Uncertainty Analysis of Estimates of Ground-Water Discharge by Evapotranspiration for the BARCAS Study Area

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Table 5. Mean and CV of precipitations in ft/year for all the subbasins with ground-water discharge areas (Welch and Bright, 2007).

Subbasin Name	Mean Precip (ft)	CV	Subbasin Name	Mean Precip (ft)	CV
Butte Valley - Subbasin 1	0.95	0.049	Snake Valley - Subbasin 3	0.56	0.088
Butte Valley - Subbasin 2	0.85	0.068	Snake Valley - Subbasin 4	0.68	0.049
Cave Valley - Subbasin 1	1.11	0.014	Spring Valley - Subbasin 1	0.81	0.018
Cave Valley - Subbasin 2	1.08	0.093	Spring Valley - Subbasin 2	0.69	0.051
Jakes Valley	0.96	0.100	Spring Valley - Subbasin 3	0.79	0.025
Lake Valley - Subbasin 1	0.99	0.067	Steptoe Valley - Subbasin 1	0.67	0.111
Little Smoky Valley - Subbasin 1	0.52	0.097	Steptoe Valley - Subbasin 2	0.77	0.140
Long Valley	0.94	0.022	Steptoe Valley - Subbasin 3	0.94	0.099
Newark Valley - Subbasin 1	0.91	0.138	Tippett Valley	0.80	0.021
Newark Valley - Subbasin 2	0.86	0.184	White River Valley -Subbasin 1	0.94	0.063
Newark Valley - Subbasin 3	0.78	0.021	White River Valley -Subbasin 2	0.75	0.044
Snake Valley - Subbasin 1	0.55	0.045	White River Valley -Subbasin 3	0.86	0.017
Snake Valley - Subbasin 2	0.55	0.061	White River Valley -Subbasin 4	0.77	0.062

Note: Lake Valley – Subbasin 2, Little Smoky Valley – Subbasin 2, Snake Valley – Subbasin 5, and Spring Valley – Subbasin 4 have no discharge areas and therefore have zero ground-water discharge.

Table 6. Summary statistics for subbasin ground-water discharge and total ground-water discharge.

Subbasin Name	Deterministic (acre-feet)	Mean (acre-feet)	CV
Butte Valley – Subbasin 1	11,319	12,575	0.689
Butte Valley – Subbasin 2	558	628	0.890
Cave Valley – Subbasin 1	1,534	1,541	0.173
Cave Valley – Subbasin 2	17	510	1.505
Jakes Valley	858	853	0.107
Lake Valley – Subbasin 1	6,135	9,403	0.472
Little Smoky Valley – Subbasin 1	3,955	3,917	0.139
Long Valley	1,234	1,976	0.884
Newark Valley – Subbasin 1	14,345	14,664	0.216
Newark Valley – Subbasin 2	7,699	8,891	0.516
Newark Valley – Subbasin 3	4,015	3,987	0.410
Snake Valley – Subbasin 1	17,361	18,182	0.351
Snake Valley – Subbasin 2	54,836	53,818	0.231
Snake Valley – Subbasin 3	39,038	38,074.	0.247
Snake Valley – Subbasin 4	21,049	20,768	0.199
Spring Valley – Subbasin 1	1,733	1,724	0.137
Spring Valley – Subbasin 2	46,991	46,772	0.218
Spring Valley – Subbasin 3	26,889	26,472	0.317
Steptoe Valley – Subbasin 1	56,945	56,161	0.291
Steptoe Valley – Subbasin 2	40,983	40,961	0.137
Steptoe Valley – Subbasin 3	3,569	3,569	0.104
Tippett Valley	1,742	1,772	0.481
White River Valley – Subbasin 1	2,114	2,121	0.127
White River Valley – Subbasin 2	8,677	8,595	0.379
White River Valley – Subbasin 3	9,124	9,096	0.175
White River Valley – Subbasin 4	56,786	56,000	0.268
Total Ground-water ET	439,509	443,032	0.241

Note: Lake Valley – Subbasin 2, Little Smoky Valley – Subbasin 2, Snake Valley – Subbasin 5, and Spring Valley – Subbasin 4 have no discharge areas and therefore have zero ground-water discharge.

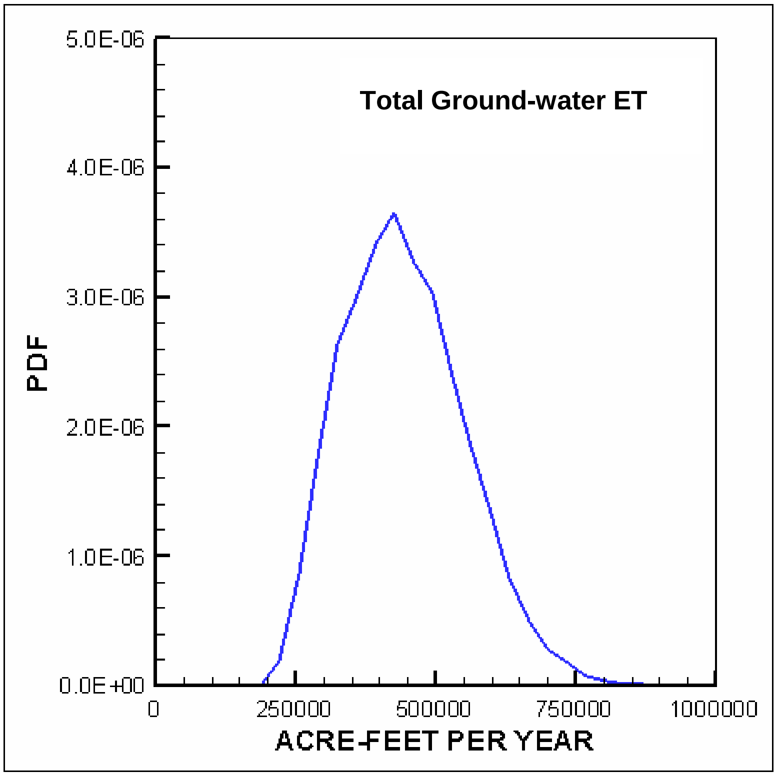

Figure 14. Probability density function generated from 10,000 realizations of simulated total annual ground-water discharge from the BARCAS study area.

SUMMARY

The coefficient of variation of total ground-water discharge, given the assumptions employed in the uncertainty analysis, had a moderate value of 0.241, although for some subbasins in the BARCAS study area, the CV of ground-water discharge estimates could be as high as 1.5. Typically, subbasins with high uncertainty of ground-water discharge estimates had mean annual ET rates for the dominant vegetation similar to mean annual precipitation rates. In these cases, the total ET for those subbasins would be supported mainly by the local precipitation. Those subbasins only contributed to a small portion of the total ground-water discharge, and therefore a high uncertainty in these valleys did not translate into high uncertainty of the total ground-water discharge estimates for the entire BARCAS study area.

It should be noted again that the ranges and uncertainties of input parameters (ET rate, acreage, and precipitation rate) used in this study were obtained from the USGS staff involved in the BARCAS study. The key assumptions used in this uncertainty analysis were: (1) the CV for the acreage of each ET unit is 10 percent, and (2) the ranges of ET rates reported in the literature and determined in this project represent ±2 standard deviations of a normally distributed variable (i.e., 95% of the measurements were assumed to be contained in this range). Since ground-water ET was calculated as the difference between total ET and local precipitation, the interplay between vegetation ET rate and local precipitation played an important role in determining the uncertainty in ground-water discharge. Specifically, because the BARCAS study area was dominated by desert shrubs, which covered over 80 percent of the total area, the relative magnitudes of the ET rates for these three desert shrub categories (dense, moderately dense, and sparse) and the local precipitation rate were the dictating factors in determining the ground-water discharge and the associated uncertainty.

The four largest valleys (Snake, White River, Spring, and Steptoe) accounted for nearly 80 percent of the total ground-water discharge area. For these four valleys, mean annual local precipitation rate was typically much lower than the mean annual ET rates for areas populated by desert shrub communities. As a result, ground-water discharge mainly followed normal distributions for these valleys. Finally, the total ground-water discharge distribution was also normally distributed, although the uncertainty (illustrated by CV) was slightly elevated due to many small yet highly uncertain valleys in the BARCAS study area.

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