work Group Meeting  
August 9-11, 2004

**Basin Hydrology** – Tom Ryan said the big concern in the basin continues to be the drought. They are completing the fifth year and about to enter the sixth year. He presented a PowerPoint presentation (**Attachment 16**).

Drought Monitor. This reached its most severe point two years ago in the summer of 2002. Most of the Colorado River Basin is still in the severe extreme drought categories. Western Colorado is showing more relief into more the moderate range and some of it even at normally dry. The San Juan and Colorado did have a little bit better runoff but it still ended up only being about 60 some percent of average in the Navajo. The drought continues.

Lake Mead's Bathtub Ring. I've been doing some collaborative presentations with Terry Fulp in the Lower Basin. This doesn't go all the way to 04 but if you think we have a distinct bathtub ring at Lake Powell, you should see Lake Mead. It's really striking.

Lake Mead's Delta Area. Here's a look at Mead's delta in 1999 and in 2003 you can see how quickly this vegetates in.

Lake Mead Water Surface Elevations, 1996 – Present. Here is a plot of just time series of Lake Powell elevations. We filled in 1980. We had a 5-year drought in the 1988 – 1992 period. We dropped 90 feet. We have a 5-year drought going on now. By the time next spring rolls around, we'll be down about 140 feet. There are three reasons why we're low for this time of year than we were in that 5 year drought before. (1) This is a more severe drought, (2) there are more uses in the Upper Basin and (3) the third one is more nebulous. There are more uses in the Lower Basin. We had a little bit of equalization in 2000 that we didn't have in 1988 at the start of that drought so it pulled it a little bit more downstream early on.

Lake Mead End of Month Elevations. In September of 1999 the system is full. Here we are in August 2004, at 54% of capacity. Lake Powell is at 40% of capacity.

Upper Colorado River Basin Precipitation. This plot gives you a timeline of precipitation. In 1999 we had a poor snow pack year but had a very wet spring. In April of 1999 it was the exact opposite of March 2004. It was very wet. It was very cool and we went from being in a bad situation to being in a reasonably good situation. We ended up with average runoff April-July 1999, filled Lake Powell, and then stayed wet because of a healthy monsoon in the summer. We hit the low point in terms of a 12-month running average, like I said two years ago. Another interesting thing to note is the last two years precipitation has been about 85% of average so you set the stage with drought conditions, you have 85% average for two years, but you can only muster up a little over half of your inflow. A little bit below average gives you quite a bit below runoff.

Unregulated Inflow to Lake Powell, 1999-2004. You can see we haven't been above average since September of 1999 and the gradual trending downward in the base flow periods particularly. We had a big monsoon - the system was full with 20,000 cfs is coming into Powell and 20,000 cfs going out of Powell.

Lake Powell. This slide depicts the amount of snowpack accumulation and deterioration that occurred in 2004. The blue line is an aggregate of 18 different snowtell sites that the NRCS considers to be indicators above Lake Powell. The blue line would be an average pattern of

accumulation in melt at the snowtell sites. The red line is what happened in 2003 and the green line is 2004. You can see we were hugging the blue line, hanging right in there at average, even a little bit above it for part of the year. You see that flat line right there is 3 weeks of no precipitation. We kind of held our own and come March 1, we're just below average in terms of precipitation. Well March we had this very warm, very dry month and we lost it. This line is not only level but going down at a time when you should be accumulating snow that's disaster. So what happens was the snow just disappeared. We lost a lot of snow through March and most of it did not end up in the river.

Lake Powell Unregulated Inflow. This is what we got out of the deal -that little bump in the hydrograph. We lost all that snow. We got a little pulse. We were a little bit above average for a little period of time but it was at great expense and the potential to be up in here when you want it to be in May and June. We were significantly below average in terms of our base flows. There was a little bit of monsoonal activity but not much. Precipitation last month was 85% of average in the basin.

Colorado River Basin Storage (8/5/2004). This gives you an indication of where the system is at. Total storage 52% for Colorado River storage. Lake Mead 54%, Lake Powell 40%, other reservoirs in the lower and upper basin are 2/3 full.

Lake Powell Capacity. This one I'd like to spend a little bit of time on and maybe build off what Brad Warren talked about on Monday. This is one we call a teacup. It is not to scale but it shows some key elevations in terms of places. There are places you don't want to go in life and there are places we don't want to go at Lake Powell. This obviously is one of them, 34090. It's our pool elevation. You can see right now we're 88 feet above it with 5.8 maf between our current storage and reaching that threshold. There are probably many scenarios of how you can get there but kind of the two that were sort of laid out that Brad talked about was 1) if we have a really bad year next year like 2002, in 18 months, we could be there. If we had two more years like we've had the past two, we could be there in 2.5 years. The probability of that happening is still not high. Our CRSS runs show there is about a 20% chance that we could reach this elevation sometime in the next six years. Of that 20%, 5% of those are where you just barely dip it and come back around and just go under where there could be some operational changes where you could shift some monthly volumes and avoid going below it. So realistically I think we're looking at about a 15% chance that this comes to play in terms of being a very serious problem. 33070 is when we run out of water. We've done some CRSS runs where we just keep the 8.23 going. I think you heard from Larry the other day that that is something being discussed but if you do keep the 8.23 going, CRSS runs show about 6% chance that you would run out of water if you continued in operation that way.

Colorado River Runoff. So where has all the water gone? This is a plot that many of you have seen. It's natural flows at Lees Ferry. We've added in estimates of what we think are natural flows these last five years. We're estimating about 9.9 maf of natural flow in this 5-year period. You can see the variability. In the 100 years of record keeping, there has never been six consecutive years of below average inflow. If you do a 4-year analysis, it will say it's time for a change but time will tell.

How long will it take to refill Lakes Powell and Mead? The answer is probably a long time. We just don't know what the runoff is going to be. The science isn't there to tell us. We've got a lot of research being done and hopefully there will come a day when we'll have some confidence about what our outyear climate, weather patterns will be but we're certainly not there now. We have put together minimum probable, most probable, and maximum probable inflow scenarios

for Lake Powell. Those are deciles, 10% on the dry, 10% on the wet and then the most probable in the middle and those have been ratcheted down from historical statistics because of the drought, because of the antecedent conditions. Most probable is about 79% of average, minimum probable is 3.8 which is 31% of average, and our maximum probable is 15.3 which is 126% of average.

It would take about 20 years to fill Lake Powell if you have average conditions and since we won't, that's really a meaningless statistic. Even with back to back 83 and 84, the two wettest years on record, you don't fill the system although you do get to a nice place. One thing I might also add is that we have our 602a storage in place. We don't begin to equalize sending more than 8.23 to the Lower Basin until we reach 36030 on Sept. 30 so like was alluded to in some discussions before, Lake Powell takes the hit earlier and then Lake Powell recovers sooner after the fact. It's likely that releases down to Mead will be 8.23 for a number of years until you get to that 36030 and you can start equalizing.

I mentioned this before. There has never been six consecutive years in the past 100 years on record so we'll see where we go next year. The two years that did happen is the period we're in now and this relative recent period of 1988-1992.

Projected Lake Powell Releases. Here are our projected releases. Very low probability that releases will be greater than 8.23 next year. We're showing our low flows to conserve sediment this fall and through December period. We're hoping for a sediment input trigger. Our current capacity at Glen Canyon if we have all eight units going, I understand is about 28,500 cfs so we are reduced a little bit because of our reduced head. You couldn't get to 45,000 even if we wanted to, assuming that all eight units were available.

Projected Lake Powell Water Surface Elevations. Here's a look at what our water surface elevations look like under most probable inflow conditions. As you can see if we have average climatology, average temperatures, precipitation, relatively, we have below average runoff about 79-80% of average, we end up about where we are right now. So it takes more than just average conditions out there to bump us up is the message I want to send.

Closing Comments. When you consider the period we've been through, the system is working remarkably well. It's been a nasty 5-year period and we still have quite a bit of storage. We're still half full. The message from the Dept. is the drought is serious but we're not yet in a crisis. I think people are starting to make moves, contingency plans and discussions are taking place. Reclamation and Interior are working with the basin states to analyze options and those discussions are broadening in terms of lots more groups getting involved in terms of working with Reclamation to share information, and so forth.