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Information in Support of the Drought DFC and Drought MAG, Barton Springs Segment of the Edwards Aquifer

Brian B. Hunt, P.G., Brian A. Smith, Ph.D., P.G., and Walter F. Holland, P.G.

This document was generated to provide a summary of technical information to the Texas Water Development Board (TWDB) in support of determining the drought Managed Available Groundwater (MAG) needed to achieve the drought Desired Future Condition (DFC) as stated below. The best available information for determining the drought MAG, based on parametric assessment of numerical modeling results, suggests that a nearly one-to-one relationship exists between pumping and springflow under low-flow conditions. The District's current management plan and rules utilize this simple water budget approach that reflects this understanding.

The Barton Springs/Edwards Aquifer Conservation District (District), and subsequently Groundwater Management Area 10, adopted an extreme drought-period DFC for the Edwards (Balcones Fault Zone) Aquifer in the Northern Subdivision of GMA 10. The DFC focuses on springflow values during drought conditions as follows:

> *During extreme drought conditions, including those as severe as a recurrence of the 1950s' drought of record, springflow of Barton Springs shall be no less than 6.5 cubic feet per second (cfs), averaged on a monthly basis.*

Relevant Data for Drought of Record Conditions

The District is fortunate to have hydrologic data from the 1950s drought that is the mandated basis for management of the aquifer. Central Texas's worst drought on record was a 10-year period from 1947 through 1956. The lowest total annual rainfall for Austin's Camp Mabry was 11.42 inches in 1954. During this drought, water levels reached historic low levels and the annual mean discharge for Barton Springs was 13 cubic feet per second (cfs) in 1956, with the lowest monthly mean discharge of 11 cfs occurring in July and August of 1956 (Slade et al., 1986). The lowest measured spring discharge value was 9.6 cfs on March 26, 1956 (Brune, 2002). Pumping during the 1950s drought was estimated to be about 0.7 cfs (Brune and Duffin, 1983). Therefore, the total (monthly average) water budget during the 1950s' drought of record was 11.7 cfs, and is the basis for our water-budget approach to management (Table 1).

Conceptual Model

Behind the numerical models and interpretations of historical data is the conceptual model of the Barton Springs segment. A key tenet of the conceptual model is that there is a nearly one-to-one relationship

between pumping and springflow decreases under low-flow conditions. This conceptual model has been developed over the decades since study of the aquifer commenced (Brune and Duffin, 1983; Sharp and Banner 1997), and has been reinforced by numerous groundwater scientists and engineers as the various numerical models were developed (Slade et al., 1985; Scanlon et al., 2001; Smith and Hunt, 2004; and Hutchison and Hill, in preparation). Figures 1 and 2 illustrate how recent numerical modeling demonstrates this concept.

Table 1. *Tabulation of the water budget from the 1950s' DOR. Data are in monthly average cubic feet per second.*

Condition	Springflow (cfs)	Pumping (cfs)*	Total Water Budget (cfs)
1950s DOR	11	0.7	11.7

*total pumping (exempt and non-exempt)

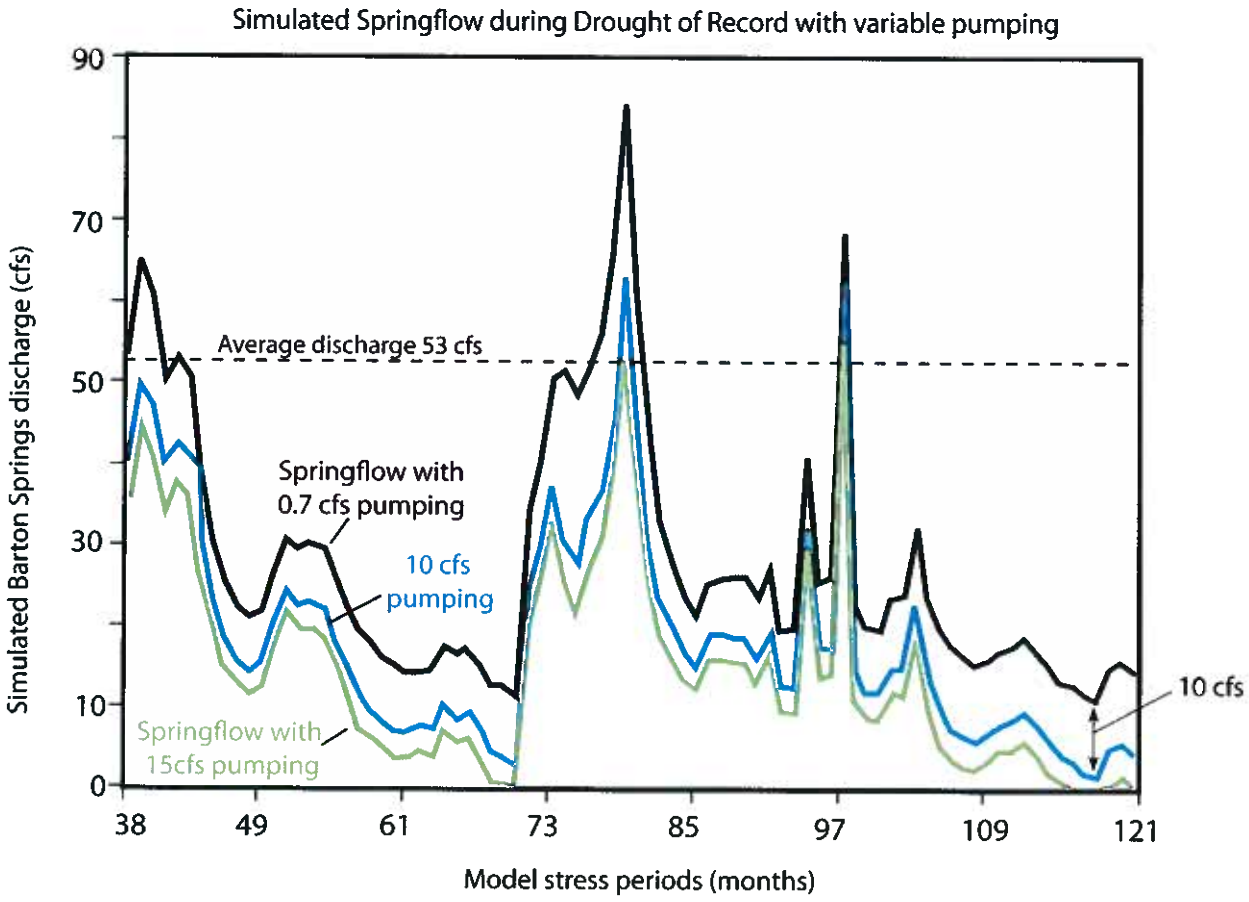


Figure 1. *Hydrograph of simulated springflow during drought of record conditions with variable pumping rates (0.7, 10, and 15 cfs). An increase of pumping from 0.7 to 10 cfs results in a decline in springflow of the same amount. Figure modified from Smith and Hunt, 2004.*

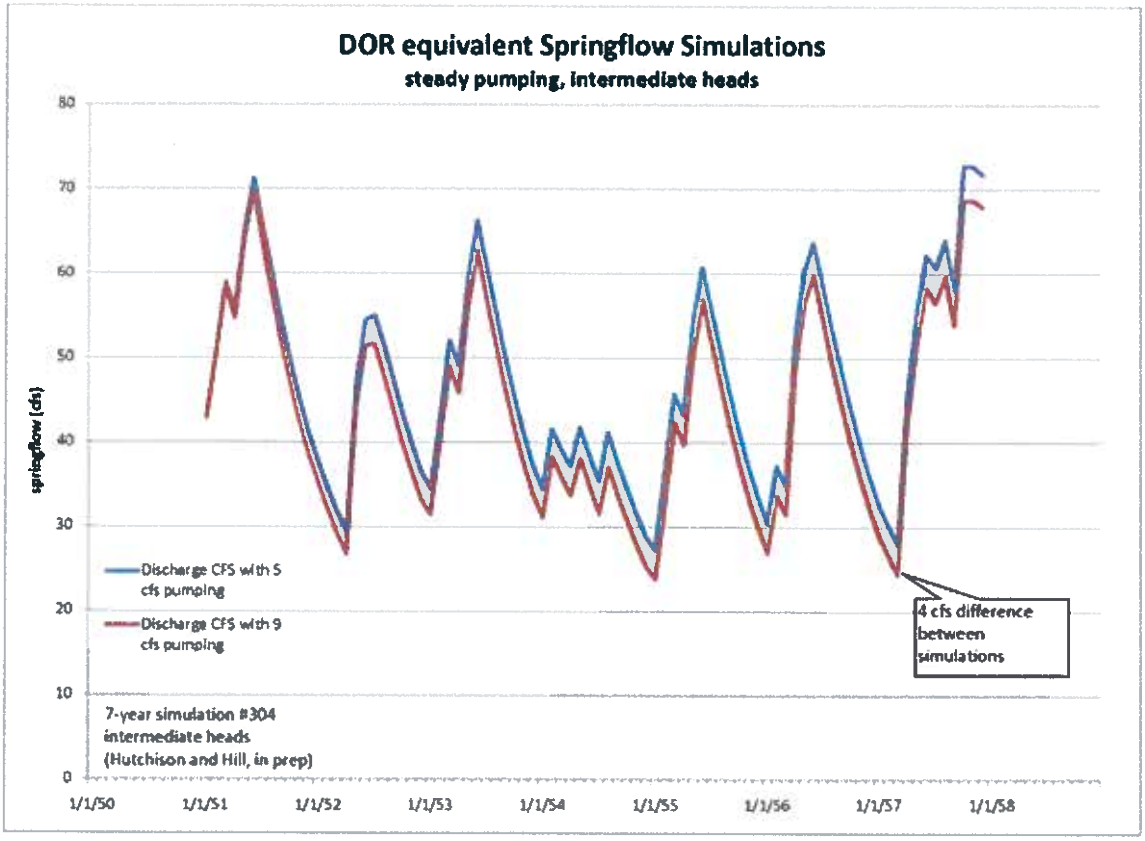


Figure 2. *Hydrograph of simulated springflow from the most recent numerical modeling (data plotted from Melissa Hill, personal communication). The two simulations differ by 4 cfs in pumping, and result in simulated springflow differences up to 4 cfs.*

Drought MAG

Table 2 is a tabulation of the MAG using the water-budget approach of 11.7 cfs described above. This approach is conservative, but until more data are available, it is the most prudent approach and is based upon a solid foundation of data. Other factors that may be important for future consideration, but are not yet quantified, are the influences of urban recharge, a dynamic southern boundary, and change in climate. In this table, the total water budget is derived by adding monthly mean springflow (11 cfs) and pumping (0.7 cfs) during the DOR. The DFC of 6.5 cfs of springflow and the estimated amount of exempt use are subtracted from the total water budget to yield a MAG (for regulated well withdrawals) of 4.7 cfs.

Table 2. *Calculation of drought MAG by decade using the water-budget approach.*

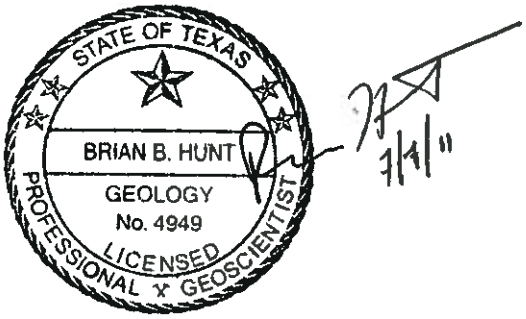
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Budget in cfs (ac-ft/yr)*	11.7 (8,470)	11.7 (8,470)	11.7 (8,470)	11.7 (8,470)	11.7 (8,470)	11.7 (8,470)
DFC in cfs (ac-ft/yr)	6.5 4,705)	6.5 (4,705)	6.5 (4,705)	6.5 (4,705)	6.5 (4,705)	6.5 (4,705)
Exempt Pumping in cfs (ac-ft/yr)	0.5 (361)	0.5 (361)	0.5 (361)	0.5 (361)	0.5 (361)	0.5 (361)
MAG or Non-Exempt Pumping in cfs (ac-ft/yr)	**4.7 (3,402)**	**4.7 (3,402)**	**4.7 (3,402)**	**4.7 (3,402)**	**4.7 (3,402)**	**4.7 (3,402)**

*total water budget derived from Table 1.

Implications for Groundwater Management

The Drought DFC was selected specifically to provide a balance between the amount of groundwater use during extreme drought and protection of the aquifer's uses and users, including both water-well users in the western part of this shared aquifer and the federally protected endangered species at Barton Springs. It is critically important that the District's curtailments of use by its regulated community result in an average monthly aggregated withdrawal by its permittees of no more than 4.7 cfs to achieve this DFC. Further, the District believes it needs the authority provided by a Management Plan that specifies a Drought DFC and a corresponding Drought MAG to achieve this management goal. In addition, the regional water plans must be based on a MAG and associated exempt use that would be available on a firm-yield basis during a recurrence of the DOR.

In conclusion, the approach outlined here yields a Drought MAG of 4.7 cfs or of 3,402 acre-feet per year, plus the exempt use estimate of about 360 acre-feet per year when considering all availability in the Barton Springs segment of the Edwards Aquifer.



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