SSPA/SNL Joint Statement
5/29/02

Summary

Representatives of S.S. Papadopulos & Associates (SSPA) and Sandia National Lab (SNL) met on May 9, 2002 to discuss their respective models and analysis of hydrology in the Albuquerque Basin; and, the respective role of the models in the regional planning process. This meeting, also attended by representatives of the New Mexico Interstate Stream Commission (ISC), the Middle Rio Grande Council of Governments (MRGCOG) and the Water Assembly (WA), was conducted at the request of the WA and MRGCOG. SSPA's involvement stems from a task authorizing support to regional planners under the Army Corps of Engineers (ACOE) Middle Rio Grande Water Supply Study (MRGWSS, Phase 3).

Whereas further review is needed by the SSPA/ISC team to understand the rationale for some differences in approach and data sets utilized by the SNL team, it appeared that the models are conceptually similar in a number of ways. Some suggested actions for improving representations of specific elements in the SNL model were identified. Also planned is a quantitative analysis to compare selected model results and further discussion to better understand some of the identified differences. It is recognized by both groups that these models are intended to fulfill different functions in the planning process, and given that, some differences are expected and appropriate.

Background and Model Overview

SSPA Model

As part of the MRGWSS Phase 2 (S.S. Papadopulos & Associates, 2000) SSPA prepared a modeling tool for the purpose of characterizing the regional water supply and it's variability under both present and hypothetical future conditions of development. Additionally, the model was used to identify the likelihood of meeting Rio Grande Compact obligations under present and future scenarios. The analysis conducted by SSPA extended from Cochiti to Elephant Butte Dam and provides a regional framework for water planning.

The SSPA model is being updated and refined as part of Phase 3 of the MRGWSS. Current work includes evaluation of the historic period of record for characterizing variability, augmentation of dependency relationships, and update with new data and findings (i.e., incorporation of recent work of USGS, USBR, etc.). As part of Phase 3, SSPA is authorized to utilize this model, supporting analyses, or other tools, as appropriate, to assist the MRG and Socorro-Sierra Planning regions in evaluation of alternatives specific to their regions; and, to evaluate the combined interaction of selected alternatives from both regions.

The SSPA model domain includes the surface water system and groundwater of the Albuquerque and Socorro basins. Surface water budgets are computed using mass balance principles, with a probabilistic overlay representing variability in supply and depletion. In the Albuquerque Basin, changes in groundwater storage and stream impacts are calculated using the OSE version of the USGS finite difference numerical model. The groundwater flow model is run to establish steady-state exchanges between the groundwater and surface water system; then, changes to the steady-state condition are calculated with additional model runs for each simulated alternative. Changes in the groundwater-surface water exchanges are superimposed on the steady-state condition in the surface water budget to simulate various alternatives. In the Phase 2 study, the results were presented as probability distribution functions for the supply, demand, and credit-debit condition at selected future points in time. (Alternatively, the results can be displayed as projected time trends, but this format was not selected in the Phase 2 study). The SSPA model, in its present form, is not operated through a graphical user interface, and it is not intended for use in visual "gaming" analyses. To simulate alternatives, the model input files are changed in accordance with anticipated process changes. Likewise, dependent relationships would be examined and re-set as necessary to simulate proposed system changes.

SNL Model

In recent years, SNL has assembled a team to integrate SNL strengths in water-related areas of specialty for the purpose of addressing water safety, security and sustainability. As part of this water initiative, SNL has developed a water supply model and applied it to the Albuquerque Basin (Tidwell et al, 2002). SNL is working with the Water Assembly to use this water supply model for screening analyses of alternatives in the MRG planning region. The ISC has asked that this model be compared to the SSPA model to ensure that technical consistency, where appropriate, is maintained throughout various elements of the regional planning evaluations.

The SNL model simulates the surface water budget and a groundwater storage account in the region from Cochiti Dam to San Acacia. Inflows in the surface water budget draw from statistical distributions based on the historical record; the riparian and agricultural consumptive use (outflow) is computed with the Penman-Monteith method using meteorological data representative of the historic period. Groundwater impacts to the surface water budget are calculated from a simple analytic function (the Glover-Balmer equation). A separate aquifer storage account is maintained, also using a water budget accounting method. The model is accessed through a visual interface that allows user-selected assumptions. Model results are immediately displayed, providing rapid feedback to users. SNL indicated that key goals of this model were rapid preliminary screening of alternatives, and presentation of concepts and results to planners. SNL notes that the simulation software would readily accept economic variables, and that the model could be extended to make economic comparisons of alternatives.

SSPA Recommendations/Comments for Continued SNL Model Development

1. SNL recreates datafiles similar to those represented in the USBR ET Toolbox to compute consumptive use.
    a. Would it be possible to avoid re-creating this record, and base calculations directly on ET Toolbox datafiles?
    b. What degree of error is introduced by the use of annual average meterological parameters in the calculation, rather than daily values?

2. The use of a single unit response function for stream depletion (Glover Balmer) is acceptable for screening purposes, but may have a narrow range of acceptance for large changes to GW pumping regime (location, magnitude or depth). The limitations of this method must be clearly stated to users.

3. Several parameters (pumping rate, distance of well from stream and time pumping was initiated) used in the Glover-Balmer equation were set at values such that a reasonable match to historic groundwater depletions reported by USGS was obtained. A "re-calibration" is recommended, whereby these parameters are preset at known values and the parameter T/S is adjusted in calibration.

4. For consistency, suggest using same data sets, periods of record, and distributions as employed by SSPA --- SSPA can provide these.

5. The linkage of the surface water and groundwater domains in the SNL model was not clear; further review of this function is needed. ISC will meet with SNL to further evaluate.

6. SSPA is incorporating updated estimates of mountain front recharge and ET consumption in the Phase 3 model. Examination of relationship of crop consumption to supply is ongoing. SSPA and SNL will stay in contact on these topics.

7. The SNL and SSPA model results can be compared through comparison of surface water outflow at San Acacia. Such a comparison would not provide assurance of consistency under all potential simulated alternatives, but might highlight some problem areas, if present.

Conclusions

It is recognized that the models are different in several ways. Key differences and implications for their use in the regional planning process include:

- The SNL model employs a user-friendly interface and instantaneous feedback and output, facilitating rapid screening of multiple alternatives.

- The SNL model approach requires that relationships be expressed as simple functions in order to rapidly calculate inter-dependent system changes; therefore, use of a simple function for groundwater depletion is necessary and appropriate. However, this method will not work for all alternatives, and limitations must be recognized.

- The SSPA model approach, in using the numerical groundwater flow model, will provide more robust results for scenarios with significant changes to groundwater elements, i.e., well pumping, aquifer recharge, canal seepage, etc.

- Ultimately, it is the hydrologic analysis, not the models, that is important. Model results, whether from the SSPA or SNL model, should be carefully examined by hydrologists to ensure that important system changes are not missed by models, prior to making water planning decisions.