

4B.4 System Operation of Brazos River Authority Reservoirs

The Brazos River Authority (BRA) has submitted to the Texas Commission on Environmental Quality (TCEQ) water rights permit application 12-5851 requesting additional appropriation of water that could be made available through system operations of the BRA's existing water rights and reservoirs. The application requested an appropriation of up to 421,449 acft/yr of firm supply. The BRA also requests authorization to use up to 90,000 acft/yr of its firm supply to produce, along with other unappropriated flows, an interruptible supply of up to 670,000 acft/yr for appropriation. By conventional definition, at least 75 percent of an interruptible supply is available at least 75 percent of the time. An initial draft permit was released by the TCEQ on December 1, 2008. A final draft permit has not been issued.

The Brazos G RWPG evaluated the BRA System Operations (Sys-Ops) as a potential water management strategy for the 2011 Brazos G Regional Water Plan (2011 Plan).

The evaluation was completed through two tasks:

1. Incorporate the BRA System Operations into the Brazos G WAM and determine the maximum amount that could be made available under the constraints of existing contractual obligations and future reservoir sedimentation conditions.
2. Determine the additional water supply that would be made available by the BRA System Operations to Water User Groups (WUGs) with needs that could potentially utilize the additional supply.

4B.4.1 Availability of Water from the BRA System Operations

The water requested in the BRA water rights permit application was the maximum amount of water that could be developed by the BRA System if all of the water were utilized (diverted) near the Gulf of Mexico. Diverting all water supply from the BRA System (both existing and new appropriations) near the Gulf maximizes the supply available by (a) allowing all BRA reservoirs to contribute and make releases, and (b) maximizes the area contributing flows (uncontrolled runoff and wastewater return flows^{1,2}) that originate downstream of the BRA reservoirs. Under this hypothetical operation (diverting all supply near the Gulf), uncontrolled flow originating downstream of the BRA reservoirs is diverted during wet times, and firmed up by releases from storage in the upstream BRA reservoirs during dry times. In this

¹ This water management strategy shall not impair or prejudice the rights of an owner of groundwater based discharges to seek or obtain authorization to reuse such discharges either directly or indirectly pursuant to Texas Water Code Section §11.042 (b) consistent with state law.

² The permit application interrupts BRA's appropriation for reuse by the discharger if such reuse is within the discharger's water service area.

fashion, a total “system” yield can be developed that is substantially greater than the sum of the individual reservoir yields.

The BRA currently holds multiple contracts to supply water to cities, districts, irrigators and industry throughout the Brazos River Basin. Many of these contracts are supplied proximate to the BRA’s reservoirs, or through lakeside diversions. This reduces the efficiency of the BRA System because (a) not every BRA reservoir can contribute releases to every contractual diversion location, and (b) diversion of the contracts from the basin upstream of the Gulf reduces the opportunity to utilize flows contributed by the basin downstream of the reservoir system. Because of this constraint, the total amount of water that the BRA could realize through system operations of its reservoirs is less than the amount stated in the permit application.

The Brazos G WAM was utilized to determine the availability of water from the BRA System. The Brazos G WAM, as developed by the Brazos G RWPG, includes 619,616 acft of the 698,440 acft of existing BRA contracts simulated at their actual points of diversion in the basin. Priority calls agreements that the BRA has accounts for 2,781 acft of this difference, and another 24,800 acft of the difference is because it is tied to supply from the Colorado River Basin. Some of the BRA contracts, especially those in the Little River System (Proctor, Belton, Stillhouse, Georgetown), are shorted, or in other words, they are not 100% reliable when simulated under the Brazos G WAM assumptions. Some of these contracts’ diversion amounts were reduced in the modeling effort so that their reliability was reported as 100%. This was done so that when the Sys-Ops component was added to the model the user just had to make sure reliabilities stayed at 100% and not some other percentage. These shortages are the result of the BRA contracting policy of meeting current demands from existing sources, realizing that new sources of water must be developed in the future to meet all contractual commitments. The thought was always that these are not shortages on these contract holders, but rather shortages on BRA as the Wholesale Water Provider (WWP). Due to a TWDB database rule, shortages can not be shown in this manner. Because of the iterative process required when modifying the Sys-Ops, instead of going back and prorating each contract and rerunning the model, select contracts were reduced and the proration was applied after the modeling step. Spreadsheet work was done that took the difference in the total contract amounts and the amount modeled, and then applied these differences using a proration to all the contracts, except in a few exceptions that BRA indicated, shown below.

- City of Temple 18,500 acft storage contract should be kept at 18,500 acft.
- City of Taylor contract – this is a needs met contract and BRA allocates 13,000 acft to meet Taylor and Jonah’s needs. BRA suggested showing a supply to Taylor of 5,344 acft (meets their 2060 demand);
- Jonah SUD – needs met contract, suggest showing an additional surface water supply of 1,960 acft (meets their 2060 needs).
- Because Lake Proctor is a stand-alone supply used to meet local needs – its supply and contracts should be excluded from the allocation of supplies and contracts in the rest of the Little River System.

The BRA System operations concept was incorporated into the Brazos G WAM by specifying which contracts could receive releases from multiple reservoirs, and then allowing those reservoirs to make releases during model simulations. The remaining water available from the BRA System (after supplying current contractual commitments) was then evaluated at the Gulf of Mexico. The BRA application includes estimates of potential system diversions at three locations: Brazos River near Glen Rose, Brazos River near Highbank, and the Brazos River at Richmond. The analysis performed for the Brazos G RWPG evaluating the effects of the BRA System Operations includes only the Brazos River at the Richmond system diversion location.

During the model simulations, the BRA contracts are met first from the BRA System, followed by the remaining amount that could be met at the Richmond diversion. This would be the maximum amount that could be realized by the BRA under the agency’s current contractual commitments. If the BRA’s contractual commitments change in the future, the availability of water from the BRA System would also change accordingly. All simulations assume Year 2060 reservoir sedimentation conditions. The Allens Creek reservoir project was included in the BRA Sys-Ops analysis, as it is permitted, but not constructed, and is included as part of the pending application on file at the TCEQ.

Results of the water availability analysis are shown in Table 4B.4-1. The sum of the BRA’s existing contractual obligations included in this analysis total 619,616 acft/year, which includes reducing some downstream contractual demands by 8% to account for delivery losses from the upstream reservoirs. Table 4B.4-2 summarizes the existing BRA contractual commitments that are located outside of the Brazos G Area in Region H.

Table 4B.4-1.
Water Availability from BRA System Operations

BRA Stand Alone Firm Yield (acft/yr)	BRA Contractual Diversions¹ (acft/yr)	Upstream Luminant Contract (acft/yr)	Diversions at Richmond (acft/yr)	Total BRA System Diversions² (acft/yr)	Yield Benefit from System Operations² (acft/yr)
631,086	619,616	76,270	137,000	832,886	201,800
¹ This value includes only the portions of contracts simulated in the model analysis. ² The Allen's Creek Project is included in these runs as it is permitted and included as part of the BRA Sys-Ops application pending with the TCEQ even though it is not currently constructed.					

Table 4B.4-2.
BRA Contracts in Region H

Owner	BRA Contracted Diversions (acft/yr)	Diversion¹ Simulated (acft/yr)
All Seasons Turf Grass, Inc.	50	50
Dow Pipeline Company	16,000	14,720
Gulf Coast Water Authority	37,668	34,654
Horizon Turf Grass, Inc.	350	350
NRG Texas, LLC	83,000	76,360
Pecan Grove MUD	3,100	2,852
City of Richmond	3,000	2,760
City of Rosenberg	4,500	4,140
South Texas Water Co.	5,625	5,175
Vulcan Const. Materials L.P.	400	368
Totals	153,693	141,429
¹ Some of these contracts were reduced for delivery losses from the main stem BRA reservoirs. BRA contracts are generally structured so that the purchaser assumes the delivery losses from the reservoir to the diversion point.		

The actual BRA contractual commitments total 670,589 acft/yr, exclusive of subordination agreements, which were simulated in the model instead of being included as contracts. The BRA has indicated plans to contract a portion of the Sys-Ops supply to Luminant Power to provide an additional 76,270 acft/yr for steam electric generation purposes out of Lake Granbury with additional releases from Possum Kingdom. This supply was evaluated and the

Brazos G 2006 Regional Water Plan was amended accordingly. After meeting existing upstream contractual commitments and the anticipated Luminant commitment, an additional 137,000 acft/yr of firm supply could be developed at Richmond by system operations of the BRA reservoirs. This total includes both currently permitted yield that is not utilized by existing contracts, and unpermitted yield that could be developed by the system operations.

The availability of interruptible supply was not evaluated for this update of the Brazos G 2011 Plan. The Richmond diversion scenario was utilized as the standard “base run” with which the remaining portion of the analysis was completed.

4B.4.2 Utilization of the BRA System Operations as a Water Management Strategy for Specific WUGs in the Brazos G Area

Water available from BRA System Operations represents a new supply of water that could be utilized to meet future needs in the Brazos G Area without construction of new reservoirs. WUGs with projected needs were identified in counties adjacent to the main stem of the Brazos River. Demands equal to those needs were included as new contractual diversions in the system operations version of the Brazos G WAM. The model was then used to determine if sufficient water was available from system operations to meet the projected needs of each of the WUGs, as well as the facility and operational costs for diversion, transmission, and treatment.

4B.4.2.1 Selected WUG with Needs

In consultation with the BRA, seventeen potential WUGs were identified proximate to the main stem of the Brazos River with projected needs. These WUG needs were simulated as being diverted from seven different locations along the main stem of the Brazos River. Figure 4B.4-1 shows the seven diversion locations, and Table 4B.4-2 lists the seventeen WUGs selected for which water available from BRA System Operations might be a feasible water management strategy. WUGs with needs based on infrastructure constraints were not included as selected WUGs.

4B.4.2.2 Water Availability to WUGs with Needs

The individual WUG diversions were incorporated into the model in upstream to downstream order, and assigned priority junior to BRA’s existing water supply contracts. As

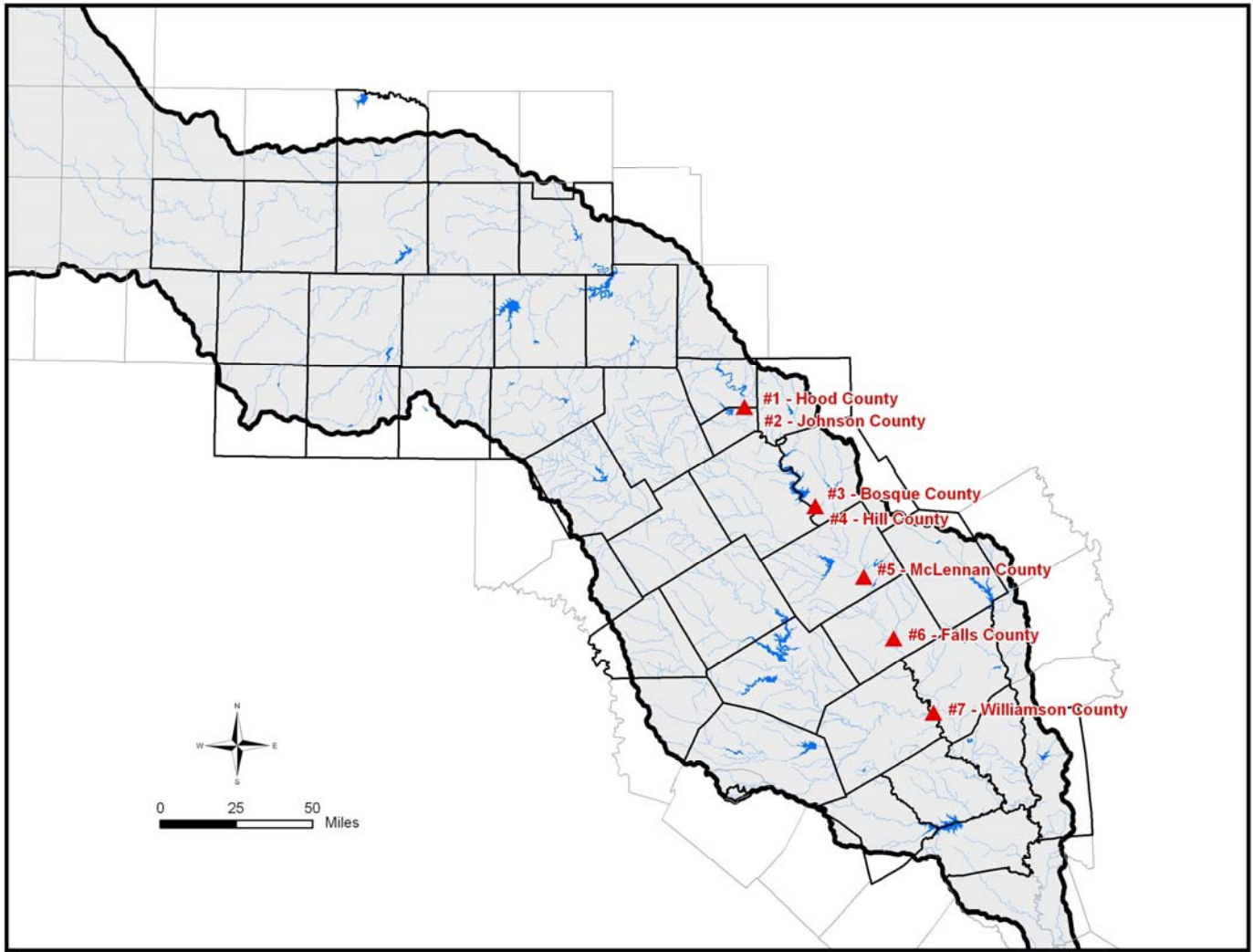


Figure 4B.4-1. WUG Diversion Locations

additional WUG diversions are added in the downstream direction, additional BRA reservoirs are capable of making releases to meet the demands, and the remaining supply available at the Richmond location is reduced in response to the additional upstream demand.

All 17 WUG needs are able to be met exclusively by the BRA system without negatively impacting any existing BRA water supply obligations. However, in order to be able to meet the additional 13,927 acft of identified WUG demands, the remaining supply at Richmond was reduced by 12,000 acft to 125,000 acft/yr.

**Table 4B.4-2.
Potential WUGs for Availability and Cost Analysis**

Diversion Location #	County	Combined WUG Need (acft/yr)	Included WUGs
1	Hood County	1,815	Cresson DeCordova Lipan Oak Trail Shores Subdivision Tolar
2	Johnson County	5,446	Cleburne Cresson Keene Parker WSC Johnson County Manufacturing
3	Bosque County	5,461	Bosque Steam Electric
4	Hill County	673	White Bluff Community WSC Woodrow-Osceola WSC
5	McLennan County	112	Robinson
6	Falls County	241	West Brazos WSC
7	Williamson County	179	Bartlett BMF WSC
Total WUG Needs		13,927	

4B.4.2.3 Costs for Meeting WUG Needs with BRA System Supply

The following sections describe the estimated facilities and operational costs associated with diverting, transmitting, and treating the BRA system water to meet the identified WUG needs. Raw water costs were set equal to the FY 2008 BRA system rate of \$54.50 per acft for most strategies to be consistent with the TWDB assumption of using September 2008 prices. Facilities and operation costs for the 6 WUG supply scenarios were estimated using the cost estimating procedure used for other water management strategies evaluated for the 2011 Plan.

Of the 17 WUG strategies evaluated, six are recommended to meet future needs. Table 4B.4-3 presents a summary comparison of the costs for the six individual WUGs for which BRA System Operation Supply is a recommended strategy. Unit costs vary considerably due to economies of scale and treatment considerations for the type of use contemplated. Desalination was considered necessary for all municipal and manufacturing uses, but not mining or steam electric uses. Large individual unit costs could be decreased by serving additional WUGs beyond those enumerated herein. The costs for the Somervell County Steam Electric need are presented in the plan section for Somervell County (Section 4C.30), updated to September 2008 prices from the 2006 plan amendment documents included in Volume II, Section 4B.21.

Table 4B.4-3.
WUGs for which BRA System Operation Supply is a Recommended Strategy

WUG	WUG Location	Demand (acft/yr)	Capital Cost	Annual Cost	Unit Cost (\$/acft)	Unit Cost (\$/1,000 gal)
Bosque Steam-Electric	Bosque County	5,222	\$17,125,000	\$3,307,000	\$633	\$1.94
White Bluff Community WS	Hill County	600	\$6,533,000	\$1,288,000	\$2,147	\$6.59
Woodrow-Osceola WSC	Hill County	150	\$4,744,000	\$819,000	\$5,460	\$16.75
Cleburne	Johnson County	1,530	\$9,337,000	\$1,526,000	\$997	\$3.06
Keene	Johnson County	157	\$1,847,000	\$481,000	\$3,064	\$9.40
Somervell County Steam-Electric	Somervell County	103,717 ¹	\$47,866,000	\$12,927,000	\$125	\$0.38

¹ 103,717 includes 27,447 of existing Luminant contract supplies from BRA and the Sys-Ops portion is 76,270 acft.

4B.4.3 Summary of Hydrologic Findings Concerning the Proposed BRA System Operations

The proposed BRA System Operations appropriation would add a considerable amount of firm supply to the Brazos River Basin that could be used in the Brazos G Area, but also in adjacent regions where the BRA supplies water, most notably Region H (Houston area). New proposed water management strategies may be impacted negatively by the BRA System Operations, but only to the extent that priority limits availability to the new options.

Supply from the BRA System Operations can be utilized to meet WUG demands throughout the Brazos Basin. Several WUGs with needs were identified, and unit cost estimates for using BRA System Operations supply to meet these needs ranged from \$286 to \$2,909 per acft.

The BRA System Operations would negatively affect the yields of several proposed water management strategies that are considered for the 2011 Brazos G Regional Water Plan. The proposed BRA System Operations appropriation would be granted with a priority date senior to any of these proposed reservoir projects, and would have a priority call on inflows. However, any of these proposed reservoirs could be operated in conjunction with the BRA

System, and the resulting increase in supply to the Brazos River Basin would be greater than that obtained from the projects operated on a stand-alone basis with a priority senior to the proposed BRA appropriation.

The benefits of including an existing water supply project (Lake Waco) into the BRA System are limited by constraints designed to protect water supply for local needs. These types of constraints would likely be included in agreements with any local entity willing to include a local water supply reservoir in BRA System Operations.

4B.4.4 Environmental and Implementation Issues

Unlike the typical implementation of a large surface water reservoir, the proposed BRA System Operations appropriation requires no environmental permits because the reservoirs already exist. However, instream flow restrictions likely to be placed on the new appropriation could limit supplies that could be developed by the project. Figure 4B.4-4 illustrates streamflows in the Brazos River at the Richmond gage, both with and without the proposed BRA System appropriation. Figure 4B.4-5 illustrates the expected Brazos River flows downstream into the Gulf of Mexico. The figures indicate that with the proposed BRA appropriation, as modeled with the majority of the proposed appropriation diverted from the lower basin, streamflows would generally be greater up to the point of diversion. However, flows into the Gulf of Mexico would generally decrease.

A summary of environmental issues for the BRA System Operations is presented in Table 4B.4-4. This water supply option has been compared to the plan development criteria, as shown in Table 4B.4-5, and the option meets each criterion.

A summary of the implementation steps for the project is presented below.

1. It will be necessary to obtain these permits:
 - a. TCEQ Water Right permit²;
 - b. U.S. Army Corps of Engineers Sections 10 and 404 dredge and fill permits for reservoirs and pipelines impacting wetlands or navigable waters of the U.S;

² Consideration of water rights permits, including the need for water for specific purposes, and conditions of the permits, is the responsibility of TCEQ, not the regional water planning process. However, the Brazos G RWPG assumes that any water appropriated by water right permits associated with this water management strategy will not impair the capability to impound and store water in surface water bodies such as sedimentation ponds, end lakes and other environmental features associated with mining and mining reclamation activities, when such are required by the Railroad Commission of Texas and other regulatory entities. This assumption is applicable only to runoff originating within the watershed that drains directly to each water body, and is not applicable to diversions from rivers or streams to maintain storage in the water bodies. Diversions of water from those water bodies for any reason are also specifically excluded from this assumption.

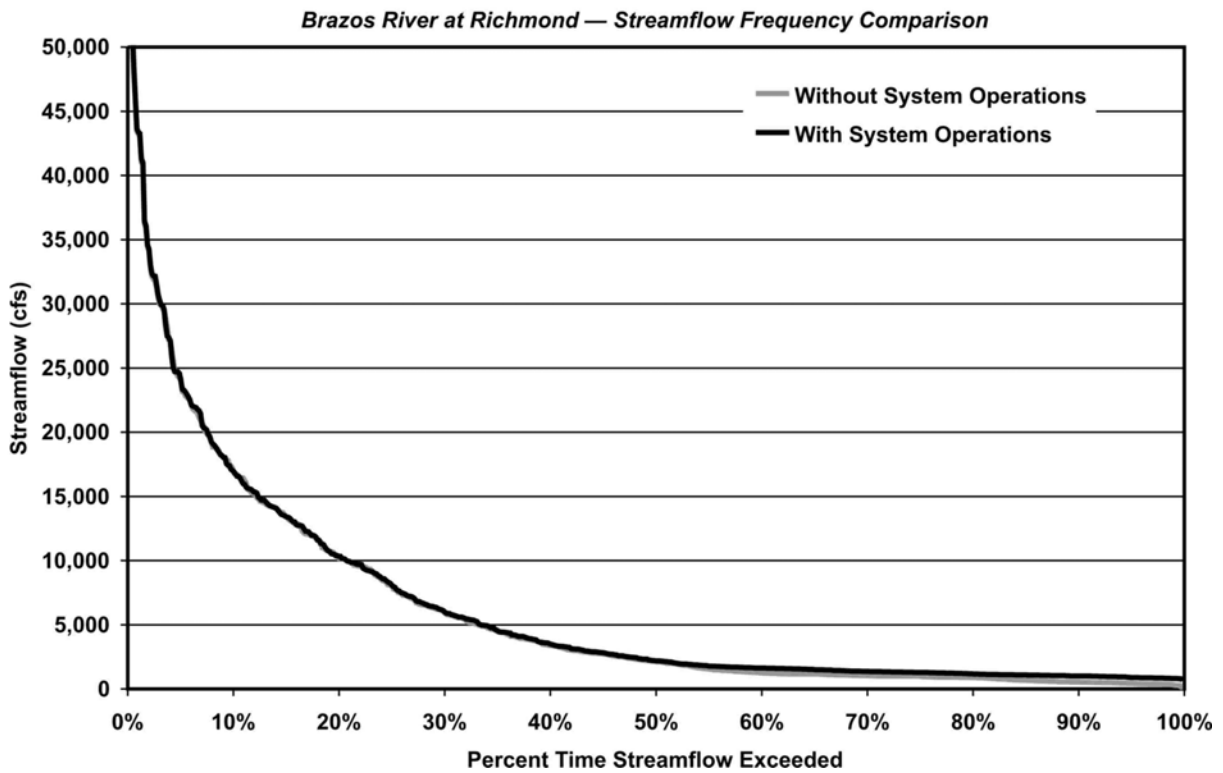
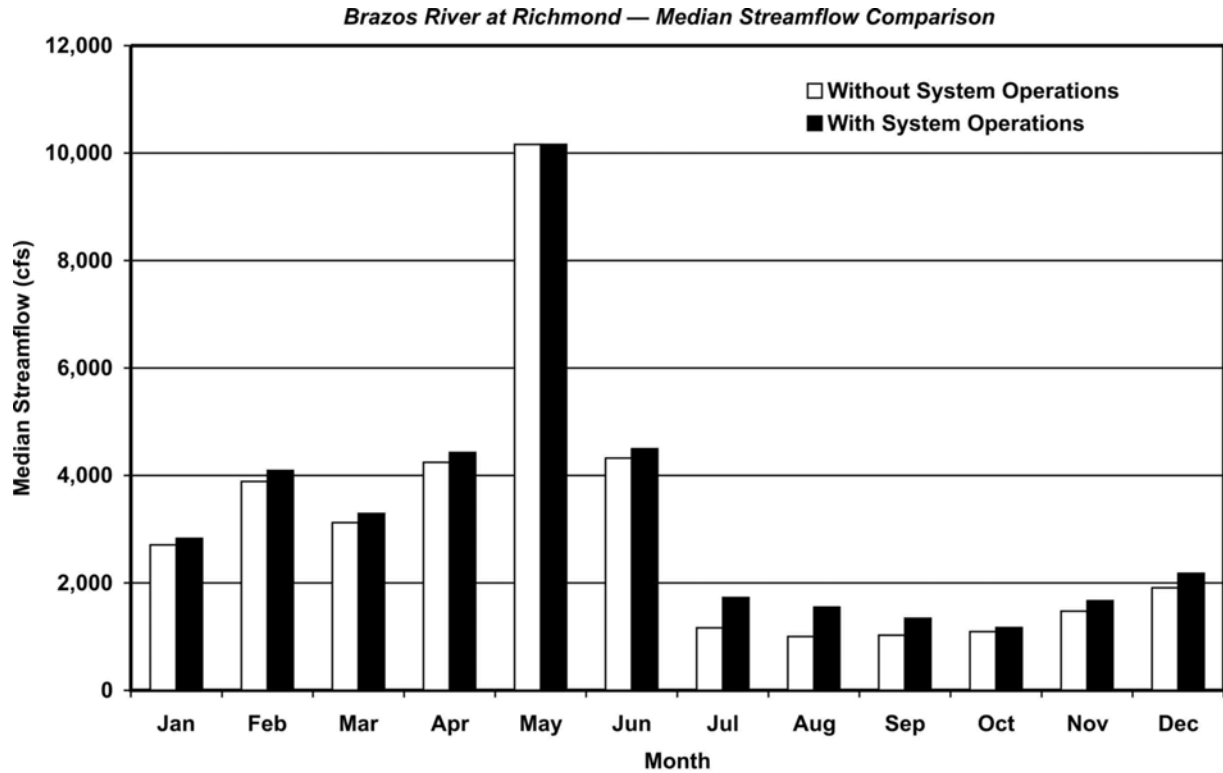


Figure 4B.4-4. BRA System Operations Streamflow Considerations at Brazos River at Richmond Control Point

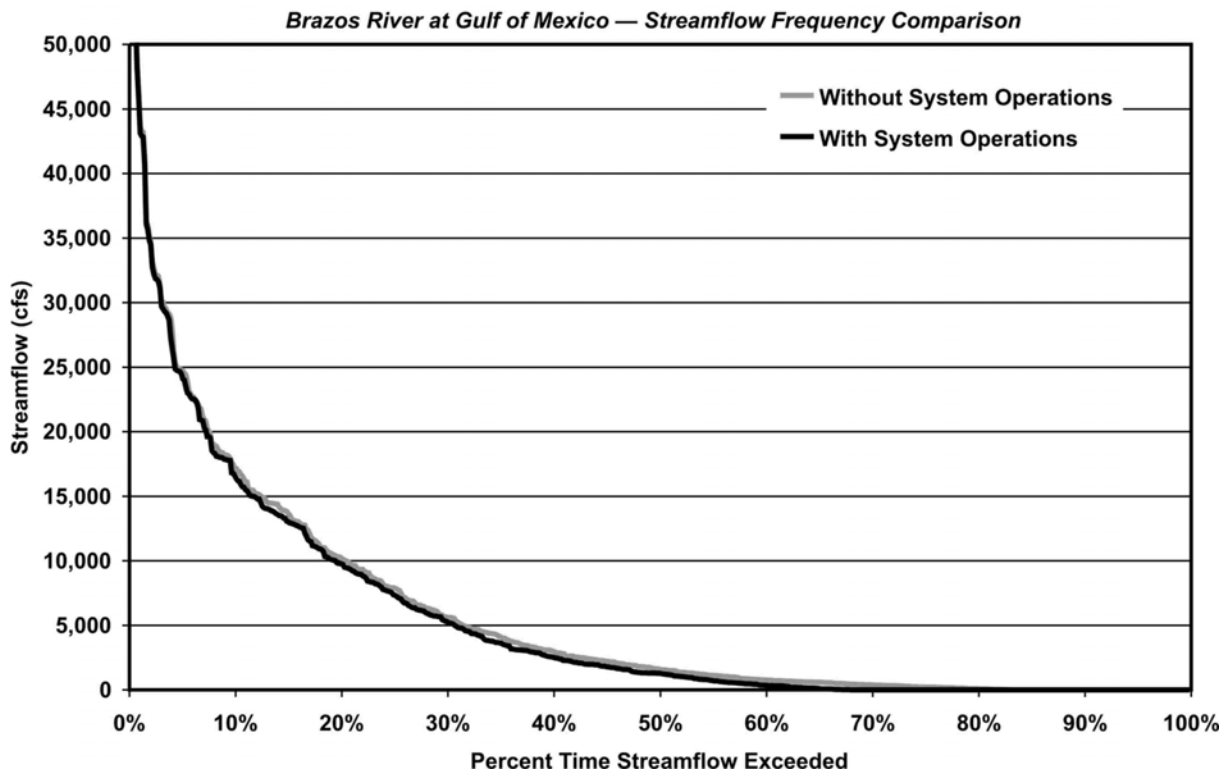
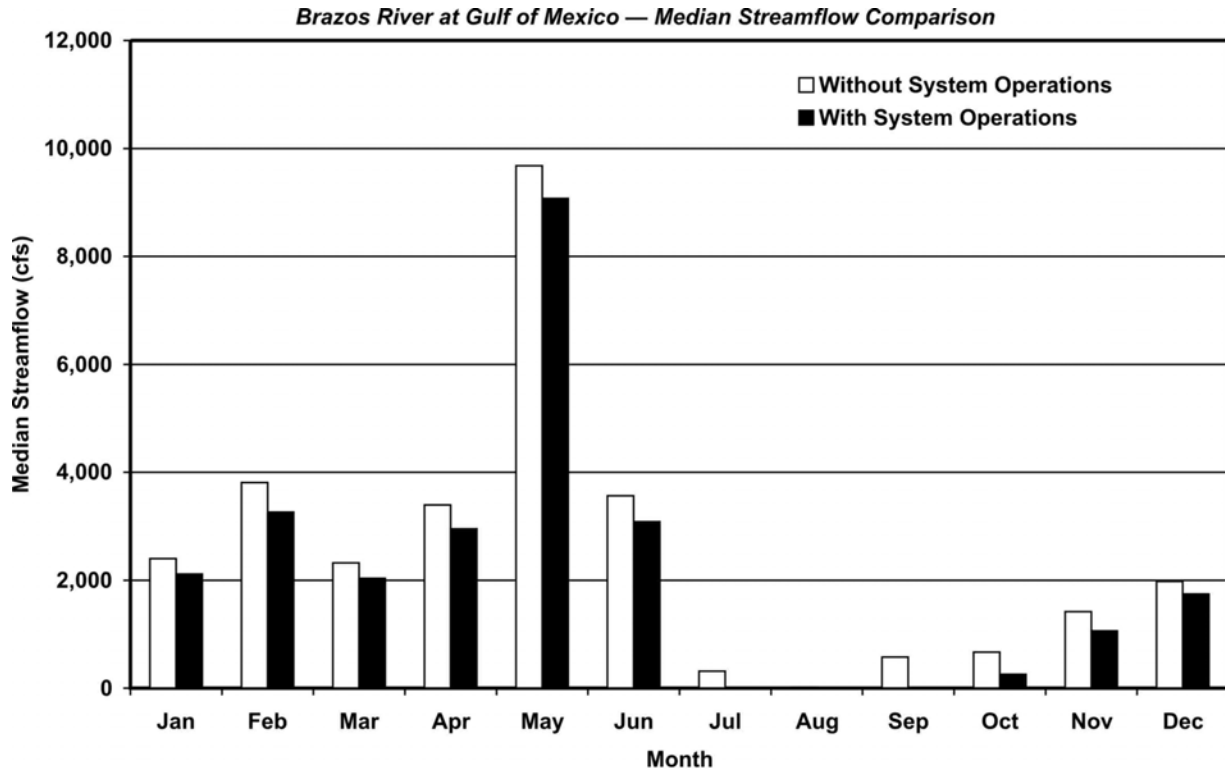


Figure 4B.4-5. BRA System Operations Streamflow Considerations at Brazos River at Gulf of Mexico Control Point

**Table 4B.4-4.
Environmental Issues: BRA System Operations**

Water Management Option	BRA System Operations
Implementation Measures	Each entity receiving the supply would have a water supply contract with the BRA.
Environmental Water Needs / Instream Flows	Possible low impacts. The primary sources of water are existing stored water and unappropriated flows diverted just upstream of the Gulf.
Bays and Estuaries	Possible low impact from reduced inflows to the Gulf.
Fish and Wildlife Habitat	Potential Impacts include constructing and maintaining easements for new pipelines or pump stations. Extent of impacts dependent on location and size of projects.
Cultural Resources	Possible low impact.
Threatened and Endangered Species	Potential Impacts include constructing and maintaining easements for new pipelines or pump stations. Extent of impacts dependent on location and size of projects.
Comments	Assumes infrastructure is needed to distribute purchased water to the entity in need.

**Table 4B.4-5.
Comparison of BRA System Operations to Plan Development Criteria**

<i>Impact Category</i>	<i>Comment(s)</i>
A. Water Supply: 1. Quantity 2. Reliability 3. Cost	1. Sufficient to meet needs ¹ 2. High reliability 3. Reasonable
B. Environmental factors 1. Environmental Water Needs 2. Habitat 3. Cultural Resources 4. Bays and Estuaries 5. Threatened and Endangered Species 6. Wetlands	1. Low impact 2. Low impact 3. Low impact 4. Low impact 5. Low impact 6. Low Impact
C. Impact on Other State Water Resources	• No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	• None
E. Equitable Comparison of Strategies Deemed Feasible	• Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	• None
G. Third Party Social and Economic Impacts from Voluntary Redistribution	• None
¹ Significant quantity for regional use and Region H	

- c. TPWD Sand, Gravel, and Marl Permit for construction in state owned streambeds;
 - d. NPDES Storm Water Pollution Prevention Plan;
 - e. GLO easement for use of the state-owned streambed; and
 - f. Section 404 certification from the TNRCC related to the Clean Water Act.
2. Permitting, at a minimum, will require these studies:
 - a. Assessment of changes in instream flows in the Brazos River.
 - b. Habitat mitigation plan.
 - c. Environmental studies of potential impact on endangered species.
 - d. Cultural resource studies and mitigation.
 3. Land will need to be acquired through either negotiations or condemnation for pipeline and other facilities.

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