GAM Run 08-60

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Texas Water Development Board
Groundwater Availability Modeling Section
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July 11, 2008

EXECUTIVE SUMMARY:

We ran the groundwater availability model for the northern segment of the Edwards (Balcones Fault Zone) Aquifer to simulate discharge to Salado Creek in Bell County and aggregated springs and streams in Williamson and Travis counties using average annual pumping rates of 7,500 acre-feet for Bell County, 10,000 acre-feet for Williamson County, and 5,600 acre-feet for Travis County. The results show that springs and streams continue to flow during every month of the simulation for Bell and Travis counties but not for Williamson County. The only difference between this request and GAM Run Report 08-59 (Anaya, 2008) is the requested pumpage for Williamson County was 15,000 acre-feet instead of 10,000 acre-feet.

REQUESTOR:

Ms. Cheryl Maxwell of the Clearwater Underground Water Conservation District acting on behalf of Groundwater Management Area 8.

DESCRIPTION OF REQUEST:

Ms. Cheryl Maxwell requested we use the groundwater availability model for the northern segment of the Edwards (Balcones Fault Zone) Aquifer to determine projected discharge from model drain cells representing Salado Creek in Bell County and drain cells representing aggregated springs and streams in Williamson and Travis counties for a simulation period beginning 2001 through 2020. Ms. Cheryl Maxwell asked that we use the same recharge model input files as used in previously requested model runs (Anaya, 2007a, and Anaya, 2007b). Ms. Cheryl Maxwell also requested that we adjust the pumpage in a manner consistent with previously requested model runs (Anaya, 2007a, and Anaya, 2007b) while using average annual pumping rates of 7,500 acre-feet for Bell County, 10,000 acre-feet for Williamson County, and 5,600 acre-feet for Travis County.

METHODS:

To address the request, we:

- used recharge distributions provided to us by staff at Turner, Collie and Braden, Incorporated which were based on the historic monthly precipitation record for the model area during the period from 1940 to 1960;

- used initial spatial pumpage distributions provided to us by staff at Turner, Collie and Braden, Incorporated and adjusted to represent average annual pumping rates of 7,500 acre-feet for Bell County, 10,000 acre-feet for Williamson County, and 5,600 acre-feet for Travis County;

- ran the model for 141 years, starting with a 100-year initial stress period (pre-1980) followed by 21 years of historical monthly stress periods (1980 to 2000), then 10 years of predictive annual stress periods (2001 to 2010), and ending with 10 years of predictive monthly stress periods (2011 to 2020) to represent a simulated repeat of the 1950s' drought of record (Please see Parameters and Assumptions Section about these stress periods);

- extracted projected discharge for drain cells representing Salado Creek in Bell County and drain cells representing aggregated springs and streams in Williamson and Travis counties, respectively, for each of the stress periods from 2001 through 2020 (Please see Parameters and Assumptions Section);

- generated a table of discharge from drain cells representing Salado Creek in Bell County and drain cells representing aggregated springs and streams in Williamson and Travis counties for stress periods 254 through 383 (2001 to 2020); and

- generated hydrographs of discharge from drain cells representing Salado Creek in Bell County, and drain cells representing aggregated springs and streams in Williamson and Travis counties for stress periods 254 through 383 (2001 to 2020).

PARAMETERS AND ASSUMPTIONS:

- TWDB staff used version 1.01 of the groundwater availability model for the northern segment of the Edwards (Balcones Fault Zone) Aquifer.

- See Jones (2003) for a more detailed discussion of assumptions and limitations of the groundwater availability model for the northern segment of the Edwards (Balcones Fault Zone) Aquifer.

- The model consists of one layer representing the northern segment of the Edwards (Balcones Fault Zone) Aquifer and assumes no hydraulic communication with the underlying Trinity Aquifer.

- The model utilizes the Drain package of MODFLOW to simulate discharge from springs and perennial streams with the assumption that the perennial streams are always gaining water from the aquifer.

- The root mean square error (a measure of the difference between simulated and actual water levels during model calibration) in the groundwater availability model is 32 feet for the 1980 steady-state calibration period (Jones, 2003).

- The initial 100-year stress period is for the model to reach equilibrium to known or observed conditions just prior to 1980. The 21 years of historical monthly stress periods from 1980 to 2000 represent the aquifer in a transient state for which the model was calibrated. The end of the 21 years of historical monthly stress periods also provides the initial conditions for starting the predictive portion of the model simulation. The next 10 years of annual stress periods represent the first phase of the predictive model simulation under normal recharge conditions and with predictive pumpage rate estimates for the period from 2001 to 2010. This 10-year period allows the modeled aquifer to reach equilibrium with predictive pumpage rates before being stressed by the simulated drought of record recharge. The final 10 years of monthly stress periods from 2011 to 2020 represent the simulated repeat of the recharge conditions during 1950s' drought of record with the predictive pumpage rate estimates.
- Initial distributed pumpage and recharge rates were developed by staff of Turner, Collie and Braden, Incorporated at the request of Ms. Cheryl Maxwell of the Clearwater Underground Water Conservation District acting on behalf of the groundwater districts in Groundwater Management Area 8. The spatial and temporal recharge distributions are based on the historic monthly precipitation record for the model area during the period from 1940 through 1960 and include the drought of record conditions of the 1950s'. The pumpage rates represent predictive estimates of pumpage for Travis and Williamson counties and drought management pumpage rates for Bell County. The spatial distribution of pumpage rates is based on the last year (2000) of the historical calibration period of the model.

RESULTS:

Discharge from the model drain cells representing Salado Creek in Bell County and aggregated natural springs and streams in Williamson and Travis counties (Figure 1) is listed in Table 1 for each annual stress period beginning with stress period number 254 to 263 (2001 to 2010) and for each monthly stress period beginning with stress period number 264 to 383 (2011 to 2020). The hydrographs (Figures 2, 3, and 4) show the response of the model drain cells to simulated model stresses of recharge and pumpage. The results show that springs and streams continue to flow during every month of the simulation for Bell and Travis counties but not for Williamson County.

REFERENCES:

Anaya, R., 2007a, GAM run 07-15: Texas Water Development Board, GAM Run 07-15 Report, 11 p.

Anaya, R., 2007b, GAM run 07-21: Texas Water Development Board, GAM Run 07-21 Report, 11 p.

Anaya, R. 2008, GAM run 08-59: Texas Water Development Board, GAM Run 08-59 Report, 11p.

Jones, I. C., 2003, Groundwater availability modeling: Northern Segment of the Edwards Aquifer: Texas Water Development Board, Report 358, 75 p.

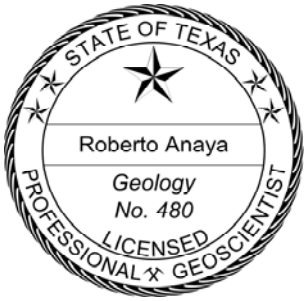

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Table 1. Discharge from model drain cells representing Salado Creek in Bell County and aggregated natural springs and streams in Williamson and Travis counties.

Time period	Stress period number	Salado Creek discharge (acre-feet per month)	Williamson County discharge (acre-feet per month)	Travis County discharge (acre-feet per month)
2001	254	1,985	3,486	216
2002	255	1,652	2,942	173
2003	256	1,857	3,428	216
2004	257	1,873	3,470	219
2005	258	1,508	2,696	158
2006	259	1,979	3,714	242
2007	260	996	1,625	112
2008	261	671	936	94
2009	262	1,383	2,372	127
2010	263	944	1454	103
JAN2011	264	338	219	97
FEB2011	265	961	1,435	96
MAR2011	266	1,189	1,905	96
APR2011	267	667	870	95
MAY2011	268	1,448	2,518	109
JUN2011	269	1,419	2,469	131
JUL2011	270	569	709	100
AUG2011	271	327	219	95
SEP2011	272	1,870	3,451	135
OCT2011	273	670	802	95
NOV2011	274	540	496	92
DEC2011	275	281	98	87
JAN2012	276	150	8	81
FEB2012	277	671	632	78
MAR2012	278	802	1,023	77
APR2012	279	2,251	4,219	202
MAY2012	280	2,374	4,486	281
JUN2012	281	1,300	1,928	107
JUL2012	282	945	1,396	104
AUG2012	283	353	227	99
SEP2012	284	776	997	95
OCT2012	285	161	22	87
NOV2012	286	1,849	3,117	100
DEC2012	287	1,822	3,127	164
JAN2013	288	741	847	95
FEB2013	289	938	1,216	96
MAR2013	290	772	997	95
APR2013	291	1,508	2,571	110
MAY2013	292	1,524	2,611	141
JUN2013	293	767	1,032	102
JUL2013	294	690	883	100
AUG2013	295	1,231	2,105	100
SEP2013	296	1,284	2,152	106
OCT2013	297	2,928	6,109	383

Time period	Stress period number	Salado Creek discharge (acre-feet per month)	Williamson County discharge (acre-feet per month)	Travis County discharge (acre-feet per month)
NOV2013	298	1,259	1,678	112
DEC2013	299	2,165	3,867	223
JAN2014	300	959	1,227	115
FEB2014	301	481	364	110
MAR2014	302	219	63	101
APR2014	303	568	511	95
MAY2014	304	745	984	91
JUN2014	305	316	170	85
JUL2014	306	344	229	80
AUG2014	307	318	194	76
SEP2014	308	411	313	72
OCT2014	309	450	424	69
NOV2014	310	490	477	67
DEC2014	311	223	43	65
JAN2015	312	626	590	65
FEB2015	313	1,636	2,685	75
MAR2015	314	744	892	75
APR2015	315	802	1,070	77
MAY2015	316	2,053	3,760	190
JUN2015	317	1,924	3,422	206
JUL2015	318	1,010	1,477	101
AUG2015	319	1,328	2,263	109
SEP2015	320	794	1,092	102
OCT2015	321	362	221	97
NOV2015	322	364	201	91
DEC2015	323	391	222	85
JAN2016	324	526	438	80
FEB2016	325	732	870	78
MAR2016	326	232	44	75
APR2016	327	129	0	71
MAY2016	328	516	388	69
JUN2016	329	380	281	67
JUL2016	330	295	161	65
AUG2016	331	409	322	63
SEP2016	332	124	2	60
OCT2016	333	210	31	58
NOV2016	334	531	461	57
DEC2016	335	708	789	59
JAN2017	336	426	301	60
FEB2017	337	789	990	63
MAR2017	338	1,381	2,158	73
APR2017	339	4,222	9,710	560
MAY2017	340	2,949	5,433	339
JUN2017	341	2,814	5,223	333
JUL2017	342	1,129	1,381	121
AUG2017	343	775	869	115
SEP2017	344	2,581	4,961	267
OCT2017	345	3,961	8,912	555

Time period	Stress period number	Salado Creek discharge (acre-feet per month)	Williamson County discharge (acre-feet per month)	Travis County discharge (acre-feet per month)
NOV2017	346	2,693	4,747	309
DEC2017	347	1,489	2,020	133
JAN2018	348	1,471	2,252	130
FEB2018	349	2,822	5,660	353
MAR2018	350	1,648	2,602	158
APR2018	351	1,532	2,542	147
MAY2018	352	1,544	2,657	155
JUN2018	353	2,222	4,323	286
JUL2018	354	1,349	2,276	139
AUG2018	355	1,140	1,916	126
SEP2018	356	3,392	7,558	476
OCT2018	357	2,448	4,471	300
NOV2018	358	1,359	1,945	133
DEC2018	359	1,037	1,470	127
JAN2019	360	501	466	118
FEB2019	361	1,239	1,996	114
MAR2019	362	363	288	106
APR2019	363	1,776	3,247	128
MAY2019	364	1,389	2,354	126
JUN2019	365	1,784	3,301	189
JUL2019	366	1,395	2,445	139
AUG2019	367	2,603	5,424	350
SEP2019	368	1,855	3,212	195
OCT2019	369	3,335	7,213	470
NOV2019	370	1,848	2,903	171
DEC2019	371	1,917	3,260	185
JAN2020	372	1,408	2,234	135
FEB2020	373	1,589	2,739	154
MAR2020	374	967	1,466	126
APR2020	375	1,546	2,795	144
MAY2020	376	769	1,128	120
JUN2020	377	1,994	3,879	212
JUL2020	378	1,181	2,018	123
AUG2020	379	1,238	2,197	122
SEP2020	380	891	1,404	115
OCT2020	381	4,600	11,202	656
NOV2020	382	2,628	4,624	289
DEC2020	383	2,965	5,774	371

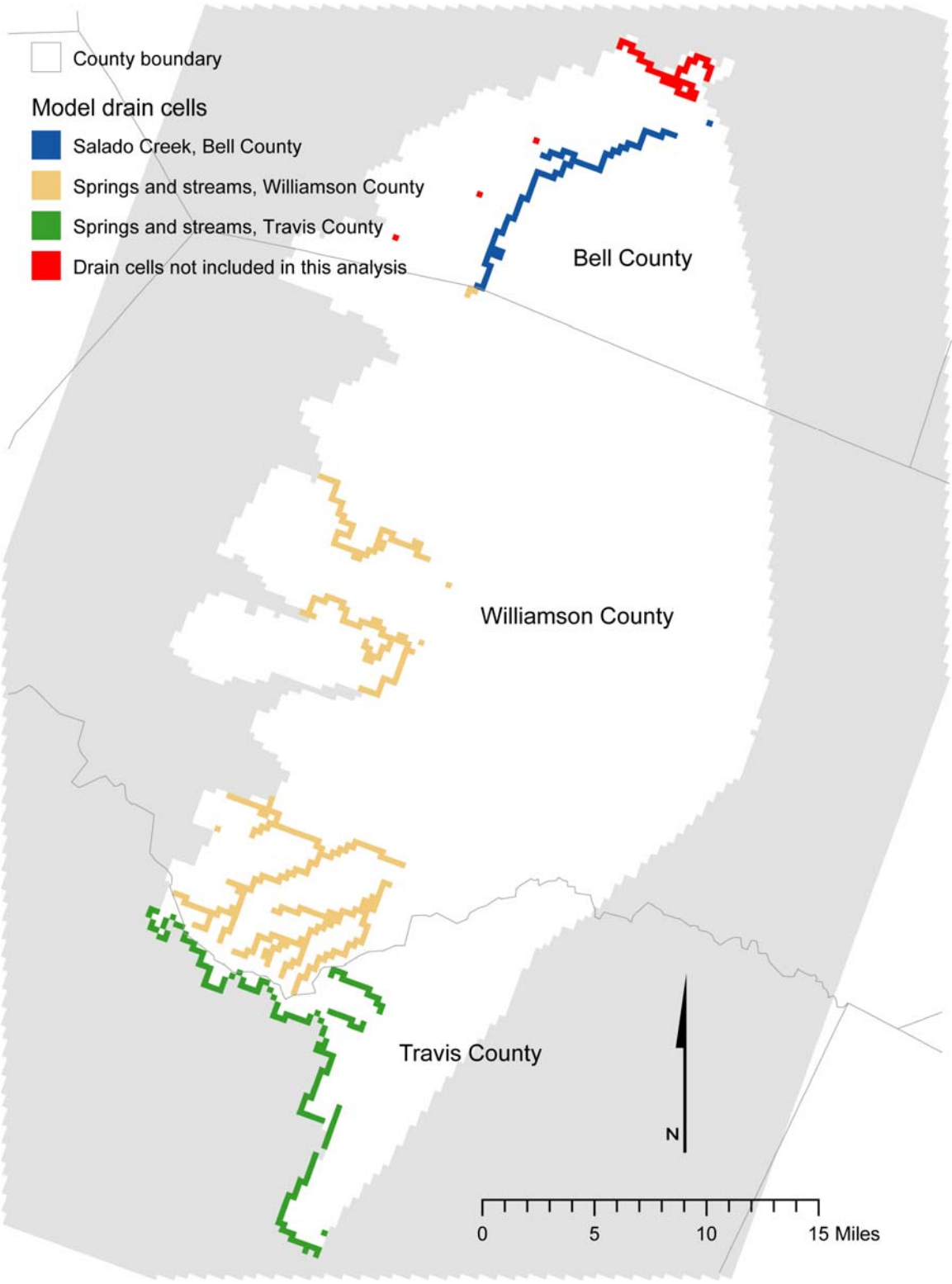

Figure 1: Model drain cells representing Salado Creek discharge in Bell County and natural spring-stream discharge in Williamson and Travis counties

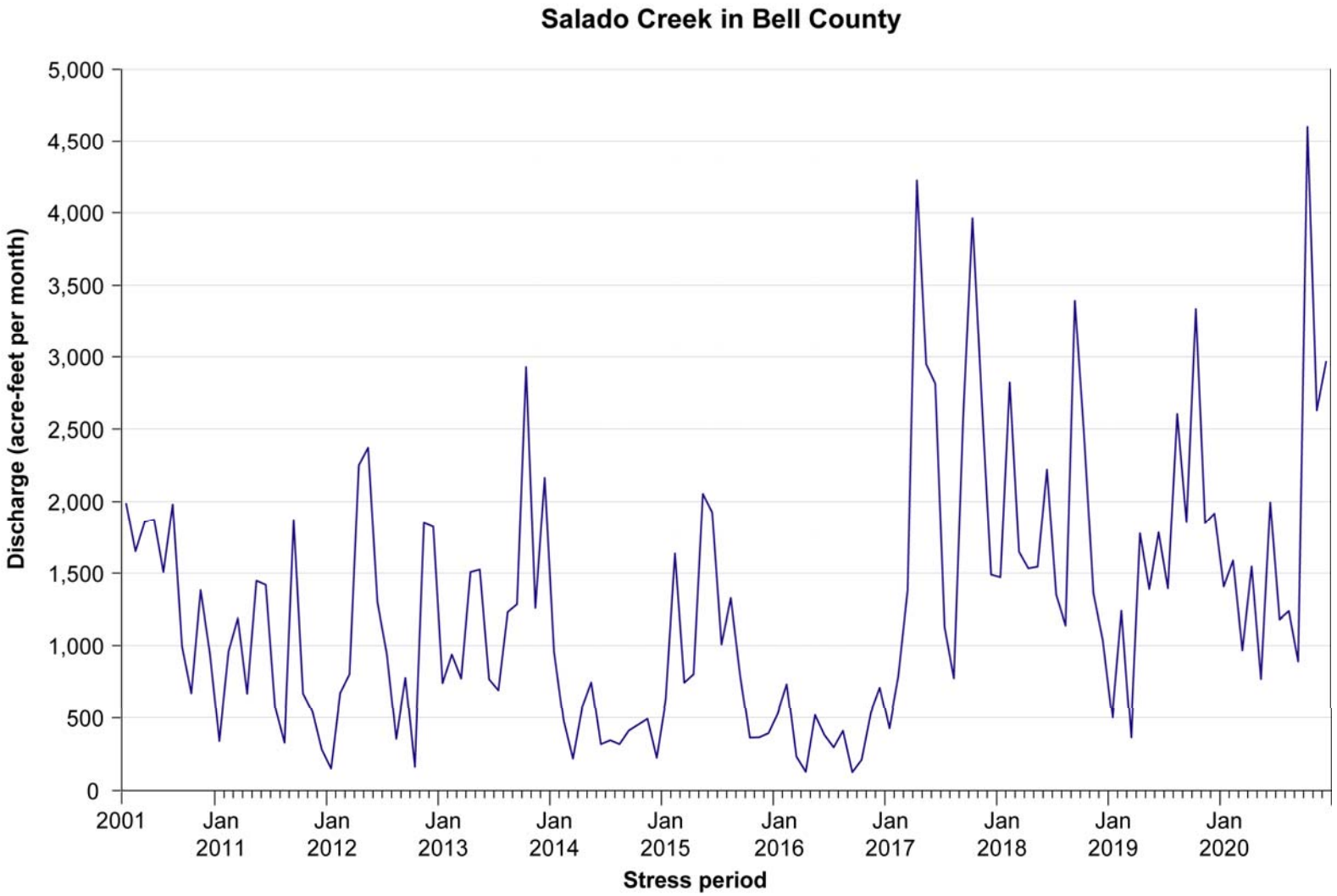

Figure 2: Hydrograph of simulated (2001 to 2020) discharge for Salado Creek in Bell County.

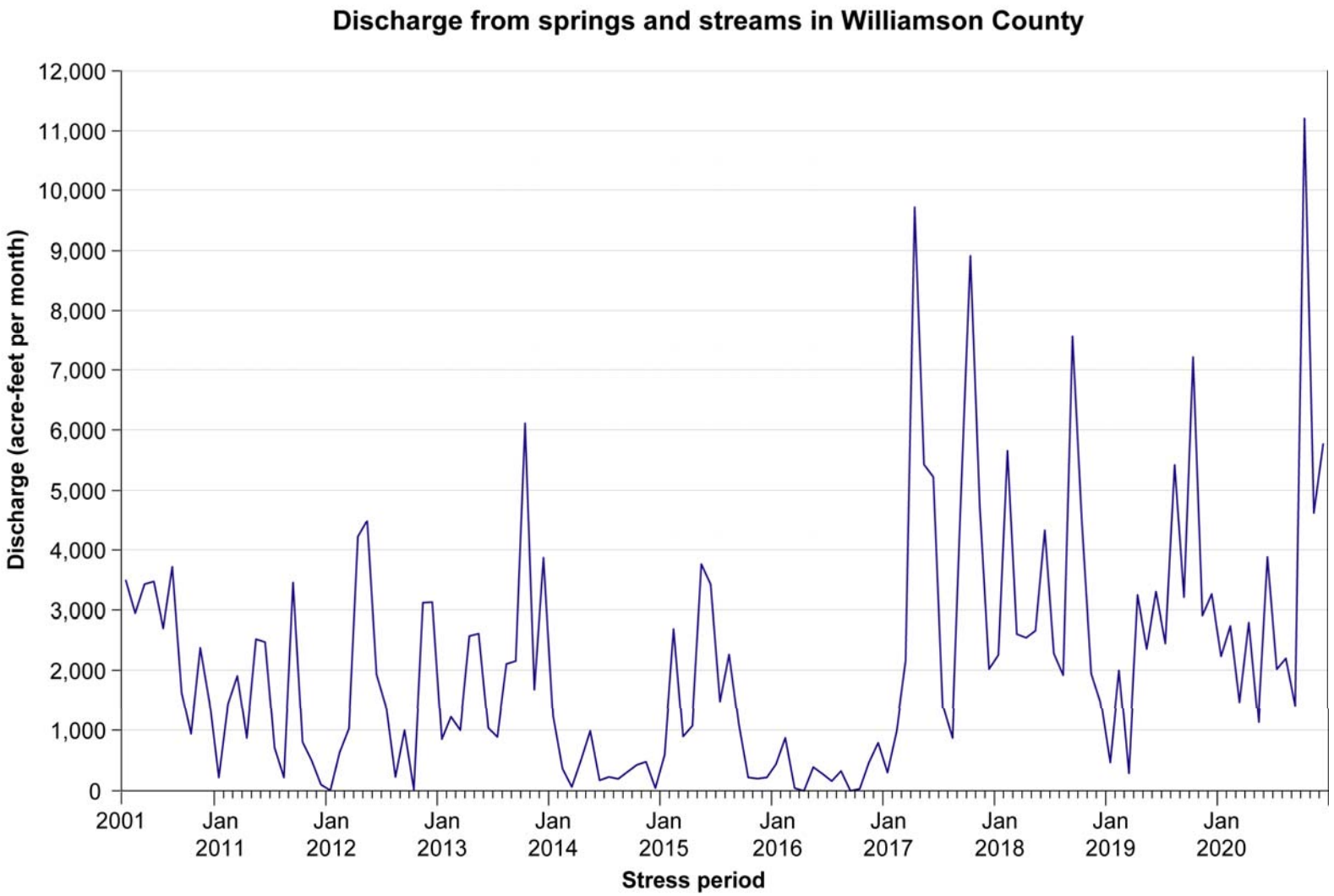

Figure 3: Hydrograph of simulated (2001 to 2020) aggregated natural spring-stream discharge in Williamson County.

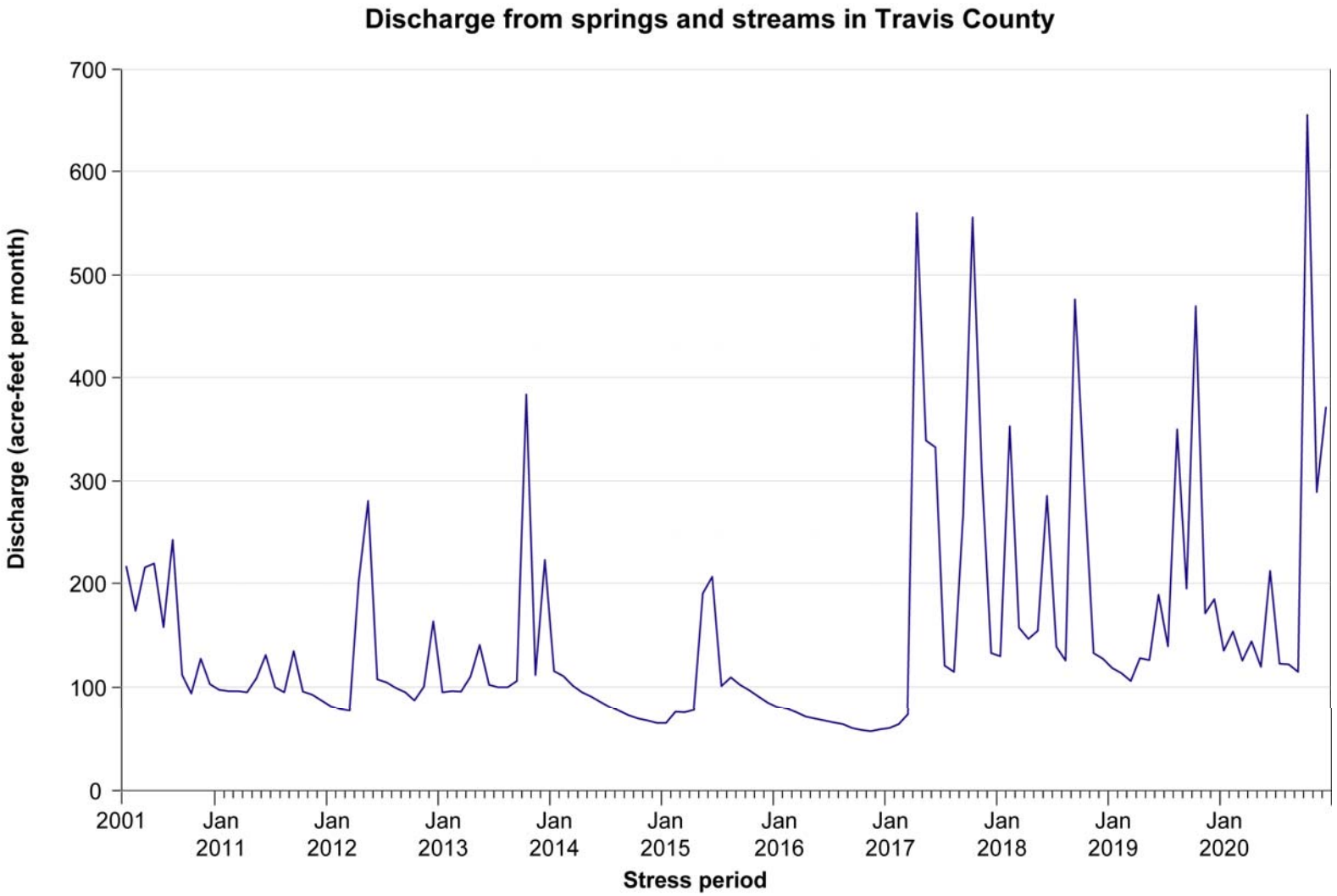

Figure 4: Hydrograph of simulated (2001 to 2020) aggregated natural spring-stream discharge in Travis County.