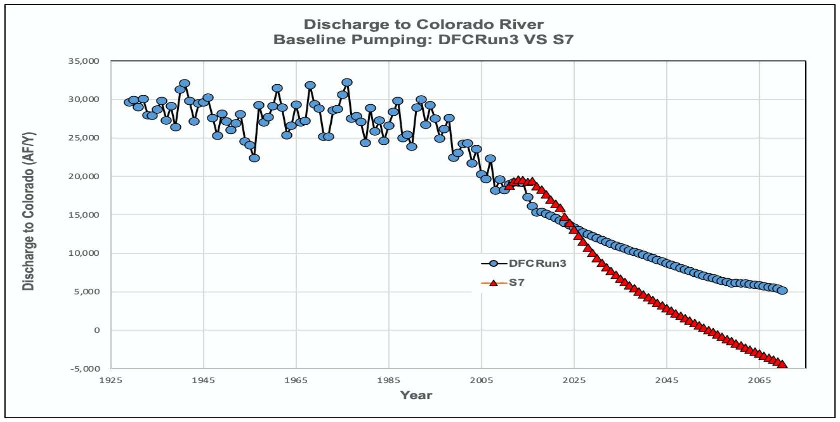
GMA-12 DFCs
Summary of Environmental Stewardship's Comments and Requests

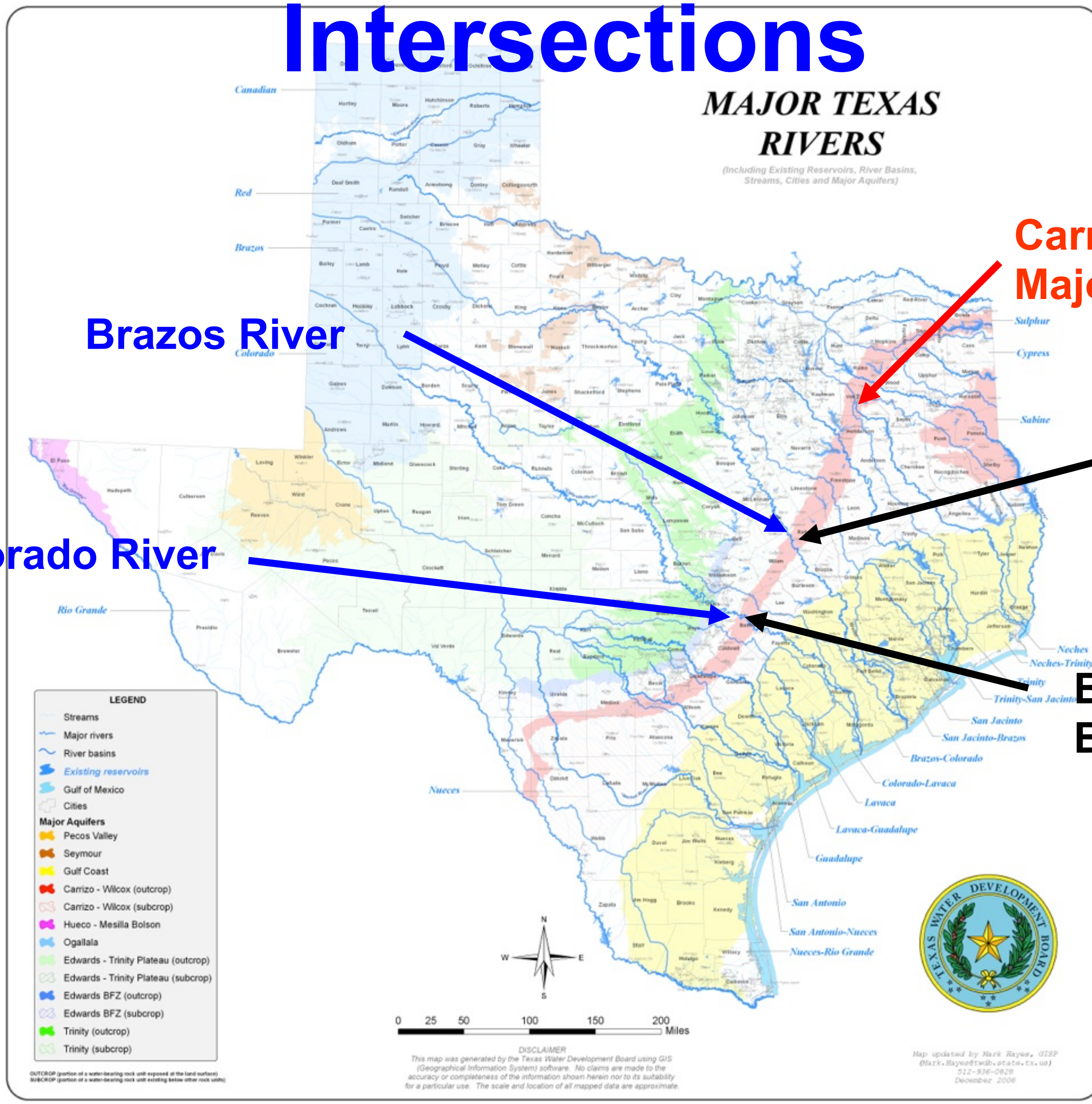


Presented to
GMA-12
December 10, 2020, Virtual Meeting

Environmental Stewardship
A Sustainable Ecosphere

Environmental-Stewardship.org

Ground & Surface Water Intersections



Carrizo-Wilcox Major Aquifer

Brazos River

Milam/ Robertson Counties

Colorado River

Bastrop, TX Bastrop County

Historically: 2012-17 DFC Review Revealed

- The Old GMA-12 GAM had deficiencies that needed corrected.
- Spring Flow and GW-Stream Exchange are potentially important environmental issues.
- Other than Saunder's studies, inadequate gain-loss data exists in GMA-12.
- The Old GAM was not a good simulator of water tables or shallow groundwater flow systems because of thick grid cells in the aquifer outcrop.
- TCEQ Environmental Instream Flow program is set up to protect the health of the Colorado and Brazos Rivers
- Groundwater flow into streams can be an important contributor for helping river authorities maintain critical or subsistence flows

2020 ES Requests

- Monitor impacts of groundwater pumping on the mainstem of the Colorado River and its tributaries.
- Perform certain hydrograph separation studies to evaluate groundwater flow contributions to the Colorado River under drought conditions and to inform development of a surface water DFC component.
- Establish a DFC component that is protective of surface water, including subsistence, base-dry and base-average flows, that will trigger corrective actions should the predictions of surface water impacts be validated and/or realized in fact.

2020 ES Requests

- Initiate the development of DFCs for the Colorado Alluvium Aquifer in anticipation of adopting such DFCs during the next planning cycle. Give consideration to the guiding principles provided in Section VII.
- Seek to establish criteria to qualitative and quantitative evaluate the impacts of reduced contributions of groundwater to baseflows into rivers and streams.
- Seek to establish criteria to determining when such impacts become unreasonable and thereby require remedial actions.

2020 ES Specific DFC Requests

- ES requests that the Districts re-adopt the current DFCs based on DFC Run 3 (New GAM) and include the following as a surface water component in the DFCs:
  - 1) subsistence flow in the Colorado River at the Bastrop Gage will be met 100% of the time.
  - 2) base-dry and base-average flow will be met during the spring (March - June) in order to protect the state-threatened Blue Sucker, and
  - 3) non-exempt pumping will be curtailed if subsistence flow drops below the month's standard expressed in cubic feet per second (cfs) for seven (7) cumulative days in any month.
- Apply the above to the following Aquifer Formations:
  - Carrizo
  - Calvert Bluff
  - Simsboro
  - Hooper

2020 ES Specific DFC Requests

- ES requests that the Districts initiate the development of DFCs for the Colorado Alluvium Aquifer in anticipation of adopting such DFCs during the next planning cycle. Give consideration to the guiding principles provided in ES Comments Section VII.

II. COMPARISON OF IMPACT OF PUMPING ON OUTFLOWS TO MAIN STEM COLORADO RIVER

- **<u>Adopted 2017 DFCs (Old GAM):</u>**

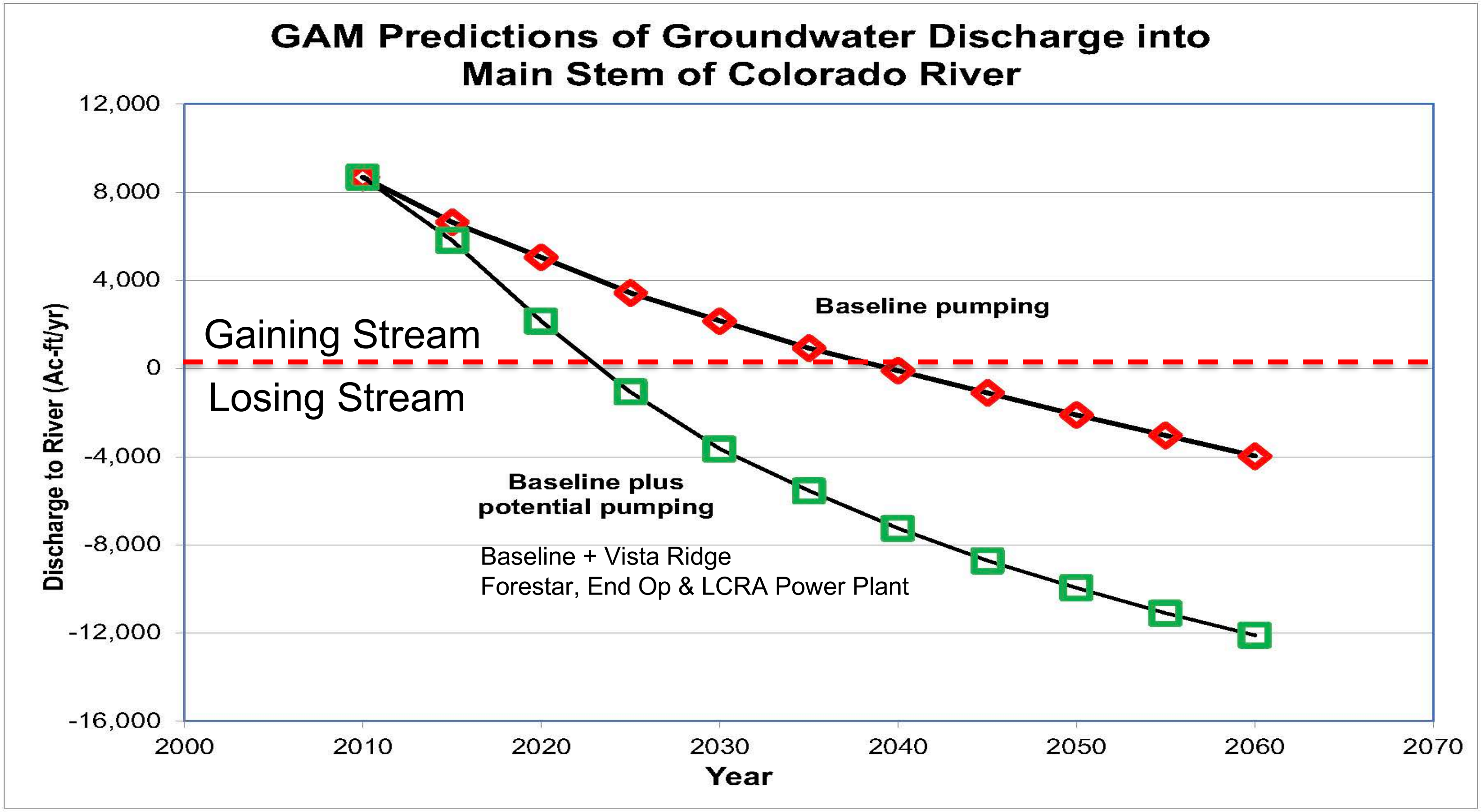


Figure 1. Predicted reduction of discharge of groundwater into the mainstream Colorado River due to combined pumping (Old GAM).

II. COMPARISON OF IMPACT OF PUMPING ON OUTFLOWS TO MAIN STEM COLORADO RIVER

- **<u>Adopted 2017 DFCs (New 2018 GAM):</u>**

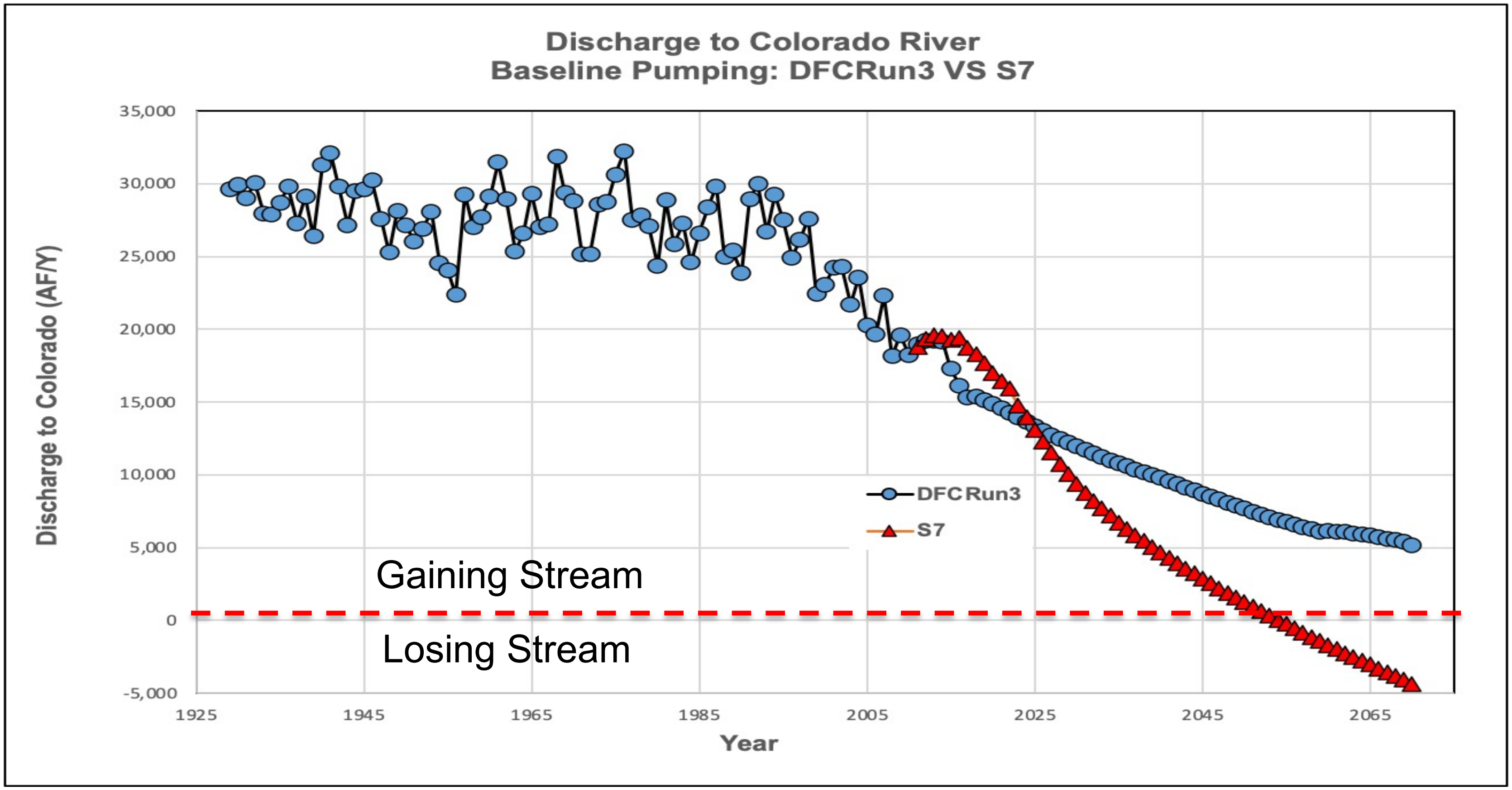


Figure 2. Predicted reduction of discharge of groundwater into the mainstream Colorado River due to DFC Run 3 and Scenario S-7 (New GAM).

Comparison of DFC Run 3 and Scenario S-7

- Average Pumping Amount:
  - **DFCRun3 = 50,900 acre-feet per year average pumping all aquifers**
  - **Scenario S-7 = 116,000 acre-feet per year average pumping all aquifers**
- The New 2018 GAM (DFCRun3- Current Adopted DFCs) predicts:
  - **Pumping *will reduce discharge* to the main stem of the Colorado River by about 14,000 ac-ft per year from 2010 to 2070.**
  - **Pumping *will not reverse its historical relationship* to the aquifers in the current planning period.**
- The New 2018 GAM (S-7)predicts that:
  - **Pumping *will reduce discharge* to the main stem of the Colorado River by about 24,000 ac-ft per year from 2010 to 2070.**
  - **Pumping *will reverse its historical relationship* to the aquifers by about 2050.**

Comparison of DFC Run 3 and Scenario S-7

- **By comparison:**
  - **The new GAM predicts that Scenario S-7 will reduce outflows by about 10,000 ac-ft per year more than DFC Run 3.**
  - **The new GAM predicts that Scenario S-7 will cause a reversal in the surface water-groundwater relationship to occur about 2050 whereas DFC Run 3 does not predict a reversal within the planning period.**
  - **Scenario S-7 (New GAM) is comparable to Baseline + potential pumping in the Old GAM.**
    - **Both predict the same magnitude of reduced outflow from the aquifer to the Colorado River; about 22,000 to 24,000 acre-feet per year.**

II. COMPARISON OF IMPACT OF PUMPING ON OUTFLOWS TO MAIN STEM COLORADO RIVER

In summary:

- **Groundwater pumping impacts outflow of groundwater to surface waters.**

- **The greater the quantity of groundwater pumped, the greater the decrease in outflows to the river.**

- **The quantity of pumping in the 2017 adopted DFCs is predicted to cause a significant decrease in outflows to the river; *an impact that may be unreasonable*.**

- **GAM Run S-7 is predicted to decrease outflow by an even greater magnitude; and impact that is *even more likely to be unreasonable*.**

III. COMPARISON OF IMPACT OF PUMPING ON OUTFLOWS TO COLORADO RIVER TRIBUTARIES

Introduction:

- Environmental flow standards have not been adopted for tributaries in this river segment
- The tributaries cannot be protected from the impacts of groundwater pumping by increased releases of surface water from the Highland Lakes.
- We need a method to protect the tributaries.
- The best method for monitoring and protecting the tributaries is likely to develop DFCs for the Colorado Alluvium Aquifer.
- Hydrological separation of stream gage records will help inform the need for instream flow and surface water-groundwater monitoring.

III. COMPARISON OF IMPACT OF PUMPING ON OUTFLOWS TO COLORADO RIVER TRIBUTARIES

New 2018 GAM combined discharge to the four tributaries (Big Sandy, Wilbarger, Piney and Cypress Creeks).

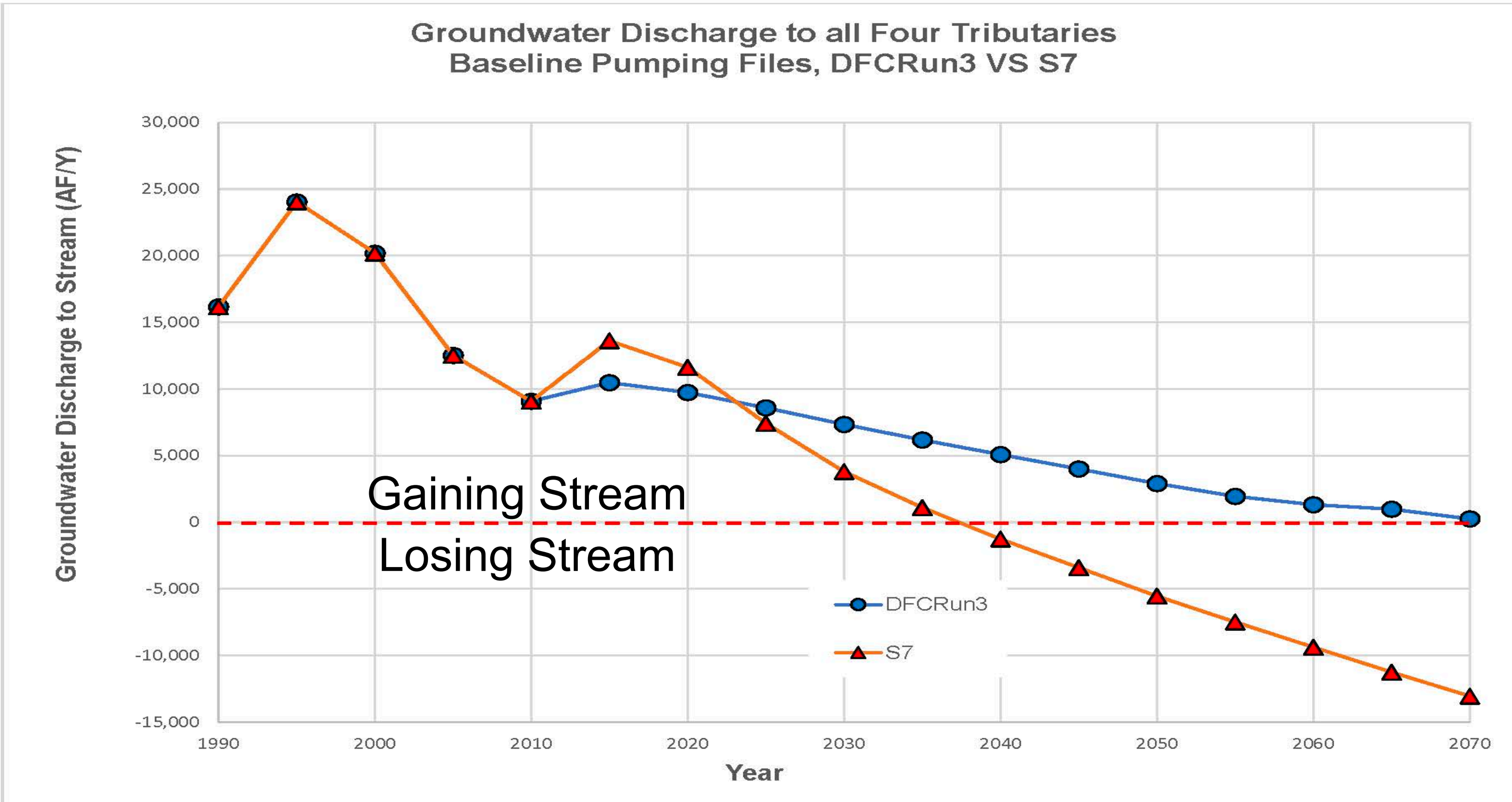
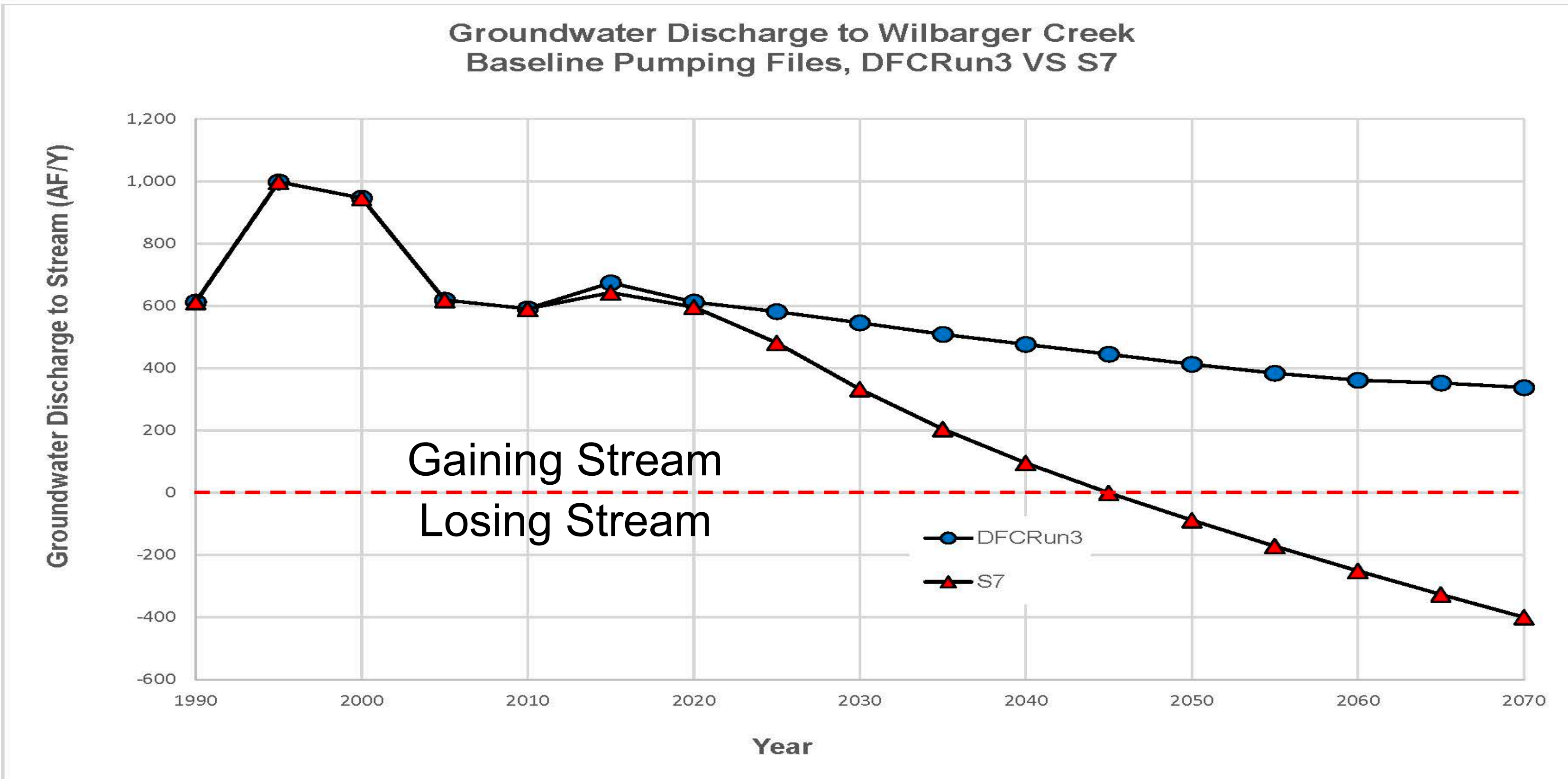


Figure 3: Groundwater Discharge to four tributaries of the Colorado River located primarily in Bastrop County, TX (New GAM).

Combined flow of four tributaries in Bastrop Co.

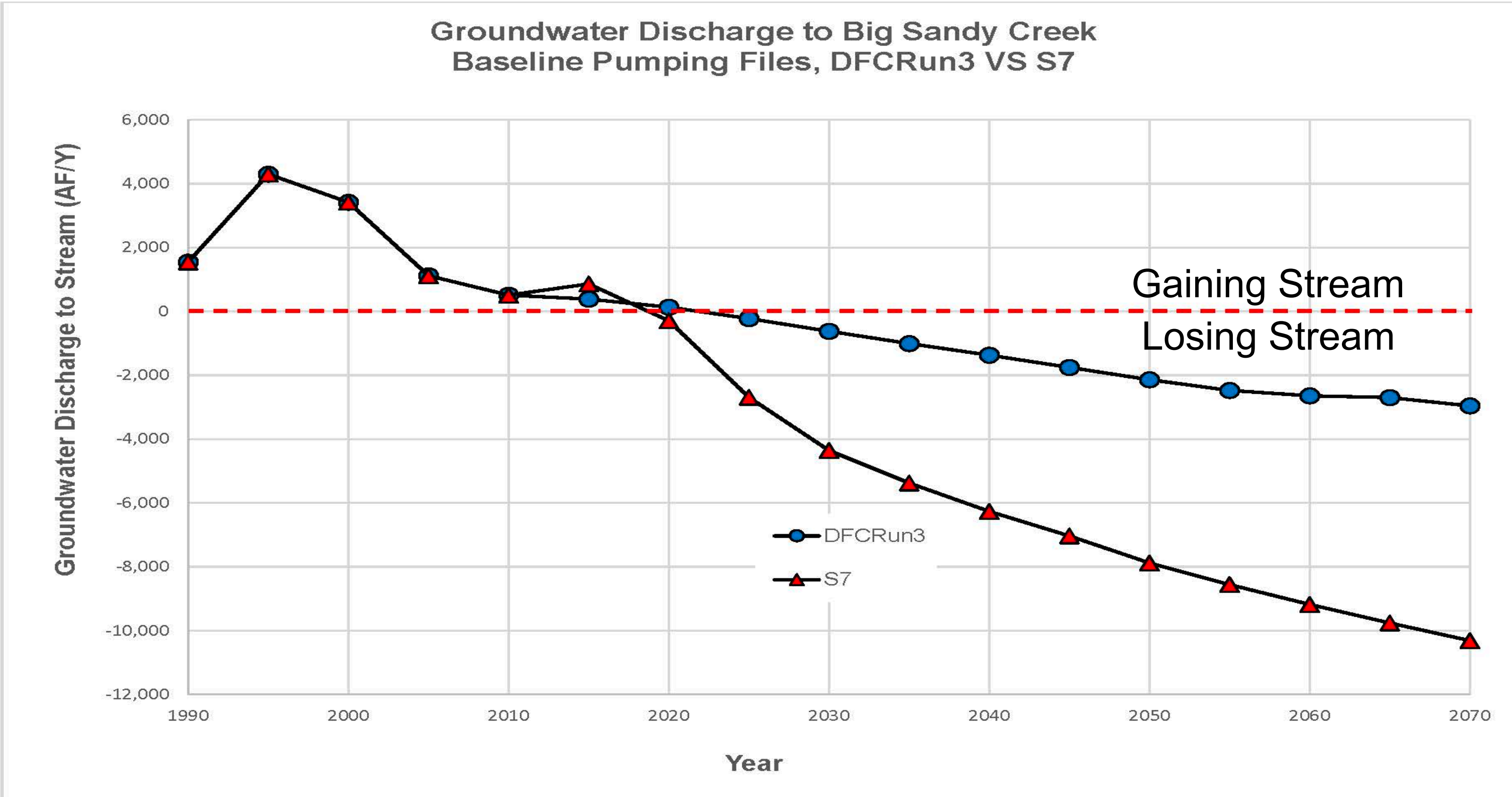
- **Combined discharge to the four tributaries:**
  - **Historic outflows were significantly higher than during development**
  - **Outflows declined during the early development period**
  - **Outflows are predicted to continue to decline as pumping increases in the current development period**
  - **Gain/Loss relationship will reverse during the planning period for currently adopted DFCs**
  - **S-7 pumping will accelerate the reversal by about three decades**

New GAM Predictions for Wilbarger Creek



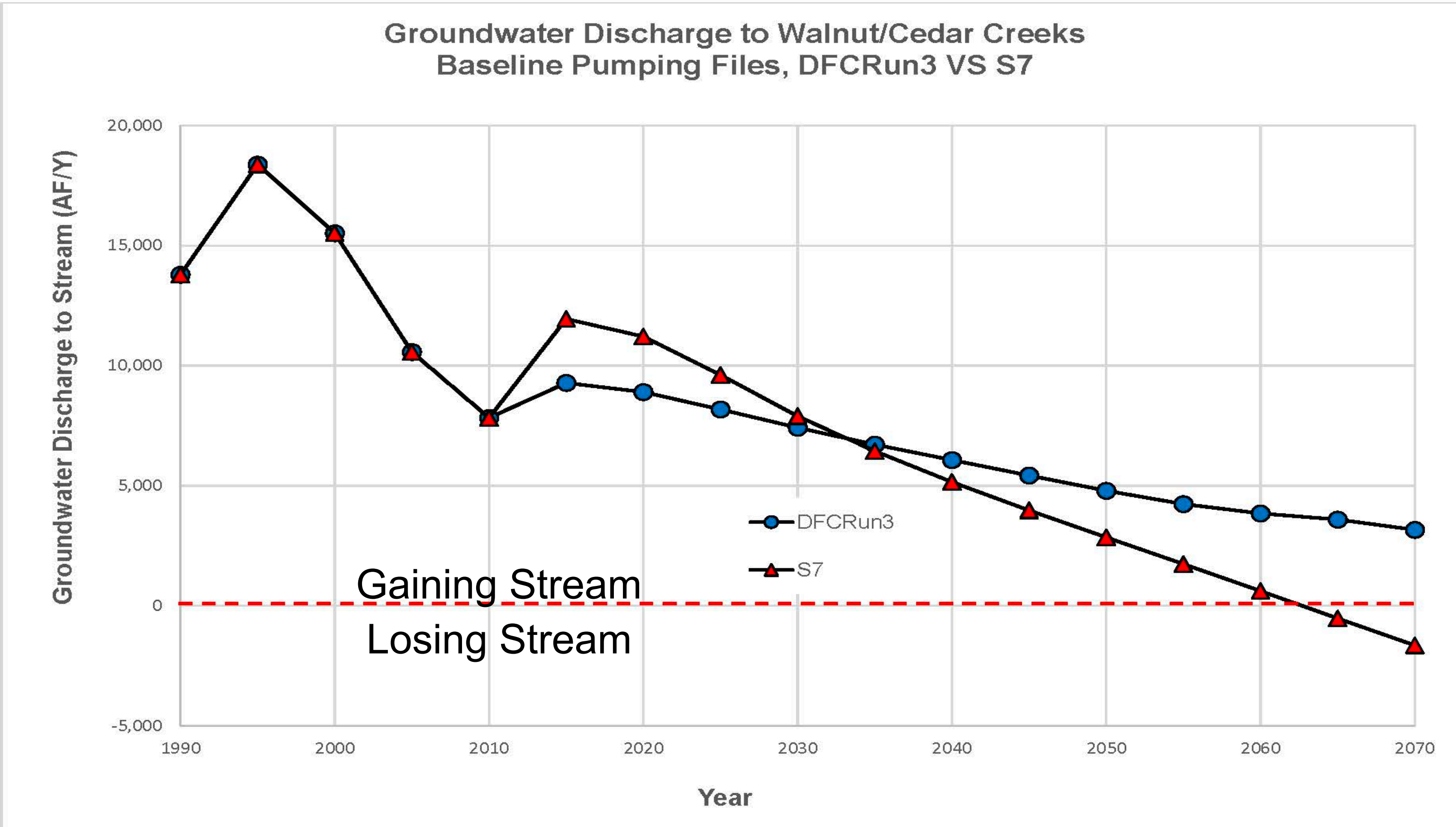
<u>Figure 4. Wilbarger Creek</u>: Overall, S-7 pumping caused a greater decline in outflows from the aquifers than DFC Run 3. Likewise, S-7 pumping is predicted to cause a reversal in the surface water-groundwater relationship whereas DFC Run 3 does not predict a reversal. Wilbarger Creek flows across the outcrops of the Hooper, and the Simsboro.

New GAM Predictions for Big Sandy Creek:



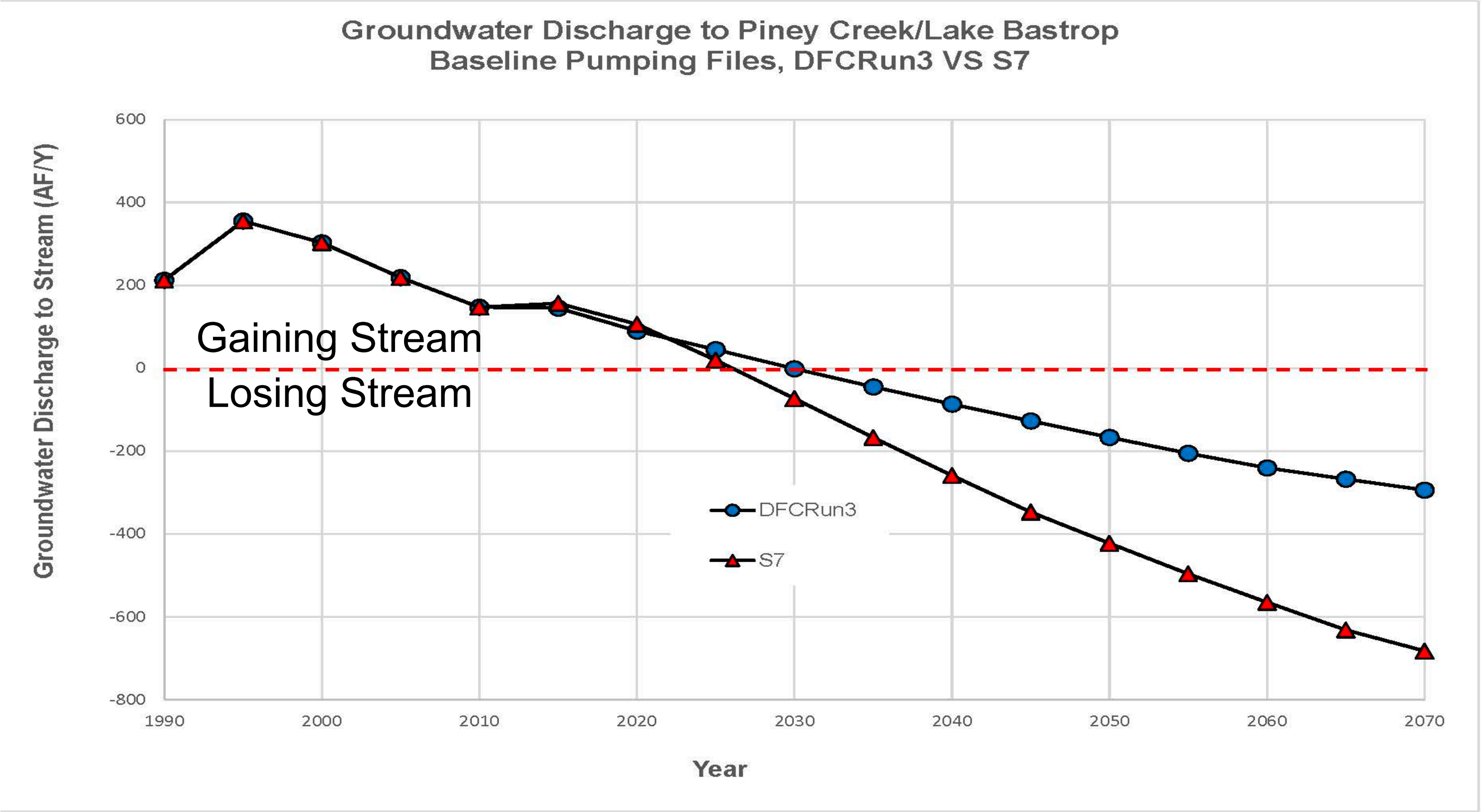
<u>Figure 4. Big Sandy Creek</u>: Overall, S-7 pumping caused a greater decline in outflows from the aquifers than DFC Run 3. Both DFC Run 3 and S-7 pumping predict a reversal in the surface water-groundwater relationship has already occurred. Big Sandy Creek flows across the outcrops of the Hooper, Simsboro, and Calvert Bluff.

New GAM Predictions for Walnut/Cedar Creek:



<u>Figure 4. Walnut/Cedar Creek</u>: Overall, S-7 pumping caused a greater decline in outflows from the aquifers. Likewise, S-7 pumping is predicted to cause a reversal in the surface water-groundwater relationship whereas DFC Run 3 does not predict a reversal. Walnut/Cedar flows across the outcrops of the Hooper, Simsboro, Calvert Bluff, and Carrizo.

New GAM Predictions for Piney Creek/Lake Bastrop



<u>Figure 4. Piney Creek/Lake Bastrop</u>: Overall, S-7 pumping caused a greater decline in outflows from the aquifers. Both S-7 pumping and DFC Run 3 are predicted to cause a reversal in the surface water-groundwater relationship. Piney Creek/Lake Bastrop flows across the outcrops of the Calvert Bluff and Carrizo.

III. COMPARISON OF IMPACT OF PUMPING ON OUTFLOWS TO COLORADO RIVER TRIBUTARIES

In summary:

- **Tributaries will change from gaining to losing streams during the current planning cycle:**
  - **Two of four reverse with the currently adopted DFCs**
  - **All reverse with S-7 pumping**
- **The best method for monitoring and protecting the tributaries is to develop DFCs for the Colorado Alluvium Aquifer.**
- **Hydrological separation of stream gage records, where such exist for tributaries, will help inform the need for instream monitoring and surface water-groundwater monitoring**
- **Initiation of the process to establish DFCs for the Colorado Alluvium Aquifer is requested as an initial basis for protecting tributary flows in the basin.**

IV. SURFACE WATER MODELING PREDICTS UNREASONABLE IMPACTS OF GROUNDWATER PUMPING ON SURFACE WATERS OF THE COLORADO RIVER

- **Use of established environmental flow standards is the appropriate means of evaluating the impact of groundwater pumping on surface waters.**
- **The Texas State Legislature recognized the value of Texas surface waters by enacting Senate Bill 3 signed into law June 16, 2007.**
- **Section 1.06 of the Bill acknowledges that *maintaining the biological soundness of the state's rivers, lakes, bays, and estuaries is of great importance to the public's economic health and general well-being*.**
- **TCEQ is required to consider and, *to the extent practicable, provide for the freshwater inflows and instream flows necessary to maintain the viability of the state's streams, rivers, and bay and estuary systems* in the granting of permits for the use of state waters.**

IV. SURFACE WATER MODELING PREDICTS UNREASONABLE IMPACTS OF GROUNDWATER PUMPING ON SURFACE WATERS OF THE COLORADO RIVER

- Expert science teams and area stakeholder committee were used to establish environmental flow regimes for the basins and bays of the state.

- "Environmental flow regimes" flow quantities that reflects seasonal and yearly fluctuations that typically would vary geographically, by specific location in a watershed, and that are *shown to be adequate to support a sound ecological environment and to maintain the productivity, extent, and persistence of key aquatic habitats in and along the affected water bodies*.

- After review by the Colorado and Lavaca Rivers Expert Science Team (CL BBEST) and the Colorado and Lavaca Basins and Matagorda and Lavaca Bays Area Stakeholder Committee (CL BBASC), a set of environmental flow recommendations were delivered to the TCEQ. The TCEQ adopted environmental flow standards on August 8, 2012 that became effective August 30, 2012 (APPENDIX 3).

Impacts on Surface Waters

Based on Mr. Trungale's analysis Environmental Stewardship, in agreement, concludes that:

- **Water in the Colorado River at Bastrop and below has, for all intents and purposes, been fully appropriated; *i.e.* no more water remains available for future appropriation as a water right.**
  - Any reductions in flows negatively impact existing water rights holders.
  - Groundwater pumping appears to create a gradual reduction of reliable streamflows, over a relatively long period of time.
- **The reduction in flows impact the ecological health of the Colorado River**.
  - Instream flow standards were adopted for the Colorado Rivers that included subsistence, base, high flow pulse, and bankfull flows necessary to maintain a sound environment for the Colorado River.
  - Subsistence flows should be considered “hands off flows” with the goal that flows should be met 100% of the time.

Impacts on Surface Waters - Continued

- **Environmental flow standards are not being met at recommended frequencies, and additional groundwater pumping will likely result in further reduction in these attainment frequencies.**
  - Attainment frequencies need to be met below Bastrop during spring when the *base dry and base average flows* are important to maintain the spawning habitat for the Blue Sucker.
  - The Blue Sucker *Cycleptus elongatus* is listed as a threatened species in Texas.
  - The Blue Sucker is a good indicator species for overall ecosystem health.
  - The 2010 Water Management Plan (WMP) had flow requirements specifically to keep Blue Sucker spawning habitat at or above 500 cfs to last for at least six weeks during the months of March, April, and May.
  - Severe drought affected the implementation of environmental releases for Blue Sucker from 2010-2012 when the LCRA requested emergency suspensions or reductions in required releases.

Impacts on Surface Waters - Continued

Impacts of reduced groundwater outflows to the Colorado River due to current and proposed DFCs:

- **Appendix 5 to Report provides detailed information regarding the attainment frequencies in the Lower Colorado River.**
  - The values in the table show the percentage of months when flows in the river are predicted to meet or exceed the adopted standards.
  - Results are provided for the three sites on the lower Colorado river where flow standards have been adopted (Bastrop, Columbus, and Wharton).

Impacts on Surface Waters - Continued

Impacts of reduced groundwater outflows to the Colorado River due to current and proposed DFCs:

- **Appendix 5 LEGEND:**
  - NAT – Naturalized Flows – frequency at which flow targets would be met or exceeded when considering the naturalized flows, which are the flows that would have been in the river had there been no human activities including reservoirs, diversions and return flows.
  - TCEQ3 – frequency at which flow targets would be met or exceeded when considering TCEQ Run3 which represents the Full Authorization data set in which all currently permitted perpetual water rights holders withdraw their full authorized amount of water.
  - DFCRun3 – frequency at which flow targets would be met or exceeded when considering groundwater pumping included in the DFC Run 3 GAM.
  - TCEQ3-DFC3 – Difference between the frequency at which flows are achieved under TCEQ3 versus DFC Run3 GAM.
  - S7 – frequency at which flow targets would be met or exceeded when considering groundwater pumping included in the Scenario S-7 GAM.
  - DFC3-S7 – Difference between the frequency at which flows are achieved under DFC Run3 GAM versus the S7 Scenario GAM.

Impacts on Surface Waters - Continued

- **Impacts of reduced groundwater outflows to the Colorado River due to current and proposed DFCs** (Appendix 5):

SUBSISTENCE FLOWS AT **BASTROP** GAGE

		TARGET ATTAINMENT FREQUENCY						
		100%						
		SUBSISTENCE FLOWS						
CP J30000	MONTH	FLOW (AC-FT/MO)	NAT % TIME MET	TCEQ3 % TIME MET	DFC3 % TIME MET	TCEQ3-DFC3 %	S7 % TIME MET	DFC3-S7 %
Bastrop	Jan	12,789	100.0%	94.6%	94.6%	0.0%	94.6%	0.0%
	Feb	15,217	98.6%	91.9%	93.2%	1.4%	91.9%	-1.4%
	Mar	16,847	97.3%	98.6%	98.6%	0.0%	98.6%	0.0%
	Apr	10,948	100.0%	100.0%	100.0%	0.0%	100.0%	0.0%
	May	16,909	100.0%	97.3%	97.3%	0.0%	97.3%	0.0%
	Jun	12,019	100.0%	100.0%	100.0%	0.0%	100.0%	0.0%
	Jul	8,423	100.0%	100.0%	100.0%	0.0%	100.0%	0.0%
	Aug	7,562	100.0%	100.0%	100.0%	0.0%	100.0%	0.0%
	Sep	7,319	100.0%	100.0%	100.0%	0.0%	100.0%	0.0%
	Oct	7,808	100.0%	100.0%	100.0%	0.0%	100.0%	0.0%
	Nov	10,710	100.0%	98.6%	97.3%	-1.4%	97.3%	0.0%
	Dec	11,436	100.0%	95.9%	95.9%	0.0%	94.6%	-1.4%
	Non-Attainment		2	6	6		6	

Impacts on Surface Waters - Continued

- **Impacts of reduced groundwater outflows to the Colorado River due to current and proposed DFCs** (Appendix 5):

SUBSISTENCE FLOWS AT **COLUMBUS** GAGE

		TARGET ATTAINMENT FREQUENCY						
		100%						
		SUBSISTENCE FLOWS						
CP J10000	MONTH	FLOW	NAT	TCEQ3	DFC3	TCEQ3-DFC3	S7	DFC3-S7
		(AC-FT/MO)	% TIME MET	% TIME MET	% TIME MET	%	% TIME MET	%
Columbus	Jan	20,905	97.3%	100.0%	100.0%	0.0%	100.0%	0.0%
	Feb	20,826	98.6%	94.6%	94.6%	0.0%	94.6%	0.0%
	Mar	23,057	91.9%	98.6%	97.3%	-1.4%	97.3%	0.0%
	Apr	17,791	100.0%	100.0%	100.0%	0.0%	100.0%	0.0%
	May	26,132	98.6%	100.0%	100.0%	0.0%	100.0%	0.0%
	Jun	31,775	98.6%	100.0%	100.0%	0.0%	100.0%	0.0%
	Jul	21,028	100.0%	100.0%	100.0%	0.0%	100.0%	0.0%
	Aug	11,682	100.0%	100.0%	100.0%	0.0%	100.0%	0.0%
	Sep	16,601	98.6%	100.0%	100.0%	0.0%	100.0%	0.0%
	Oct	11,682	100.0%	100.0%	100.0%	0.0%	100.0%	0.0%
	Nov	12,019	100.0%	97.3%	100.0%	2.7%	100.0%	0.0%
	Dec	18,507	98.6%	94.6%	91.9%	-2.7%	91.9%	0.0%
	Non-Attainment		7	4	3		3	

Impacts on Surface Waters - Continued

- **Impacts of reduced groundwater outflows to the Colorado River due to current and proposed DFCs** (Appendix 5):

SUBSISTENCE FLOWS AT **WHARTON** GAGE

		TARGET ATTAINMENT FREQUENCY						
		100%						
		SUBSISTENCE FLOWS						
CP K20000	**MONTH**	**FLOW**	**NAT**	**TCEQ3**	**DFC3**	**TCEQ3-DFC3**	**S7**	**DFC3-S7**
		(AC-FT/MO)	% TIME MET	% TIME MET	% TIME MET	%	% TIME MET	%
Wharton	**Jan**	19,368	100.0%	100.0%	100.0%	0.0%	100.0%	0.0%
	Feb	16,827	98.6%	98.6%	100.0%	1.4%	100.0%	0.0%
	Mar	12,543	97.3%	98.6%	98.6%	0.0%	98.6%	0.0%
	Apr	16,066	100.0%	98.6%	100.0%	1.4%	100.0%	0.0%
	May	18,692	100.0%	100.0%	100.0%	0.0%	100.0%	0.0%
	Jun	22,076	100.0%	97.3%	97.3%	0.0%	97.3%	0.0%
	Jul	13,035	100.0%	98.6%	98.6%	0.0%	98.6%	0.0%
	Aug	6,579	100.0%	100.0%	100.0%	0.0%	100.0%	0.0%
	Sep	11,186	100.0%	98.6%	98.6%	0.0%	97.3%	-1.4%
	Oct	9,038	100.0%	98.6%	100.0%	1.4%	100.0%	0.0%
	Nov	10,294	100.0%	98.6%	100.0%	1.4%	100.0%	0.0%
	Dec	12,420	100.0%	97.3%	94.6%	-2.7%	94.6%	0.0%
	Non-Attainment		2	9	5		5	

Impacts on Surface Waters - Continued

- **Impacts of reduced groundwater outflows to the Colorado River due to current and proposed DFCs** (Appendix 5):

BASE FLOWS– DRY CONDITIONS AT **BASTROP** GAGE

		TARGET ATTAINMENT FREQUENCY						
		80%						
		BASE FLOWS - DRY CONDITIONS						
CP J30000	MONTH	FLOW (AC-FT/MO)	NAT % TIME MET	TCEQ3 % TIME MET	DFC3 % TIME MET	TCEQ3-DFC3 %	S7 % TIME MET	DFC3-S7 %
Bastrop	Jan	19,245	97.3%	85.1%	86.5%	1.4%	85.1%	-1.4%
	Feb	17,605	98.6%	83.8%	85.1%	1.4%	85.1%	0.0%
	Mar	16,847	97.3%	98.6%	98.6%	0.0%	98.6%	0.0%
	Apr	17,077	100.0%	98.6%	98.6%	0.0%	98.6%	0.0%
	May	35,601	98.6%	95.9%	95.9%	0.0%	95.9%	0.0%
	Jun	24,872	100.0%	98.6%	98.6%	0.0%	98.6%	0.0%
	Jul	21,336	98.6%	98.6%	100.0%	1.4%	100.0%	0.0%
	Aug	11,928	100.0%	100.0%	100.0%	0.0%	100.0%	0.0%
	Sep	14,042	98.6%	98.6%	98.6%	0.0%	98.6%	0.0%
	Oct	15,064	98.6%	95.9%	95.9%	0.0%	94.6%	-1.4%
	Nov	16,839	97.3%	70.3%	63.5%	-6.8%	62.2%	-1.4%
	Dec	19,122	98.6%	73.0%	71.6%	-1.4%	71.6%	0.0%
	Non-Atta		0	2	2		2	

Impacts on Surface Waters - Continued

- **Impacts of reduced groundwater outflows to the Colorado River due to current and proposed DFCs** (Appendix 5):

BASE FLOWS– DRY CONDITIONS AT **COLUMBUS** GAGE

		TARGET ATTAINMENT FREQUENCY						
		80%						
		BASE FLOWS - DRY CONDITIONS						
CP J10000	**MONTH**	**FLOW**	**NAT**	**TCEQ3**	**DFC3**	**TCEQ3-DFC3**	**S7**	**DFC3-S7**
		(AC-FT/MO)	% TIME MET	% TIME MET	% TIME MET	%	% TIME MET	%
Columbus	**Jan**	29,944	93.2%	68.9%	68.9%	0.0%	68.9%	0.0%
	Feb	32,766	93.2%	64.9%	60.8%	-4.1%	60.8%	0.0%
	Mar	32,280	90.5%	73.0%	73.0%	0.0%	71.6%	-1.4%
	Apr	32,965	95.9%	93.2%	93.2%	0.0%	93.2%	0.0%
	May	59,397	91.9%	93.2%	93.2%	0.0%	93.2%	0.0%
	Jun	57,540	89.2%	93.2%	93.2%	0.0%	93.2%	0.0%
	Jul	35,047	91.9%	98.6%	98.6%	0.0%	98.6%	0.0%
	Aug	19,061	98.6%	100.0%	100.0%	0.0%	100.0%	0.0%
	Sep	24,099	95.9%	100.0%	100.0%	0.0%	98.6%	-1.4%
	Oct	21,889	98.6%	91.9%	87.8%	-4.1%	87.8%	0.0%
	Nov	28,561	86.5%	50.0%	50.0%	0.0%	47.3%	-2.7%
	Dec	28,530	91.9%	63.5%	60.8%	-2.7%	60.8%	0.0%
	Non-Atta		0	5	5		5	

Impacts on Surface Waters - Continued

- **Impacts of reduced groundwater outflows to the Colorado River due to current and proposed DFCs** (Appendix 5):

BASE FLOWS– DRY CONDITIONS AT **WHARTON** GAGE

		TARGET ATTAINMENT FREQUENCY						
		80%						
		BASE FLOWS - DRY CONDITIONS						
CP K20000	MONTH	FLOW	NAT	TCEQ3	DFC3	TCEQ3-DFC3	S7	DFC3-S7
		(AC-FT/MO)	% TIME MET	% TIME MET	% TIME MET	%	% TIME MET	%
Wharton	Jan	30,251	97.3%	73.0%	73.0%	0.0%	73.0%	0.0%
	Feb	33,155	93.2%	71.6%	67.6%	-4.1%	64.9%	-2.7%
	Mar	32,649	91.9%	62.2%	62.2%	0.0%	62.2%	0.0%
	Apr	33,381	97.3%	59.5%	59.5%	0.0%	59.5%	0.0%
	May	60,565	91.9%	54.1%	56.8%	2.7%	55.4%	-1.4%
	Jun	58,552	89.2%	60.8%	59.5%	-1.4%	58.1%	-1.4%
	Jul	35,478	93.2%	79.7%	74.3%	-5.4%	73.0%	-1.4%
	Aug	19,307	97.3%	79.7%	77.0%	-2.7%	77.0%	0.0%
	Sep	24,396	95.9%	73.0%	67.6%	-5.4%	67.6%	0.0%
	Oct	22,135	100.0%	71.6%	71.6%	0.0%	70.3%	-1.4%
	Nov	28,919	91.9%	62.2%	60.8%	-1.4%	59.5%	-1.4%
	Dec	28,899	93.2%	68.9%	68.9%	0.0%	67.6%	-1.4%
	Non-Atta		0	12	12		12	

Impacts on Surface Waters - Continued

- **Impacts of reduced groundwater outflows to the Colorado River due to current and proposed DFCs** (Appendix 5):

BASE FLOWS– AVERAGE CONDITIONS AT **BASTROP** GAGE

		TARGET ATTAINMENT FREQUENCY						
		60%						
		BASE FLOWS - AVERAGE CONDITIONS						
CP J30000	MONTH	FLOW (AC-FT/MO)	NAT % TIME MET	TCEQ3 % TIME MET	DFC3 % TIME MET	TCEQ3-DFC3 %	S7 % TIME MET	DFC3-S7 %
Bastrop	Jan	26,624	93.2%	56.8%	56.8%	0.0%	56.8%	0.0%
	Feb	27,601	94.6%	52.7%	52.7%	0.0%	52.7%	0.0%
	Mar	30,559	87.8%	74.3%	68.9%	-5.4%	67.6%	-1.4%
	Apr	37,785	95.9%	77.0%	75.7%	-1.4%	75.7%	0.0%
	May	50,665	93.2%	89.2%	89.2%	0.0%	89.2%	0.0%
	Jun	43,616	87.8%	93.2%	93.2%	0.0%	93.2%	0.0%
	Jul	37,507	87.8%	93.2%	93.2%	0.0%	93.2%	0.0%
	Aug	23,426	91.9%	97.3%	97.3%	0.0%	97.3%	0.0%
	Sep	25,170	94.6%	91.9%	89.2%	-2.7%	87.8%	-1.4%
	Oct	26,624	93.2%	74.3%	68.9%	-5.4%	66.2%	-2.7%
	Nov	25,229	87.8%	47.3%	47.3%	0.0%	47.3%	0.0%
	Dec	27,669	86.5%	54.1%	52.7%	-1.4%	52.7%	0.0%
	Non-Atta		0	4	4		4	

Impacts on Surface Waters - Continued

- **Impacts of reduced groundwater outflows to the Colorado River due to current and proposed DFCs** (Appendix 5):

BASE FLOWS– AVERAGE CONDITIONS AT **COLUMBUS** GAGE

		TARGET ATTAINMENT FREQUENCY						
		60%						
		BASE FLOWS - AVERAGE CONDITIONS						
CP J10000	MONTH	FLOW	NAT	TCEQ3	DFC3	TCEQ3-DFC3	S7	DFC3-S7
		(AC-FT/MO)	% TIME MET	% TIME MET	% TIME MET	%	% TIME MET	%
Columbus	Jan	50,911	75.7%	50.0%	50.0%	0.0%	50.0%	0.0%
	Feb	49,705	81.1%	45.9%	47.3%	1.4%	45.9%	-1.4%
	Mar	62,717	73.0%	50.0%	45.9%	-4.1%	45.9%	0.0%
	Apr	58,135	82.4%	52.7%	48.6%	-4.1%	48.6%	0.0%
	May	80,917	87.8%	86.5%	86.5%	0.0%	85.1%	-1.4%
	Jun	85,685	78.4%	86.5%	86.5%	0.0%	86.5%	0.0%
	Jul	55,031	75.7%	87.8%	85.1%	-2.7%	85.1%	0.0%
	Aug	31,727	89.2%	90.5%	86.5%	-4.1%	85.1%	-1.4%
	Sep	36,297	93.2%	82.4%	78.4%	-4.1%	79.7%	1.4%
	Oct	45,562	86.5%	62.2%	62.2%	0.0%	59.5%	-2.7%
	Nov	44,925	75.7%	43.2%	43.2%	0.0%	43.2%	0.0%
	Dec	45,316	75.7%	41.9%	36.5%	-5.4%	36.5%	0.0%
	Non-Atta		0	6	6		7	

Impacts on Surface Waters - Continued

- **Impacts of reduced groundwater outflows to the Colorado River due to current and proposed DFCs** (Appendix 5):

BASE FLOWS– AVERAGE CONDITIONS AT **WHARTON** GAGE

CP K20000	MONTH	FLOW	NAT	TCEQ3	DFC3	TCEQ3-DFC3	S7	DFC3-S7
		TARGET ATTAINMENT FREQUENCY						
		60%						
		BASE FLOWS - AVERAGE CONDITIONS						
		(AC-FT/MO)	% TIME MET	% TIME MET	% TIME MET	%	% TIME MET	%
Wharton	Jan	51,526	77.0%	58.1%	56.8%	-1.4%	56.8%	0.0%
	Feb	50,316	83.8%	48.6%	48.6%	0.0%	48.6%	0.0%
	Mar	63,701	74.3%	44.6%	43.2%	-1.4%	43.2%	0.0%
	Apr	60,158	85.1%	48.6%	45.9%	-2.7%	45.9%	0.0%
	May	85,898	85.1%	44.6%	44.6%	0.0%	44.6%	0.0%
	Jun	89,970	77.0%	32.4%	33.8%	1.4%	33.8%	0.0%
	Jul	55,707	78.4%	44.6%	36.5%	-8.1%	37.8%	1.4%
	Aug	32,096	90.5%	73.0%	73.0%	0.0%	70.3%	-2.7%
	Sep	36,714	94.6%	51.4%	48.6%	-2.7%	48.6%	0.0%
	Oct	46,054	87.8%	48.6%	48.6%	0.0%	47.3%	-1.4%
	Nov	45,461	79.7%	41.9%	40.5%	-1.4%	40.5%	0.0%
	Dec	45,869	78.4%	54.1%	52.7%	-1.4%	52.7%	0.0%
	Non-Atta		0	11	11		11	

Impacts on Surface Waters - Continued

RESULTS for TCEQ Simulation:

- In many months at multiple sites the target frequencies are not met.
- Of particular concern is the failure to achieve the desire frequency of 60% of the time for the base average flows to provide spring spawning habitat for the Blue Sucker in (March and April) in the Columbus reach.

Impacts on Surface Waters - Continued

RESULTS for DFC Simulations:

- The column labeled “TCEQ3-DFC3” shows that the attainment frequencies would be expected to fall due to the pumping that is projected by the New GAM run that **represents the currently adopted DFCs.**
- The column labeled “DFC3-G7” show the additional decrease that would be expected **if Scenario S7 were to be adopted**.
- In months where the attainment frequencies are already failing to meet the target frequencies, such as the base-average targets in March and April at Columbus, **an unsound environmental condition would be made even worse.**
- The flow standards were developed to support the full community of species in the lower Colorado and **these negative trends extend the entire length of the river and into Matagorda Bay**.

Impacts on Surface Waters - Continued

In Summary:

- **Texas groundwater law requires that permits for wells shall consider whether the proposed use of water unreasonably affects existing groundwater and surface water resources for existing permit holders**.
  - The effect of the proposed groundwater pumping on surface water resources is unreasonable because it increases the shortfalls in meeting environmental flow targets.
  - Since the flows in the river are already often below levels needed to maintain the ecological health of the river, then any additional pumping that causes further instream flow reduction is unreasonable.

Impacts on Surface Waters - Continued

Summary - continued:

- **Groundwater and surface water sources are physically connected and considering them as independent and disjointed is contrary to reality.**
    - The best available science concludes, logically, that pumping water from aquifers near the Colorado River and its tributaries will *reduce the flow in the river and the tributaries*.
    - The reduction in flow will also mean that the flows needed to maintain a sound environment, which in some cases are already not being meet, *would be further reduced below levels recommended by the best available science*.
    - The *uncertainty regarding the precise magnitude of the river flow decline does not change the fundamental dynamics*.
    - Groundwater pumping will decrease flows in the river and the tributaries, and for the reasons stated above, the river cannot afford the reduction.

V. THE NEED FOR FIELD STUDIES TO VALIDATE THE NEW GAM AND INFORM WATER MANAGEMENT PLANS

The following conclusions from this analysis should inform the path forward:

- The New 2018/2020 GAM is the best model to use.
- Field studies are needed to confirm the impacts of groundwater pumping on surface waters and to provide empirical data to update the GAM.
- Sufficient monitoring of the interaction between surface water and groundwater is needed to address conjunctive use of water in the District's management plans and in the adoption of the DFCs.
- Monitoring is required to have sufficient knowledge to mitigate, and, if possible, prevent such impacts predicted by the modeling.

V. THE NEED FOR FIELD STUDIES TO VALIDATE THE NEW GAM AND INFORM WATER MANAGEMENT PLANS

In summary:

- Field studies to monitor surface water-groundwater interaction are needed in order to validate the New 2020 GMA-12 GAM
- The methodology for conducting such studies have been developed and practiced in other portions of the Colorado River basin and are described in documents available to the Districts.
- Pilot studies that are currently underway should help refine the methodology and identify suitable monitoring sites within the Utley-Bastrop segment of the basin.
- Funding is needed to enable such monitoring to proceed in a timely manner.

VI. GMA-12 PRESENTATION: CONSIDERATION FOR ENVIRONMENTAL IMPACTS

Hydrologic separation of gage data to quantify drought conditions

- A hydrograph separation on the three-year period represented in Figure 8, with irrigation releases and return-flows accounted for, would likely reveal a very good estimate of actual groundwater outflows to the river from the Carrizo-Wilcox Aquifer group.

- During this period the bank storage for the river had likely been exhausted and the river was relying on the minimum flows passing through the Austin gage at Longhorn Dam, City of Austin, Pflugerville and Elgin return flows, and groundwater baseflows.

VI. GMA-12 PRESENTATION: CONSIDERATION FOR ENVIRONMENTAL IMPACTS

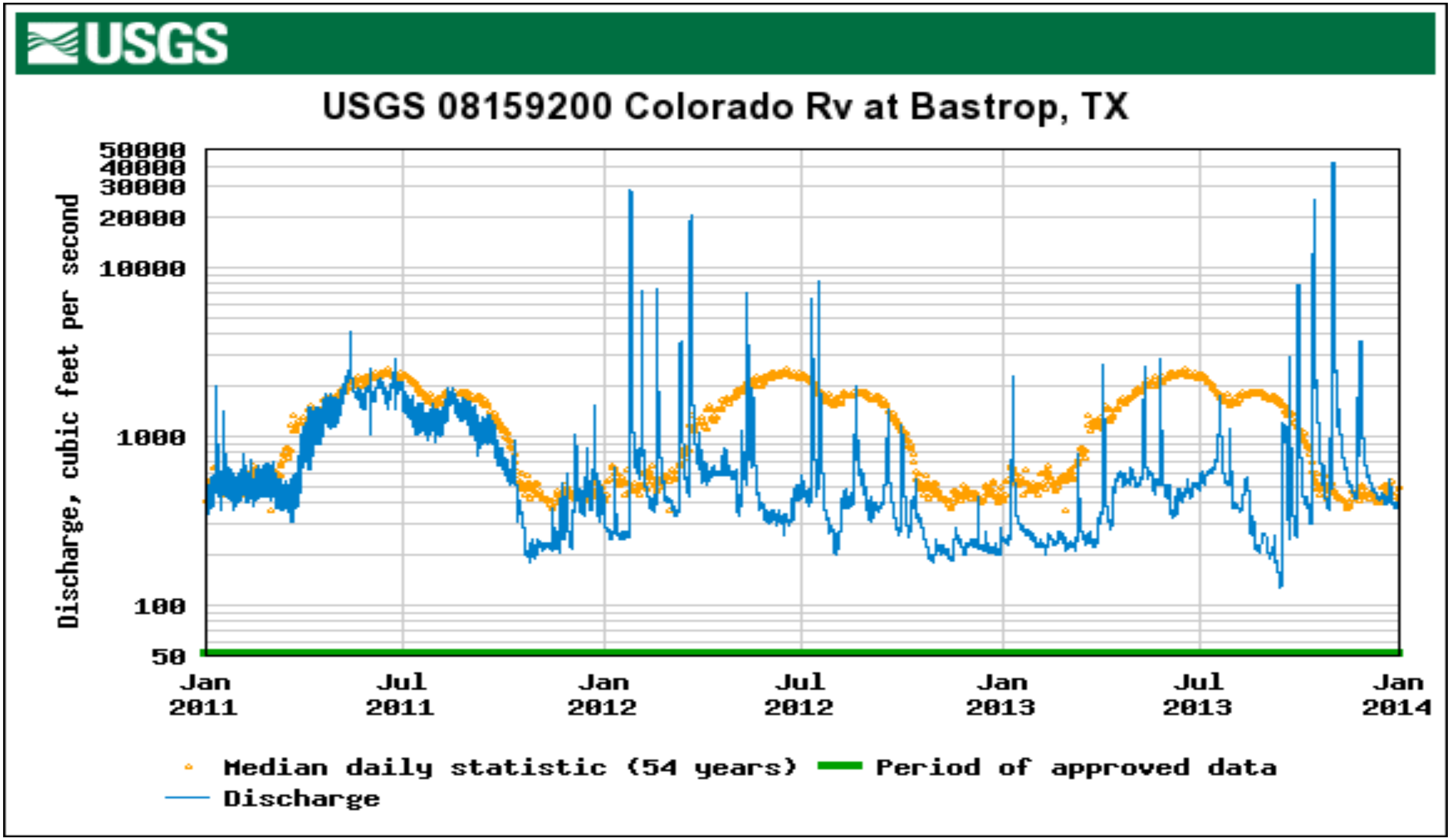


Figure 8. Colorado River at Bastrop gage during drought period Jan. 2011 - Dec. 2013. A hydrograph separation is requested for the period.

VI. GMA-12 PRESENTATION: CONSIDERATION FOR ENVIRONMENTAL IMPACTS

In summary:

- Environmental Stewardship again requests that GMA-12 direct the consultants to prepare hydrographic separations as described above for the period January 2011 through December 2013 for the Bastrop, Wilbarger and Big Sandy gages of the Colorado River to gain insights on the quantity of groundwater that was being contributed to river flow for this extraordinary drought period.

VII. SELECTION OF DFCs THAT BALANCE IMPACTS ON SURFACE WATERS WITH DEVELOPMENT OF GROUNDWATER RESOURCES

Proposed DFC Component for Bastrop Gage

- Subsistence flow in the Colorado River at the Bastrop Gage will be met 100% of the time throughout each year.
- Base-dry and base-average flow will be met during the spring (March - June) in order to protect the state-threatened Blue Sucker.
- Non-exempt pumping within the Colorado River basin will be proportionately curtailed if subsistence, base-dry or base-average flow drops below the month's standard, expressed in cubic feet per second (cfs), for seven (7) cumulative days during any month.

VII. SELECTION OF DFCs THAT BALANCE IMPACTS ON SURFACE WATERS WITH DEVELOPMENT OF GROUNDWATER RESOURCES

Proposed DFC Component for Colorado Alluvium Aquifer

- DFC components for Colorado River Alluvium should follow these guiding principles:
  - DFC components should be developed for Bastrop and Fayette counties.
  - DFC components should maintain the overall gaining status of the river; that is, the river continues to gain groundwater from the alluvium and the hydrologically connected underlaying aquifers.
  - DFC components should contribute to maintaining the biological soundness of the river and its tributaries by reflecting the environmental flow standards that have been adopted for the Bastrop gage.
  - DFC component should consider the major tributaries associated with the alluvium and the aquifers communicating with those tributaries; Carrizo, Wilcox Group, Sparta, Queen City and Yegua-Jackson.
  - DFC components should be measured and monitored at appropriate surface water-groundwater sites associated with the Utley, Bastrop, Smithville and La Grange river gages.

VII. SELECTION OF DFCs THAT BALANCE IMPACTS ON SURFACE WATERS WITH DEVELOPMENT OF GROUNDWATER RESOURCES

In Summary, ES asks that GMA-12 consider the following factors:

- The current adopted 2017 DFCs are the most protective of surface waters in the Colorado River basin of the DFCs under consideration; as predicted by both the Old and New GAM.

- The GAMs predict that the significant quantity of newly permitted pumping since the 2017 DFCs were adopted have the potential of causing increased and potentially greater impacts on the Colorado River and its tributaries.

- Available surface-water impact methodologies indicate that the impacts of increased groundwater pumping are potentially unreasonable.

- Field data are needed to validate the New 2020 GAM and to verify what conditions exit.

VII. SELECTION OF DFCs THAT BALANCE IMPACTS ON SURFACE WATERS WITH DEVELOPMENT OF GROUNDWATER RESOURCES

Based on a consideration of these factors, ES requests that the Districts, as a part of Consideration 4, take the following actions:

- Monitor impacts of groundwater pumping on the mainstem of the Colorado River and its tributaries.
- Perform certain hydrograph separation studies to evaluate groundwater flow contributions under drought conditions and to inform development of a surface water DFC component.
- Establish a DFC component that is protective of surface water, including subsistence, base-dry and base-average flows, that will trigger corrective actions should the predictions of surface water impacts be realized in fact.
- Initiate the development of DFCs for the Colorado Alluvium Aquifer in anticipation of adopting such DFCs during the next planning cycle.

VII. SELECTION OF DFCs THAT BALANCE IMPACTS ON SURFACE WATERS WITH DEVELOPMENT OF GROUNDWATER RESOURCES

Based on a consideration of these factors, ES requests that the Districts, as a part of Consideration 4, take the following actions:

- Seek to establish criteria to qualitative and quantitative evaluate the impacts of reduced contributions of groundwater to baseflows into rivers and streams.
- Seek to establish criteria to determining when such impacts become unreasonable and thereby require remedial actions.

Why these are GMA-Wide Concerns.

- Impacts of groundwater pumping on surface waters are experienced in all watersheds within the GMA-12 territories.
- These comments focus on the Colorado River basin since DFCs already exist for the Brazos River Basin.
  - DFCs should likely include a surface water component for the river and tributaries.
- All Districts need to address conjunctive water management in their water management plans and in the adoption of the DFCs.
  - Sufficient monitoring of the interaction between surface water and groundwater is needed GMA-wide to perform this function.
- GAM modeling shows the possibility of future unreasonable effects on surface water resources caused by the cumulative effects of GMA-wide pumping.
  - GMA-wide monitoring is required to have sufficient knowledge to mitigate, and, if possible, prevent such impacts.

Environmental Stewardship

A Sustainable Ecosphere

Environmental-Stewardship.org
512-300-6609
info@envstewardship.org