Reply to Comment on "The persistence of the water budget myth and its relationship to sustainability" by J.F. Devlin and M. Sophocleous, Hydrogeology Journal (2005), 13:549–554

J. F. Devlin · Marios Sophocleous

The authors would like to thank Prof. Loáiciga for showing interest in the Devlin and Sophocleous (2005) article and for the Comment. Clarification of a few points made in the Comment may benefit the readers.

The original subject article (Devlin and Sophocleous, 2005) was drafted to help bridge a perceived communication gap between two groups in the hydrogeological community: those concerned with *sustainable pumping* and those concerned with *sustainability*. The former group has held that sustainable pumping rates can be determined without measuring recharge. The latter group holds that recharge measurements are necessary because *sustainability* is broader than just *sustainable pumping*. In the original article, there was an attempt to show that the two groups define these problems differently and therefore, paradoxically, they are both correct. The article attempted to demonstrate the correctness of both arguments by deriving the mass balance that underlies the water budget myth (which incorrectly holds that recharge estimates are necessary for the calculation of *sustainable pumping* rates) in detail, and showing where it fails by explicitly examining its underlying assumptions. In making this analysis, the steady state case was assumed ($dV/dt=0$, where V is aquifer storage and t is time) and Bredehoeft's island aquifer was used as an example (Bredehoeft 2002). Both of these are simplifications of reality that were felt to be helpful in explaining relevant concepts. Also discussed, were the aspects of *sustainability* that justify the need for recharge data over and above simple *sustainable pumping* requirements.

The Comment presents a development of the water balance equation that deals with the transient case. The equations were applied to the *sustainable pumping* case which was defined as "groundwater extraction that strives to satisfy water-supply requirements without deleterious impacts to the environment" (Loáiciga, this issue). Here the confusion in the hydrogeological community is clearly evident, and is partially semantic. The definition of *sustainable pumping* used in the Comment is consistent with use of the term *sustainability* in the original subject article. This explains why the Comment holds that "the distinction between sustainable pumping and sustainable groundwater-resources, as a corollary, makes the water budget myth an innocuous…concept". The Comment appears not to uphold the original perception that the hydrogeological community distinguishes between the concepts of *sustainable pumping* and *sustainability*.

A second point of confusion arises from the comparison of the transient case, given in the Comment, to the steady state case presented in Devlin and Sophocleous (2005). The recognition that *sustainable pumping* rates or *sustainability* might vary in time is important. Moreover, it is acknowledged that transience in the water balance equation is generally a more realistic scenario than steady state. However, it is worth noting that the general transient problem is not at all trivial. Simplistic assumptions were necessary in the development of the transient case described in the Comment, for example, the assumption of linear reservoir release ($D=\gamma V$). More importantly, the transient case was not necessary to demonstrate the conceptual error in the water budget myth. Toward that end, transience merely serves to introduce complexity in the form of functions that cannot yet be easily defined—such as recharge as a function of time-varying precipitation and pumping—a point acknowledged in the discussion of Eq. 10 in the Comment. By introducing transience, the Comment is redefining the scope of the discussion. The authors of this Reply agree with many of the issues raised in the Comment and consider them interesting and useful points for future research. However, the Comment may be inadvertently contributing to the confusion the original article (Devlin and Sophocleous 2005) hoped to alleviate.

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J. F. Devlin (✉)
Associate Professor, Department of Geology,
University of Kansas,
Kansas, USA
e-mail: jdevlin@ku.edu

M. Sophocleous
Senior Scientist, Kansas Geological Survey,
University of Kansas,
Kansas, USA

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