Supplemental Comments to
Post Oak Savannah and Lost Pines GCD Board of Directors
Regarding Revised Desired Future Condition
by
Environmental Stewardship and Simsboro Aquifer Water Defense Fund

September 8, 2021

OUR REQUEST

Environmental Stewardship & Simsboro Aquifer Water Defense Fund (SAWDF) request that the Districts reject the DFCs currently proposed for the Carrizo Wilcox Aquifer Group so that GMA-12 can revisit and, to the extent necessary, revise the proposed DFCs.

Environmental Stewardship & SAWDF are seeking to have DFCs developed that provide a stable basis for allocating future pumping and that follow these three criteria:

1. Sustainable management of the aquifers consistent with the District's Management Plan so that those resources can continue to be used by future generations,
2. Preservation of the resilience of the Colorado and Brazos Rivers to drought conditions by maintaining a gaining relationship with the aquifers, and
3. Protection of exempt landowner domestic and livestock wells.

INTRODUCTION

Consideration of revisions to the *currently adopted* DFCs requires a sound understanding of the consequences of the currently adopted DFCs and the consequences of the proposed DFCs. To aid in that understanding, Environmental Stewardship retained George Rice to develop a "conservation standard" or "conservation bookend" using GAM DFC Run3 (S-3) pumping file and the methodology recently used by neighboring GMA-11 to establish a baseline for additional modeling. GAM DFC Run3 best represents the drawdowns, impacts on surface waters, and impacts on domestic wells that would be expected from the pumping anticipated under the currently adopted 2017 DFCs. Because Mr. Rice used the new GAM to develop this standard, the resulting drawdowns will not precisely match the adopted drawdowns that resulted from using the same amount of pumping in the old GAM. Nonetheless, the starting point -- the same specific amount of pumping demand as was used in the currently adopted DFCs – will provide a defensible starting point for understanding the amount of conservation needed to protect surface waters and domestic wells.

As a reminder, **the essence of conservation and preservation of an aquifer resource is that the rate at which we deplete our aquifers must be in balance with the long-term protection of the aquifer and its associated surface waters.** The conservation and preservation of an aquifer resource is not achieved if aquifer depletion is driven only by the desire for development, against which we simply wait for damage to the ecosystem's sustainability before attempting to bring it back "in balance" **Only when a definite "conservation standard" describing a sustainable ecosystem is established — an ecosystem that is preserved in perpetuity — can we then determine how much of that aquifer we can develop in balance with the conservation standard.**

In the GMA-11 process, the results of a base simulation (Technical Memorandum 20-05[1]) was developed. Using that baseline and with the desire to provide a steady pumping rate for use in regional

[1] Hutchison, William R, Ph.D., P.E., P.G. December 30, 2020. GMA 11 Technical Memorandum 20-05. Base Simulation

water planning, GMA 11 ran an additional set of simulations that resulted in a constant pumping scenario for each county-river basin-aquifer unit in GMA 11. Technical Memorandum 21-01[2] Draft 2 reports on the development and results of the 33 iterations used to reach a constant pumping scenario[3] that would be expected to be sustained if the model were run for a longer period. The process is discussed in GMA-11's Explanatory Report (Draft 2)[4]. All of these GMA-11 documents are available on its public information[5] Google Drive.

To ultimately accomplish the objectives in criteria 1 and 2 above -- sustainable management while protecting the resilience of surface water through a drought of record and establishing a conservation standard -- different limitations will be placed on GAM DFCRun3. The pumping rates in GMA 12 have been adjusted so that the discharge of groundwater to the Colorado River for the Lost Pines District is approximately equal to the average rate for the period 2001 – 2010.[6] A similar conservation standard was developed for all surface waters in GMA-12. This work provides conservation standards for both Lost Pines and GMA-12 to be used in balancing conservation and development relative to consideration #4 as DFCs are developed.

CONSERVATION STANDARDS FOR GMA-12 AND LOST PINES GCD

A. Rice Studies (Initial Report):

Initial work performed by Mr. Rice can inform the GMA District's current consideration of next steps in the DFC process. In preparation for the conservation standard GAM run, Mr. Rice developed water budgets for Lost Pines GCD and GMA-12 as a whole. These two runs provide a model for what can be done for each District in GMA-12 to set individual district conservation standards.

The GAM 2020 model was run to produce water balances for two areas: the Lost Pines GCD and GMA 12. The pumping file DFCRun3.WEL was used for both runs. Water balances were prepared for two time periods; period 1 (2001 – 2010) and period 2 (2061 – 2070). As would be expected, the outflow from both areas increased between period 1 and period 2.

In the Lost Pines GCD, the increased outflow was due to increased pumping and to an increase in the amount of groundwater flowing into neighboring counties. In GMA 12, almost all the increased outflow was due to increased pumping. For both areas, the largest source of water for the increased outflow was a reduction in the amount of groundwater discharged to streams. For the Lost Pines GCD, the reduction in discharge to streams accounted for 63% of the increased outflow. For GMA 12, the reduction in discharge to streams accounted for 77% of the increased outflow.

---

for Joint Planning with Updated Groundwater Availability Model for the Sparta, Queen City, and Carrizo-Wilcox Aquifers

[2] Hutchison, William R, Ph.D., P.E., P.G. February 28, 2021. GMA 11 Technical Memorandum 21-01Draft 2. March 4, 2021. Adjusted Pumping Simulations for Joint Planning with Updated Groundwater Availability Model for the Sparta, Queen City, and Carrizo-Wilcox Aquifers.

[3] Note: This scenario did not include the protection of surface waters and resulted in a pumping quantity that sources 54% of the water from surface waters (Induced inflow from the alluvium). The final proposed DFCs sources 72% of the pumped water from surface waters.

[4] Hutchison, William R, Ph.D., P.E., P.G. February 28, 2021. Desired Future Condition Explanatory Report (Draft 2) Carrizo-Wilcox/Queen City/Sparta Aquifers for Groundwater Management Area 11.

[5] GMA-11 public information google drive https://drive.google.com/drive/folders/1ronw7ke38_lU4BHGEHbQQ0j9D7fYmFr?usp=sharing

[6] A gaining relationship to the aquifers.

In the Lost Pines GCD, the net amount of water derived from storage increased between periods 1 and 2. This increase accounts for about 8% of the increased outflows from Lost Pines.

In GMA-12, on the other hand, the amount of water derived from storage decreases between periods 1 and 2. This decrease represents about 13% of the increase in outflows. Thus, water that had previously come from storage must come from another source. That source is primarily a reduction in the amount of groundwater discharged to streams.

In the LPGCD, net outflow to wells in period 1 is about 27% of total outflows. In period 2 it is about 50% of total outflows. In GMA-12, net outflow to wells in period 1 is about 30% of total outflows. In period 2 it is about 61% of total outflows.

In the Lost Pines GCD, net groundwater discharges to streams decreased by approximately 36,000 AFY. In GMA-12, they decreased by almost 150,000 AFY

Details of the water balances for Lost Pines GCD and GMA 12 are presented in appendices 1 and 2, respectively.

Key Consequences of Initial Studies

Mr. Rice's preliminary work confirms the integral connection between surface water resources and groundwater management within Lost Pines GCD and GMA 12. Any decision that allows or enables increased pumping of groundwater has the potential to reduce the reliability of surface water flows. The DFC now before the District fail to adequately account for that connection, and should be rejected so that a DFC can be developed that is informed by serious consideration of sustainable management of the aquifers.

B. Estimated pumping limits that protect outflows to surface waters at 2001-2010 average level of discharge to the Colorado River Main Stem in Lost Pines District, and all surface waters for GMA-12.

The following graph (Figure A3-1 from Appendix 3) estimates that pumping would need to be reduced by about 90% from the DFCRun3 pumping rate to restore groundwater discharge to the Colorado River to the 2001-2010 average discharge rate of 21,100 AFY. However, a repeat of the 2001-2010 pumping rate after 2019 gets close to restoring discharges to the target rate, demonstrating that there may be other ways to reach the objective other than a uniform reduction in pumping. By 2070 the pumping rate in DFCRun3 is approximately 355,000 AFY.

Comparing the results above with those using pumping file S-12 (Figure A3-4 in Appendix 3) gave an unexpected result -- a 90% reduction in pumping resulted in a discharge rate greater than 21,100 AFY. Rice notes that the distribution of pumping in the two files is different and this may have influenced the results. Pumping file DFCRun3 has over 70,000 wells after 2020, whereas the number of wells in S-12 after 2020 is about 24,000. This difference in distribution of wells may account for this unexpected result but needs to be better understood. Pumping file S-12 has an approximate pumping rate of 547,000 AFY by 2070.

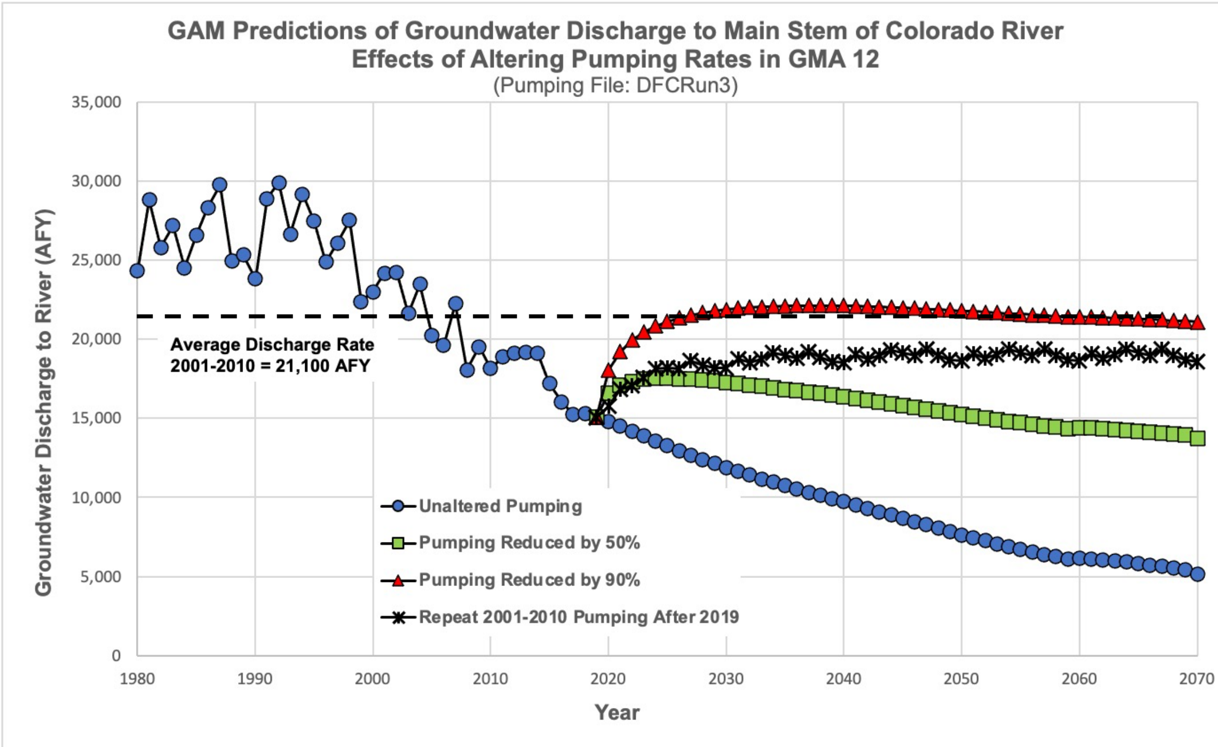

Figure A3-1. Effects of Reduced Pumping on Groundwater Discharge to the Colorado River (Pumping File DFCRun3).

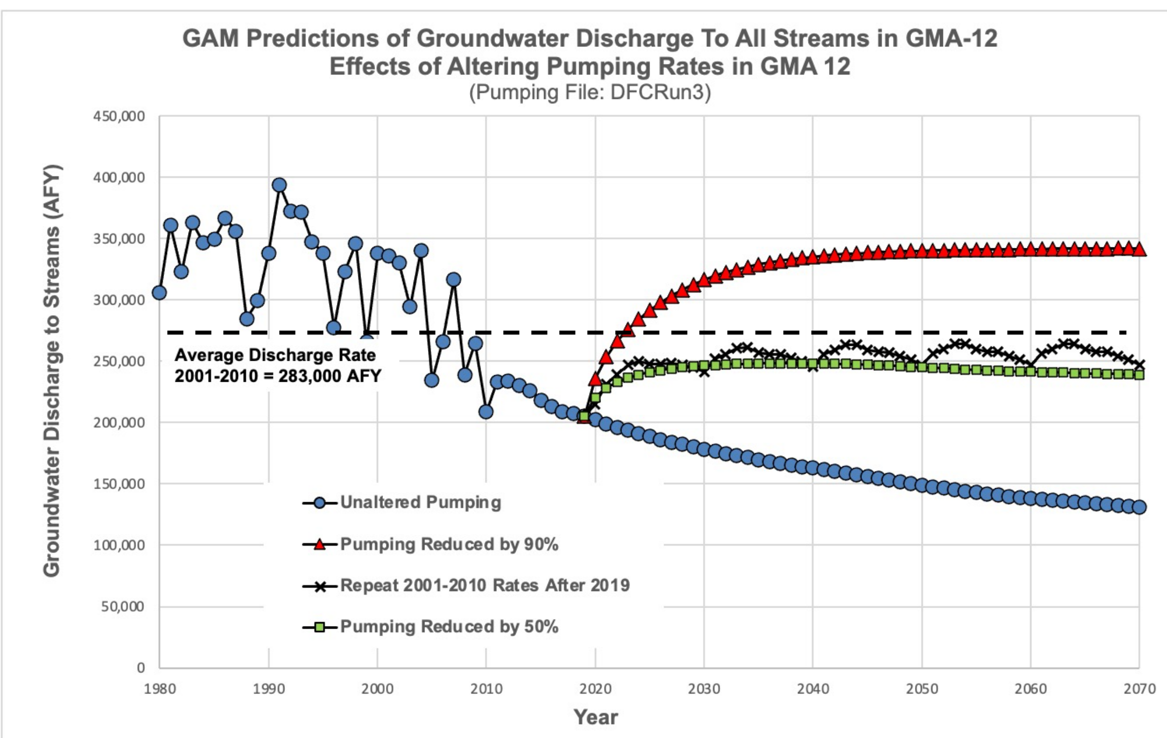

Figure A3-2 Effects of Reduced Pumping on Groundwater Discharge to All Streams in GMA-12 (Pumping File DFCRun3)

Figure A3-2 above predicts the effects of reduced pumping on *all streams* in GMA-12. In this analysis a 90% reduction in pumping restores the discharges to a rate approaching the historical pre-developmental period. Again, it appears that the distribution in pumping throughout GMA-12 may have an influence on how much reduction is needed to accomplish a desired target rate.

Pumping rates for the above analyses are provided in figures A3-3 and A3-5 (Appendix 3).

Key Results: of Reduced Pumping Studies

These studies provide a method for estimating the amount of pumping that can be made available for permitted and exempt pumping once a conservation standard is agreed upon by the Districts and stakeholders. It appears that several variables need to be investigated to provide efficient allocation of groundwater between conservation and development. Each district can use these analytical methods to develop a conservation standard that is physically possible and allows for the development of stable and achievable DFCs to quantify current and future pumping limits.

IMPACTS ON DOMESTIC & LIVESTOCK WELLS IN GMA-12

The third criteria important for stable DFCs is protection of exempt domestic and livestock wells. All the counties in GMA-12 are classified as rural, and their citizens and economies depend on these exempt wells to meet their freshwater needs.

Completed Depth of Exempt Wells
A note about exempt wells. These are small bore wells that produce anywhere from 5-50 gallons per minute. The cost of drilling an exempt well runs from $30-$40 per foot. As you can imagine, when a driller reaches a good 60-80 feet of water-bearing sand, the landowner usually chooses to stop drilling to save money. So, exempt wells may not be completed in the bottom of an aquifer/formation.

Pump depth in Exempt Wells
A typical pump may draw the water level in the well pipe down by 50 feet or more when running for a length of time. While the location of the pump depends on the refresh rate of the well, a good rule of thumb for a submersible pump is 100 feet below the surface of the water. The pump must stay submerged to keep from overheating and damaging the well.

Criteria for Negative Impact/Mitigation
This is important when evaluating negative effects on exempt wells. If the pump is only 100 feet below the surface of the water, and it will draw down 50 feet while running, then the landowner can only sustain 50 feet of permanent drawdown before the well needs to be mitigated. In this report SAWDF uses predicted drawdown of “50 feet or greater” as the criteria for determining when a well will require mitigation.

Data Set for this Report[7]
For this report, SAWDF downloaded two databases from the TWDB; Groundwater Database [GWDB] and the State Driller Report Database [SDRDB] which are updated nightly.

---

[7] www.twdb.texas.gov/groundwater/data/gwdbrpt.asp & www.twdb.texas.gov/groundwater/data/drillersdb.asp

Approximately 50% of **all** wells in GMA-12 are labeled as domestic or livestock wells.

GMA-12 Wells	All Purposes	Domestic Stock	Percent
LPGCD	4,279	2,788	65%
POSGCD	3,685	1,957	53%
BVGCD	5,226	1,692	32%
METGCD	5,656	2,075	37%
FCGCD	1,136	784	69%
	19,982	9,296	47%

More than half of these exempt wells are completed in the Sparta, Queen City, or Carrizo-Wilcox aquifers as modeled in the GAM2020 used by GMA-12 to evaluate the DFC.

Geographic Information Software [GIS]

SAWDF employed GIS software to map the location of the wells from the TWDB databases and overlay the predicted drawdowns in each aquifer/formation from Run S-12 of the GAM2020. The results are in the table below.

	GMA-12 Wells [within Modflow grid]	Domestic Stock	Drawdown >= 50 ft	Percent Impacted
	Sparta	783	244	31%
	Queen City	1,130	104	9%
Wilcox Group	Carrizo	467	325	70%
Wilcox Group	Calvert Bluff	1,304	735	56%
Wilcox Group	Simsboro	352	246	70%
Wilcox Group	Hooper	848	156	18%
	TOTAL	4,884	1,810	**37%**

POSGCD is acutely aware of the impacts on exempt wells in the Carrizo formation and is taking action to address the DFC for this formation. **The data above suggests the need to also apply the same analysis to the Wilcox group where impacts in the Calvert Bluff and Simsboro formations exceed 50%**.

More than 50% of exempt wells completed in the Wilcox Group in three districts may require mitigation, as the tables below indicate.

	LPGCD Wells [within Modflow grid]	Domestic Stock	Drawdown >= 50 ft	Percent Impacted
Wilcox Group	Carrizo	202	143	71%
	Calvert Bluff	512	240	47%
	Simsboro	163	100	61%
	Hooper	345	80	23%
	TOTAL	**1,222**	**563**	**46%**

	POSGCD Wells [within Modflow grid]	Domestic Stock	Drawdown >= 50 ft	Percent Impacted
Wilcox Group	Carrizo	107	102	95%
	Calvert Bluff	218	216	99%
	Simsboro	65	61	94%
	Hooper	225	71	32%
	TOTAL	**615**	**450**	**73%**

	BVGCD Wells [within Modflow grid]	Domestic Stock	Drawdown >= 50 ft	Percent Impacted
Wilcox Group	Carrizo	46	28	61%
	Calvert Bluff	247	186	75%
	Simsboro	94	78	83%
	Hooper	139	5	4%
	TOTAL	**526**	**297**	**56%**

Aquifer Uses

Among other considerations, Section 36.108(d)(1) directs the joint planning process to acknowledge "*aquifer uses or conditions within the management area, including conditions that differ substantially from one geographic area to another*.

GMA-12 members have noted, on multiple occasions, that only POSGCD and LPGCD have issued export permits for groundwater produced from the Carrizo-Wilcox Aquifer. Both the magnitude of the permits and their use, to serve population growth in other regions of Texas, are "substantially different" from the other districts in GMA-12. These "substantial differences" in "aquifer uses" must be acknowledged by GMA-12.

Private Property Rights
Section 36.108(d)(7) also directs the joint planning process to consider *"the impact on the interests and rights in private property, including ownership and the rights of management area landowners and their leases and assigns in groundwater as recognized under Section 36.002"*. This includes both those who wish to conserve their water and those who produce it or lease their water rights to other producers.

1,462 domestic or livestock wells in the Carrizo-Wilcox Aquifer are predicted to require mitigation under the proposed DFCs. These landowners will suffer a loss of 50 feet or more in groundwater. This is groundwater that will never be recovered, which diminishes property values and creates financial hardship on landowners and livestock operations.

Achievable DFCs
The GMA-12 joint planning process has been dominated by a focus on "maximum production" as the standard for achieving the DFC. SAWDF and Environmental Stewardship have provided the necessary research to enable GMA-12 to change the focus and establish a new standard, one focused on achieving a DFC that gives balance to management of groundwater.

SAWDF urges each of these districts to reject the proposed Desired Future Conditions and explore pumping scenarios that support:

1. Sustainable management of the aquifers consistent with the District's Management Plan so that those resources can continue to be used by future generations,
2. Preservation of the resilience of the Colorado and Brazos Rivers to drought conditions by maintaining a gaining relationship with the aquifers, and
3. Protection of exempt landowner domestic and livestock wells.

APPENDIX 1: Water Balance for LPGCD (DRAFT REPORT)

The GAM2020 model was run using the pumping file DFCRun3.WEL. The results for two periods were examined: period 1 (2001 – 2010) and period 2 (2061 – 2070). Tables A1 -1 and A1-2 list the predicted inflows and outflows for each period.

Some of the flow components are both inflows and outflows. This is the case for streams. Some stream nodes are losing water to the underlying aquifers (inflow) while others are receiving discharge from the aquifers (outflows).[8] For the storage component, the GAM treats water released from storage is an inflow, and water that enters storage is an outflow. Net inflows and outflows are shown in tables A1-3 and A1-4.

Table A1-1
LPGCD Inflows

Component	Period 1 2001-2010 (AFY)	Period 2 2061-2070 (AFY)	Difference P2 – P1 (AFY)
Streams	78342	87638	9296
Overlying Units	91	266	175
Recharge	76941	86466	9525
POSGCD	9059	16090	7031
Caldwell Co.	3095	3175	80
Fayette Co.	1563	2056	493
Williamson Co.	3498	3666	168
Washington Co.	431	1244	813
From Storage	25725	21496	-4229
Sum	198745	222097	23352

[8] Note that the stream values in this section are for all streams in the LPGCD, not only for the Colorado River and its tributaries.

Table A1-2
LPGCD Outflows

Component	Period 1 2001-2010 (AFY)	Period 2 2061-2070 (AFY)	Difference P2 – P1 (AFY)
Wells	26680	55274	28594
Drains	9707	3837	-5871
Streams	128001	100892	-27109
ET	261	196	-65
Overlying Units	3576	2590	-986
POSGCD	12076	26046	13970
Caldwell Co.	604	10968	10364
Fayette Co.	7434	20701	13267
Williamson Co.	271	222	-50
Washington Co.	1021	1316	295
To Storage	9015	59	-8956
Sum	198646	222097	23453

Inflows and outflows balance (within 1%) for both periods, as well as for the difference between the periods (compare tables A1-1 and A1-2).

Table A1-3
Net Inflows

Component	Period 1 2001-2010 (AFY)	Period 2 2061-2070 (AFY)	Difference P2 – P1 (AFY)
Recharge	76941	86466	9525
Williamson Co.	3227	3444	217
From Storage	16710	21437	4727
Sum	99369	111347	14469

Table A1-4
Net Outflows

Component	Period 1 2001-2010 (AFY)	Period 2 2061-2070 (AFY)	Difference P2 – P1 (AFY)
Wells	26680	55274	28594
Drains	9707	3837	-5871
Streams	49659	13254	-36405
ET	261	196	-65
Overlying Units	3485	2324	-1161
POSGCD	3017	9956	6939
Caldwell Co	-2491	7793	10284
Fayette Co.	5871	18645	12,774
Washington Co.	590	72	-518
Sum	99270	111351	14571

Again, the inflows and outflows balance (within 1%).

Components Contributing to Increased Outflows

Between periods 1 and 2, outflows from LPGCD increased by about 58,000 AFY. The majority of this increase was due to increased pumping and flows to the surrounding counties. The increased outflows were largely offset by decreases in outflows to streams and drains. The increased outflows, and the sources contributing to the increase are shown in tables A1-5 through A1-8.

Table A1-5
Increased Outflows, Period 1 – Period 2

Component	Increase from P1 to P2 (AFY)
Wells	28594
To surrounding counties	29262
Sum	57856

Table A1-6
Increased Inflow, Period 1 – Period 2

Component	Increase from P1 to P2 (AFY)	Percentage of Increased Outflows
Recharge	9525	16.5

Table A1-7
Decreased Outflows, Period 1 – Period 2

Component	Decrease from P1 to P2 (AFY)	Percentage of Increased Outflows
Discharge to Streams	36405	62.9
Discharge to Drains	5871	10.1
ET	65	0.1
To Overlying Units	1161	2.0

Table A1-8
Increased Contribution from Storage

Component	Increase from P1 to P2 (AFY)	Percentage of Increased Outflows
From Storage	4727	8.17

Total Percent = 99.8

Note that most of the increased outflow is balanced not by increased inflows, but by a decrease in outflows from other components, primarily from streams. This is caused by pumping capturing some of the groundwater that would otherwise be discharged to the streams. The increased recharge is due to the fact that after 2010, recharge in the GAM is held to a constant value. Prior to 2010, recharge varies yearly.

APPENDIX 2: Water Balance for GMA-12 (DRAFT REPORT)

The same type of water balance performed for the LPGCD (appendix 1) was also performed for GMA 12.

Table A2-1
GMA 12 Inflows

Component	Period 1 2001-2010 (AFY)	Period 2 2061-2070 (AFY)	Difference P2 – P1 (AFY)
Streams	283515	332328	48813
Overlying Units	1195	5104	3909
Recharge	483041	526795	43754
Outside GMA12	21078	32276	11198
From Storage	74307	50021	-24286
Sum	863136	946524	83388

Table A2-2
GMA 12 Outflows

Component	Period 1 2001-2010 (AFY)	Period 2 2061-2070 (AFY)	Difference P2 – P1 (AFY)
Wells	167618	351071	183453
Drains	88476	73689	-14787
Streams	566552	466513	-100039
ET	3603	2707	-896
Overlying Units	10309	5081	-5228
Outside GMA12	26589	47462	20873
Sum	863147	946523	83376

Inflows and outflows balance (within 1%) for both periods, as well as for the difference between the periods (compare tables A2-1 and A2-2).

Table A2-3
Net Inflows

Component	Period 1 2001-2010 (AFY)	Period 2 2061-2070 (AFY)	Difference P2 – P1 (AFY)
Recharge	483041	526795	43754
From Storage	74307	50021	-24286
Sum	557348	576816	19468

Table A2-4
Net Outflows

Component	Period 1 2001-2010 (AFY)	Period 2 2061-2070 (AFY)	Difference P2 – P1 (AFY)
Wells	167618	351071	183453
Drains	88476	73689	-14787
Streams	283,037	134,185	-148852
ET	3603	2707	-896
Overlying Units	9114	-23	-9137
Outside GMA12	5511	15186	9675
Sum	557359	576815	19456

Again, the inflows and outflows balance.

Components Contributing to Increased Outflows

Between periods 1 and 2, outflows from GMA 12 increased by over 190,000 AFY. The majority of this increase was due to increased pumping, with a relatively small amount due to increased groundwater flows to areas outside of GMA 12. The increased outflows, and the sources contributing to the increase are shown in tables A2-5 through A2-8.

Table A2-5
Increased Outflows, Period 1 – Period 2

Component	Increase from P1 to P2 (AFY)
Wells	183,453
To outside GMA 12	9675
Sum	193,128

Table A2-6
Increased Inflow, Period 1 – Period 2

Component	Increase from P1 to P2 (AFY)	Percentage of Increased Outflows
Recharge	43,754	22.7

Table A2-7
Decreased Outflows, Period 1 – Period 2

Component	Decrease from P1 to P2 (AFY)	Percentage of Increased Outflows
Discharge to Streams	148,852	77.1
Discharge to Drains	14,778	7.7
Discharge to Overlying Units	9137	4.7
ET	896	0.5

Table A2-8
Decreased Contribution from Storage

Component	Decrease from P1 to P2 (AFY)	Percentage of Increased Outflows
From Storage	24,286	-12.6

Total Percent = 100.1

Note that most of the increased outflow is balanced not by increased inflows, but by a decrease in outflows from other components, primarily from streams. This is caused by pumping capturing some of the groundwater that would otherwise be discharged to the streams. The increased recharge is due to the fact that after 2010, recharge in the GAM is held to a constant value. Prior to 2010, recharge varies yearly.

APPENDIX 3: Effects of Reducing Pumping in GMA-12 (DRAFT REPORT)

Pumping file DFCRun3

Between 2001 and 2010, the average discharge of groundwater to the main stem of the Colorado River was approximately 21,000 AFY. This value is based on a GAM2020 run using the pumping file DFCRun3. GAM runs predict that groundwater pumping will cause discharges to the Colorado River to decline. Between 2061 and 2070, the average predicted discharge rate is approximately 5700 AFY.

The question addressed in this appendix is: How much would pumping have to be reduced to restore groundwater discharges to the earlier rate, approximately 21,000 AFY?

To answer this question, pumping rates throughout GMA-12 were reduced by varying amounts. The reductions started in 2020. As shown in figure A3-1, a reduction of 90% would result in an average discharge of 21,000 AFY between 2061 and 2070. The results of reducing pumping by 50% are also shown.

There may be ways, other than a uniform reduction in pumping, to restore discharges to a desired level. Figure A3-1 also shows the results for a scenario where the pumping rates from 2001 to 2010 were repeated for each decade from 2020 to 2070.

Figure A3-2 shows the effects of reduced pumping on all streams in GMA-12, not just the main stem of the Colorado River.

Figure A3-3 shows pumping rates for: unaltered DFCRun3 pumping, a 90 percent reduction in pumping, and the repetition of the pumping rates from 2001 to 2010.

Pumping file S-12

The same type of analysis described above was performed using the S-12 pumping file. The major difference between the pumping files is the amount pumped in GMA-12. By 2070, the pumping rate in DFCRUN3 is approximately 355,000 AFY. For S-12 the rate in 2070 is about 547,000 AFY.

As shown in figure A3-4, a 90 percent reduction in S-12 pumping results in a discharge greater than 21,000 AFY. This result is unexpected because the pumping rate for S-12 is greater than that for DFCRun3. However, the distribution of pumping in the two files is different. In pumping file DFCRun3, the number of wells after 2020 is over 70,000. In S-12, the number of wells after 2020 is approximately 24,000. This difference in the distribution of wells may account for this unexpected result.

Figure A3-5 shows pumping rates for unaltered S-12 pumping, and a 90 percent reduction in pumping.

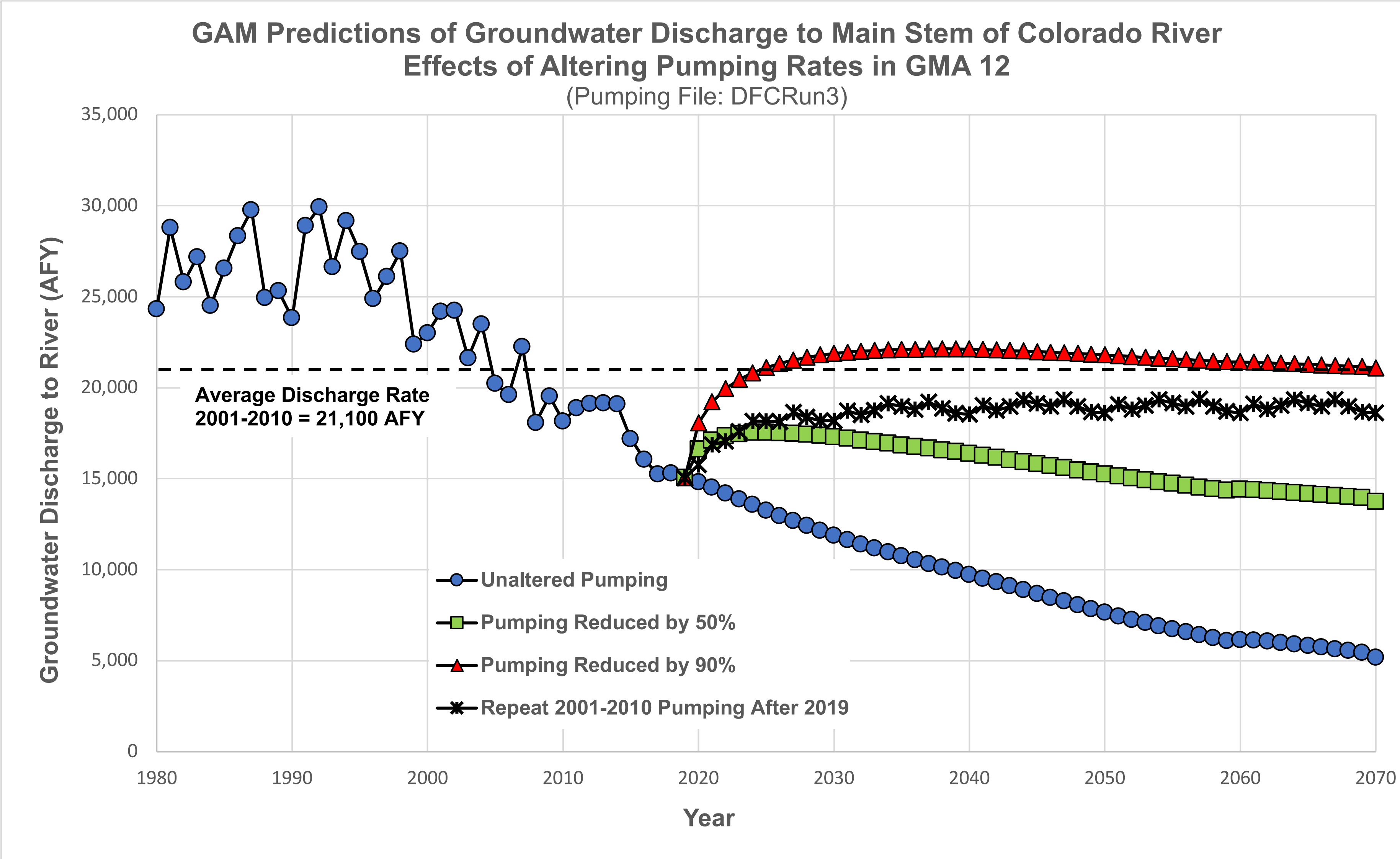

Figure A3-1
Pumping File DFCRun3, Effects of Reduced Pumping on Groundwater Discharge to the Colorado River

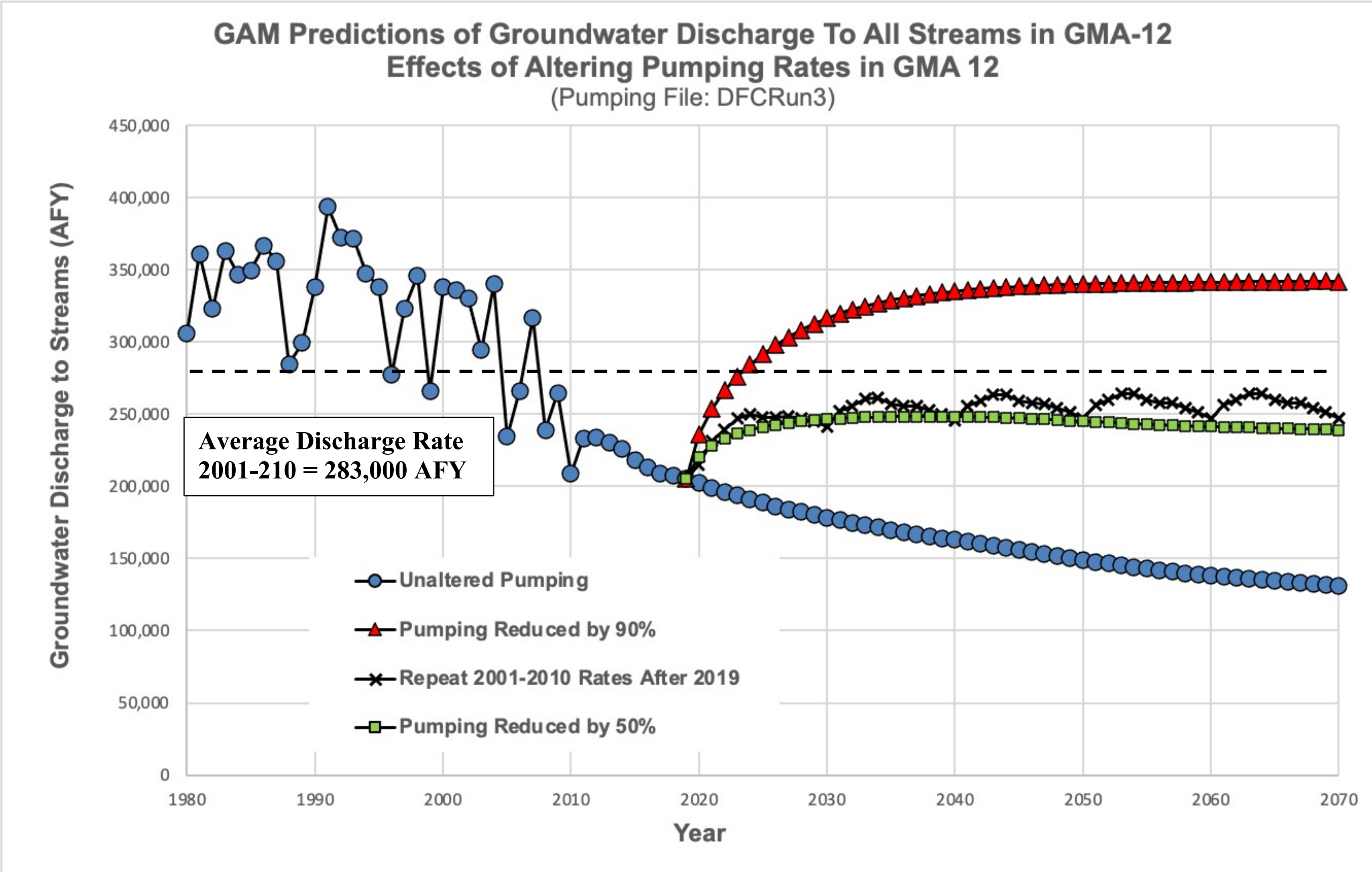

Figure A3-2

Pumping File DFCRun3, Effects of Reduced Pumping on Groundwater Discharge to All Streams in GMA-12

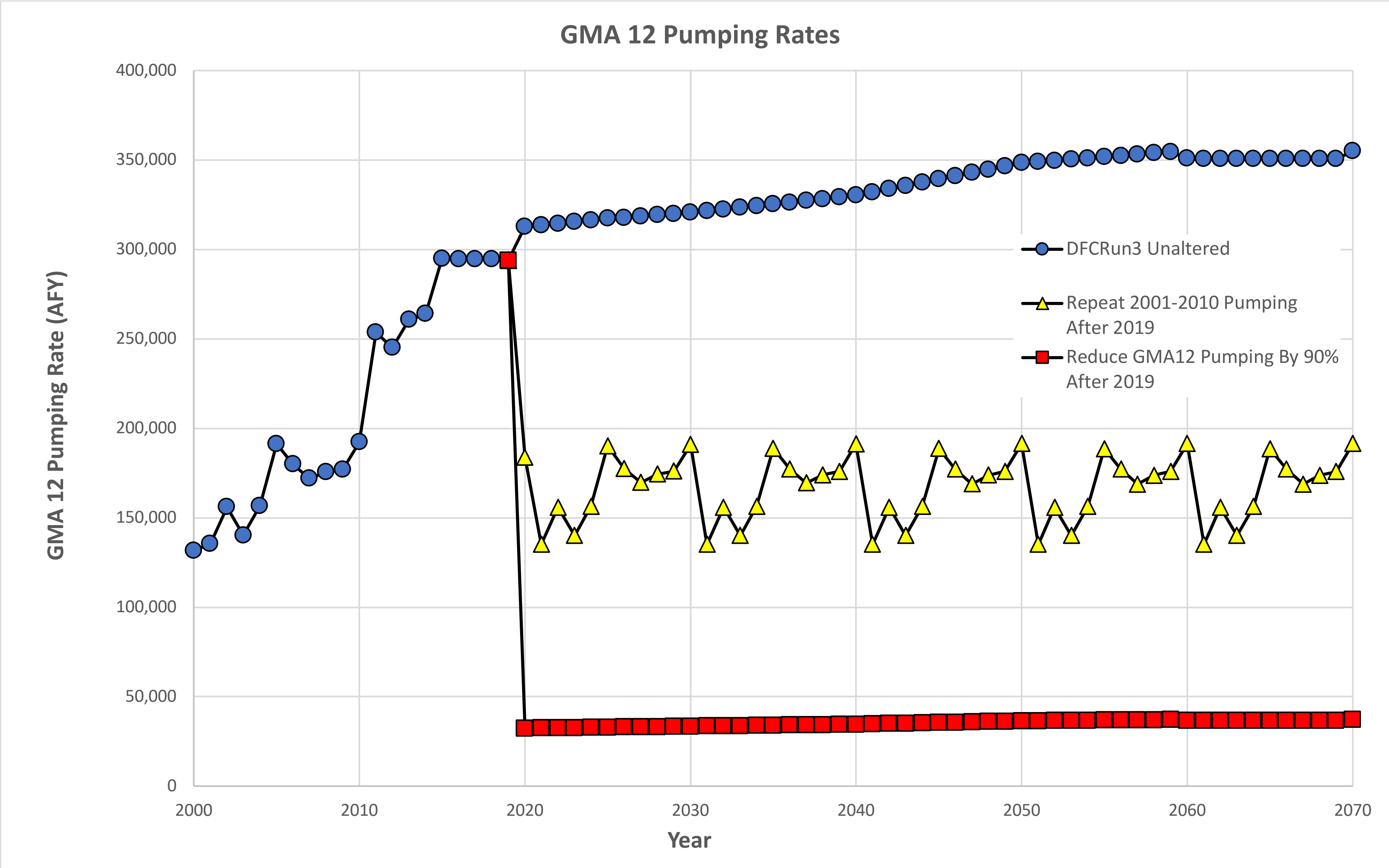

Figure A3-3
DFCRun3 Pumping Rates in GMA-12

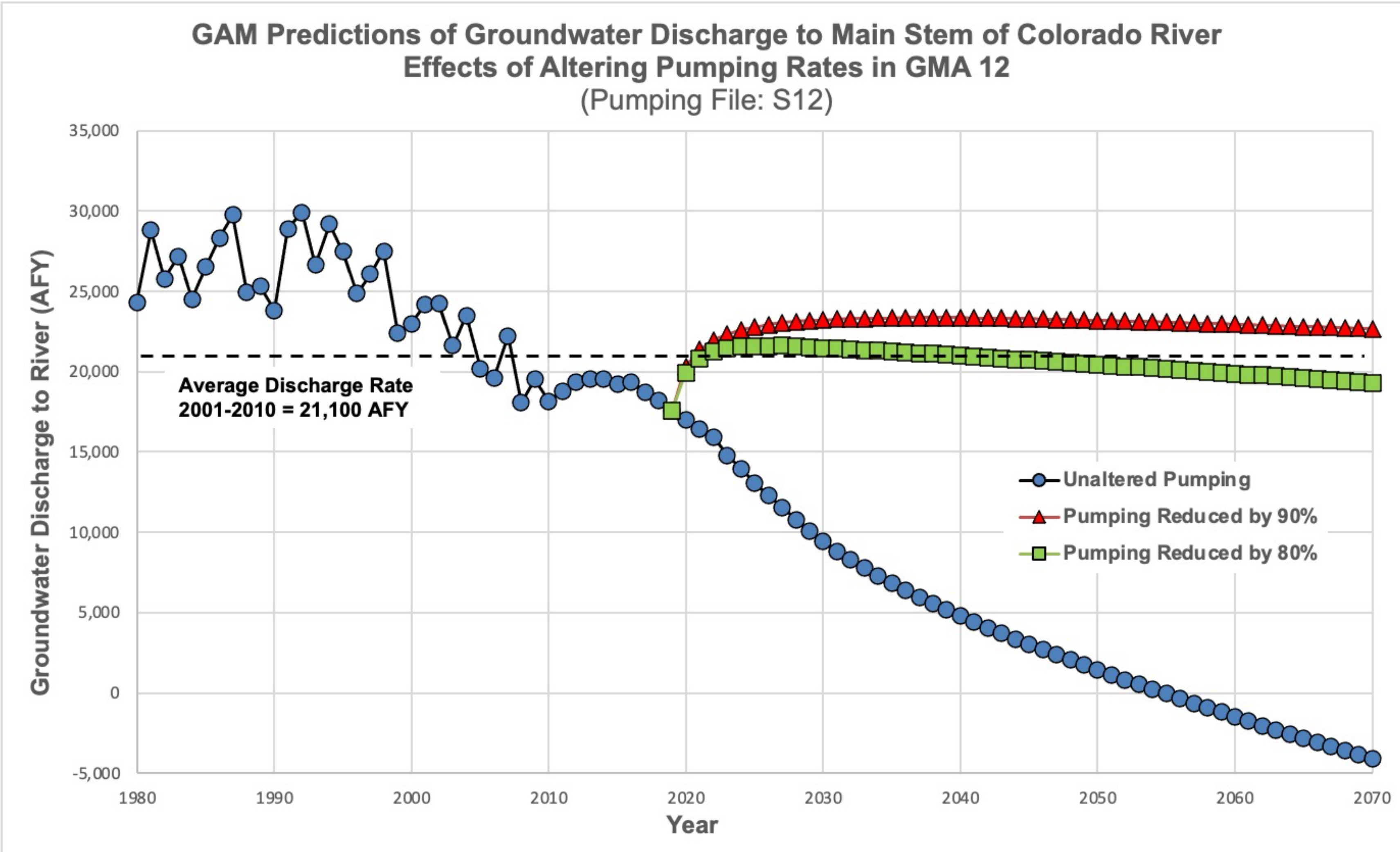

Figure A3-4
Pumping File S-12, Effects of Reduced Pumping on Groundwater Discharge to the Colorado River

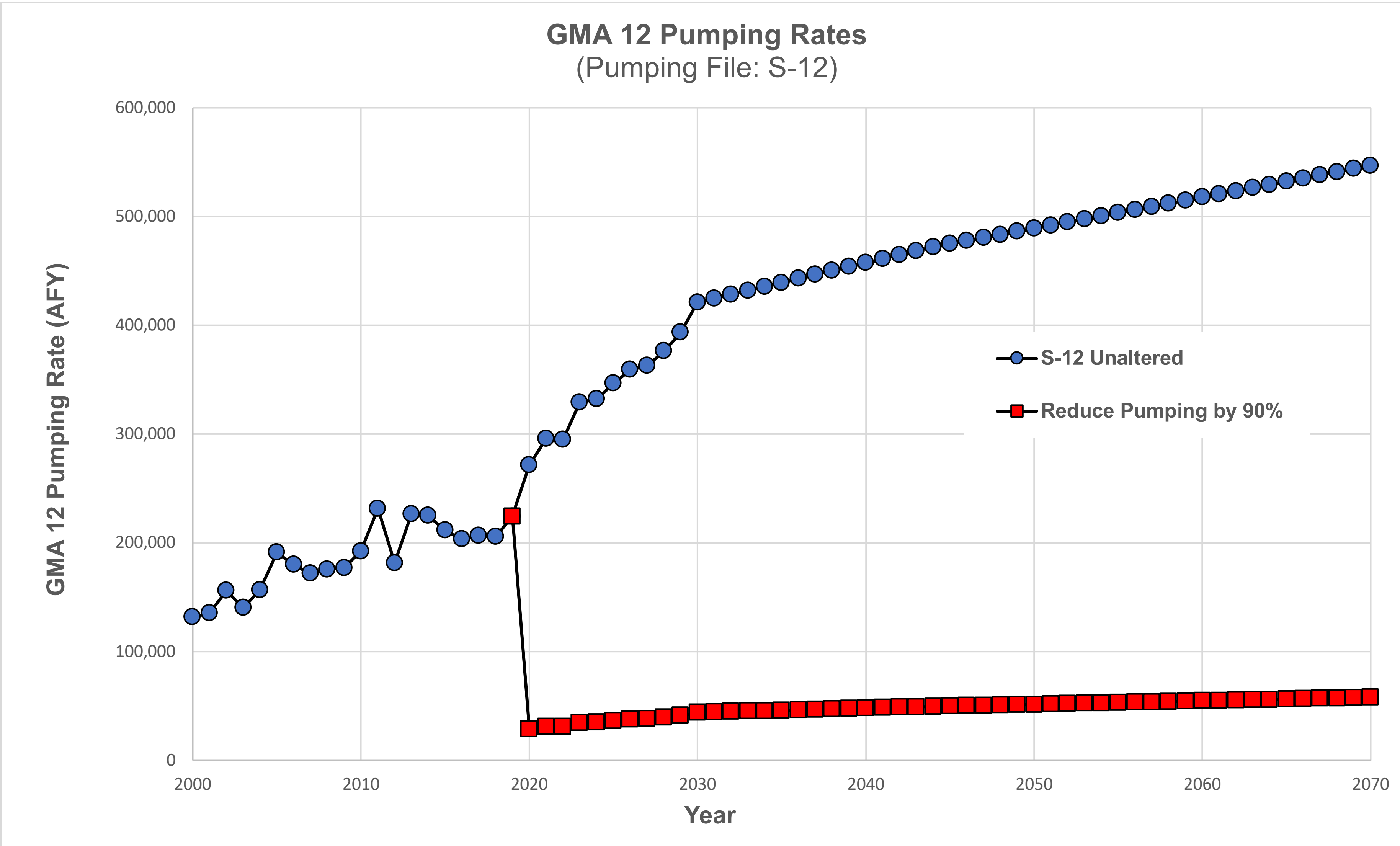

Figure A3-5
S-12 Pumping Rates in GMA-12