May 7, 2010

Mr. Douglas Dunham
AAWS & Recharge Permitting Manager
Arizona Department of Water Resources
Water Management Division
3550 N. Central Avenue
Phoenix, Arizona 85012

Re: Comments on Draft Substantive Policy Statement – Hydrologic Studies Demonstrating Physical Availability of Groundwater for Assured and Adequate Water Supply Applications

Dear Mr. Dunham:

The Metropolitan Domestic Water Improvement District (District) has comments on the above-mentioned Arizona Department of Water Resources' (Department) draft substantive policy. The District does not support revised modeling section of the draft policy because the revisions would place an unreasonable technical and financial burden on entities seeking physical availability determinations from the Department. The Department has not adequately and reasonably justified the technical use of numeric models given the general criteria presented in the draft policy versus the cost and benefit compared to other modeling options. The draft policy would direct most applicants to use more data intensive and burdensome numeric models rather than more efficient analytical or analytic element models. The District recommends strongly that the Department either maintain the current policy on modeling or revise the modeling section to incorporate efficiency (see specific comments).

Secondly, the District also does not support the Department's mandate in Section III (F)(1) that water level projections be modeled for a one foot decline over 100 years as scientifically sound and reasonable. The policy does not state the legal basis for requiring the applicant to calculate and plot a one foot decline. Lastly, the benefit of such a calculation has not been demonstrated by the Department to justify the expense.

Specific Comments

Page 6, Section 1, last paragraph, last sentence, delete "advanced", "extra", and "advanced" since the section provides no guidance of what these are or mean.

Page 8, Section D, the addition of "or" to "and/or adequate water supply" is appreciated to make the policy conform to rule.

Page 8, Section A(1), 1st paragraph, 2nd sentence, "In certain cases" has been added, but no examples are provided by the Department for when the existing decline rate is acceptable or not acceptable.

Page 9, Section D(1), 2nd paragraph, 2nd sentence, guidance needs to be included in the policy by the Department of what is a relatively small number of exempt wells for a project. Whether the number equates to the number of exempt wells or the estimated volume from exempt wells being greater than a percent of the total demand (1%, 5%, 10%, etc...). The guidance would help applicants make project planning easier and quicker.

Page 9, Section D(1), 3rd paragraph, 2nd sentence, recommend deleting this sentence because of the recent Department reorganization and note instead the information is available online at Department website.

Page 9, Section D(2), adjust the wording in first sentence and footnote 6 to be consistent.

Page 10, Section D(3)(a), revise terms "current demand", "committed demand", and "projected demand" to be consistent with heading terms of "existing uses", "issued demands", and "application demand."

Page 11, Section F, introduction, insert "prior to the pre-application meeting" at the end of the 3rd sentence.

Pages 11 through 14, Section F (3), (4), (5), (7), (8), (9), (10), (12), and (13) replace "characterization and evaluation" with "hydrologic report" for consistency with Sections F(6), (14), (15), (16), and relabeled Sections F and G on page 16 as Sections G and H.

Page 12, Section F(5), state why and what purpose geophysical data must be presented since the Department requires well(s) and a 48-hour aquifer test must be conducted to predict the 100 year drawdown depth to prove physical availability. The relevance of geophysical data should be stated, so the applicant can address the Department's concern in this section of the hydrologic report.

Page 12, Section F(8), 5th sentence, insert "registered professional" before "requirements."

Page 13, Section F(11), 1st sentence, delete "site-specific" before "aquifer" and insert after data "within the project area." Also, provide guidance in this section of how to determine the number of aquifer tests to assist the applicant in scoping the project. Excellent guidance was provided at the end of the paragraph under what conditions an aquifer test could be terminated for less than 48 hours and how long to measure recovery.

Page 13, Section 11, 2nd paragraph, 1st sentence, the Department needs to clarify in the guidance how the applicant can determine under what conditions a 48-hour test is not adequate, otherwise the applicant will not be able to effectively scope the project prior the pre-application meeting.

Page 14, Section 11, 1st paragraph, 1st sentence, the statement implies an applicant with existing wells must complete an aquifer test at each well eventhough the project demand might be distributed among the wells over the project life. For small developments this would be burdensome, expensive and inefficient use of resources. The policy should clarify multiple aquifer tests would not be required if existing wells have similar construction and produce from the same aquifer.

Page 14, Section 11, 2nd paragraph, 3rd sentence, guidance should be given in the policy of under what conditions the applicant should avoid the use of a simple Thesis or Cooper-Jacob analysis.

Page 16, 1st sentence, delete "meet all applicable physical availability criteria"

Page 16, Section IV, insert "and/" before "or" for consistency with other sections.

Page 17, Section A(1), a prediction of the location for a one foot decline after 100 years is beyond a model's accuracy and given the model is using water levels with a contour interval of 20 feet. The Department has not addressed the legal basis of why a one foot decline prediction is necessary. Well impact analysis has a legal basis of 10 feet over 5 years, the District is not aware of a legal basis for a more stringent criteria for AWS applications.

Section IV.A. (General Background on AAWS Groundwater Models): "First, the groundwater model used in the study must be appropriate to replicate [emphasis added] and analyze they hydrogeology within the project study area."

Comment: By their very nature as models of a natural system, groundwater models cannot "replicate" that system. At best, they can only approximate the functioning of that system and human-caused perturbations of that system. This is an important distinction, and the goal of pre-application negotiations between the Department and the applicant should be to acknowledge that an exact replication is not possible and to determine how close of an approximation is sufficient to make the required demonstrations.

Section IV.B.1. (Model Selection Considerations): "There are two types of groundwater flow models that are accepted by the Department – analytical and numerical."

Comment 1: Please clarify the Department's legal authority to restrict the type of models that an applicant may use to make the required demonstrations.

Comment 2: Locking in acceptable methods in a substantive policy would prevent both the

Department and the applicant from using new methods as modeling technology improves over time.

Comment 3: In restricting the allowed types of models to the two mentioned, the Department has prohibited analytic element models (AEM). AEMs offer a method that is in-between analytical solutions and numerical models in complexity, time required, and total cost. Not every project and modeling situation fits the either-or, bifurcated milieu as presented in the draft policy statement.

Acknowledging that analytical solutions cannot account for the complexities often present in hydrologic systems, in this current era of tight budgets and fiscal restraint, the Department should not attempt to steer applicants to the most costly and time consuming (for both the Department and the applicant) method for estimating resultant groundwater levels after 100 years of a project's life. AEMs offer a method that is more robust than analytical solutions because AEMs employ superposition of the various hydrologic features present within a model domain (up to hundreds if necessary) and is much quicker to construct and cheaper to run than elaborate numeric models.

Because few commercially available AEMs today employ transient flow modeling, the question has been raised whether transient or steady state models are more appropriate for groundwater drawdown predictions. The District asserts that no one type of model exists that is appropriate for all modeling situations. If most pumping stresses are initiated at the beginning of the model period, then transient and steady state models should be sufficiently similar to meet the required demonstrations. While current research is aimed toward the development of transient AEMs[1,2], if groundwater withdrawals are expected to vary significantly through the estimation period, then currently a numeric model may result in a more accurate prediction. On the other hand, steady state models are often more conservative: "Steady-state assumptions, which ignore ground-water release from storage, can be expected to result in an estimate of the higher range of system response to a hydrologic stress."[3] Thus, 100-year drawdown predictions will likely not be underestimated by a steady-state model. The Department should evaluate each project case-by-case to determine whether a transient or steady state model is sufficient to make the required demonstration. Haitjema[4] reportedly provided guidance on what aquifer settings are appropriate for steady state or transient modeling.

AEM is not a new method of modeling groundwater flow that has yet to be accepted by regulatory agencies. "EPA continues to support the analytic element method as a quick and relatively easy way to perform basic ground water flow modeling for environmental regulation (S.R. Kraemer, written

---

1 Neuman, Shlomo P. "Forward and Inverse Transient Analytic Element Models of Groundwater Flow." USGS research project 2004AZ68G, end date 08/31/2007.

2 Strack, O.D.L. 2006. The Development of New Analytic Elements for Transient Flow and Multiaquifer Flow. In Ground Water, Vol. 44, No. 1, PP. 91-98. January-February 2006.

3 Juckem, Paul F. and Hunt, Randall J. 2007. Simulation of the Shallow Ground-Water-Flow System near Grindstone Creek and the Community of New Post, Sawyer County, Wisconsin. USGS Scientific Investigations Report 2007–5014.

4 Haitjema, H.M., 1995, Analytic Element Modeling of Groundwater Flow, Academic Press, San Diego, CA, 394 p.

communication, 2005)."[5] In summary, the Department should evaluate each project on a case-by-case basis. As stated in the August 31, 2007 substantive policy statement ("Hydrologic Studies Demonstrating Physical Availability of Groundwater for Assured and Adequate Water Supply Applications"), "The applicant must use the most appropriate modeling approach for the study area." The District asserts that the modeling approaches that are considered must include analytic element modeling in addition to analytical solutions and numeric models.

Section IV.B.1. (Model Selection Considerations), first bullet: "... a large model area generally requires a numerical model."

Comment: This statement is not always true. For example, the metropolitan area of the "Twin Cities" of Minnesota, and area of approximately 7,800 square kilometers, was modeled with AEM[6]. Additionally, Hunt (2006) reported on six projects where AEM was applied to large, multiaquifer problems with areas ranging from 4,200 up to 450,000 square kilometers.

Section IV.B.1. (Model Selection Considerations), fifth bullet: "...a large project demand generally requires a numerical model."

Comment: This assertion is not supported. Large or small, project demand is only one variable among many that leads to a prediction of groundwater levels 100 years into the future. The complexity of the aquifer system and the stresses thereon should have a stronger influence on the type of model chosen than simply the amount of extraction.

Section IV.B.1. (Model Selection Considerations), sixth bullet: "...a larger number and volume of issued AAWS determinations and GIU permits generally requires a numerical model"
And Section IV.B.1. (Model Selection Considerations), seventh bullet: "...a significantly large volume and distribution of non-AAWS uses generally require a numerical model"

Comment: These assertions are not supported. As stated above, numerical models are not the only types of models that can simulate a large number of hydrologic features. Assuming the "large volume" mentioned in the draft refers to the number of extraction wells, then AEM can simulate "several hundreds[7]" of hydrologic features, or elements.

Section IV.B.2. (Conditions When a Numerical Model Must be Used)

---

5 Hunt, Randall J. 2006. Ground Water Modeling Applications Using the Analytic Element Method. In Ground Water, Vol. 44, No. 1, PP. 5-14. January-February 2006.
6 Minnesota Pollution Control Agency. 2005. "Metropolitan Area Groundwater Model – Overview." Web site: http://www.pca.state.mn.us/water/groundwater/mm-overview.html
7 Groundwater Flow Modeling Laboratory. 2010. http://www.indiana.edu/~grwater/aem.html

Comment: This section should be revised to account for the possibility that AEM could be the preferred simulation method for a particular project.

Section IV.B.3. (Conditions When an Analytical Model May be Used Without Prior Approval)

Comment: The conditions contained in this section appear to be arbitrary and overly restrictive. The Department and the applicant should agree upon the appropriate method on a case-by-case and site-by-site basis. However, such restrictive conditions could be useful if the Department were to offer general, or "expedited," permits.

Section IV.B.3.b (Available Saturated Thickness of Source Aquifer): "In areas where existing well depths do not exceed the maximum 100-year depth-to-water level ... the available saturated thickness is calculated by subtracting the current depth-to-water from ... the maximum depth of wells located in the area of the proposed withdrawals..."

Comment: The purpose of the saturated thickness is unclear. If saturated thickness is being used only for a model's input parameters, then it should be made clear. If, however, the Department is proposing to raise the administrative aquifer floor based upon the happenstance of existing wells, then the Department should provide its legal authority to do so.

Section IV.C.1. (Limitations/Advantages of Numerical Models): "...a numerical model will be required for most AAWS applications..." [Emphasis added]

Comment: Given that numerical models are more costly to implement, both in time and money, does the Department intend to continue its current practice of duplicating the applicant's modeling efforts?

Section IV.F.3. (Irrigation District Pumping for Non-AAWS Use): "When demonstrating physical availability for an AAWS application, the applicant must take into account the groundwater withdrawals from an irrigation district's wells based on the average historic groundwater withdrawals from those wells."

Comment: The time frame for this requirement needs clarification. Is the average withdrawal an annual average? Is it based upon the entire life of the well? Are years when the well was inactive averaged in as zeroes? Or does the Department consider only a subset of withdrawals over the wells lifespan, such as the last five years?

Edits

Page 5, Section II, introduction, 1st sentence, replace Part II (C) as Part III (D) as appropriate reference?

Page 5, Section II, introduction, 2nd sentence, replace "subdivision" with "projects" for consistency with footnote 3.

Page 5, Section II (B)(1), 1st sentence, delete "sufficient" because it is redundant since it is addressed in the next sentence, and the word is not used in the current policy. For 2nd sentence, retain wording from current policy for better clarity. ... available at a greater than 1200 feet below land surface depth, together with any groundwater....1200 feet below.... (below is misspelled as blow).

Page 6, Section 1, 2nd paragraph, replace "variance" with "exemption" or "exception" for consistency with terminology used in 1st paragraph and introduction in Section III (B).

Page 6, Section III, insert reference to Section IV (1) and IV (F).

Page 7, Section C, use wording from current policy, replace "physically available" with "sufficient" and add "for 100 years" after "demand."

Page 8, Section C, 1st paragraph, 1 sentence, reference to Section III (E)(1) is mislabeled?

Page 9, Section 1, check reference Section III (E)(15) for possible amendment.

Page 10, Section E, insert "and/" before "or" in 1st sentence to be consistent with ADWR's insertion in Section D. Also, add "surface water" to list of supply.

Page 13, Section 9, end of 1st sentence, a definition is needed of what constitutes "achievable."

Page 14, 1st paragraph, 2nd sentence, insert "not" before "similar" and "then" before "the applicant."

Page 14, Section 13, is reference to Section IV(D)(5) correct? In the next sentence is "agricultural urbanization" mean the conversion of agriculture to urbanization? If so, more clearly state it.

Page 14, Section 14, delete "advanced" in the 9th sentence since the meaning is not defined.

The District appreciates this opportunity to comment on the draft policy. Please call us if you have questions on these comments at (520) 575-8100.

Sincerely,

Michael W. Block
District Hydrologist

Gary C. Burchard, R.G.
Hydrogeologist