



July 6, 2009

Jack Wilson, Mayor  
City of Prescott  
201 Cortez Street  
Prescott, Arizona 86303

Re: Wilson letter of June 8, 2009

TRANSMITTED VIA EMAIL

Dear Mayor Wilson:

The letter you wrote to me on June 8, with a copy to Bill Meyer, was a follow-up to our conversation on April 18, 2009. I am writing, with Bill's assistance, to address your comments and to present some additional support for my position concerning the expected effect of Prescott's pumping in the Big Chino sub-basin on the Verde River.

I do recall our conversation on that day including discussion of the US Bureau of Reclamation (USBR) report of 1994; however, I can't recall the details. I have, however, frequently referred to the USBR report as one of many pieces of expert evidence that Prescott's pumping of groundwater in the Big Chino sub-basin would reduce flow in the Verde River.

At the City's presentation at the March CWAG meeting, Jim Holt stated:

“I don't believe that the existing scientific investigations in the Big Chino have ever suggested that groundwater pumping at the Big Chino Water Ranch or even within the upper portion of the Big Chino sub-basin will have an effect on the baseflow of the Verde River.”

On April 18, I might have recalled that statement and explained to you that the USBR study had indeed concluded that there would be an effect. I might have also pointed out that the USBR study includes mathematical models that connect the groundwater in the Big Chino to the Verde River and thus are another expression of that Agency's determination that pumping will result in flow reduction in the Verde River.

What follows are the points I would like to make concerning your analysis and the effect of pumping groundwater on the Verde River.

**A. Rationale for the conclusion that Prescott's pumping would greatly affect the upper Verde River**

My rationale for concluding that Prescott's pumping would have a significant adverse effect on the upper Verde River is as follows:

1. The USGS reports by Blasch and Wirt have independently concluded that the Big Chino sub-basin provides about 80% of the upper Verde River's baseflow. This figure has been confirmed or accepted by other investigators, including Prescott's consultant, Ed McGavock. I note, however, that Mr. McGavock has recently testified to a percentage range of 60-80.
2. Government studies by USGS, ADWR and USBR have concluded that groundwater flows only toward the Verde River. For example, the abstract in the Blasch report states "Ground-water outflow from the Big Chino Valley occurs only as base flow in the Verde River."
3. The Blasch report's estimates of evapotranspiration and observations of many others lead to the conclusion that groundwater losses to evapotranspiration are relatively minor and therefore potential reduction in evapotranspiration resulting from the lowering of groundwater levels from pumping will not significantly reduce the impact of pumpage on the flow of the River.
4. Groundwater pumping with its concurrent lowering of the groundwater table will not induce increased recharge from direct precipitation in the Big Chino sub-basin or from new or increased groundwater inflow from adjacent groundwater basins. The former is precluded owing to few if any places in the Big Chino and Williamson Valleys where evapotranspiration from the groundwater system is presently occurring. The latter is precluded due to geologic considerations and the relative distance to the other groundwater basins and discharge areas of the other basins compared to the distance to the Verde River.
5. Consequently, groundwater removed from the Big Chino will eventually result in a near equal reduction in flow in the Verde River. Prescott's potential to export 11,500 acre-feet per year (AFY) from the Big Chino represents a high percentage of the current baseflow of about 18,000 AFY. Part of the 11,500 AFY figure would be offset by elimination of on-going irrigation on the Big Chino Water Ranch (Ranch); however, recent irrigation rates (not historical), while requested of Jim Holt by me, have not been provided.

**B. The numeric model currently under development by USGS is not needed to conclude that pumping would have a significant adverse effect on the River.**

Prescott representatives have stated on a number of occasions that a numeric model is needed to determine the effect of Prescott's pumping on the River. This type of statement in its simplistic form is misleading and certainly unclear.

Many experts have stated that the conceptual models of the basin constructed by the three government agencies listed above lead to the conclusion that pumping groundwater will eventually result in a near equal reduction of flow in the Verde River. These conceptual models clearly point out that groundwater in the Big Chino valley discharges only to the Verde River, and given this, removal of water from the valley removes this discharge to the River by an equal

or nearly equal amount. A numeric model will only quantify the reduction in groundwater discharge to the River in space and time. The above benefits of a numeric groundwater model have repeatedly been stated by me and by experts in hydrology.

It should be noted that I and many others concerned about the Verde River do not find a delay in significant reductions to be acceptable, whether it is decades or a century.

It is also noted that that at the same time Prescott states that their pumping will not affect the River it also states that a numeric model, which is not yet available, is needed to determine if an effect will occur. Which is it?

## **C. U.S. Bureau of Reclamation Report, 1994**

### **1. General**

Your June 8th letter included your analysis of the USBR Big Chino Groundwater Study, 1994. On the first page of your analysis you correctly quote the purpose and objective of the study. You follow the quote with a paragraph where you explain that pumping near the Verde springs was problematic and imply that is the reason the City moved its withdrawal location farther up the valley to the Ranch.

Your presentation of a discussion and rejection of the option to pump close to the Verde seems to be based on a misunderstanding of the USBR objective. Where the USBR's report states their objective as "evaluating the effect of pumping large amounts of groundwater from the valley immediately adjacent to the Verde River..." the word "immediately" refers to the location of the valley and not necessarily a pumping location immediately adjacent to the River. It is apparent that the USBR's evaluation is for the entire valley because in the report the USBR determined that the upper part of the basin is hydrologically connected to the River and because the USBR models include the entire valley.

Significantly, although you quoted largely from the USBR report, you overlooked the main purpose and conclusion of their study. As stated in the USBR report, "The Bureau of Reclamation acting for the Secretary of the Interior was charged with the task of technically deliberating whether or not such withdrawals (*large withdrawals of groundwater in Big Chino Valley*) of groundwater would affect the surface waters of the Verde River."

The USBR report states in Section III of III, Hydrology and Hydrogeology, page 11,

"What Reclamation did conclude was that there is insufficient evidence to technically support a "closed basin" in Big Chino Valley. A true "closed basin" in Big Chino Valley could have provided the opportunity for continued evaluation of the groundwater resource. The absence of proof for a "closed basin" in the Big Chino Valley does not allow Reclamation to insure that the authorized construction of a diversion of water in the valley would not affect the spikedace."

The above conclusion is based on the two steady-state models constructed by the Bureau wherein groundwater from the upper Big Chino valley flowed across, around, and under the so-called

“clay plug” to the lower Big Chino valley and then onward to the Verde River. Given this result, the Bureau understood that pumpage would reduce groundwater discharge from the Big Chino valley to the Verde River. Given this understanding there was no need for the Bureau to construct a transient model.

It should also be understood that the Bureau’s modeling efforts demonstrated that groundwater in the upper and central parts of the Big Chino Valley moves down valley and downward from the basin fill deposits into the underlying Martin Limestone; moved upward from the Martin Limestone in the lower Big Chino valley and to the Verde River. Their models also demonstrated that groundwater in the basin fill moves into the Martin Limestone below Paulden to discharge to the Verde River.

Because their modeling covered all of the Big Chino Valley, including Williamson Valley and the Verde River, their understanding of the overall groundwater flow system exceeds that of other studies before and since that fail to include the entire flow system. The forthcoming model of the USGS will include a larger area and therefore it will provide additional understanding, but the USGS has already concluded that groundwater in the Big Chino valley discharges to the Verde River.

Your analysis also correctly and tellingly quotes from the USBR report in part as follows:

“The results of this investigation suggest that groundwater pumping in the upper Big Chino Valley would have an adverse effect on the flow and perhaps the biota of the Verde River.”

You go on to write that this conclusion is not from the groundwater model. As stated above, this conclusion was indeed from the USBR modeling.

## **2. USBR Groundwater Models**

Your analysis also quotes from USBR report in part as follows:

“The geologic and geophysical investigations have not confirmed the extent of this zone [semi-pervious material (clay)] on the west side of the valley.”

You go on to write that this conclusion is not from the groundwater model. However, in Section III of III, Appendix C, Summary, page 2, the report states:

“Two conclusions are drawn from the model results. They are; 1) that the upper and lower parts of the Big Chino Valley are hydrologically connected, and 2) that the flows in the Verde River can be accounted for by the known recharge sources in Big Chino Valley, both streams and precipitation.”

The City has repeatedly contended that the Northwestern part of the basin is not hydrologically connected to the Verde and thus your pumping would not affect the river. The USBR models and other information in their report refute that contention.

Along those same lines, the USBR conclusion presented below (from Section I of III, Perspective, page 7) is worth noting:

“It is concluded that this investigation will not provide enough evidence to support a recommendation to the Secretary of the Interior to proceed with acquisition of water and land in the Big Chino Valley to effect a full or partial settlement for the Fort McDowell Implementation. This conclusion is the result of findings of the study which do not support a location in the Big Chino Valley where a large diversion of groundwater out of the valley would not result in a depletion of flows in the upper Verde River.”

In your analysis, you state that there is only one model and you refer to separate calibrations of all seven layers and then the top three layers. Both Bill Meyer and the USBR repeatedly refer to two models; a seven layer model and a three layer model. Section III of III, Groundwater Modeling, pages 13 and 14 read:

“The groundwater modeling efforts resulted in two calibrated, steady-state models. Transient conditions were not modeled due to lack of adequate data for calibration. The first model was run and calibrated using seven layers. The second model was run and calibrated using only the upper three layers from the first model. In both models, the heads in the layers were recorded and compared between calibration runs. Both models showed similar results. They are; 1) there is a negative or downward gradient in heads in the northern and central parts of Big Chino Valley and a positive or upward gradient in the southern part of the Valley, 2) the northern and southern parts of the Valley are hydrologically connected to the east, west, and beneath the semi pervious material that has been referred to as the 'clay barrier', and 3) the flows in the upper Verde River under steady state conditions can be accounted for by the known recharge sources in Big Chino Valley, both from areal precipitation and streams, and areal precipitation recharge from Little Chino Valley.”

In addition to describing the development of two models, the above quote describes groundwater flowing around and through the semi-pervious playa and thus debunks the City's contention that the playa is a “plug” that hydraulically separates the upper and lower parts of the basin.

In your letter you correctly state that the USBR model was calibrated for only steady-state conditions and not transient conditions. You then refer to “the generalized nature of the existing information” and write that any conclusion related to effects from pumping would be conjecture.

The USBR did not do this study so that they could simply conjecture. They drew clear conclusions and those conclusions are the scientific opinions of an independent agency that carefully evaluated the data. Their modeling efforts were designed to examine the feasibility of withdrawing large amounts of groundwater from the upper Big Chino Valley above the playa deposits without impacting the flow of the Verde River. In effect, they examined the ability of the so-called “clay plug” to isolate the impact of pumpage to the upper valley alone. They, of course, concluded that the impact of this pumpage would not be isolated. Instead, as stated above, they concluded that the “findings of their study do not support a location in the Big Chino Valley where a large diversion of groundwater out of the valley would not result in a depletion of flows in the upper Verde River.”

#### **D. The bathtub analogy is useful.**

In your March presentation to CWAG, you stated that the bathtub analogy for the Big Chino aquifer used by your critics is inappropriate. The analogy has been used to illustrate that the Verde River is similar to the overflow in a bathtub. If you withdraw water by pumping from the bathtub at a rate equal to the inflow, water will cease to flow from the bathtub’s overflow outlet and will do so irrespective of the bathtub’s volume. As such, the analogy is useful to help understand that the large volume of the Big Chino aquifer is not relevant to the environmental concern for maintaining flow in the River.

USBR’s “bathtub” discussion of the boundary conditions of the Big Chino sub-basin (Appendix C, Groundwater Model Development, page 19) presented below is informative.

“The boundary conditions for the model are established based on the known material properties and the distribution of the materials at the surface and in the subsurface. The Big Chino Valley forms a classic basin in that it has 'no-flow boundaries' on all sides and in the subsurface. The only inputs are from three streams that cross the model boundaries and from precipitation. The only outlets from the model is from evaporation, evapotranspiration, and from surface flows. Evaporation and ET are accounted for in the calculation of recharge from precipitation. Therefore, the only 'flow boundaries' within the model are the Verde River cells. Thus, for model purposes, the Big Chino Valley becomes a '**bathtub**' (emphasis added) with several inlets and only one outlet.”

#### **E. Hydraulic Gradients**

At the March CWAG meeting, you showed the hydraulic gradient developed by Karen Schwab of ADWR. You seemed to be saying that the steep gradient shows that it is not a bathtub and that the high water table near the Big Chino Water Ranch allows you to withdraw water without affecting the River.

The fact is Karen Schwab did not show water level contours in the playa area so that it is not possible to reference this paper as your source for the hydraulic gradient you presented. On the other hand, the two Southwest Ground-water Consultant reports prepared for the city (C.V. / C.F. Ranch Acquisition Hydrology Report, 2004 and Big Chino Ranch Acquisition Hydrology Study, 2005) both show water level contours across the playa deposits as well as the other parts of the Big Chino and Williamson Valleys and the hydraulic gradient in the playa deposits derived from these reports are almost identical to hydraulic gradients in the remaining areas of the two valleys.

Although your premise that the gradient you presented demonstrated that pumpage above the playa deposits would not impact water levels in the lower valley and flow of the Verde River is incorrect on its face, your acceptance of the two Southwest Ground-water Consultants reports should convince you that the gradient you presented doesn't exist.

#### **F. ADWR Verde River Watershed Study, 2000**

I recommend you review the report of this independent government agency. The water budget developed in the report has the Verde River as the only natural discharge from the Big Chino sub-basin system. As such, an increase in pumping will be counterbalanced by a reduction in River flow.

#### **G. USGS, *Hydrogeology of the Upper and Middle Verde River Watersheds, Central Arizona* (Blasch Report).**

The Blasch report (another independent government agency) has been discussed previously. Its water budget also has the Verde River as the only outflow for groundwater. Thus, an increase in pumping will lower the water table and will reduce flow in the Verde River.

#### **H. Southwest Ground-water Consultants (SWGC)**

These long-time paid consultants for the City constructed a numeric model to evaluate the drawdown of the City's pumping as required for an application for an assured water supply determination. The assured water supply process requires that a hundred-year withdrawal of groundwater does not cause the water table to drop to more than 1,000 feet below grade. In your letter you imply that this model and its acceptance by ADWR for your application is proof that the City's pumping will not affect the Verde River.

I have not reviewed the model, but there a number of obvious deficiencies for the implication you draw. You are probably aware that Bill Meyer and Ed Wolfe, two very qualified and independent scientists, have reviewed the SWGC report and model and identified major problems, much to the dismay of SWGC.

The most obvious model deficiency for evaluating the effect of pumping on the Verde River is the fact that the southeastern boundary of the model does not extend to the Verde River and therefore, for this reason alone, cannot evaluate the potential impact of Prescott's pumpage on

the Verde River. I note that ADWR recommended that the boundary should be extended to the River for this purpose, but this recommendation was not followed.

In your letter, you state that the model resulted in a mere 10-foot decline in the water table at the model SE boundary with Prescott's pumping. That indeed would be important if accurate. However the 10-foot lowering at the SE boundary was "imposed on the model" by SWGC and was not an outcome of the model runs (this is discussed in various letters between ADWR and SWGC (see the June 29, 2004 letter from SWGC to Karen Modesto). This information is also presented in the SWGC 2004 and 2005 reports to the city (see page 6-11 on Boundary Condition and illustration 6-13 of the 2005 report). As such, it is an arbitrary model input and not a model output. If the model were constructed to evaluate the effect on the Verde, it would have been constructed to reach the Verde and the groundwater elevation of the Verde springs and River would serve as an appropriate boundary condition for withdrawals. Because SWGC imposed the 10-foot decline, in no way can the model result imply a minimal effect on the Verde River.

As to your statement that ADWR rigorously reviewed the model, you must realize that their review had nothing to do with the effect on the Verde River, but only on meeting the maximum drawdown requirement. In addition, although SWGC replied to some of the concerns expressed by ADWR, a review of the correspondence between them strongly suggests that ADWR has significant concerns that were not addressed by SWGC.

## **I. Statements of involved or prominent parties**

### **1. John Hoffman, USGS**

At a presentation to the Verde Watershed Association on June 21, 2007, John Hoffman, Director of the US Geological Survey Arizona Water Science Center and an author of the report *Hydrogeology of the Upper and Middle Verde River Watersheds, Central Arizona* (2006), (Blasch Report) asked and answered the following question:

“Will groundwater pumpage from the Big Chino sub-basin reduce groundwater outflow from the Big Chino sub-basin to the Verde River? And the answer of course is ‘Yes.’ It is not a matter of if. It is just a matter of when.”

At the same meeting, from slide 47 of his presentation:

“If Pumpage from wells equals or exceeds total recharge in the long term, natural discharge of ground water to springs, riparian habitat and streams from the aquifer will eventually be eliminated. Again, timing of the reduced discharge is a function of the distance pumping is from the recharge (sic) area, and the hydraulic properties and geometry of the aquifer.”



As a high-level manager at USGS and an author of the Blasch report, it would be difficult to reference a more qualified and authoritative voice than John Hoffman. Yet, you have dismissed his opinion as not being the opinion of his agency. This makes no sense because for the USGS, the pumping issue is a scientific determination and not an agency opinion or determination. This denial indicates unwillingness on your part to accept reality.

## **2. Laurie Wirt, USGS, Deceased**

Laurie Wirt was the lead author of the USGS report *Geologic Framework of Aquifer Units and Ground-Water Flowpaths, North-Central Arizona, 2005*. The report evaluated the sources of groundwater flow to the upper Verde River. She presented her findings at the well-attended Yavapai County Water Advisory Committee meeting in Chino Valley on May 17, 2006. During the question-and-answer period, I asked her if she concluded that withdrawing groundwater from the Big Chino would result in a near equal reduction of flow in the Verde River and she answered, "Yes."

## **3. Frank Corkhill, ADWR**

Frank Corkhill is ADWR's chief hydrologist. At the hearing on April 15, 2009 for Prescott's assured water supply permit, he was asked to agree:

1. "that groundwater flows from the Big Chino basin-fill aquifer system in a northeasterly (sic) direction toward the headwater? His answer was, "I would";
2. "that groundwater eventually flows into the springs that form the beginning of the Verde River?" His answer was, "That's my opinion"; and
3. "that water taken out of Big Chino would have to result in a reduction in flows to the headwaters of the Verde River?" His answer was, "My opinion, that would happen."

## **4. Bill Meyer and Ed Wolfe, USGS, Retired**

Meyer and Wolfe, an experienced and well-respected hydrologist and geologist, respectively, have reviewed the major studies of the hydrology and geology of the Big Chino sub-basin and have concluded that groundwater withdrawals from the Big Chino will result in eventual near equal reduction in the Verde River. Their many review reports are available on their web site <http://upperverdewaterissues.org/>.

## **5. Ed McGavock, Errol L. Montgomery Associates**

At the request of the Upper Verde River Watershed Protection Coalition, Ed McGavock was paid to conduct a review of the Blasch and Wirt reports. At a televised presentation to the Coalition he made the following statement:

"The crux of the matter from a technical standpoint is pretty simple. If the entire Big Chino basin acts as one aquifer, (then) the basin fill is very

well connected to the limestones. You pump out of either aquifer, it's all one aquifer. It is almost inescapable you will eventually impact the springs. You are taking out part of the water that is going to the springs."

The connection between the basin fill and the limestone aquifer that McGavock states is necessary for pumpage in the Big Chino Valley to impact flow of the Verde River is amply illustrated by the USBR models and the model constructed by SWGC for the City. McGavock, however, goes on to question whether the basin fill and the underlying limestone aquifer are connected to each other. He said:

"Now, move to the opposite end of the spectrum and speculate that maybe most of the water moves down to the springs from the aquifer in which the water went in the limestones and its not well connected to the basin fill aquifer and you pump only out of the basin fill, a model very likely will show a small impact if any. Now that's a long way from being established and it's also a very long way from being disproved."

McGavock's concept here is that if there is an impermeable barrier between the basin fill and limestone formations, you could pump from one aquifer and still have flow going to the River from the other. This possible concept of an impermeable barrier, including McGavock's basis for it, have been rejected by others including the work of the USBR and SWGC discussed above, the USGS, and Meyer and Wolfe.

## **6. Arizona Game and Fish Department**

In a letter to ADWR, September 12, 2008 regarding the City of Prescott's application for Assured Water Supply including the importation of up to 14,000 acre-feet per year, the Department wrote:

"The Department believes the action outlined in the ADWR notice will substantially reduce baseflow in the upper Verde River, resulting in significant impacts to wildlife habitat, as well as direct impacts to the Department's Upper Verde Wildlife Area."

## **7. Herb Guenther, ADWR**

ADWR Director Herb Guenther was quoted in The Daily Courier ("Mason helps air Verde water issues," November 10, 2007) as saying, "If we significantly exceed natural and artificial recharge, the probability is ... we eventually impact the base flow" of the Verde River.

## **8. John McCain, US Senator from Arizona**

From the Daily Courier, December 30, 2008:

"We all know the Verde River is threatened, OK?" McCain told The Daily Courier before Tuesday's private meeting. "And all of us are committed to see that not happen. So we all have a common goal here."

McCain said he "respects and admires" Arizona Department of Water Resources Director Herb Guenther, who knows more about water than anyone he knows. "Herb says the Verde River will go dry," McCain related. "Now, as to the argument as to when, Herb's not that specific."

## **9. William Greenslade, Consultant, SWGC**

At the hearing for Prescott's assured water supply application, this paid consultant to the City was asked under cross examination if he agreed with the testimony of ADWR Chief Hydrologist, Frank Corkhill, that pumping from Prescott's project would impact the Verde springs and headwaters. Greenslade twice testified that he agreed.

Greenslade also testified under cross examination that the effects will be small at any time. That less than clear statement raises the question of what the impact would be over time.

## **J. Summary**

The evidence and testimony described above is overwhelming that Prescott's pumping would significantly reduce flow in the Verde River. "It is not a matter of if; it's just a matter of when" to again quote USGS hydrologist John Hoffman. I rely heavily on the independent scientists, but even your paid consultants lend support to an effect on the Verde.

Because of the overwhelming evidence for an effect, I have for some time believed that the denials by the City representatives were a legal tactic rather than a determination based on scientific facts. I am puzzled by your attempts to explain away or brush aside the evidence and the opinions of so many independent experts while your fellow representatives simply avoid discussion of the issue. I hope the above compilation of information is persuasive. I would be happy to discuss this further.

Sincerely,

John Zambrano  
Vice President  
Citizens Water Advocacy Group  
(With Bill Meyer, Retired USGS Hydrologist and not a CWAG member)

cc: Bill Meyer  
Jim Holt  
Elected Officials

*"It is difficult to get a man to understand something when his salary depends upon his not understanding it."* Upton Sinclair