IN THE SUPERIOR COURT OF THE STATE OF ARIZONA

IN AND FOR THE COUNTY OF MARICOPA

IN RE THE GENERAL ADJUDICATION OF ALL RIGHTS TO USE WATER IN THE GILA RIVER SYSTEM AND SOURCE	W-1, W-2, W-3, W-4 (Consolidated) Contested Case No. W1-103 **ORDER FOR ARIZONA DEPARTMENT OF WATER RESOURCES TO PROVIDE ADDITIONAL INFORMATION**

CONTESTED CASE NAME: *In re Subflow Technical Report, San Pedro Watershed*

REPORT INVOLVED: Groundwater Flow Model of the Upper San Pedro Groundwater Basin, February 2024.

DESCRIPTIVE SUMMARY: The Arizona Department of Water Resources is ordered to provide additional information regarding the February 2024 Groundwater Flow Model Report by **August 29, 2024.** A status conference is scheduled **for Tuesday, October 29, 2024, at 10:00 am.**

NUMBER OF PAGES: 13

On February 20, 2024, the Arizona Department of Water Resources ("ADWR") filed *Groundwater Flow Model of the Upper Sand Pedro Groundwater Basin* ("Report"). This Report documented the development of a groundwater flow model for the Upper San Pedro groundwater basin ("Model"). This Model was developed by ADWR to predict whether pumping of a particular groundwater well located outside of the subflow zone will impact water within the subflow zone. Objections to the Report and Model were required to be filed not later than April 22, 2024. Comments were

received from ASARCO, Arizona State Land Department ("ASLD"), Arizona Public Service Co. ("APS") with BHP Copper, Arizona Water Company, the City of Chandler, the City of Cottonwood, Freeport Minerals Corp ("Freeport"), the Gila River Indian Community ("GRIC"), Liberty Utilities, the San Carlos Apache Tribe, the Salt River Project Agricultural Improvement and Power District with the Salt River Valley Water Users' Association (collectively "SRP"), the St. David Irrigation District ("SDID"), and the United States. Additionally, technical reports were presented from Clear Creek Associates on behalf of the City of Cottonwood and SDID, Matrix New World Engineering on behalf of Arizona Water Company, Montgomery and Associates on Behalf of APS and BHP Copper, and Tetra Tech on behalf of Freeport. [1]

The overarching concern in most of the comments was the lack of full explanations in the Report for many aspects of the Model. Irrespective of the level of effort to construct a numerical model such as the Model, a model will always be nothing more than an estimated, or approximated, simplified, representation of a complex system. Here, the complex system is the interaction between groundwater and surface water in the San Pedro River watershed. For any such representation to be trusted, full transparency regarding the model's ability to capture the features and behaviors, assessed on the basis of its ability to replicate the past, is paramount. All modeling that attempts to predict the future operates with some degree of uncertainty. To avoid constant litigation regarding the modelling results, sufficient information must be provided so that parties are confident that uncertainty has been reduced as much as practicable and are therefore willing to accept what level of potential error remains.

Despite eleven (11) separate sets of objections[2], there was considerable

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[1] No determination has been made here as to whether any of the third-party technical reports may meet the requirements of Rule 702 of the Arizona Rules of Evidence.

[2] ASARCO and Liberty Utilities filed motions to join in the objections of Freeport, APS/BHP, Arizona Water Company, and the SDID.

agreement among the objecting parties. The comments fell roughly into three categories:

1. Unsubstantiated methodology
2. Data gaps and inadequately documented assumptions
3. Inadequately documented calibration

The San Pedro Groundwater Flow Model will be used for both cone of depression testing, and subflow depletion testing in the San Pedro River Watershed. As stated by Judge Brain and reiterated by multiple commentors, the cone of depression test is jurisdictional, and the subflow depletion test is evidentiary.[3] Because the subflow depletion analysis can shift the presumption from a well is pumping percolating groundwater to the well is pumping appropriable subflow, it is very important that the Model is as accurate a representation and prediction of hydrologic conditions as possible.

A threshold issue is the purpose of the Model. The Introduction to the Report states the Model "will be used in the adjudication proceedings for cone of depression testing and subflow zone depletion testing on wells." Report at 1-1. Elsewhere, the Report states, "This report presents . . . ADWR's effort to calculate subflow zone depletion *caused by wells within the study area.*" (emphasis added). Report at 1-5. However, the Report also includes a disclaimer stating that the Model "is developed for regional scale studies" and "should not be used for well placement . . . or anything outside the model's intended purpose." Report at 8-2. These statements are potentially incongruous regarding how the Model can and will be used.

Several of the hydrographs presented in Figures 6-31 through 6-34 show that the simulated water levels do not match the observed trends. This overall poor match by the Model to the observed water level trends does not support the model as an adequate

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[3] *See generally* W1-W4, Order RE: Report of the Special Master on Methodology for Determination of Cone of Depression (July 8, 2022). ("Brain Order").

representation of the aquifer system. Section 6 of the Model Report attempts to describe the model calibration process but does not provide sufficient information to justify why the discrepancies are considered acceptable. Since the purpose of the Model is to predict hydrologic conditions, the disparities are not reassuring.

The Report is the documentation of the Model – not just the "what," but the "why" and "how" as well. The Report must provide sufficient detail and explanation for the reader of all aspects of the Model.[4] Based upon a review of the Report, all timely filed objections, and submitted technical comments, it is the opinion of the Court that additional information is necessary to fully understand, evaluate, and potentially refine the Model.

THEREFORE, IT IS ORDERED that ADWR develop an addendum to the Report ("Addendum") that includes the following additional information:

A. UNSUBSTANTIATED METHODOLOGY

1. A clear explanation of the use and limitations of the Model, including ADWR's current expectations regarding who (ADWR, Claimants, other parties, etc.) will be using the Model and at what point in the proceeding.
2. Because of the coarseness of the grid along the study area boundaries it is difficult to assess alignment with the Upper San Pedro USGS hydrological unit. It appears in Figures 1-1 and 2-1 that the study area is not a complete match with the Upper San Pedro USGS hydrological unit. The Addendum must provide a detailed depiction of the Model area overlain on a USGS topographic map including the location and dimensions of the Model's

[4] Certainly, the Court does not expect the Report or Addendum to be a primer on modeling for the uninitiated. However, readers with a basic understanding of groundwater flow and the process of creating a model by providing specific parameters to calculate outcomes based on specific inputs, should be able to follow what ADWR did, why they did it, and how they did it.

cells. A larger version of Figure 5-5 would especially be beneficial in understanding the adequacy of the grid detail along the study area boundaries.

3. A latitude and longitude grid should overlie the study area boundary. Specific features such as springs, gauges, and wells should be identified wherever possible.

4. The Addendum must provide additional detail and information regarding the quantification method of the water included within the Model, including cumulative water in storage, how the vertical extent of the subflow zone has been defined within the grid, and the contribution of water from the basin fill aquifer to the subflow or river surface flow.

5. The limits of the subflow zone are delineated based upon predevelopment conditions. However, predevelopment conditions may not be appropriate to predict current hydrologic behavior for the subflow depletion test. The Addendum must include detailed information regarding if, and how, predevelopment conditions were applied within the Model. The Addendum must also explain in detail how the Model addresses current conditions, such as the large-scale depletion of groundwater in the San Pedro Watershed caused by ongoing pumping.

6. The Addendum must discuss the differences between actual current conditions and future expected conditions in the region including an evaluation of the effect of future changes in conditions on the reliability of the cone of depression and subflow depletion tests. The Addendum must also evaluate the difficulty of adjusting the Model to address any changes.

7. The rationale for and effects of using separated baseflow in the calibration should be adequately described so that effects on calibration can be evaluated.

8. A near universal objection regarding the Model was a failure to use a

transient model for the subflow depletion testing. The Addendum must document why a steady state model was chosen instead of a transient model and how the steady state model meets the requirements of determining the **current state** of water withdrawal as required by the Brain Order, where the depletion test must determine "whether a well is currently withdrawing subflow". Brain Order at 5.

9. The Report states "net flow across the subflow zone boundary" was calculated as part of the subflow depletion test, Report at 9-4. This appears to estimate the effect of well pumping on both water leaving the subflow zone ("subflow depletion") and tributary groundwater entering the subflow zone ("capture depletion"). The Gila Adjudication held that tributary groundwater is not subflow,[5] Therefore, a well does not pump subflow by causing capture depletion. The Addendum must explain if capture depletion is included as part of the methodology, and if so, why such inclusion does not violate *Gila IV*.

10. The Model representation of the subflow zone does not appear to include some perennial reaches that flow over basin fill and bedrock material that have been delineated as subflow zone.[6] However, on Figure 9-2b, the hypothetical pumping well located South of St. David appears to intersect the subflow zone in these perennial river reaches that are not included in the modeled area. The Addendum must provide a justification as to why some reaches within the subflow zone were not included and how that may affect Model accuracy.

11. The historical transient modeling uses only a single time step per stress

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[5] *In re the General Adjudication of All Rights to Use Water in the Gila River System and Source*, 198 Ariz. 330, 336, 9 P.3d 1069 (2000) ("Gila IV").

[6] Subflow zone delineation in red on Figures 9-2a and 9-2b.

period, which forces a linear solution in one jump instead of the typical exponential response during actual groundwater pumping. The Addendum must document justification of why only a single time step was determined appropriate, whether using additional time steps was evaluated, and if so, how the Model results differed.

12. Water levels in layer 1 (the subflow zone) may be resistant to change due to geology and proximity to the surface waters. The Addendum must provide an analysis and explanation of how the Model addresses such potential resistance and accurately assesses drawdown and depletion in layer 1.

13. The Addendum must clarify why there are areas in the Report where the simulated water table appears to be above ground surface, and why these areas are "not expected to compromise the model application for predictive simulations."[7] The Addendum must provide evidence that high simulated water levels, anywhere in the study area, are not causing artificially high water levels in the subflow zone.

14. A number of assumptions were made regarding evapotranspiration and deep percolation of effluent discharge, Report at 5-11, and deep percolation related to stormwater management, *Id.* at 5-12, without any explanation for the values. The Addendum must include additional information and details on why the assumed values were chosen.

B. DATA GAPS AND INADEQUATELY DOCUMENTED ASSUMPTIONS

1. In order to trust the validity of the Model, the validity of the data must be evaluated. The Addendum must provide citations, or other explanations for:

   - The "retirement" of pumping within the San Pedro Riparian National

[7] *See* Report at 6-5; Report at figs. 6-16 to 6-20 (pink areas near St. David).

Conservation Area. Report at 2-3.

- The change of groundwater flow direction due to pumping in Sierra Vista and Huachuca. *Id.* at 2-4.
- The historical volumes of groundwater used in the basin. *Id.*
- The timing for agricultural surface water diversions. *Id.*
- Citations for the BLM monitoring well data. *Id.* at 1-6.
- Measured spring flow values from Murray Spring, Moson Spring, Horsethief Spring, and Lewis Springs. *Id.* at 3-8

2. The Addendum must provide GIS data and well logs for wells referenced in Section 3.2.
3. Grid size has a direct influence on the precision of simulated water levels which is very important when a jurisdictional determination can be a matter of 0.1 feet. The Addendum must provide a justification for the model grid size, including grid cell thickness, as well as an analysis of whether the grid sizing, including thickness, is appropriate. GIS data for the model grid should be made available for proper evaluation of model discretization.
4. Climate and precipitation data referenced in the Report is over 50 years old in some instances and does not appear to account for altered weather patterns in Arizona as a result of global climatological changes. *Id.* at 2-1. The Addendum must explain how this data approximates current conditions and how continued climatological change in the future is addressed by the Model.
5. Data used to estimate leakage rates for the cells representing the Pomerene Canal and the St. David Canal are from 1991. *Id.* at 5-9. The Addendum must provide additional information and evidence that changes in structural and ecological conditions of the canals over 30 years have not affected the reliability of the data.
6. Data used in the Report to estimate deep percolation of agricultural return

flow values for the Sonoran Watershed are from 2007 data. *Id.* However, the same type of data for the Benson and Sierra Vista Watersheds are from 1991. *Id.* The Addendum must justify the differing data sets and provide additional information and evidence that climatological conditions continue to support data over 30 years old for the Benson and Sierra Vista Watersheds.

7. The subsurface outflow from the model is only 1,200 AF/yr. *Id.* at 3-9. This seems rather low for the amount of recharge claimed in the Report. *Id.* at 3-7. The Addendum must discuss this potential disconnect in more detail and explain how it was addressed in the Model.

8. The Model uses hydraulic conductivities from 67 pumping tests conducted by ADWR *Id.* at 5-6. Neither the Report nor Appendix B-1 include any data about the pumping tests. The Addendum must include detailed information about the pumping tests and the calculation of the hydraulic conductivities included in Appendix B-1. Additionally, the Model Report does not contain sufficient information to explain the unexpected spatial distribution of hydraulic conductivity. The Addendum must explain in detail how the hydraulic conductivity values were applied throughout the study area and justify why some areas appear to have potentially flawed values.

9. The Report states that "storage coefficient (also known as storativity), instead of specific storage, was used to define the storage properties of the model cells." Report at 5-5. Storativity and specific storage values are not equivalent and describe different aquifer storage properties. The Addendum must explain why the storage coefficient instead of specific storage was used and evaluate how the differences in the storage properties evaluated will affect Model outcomes.

10. Hydraulic conductivity generally decreases as grain size decreases.

However, there are multiple instances in the Report where that does not appear to be the case: Figures 5-15 and 5-23 it appears the hydraulic conductivity in layers 2 and 4, respectively, is highest in the center of the basin where the grain size is smallest. And in Figure 5-19, the hydraulic conductivity in layer 3 appears similar inside the area delineated "Fine Grain Extent" to the area outside the delineation. The Addendum must explain this discrepancy or provide a justification of why ADWR believes it is not an issue.

11. The Addendum must explain the evapotranspiration values used in the Model, why the modeled values are significantly lower than published estimates,[8] and how evapotranspiration differences between wet and dry years was addressed in the Model.

C. INADEQUATELY DOCUMENTED CALIBRATION

1. The Addendum must explain in detail the process of defining the initial and final aquifer property values for conductivity, evapotranspiration, and recharge, based on the conceptual model, and precisely how those values were adjusted during the calibration process. The Addendum must include the conditions under which an adjustment was made to a parameter, any measured data that was used, a description or table detailing the initial and final calibrated parameters, and maps where appropriate.

2. It appears a PEST calibration package was used; therefore, inclusion of PEST calibration input and output files should be included as part of the Model documentation.

3. An unfortunately small percentage of water levels predicted by the Model matched the observed values. Over prediction was as likely as

[8] *See* Report at 3-7.

underprediction, and in some cases the predicted trends were completely inverse from the observed valued. The cause and impact of these discrepancies, as well as ADWR's rationale to accept these values and not to recalibrate the Model must be explained and documented in the Addendum.

4. A sensitivity analysis was mentioned, however the Report provided little details. Further, no uncertainty analysis was ever mentioned. Sensitivity analysis examines how the model results change when one or more inputs or settings are varied. Uncertainty analysis quantifies and communicates the degree of confidence or error in the data, assumptions, parameters, and outputs of a model. Both analyses are essential for assessing the robustness, relevance, and credibility of the Model. The Addendum must include detailed sensitivity and uncertainty analyses that meet generally accepted standards for evaluating a groundwater model, such as ASTM International, USGS, or other equivalent scientifically accepted standard.

5. The water budget simulation was mentioned as a "qualitative" check of the Model. Report at 6-6; however, no analysis was provided as to what the simulation suggested about the quality of the Model. The Addendum must explain how the water budget simulation provides additional support to a model's predictive behavior and what the current budget simulation presents regarding the Model.

IT IS FURTHER ORDERED that the Addendum including detailed explanations or additional data as outlined in the preceding, shall be filed by ADWR no later than **August 29, 2024.** The Addendum shall be provided to all parties on the W1-103 Court Approved Mailing List.

IT IS FURTHER ORDERED that ADWR shall make no changes to the Model

at this time. If during the preparation of the Addendum, ADWR determines the Model could be improved, the Addendum should include recommendations only for such improvements.

IT IS FURTHER ORDERED scheduling a status conference on **Tuesday, October 29, 2024, at 10:00 am.** Parties attending the conference should be prepared to discuss the following:

- The adequacy of the additional explanations of the Model in the ADWR addendum.
- Any recommendations for improvement of the Model by ADWR, including an estimated time frame for completion.
- Any additional recommendations for improvement of the Model by the reviewing parties.

Signed this 17th day of June 2024.

Sherri L. Zendri
Special Water Master

The original of the foregoing was delivered to the Clerk of the Maricopa County Superior Court on June 17, 2024, for filing and distributing a copy to all persons listed on the Court approved mailing list for this contested case.

Emily Natale

Court Connect Hearing Notice for In re San Pedro Subflow Technical Report

This hearing will be conducted through the new Court Connect program offered by the Superior Court of Arizona in Maricopa County. This new and innovative program allows Court participants to appear online, rather than in a physical courtroom. Hearings are preferably conducted by videoconference but can also be conducted by phone. Lawyers (and self-representing litigants) are responsible for distributing this notice to anyone who will be appearing on their behalf.

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Case Name: In re San Pedro Subflow Technical Report, Contested Case No. W1-103
Start Date/Time: October 29, 2024 at 10:00 a.m.

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