

4B.18 Reallocation of Storage in Federal Reservoirs

4B.18.1 BRA Reservoirs Excluding Lake Aquilla¹

4B.18.1.1 Description of Option²

Reservoirs owned by the United States Army Corps of Engineers (USACE) typically serve multiple functions, including flood control, water supply and recreation. Most USACE reservoirs contain a significant amount of storage dedicated to flood control. This flood control storage is used to temporarily hold flood waters in the top few feet of the reservoir to reduce flooding downstream. It is possible to increase the available water supply from these reservoirs by changing some of the flood control storage to the reservoir storage dedicated to water supply, or conservation storage. This process is commonly called reallocation. In 2008, the USACE in conjunction with the Brazos River Authority (BRA) published a feasibility study of reallocating flood control storage to water supply storage for nine lakes in the Brazos River Basin: Lake Aquilla, Lake Belton, Lake Georgetown Lake Granger, Lake Proctor, Lake Somerville, Stillhouse Hollow, Lake Waco and Lake Whitney. The USACE has the authority to reallocate at its own discretion up to 50,000 acft or 15 percent of the total flood storage, whichever is less. Additional reallocation of flood storage to conservation storage requires the approval of the U.S. Congress.

4B.18.1.2 Available Yield from Reallocation in Federal Reservoirs Excluding Lake Aquilla

The USACE study evaluated four alternatives for each reservoir:

- Alternative #1 – Elevation corresponding to half the maximum discretionary authority as described in Alternative #2 below.
- Alternative #2 – Elevation corresponding to the maximum discretionary authority (defined as the authority given to the chief of Engineers to make allocation adjustments without additional authorization by Congress, which is 50,000 acft or fifteen percent of total authorized storage whichever, is less).
- Alternative #3 – Elevation corresponding to one foot above the elevation determined for Alternative # 2.
- Alternative #4 –Thirty percent of the authorized flood control pool storage, rounded to the nearest foot.

¹ U.S. Army Corps of Engineers, Fort Worth District, *DRAFT Information Paper (FSM Document) for Brazos River Basin Systems Assessment Feasibility Study Phase I*, July 2008.

² U.S. Army Corps of Engineers, Fort Worth District, *DRAFT Information Paper (FSM Document) for Brazos River Basin Systems Assessment Feasibility Study Phase I*, July 2008.

Results of the yield analysis, excluding Lake Aquilla, which has been selected for further evaluation during this planning cycle using slightly different criteria, are shown in Table 4B.18.1.2-1. The yields in Table 4B. 18.1.2-1 use both the USACE SUPER model and the TCEQ Brazos WAM. The SUPER program operates using a daily time step simulating the operation of a multi-purpose system of reservoirs over a historical period. SUPER has a limited number of other demands in the Brazos Basin and operates from upstream to downstream. The Brazos Water Availability Model (WAM) Run 3 is specifically designed to model the priority system used for Texas water rights. The priority system assigns each diversion and storage right a priority date. For older water rights, the priority date is based on the time of first use. For newer water rights, the priority date is based on the date that the permit application was approved by the state. In the Brazos WAM, water is distributed based on the priority of the water right, as well as the geographic location of the right. Water rights with older priority dates are allocated water before water rights with newer priority dates. The yields using the Brazos WAM assume that the additional supply from the reservoir above current permitted amounts has the most junior priority date. As a result, the additional yield is last in line when water is allocated by the model. The BrazosWAM also has all water rights operating at their full permitted amounts. These differences in the models, as well as differences in hydrology and other data, explain the difference between the yields using SUPER and the yield using the Brazos WAM.

The USACE study did not identify any clear candidates for reallocation, nor did the USACE exclude any of the nine reservoirs from further consideration. Based on the upcoming need for additional water and the limited economical alternatives, the USACE selected Lake Aquilla for further study in the second phase of the study. The reallocation strategy described in this plan will focus on reallocation of Lake Aquilla. Other reservoirs may be considered for reallocation in future planning cycles.

Table 4B.18.1.2-1
Yield Increase from Reallocation from 2008 USACE Study

Reservoir	Scenario	Top of Conservation Pool		Surface Area (acres)	COE SUPER Model Yield (acft/yr)	BWAM 3 Yield ^a (acft/yr)
		Elevation (feet)	Storage (acft)			
Belton	Existing	594	435,225	12,135	129,714	101,102
	Alternative 1	596	460,576	12,903	132,118	101,150
	Alternative 2	598	484,958	13,262	134,302	101,150
	Alternative 3	599	498,307	13,437	135,263	101,150
	Alternative 4	606	599,309	15,173	142,670	104,750
Georgetown	Existing	791	36,904	1,287	16,590	11,516
	Alternative 1	796	43,864	1,490	17,138	11,510
	Alternative 2	803	54,434	1,751	17,955	11,810
	Alternative 3	804	56,202	1,786	18,067	11,810
	Alternative 4	809	66,509	1,980	18,799	12,220
Granger	Existing	504	52,525	4,064	22,821	16,988
	Alternative 1	507	68,280	5,020	26,287	17,240
	Alternative 2	510	82,864	5,708	29,661	17,420
	Alternative 3	511	88,681	5,927	30,018	17,450
	Alternative 4	514	109,419	6,760	31,354	17,970
Proctor	Existing	1162	55,457	4,537	29,107	19,537
	Alternative 1	1167	81,362	5,760	33,205	20,150
	Alternative 2	1171	105,097	6,639	37,267	20,150
	Alternative 3	1172	111,848	6,863	38,089	20,150
	Alternative 4	1177	150,542	8,140	40,155	20,150
Somerville	Existing	238	147,104	11,555	44,690	42,338
	Alternative 1	240	171,034	12,520	48,140	44,410
	Alternative 2	242	197,094	13,540	50,588	46,410
	Alternative 3	243	210,924	14,120	51,877	47,720
	Alternative 4	245	240,279	15,230	54,629	48,790
Stillhouse Hollow	Existing	622	227,825	6,484	73,760	63,008
	Alternative 1	625	247,630	6,780	75,550	64,320
	Alternative 2	629	277,488	7,260	77,746	66,330
	Alternative 3	630	284,956	7,377	78,312	66,330
	Alternative 4	638	345,329	8,240	82,933	70,200
Waco ^b	Original	455	144,830	8,437	83,564	Not evaluated ^c
	Existing	462	199,227	8,437	94,727	
	Alternative 1	463	207,751	8,611	95,802	
	Alternative 2	473	307,560	11,309	104,931	
Whitney ^d	Existing	533	554,203	23,220	143,668	34,380
	Alternative 1	534	578,088	24,210	161,366	40,570
	Alternative 2	535	602,623	24,860	178,380	46,990
	Alternative 3	536	627,768	25,430	190,181	46,990
	Alternative 4	545	883,518	31,190	312,228	72,060

Notes

a Yields calculated in USACE study using the TCEQ Brazos WAM Run 3. These yields do not necessarily match yields used by the Brazos G Water Planning Group.

b A portion of the flood storage in Lake Waco has already been reallocated. The conservation elevation of the reservoir was raised from 455 feet to 462 feet in 2003.

c Brazos WAM yields for Lake Waco were not determined in the USACE study.

d COE SUPER utilized full reservoir storage to compute yield while the BWAM3 Yield was computed using only the TCEQ-authorized portion.

4B.18.2 Lake Aquilla

4B.18.2.1 Description of the Lake Aquilla Option

Figure 4B.18.2.1-1 is an aerial map of Lake Aquilla showing the water surface area at the four alternative pool elevations discussed in Section. According to a March 2008 volumetric survey of Lake Aquilla, at the current conservation elevation of 537.5 feet, the lake has 44,566 acft of storage and a surface area of 3,066 acres³ (Table 4B.18.2.1-1). The flood storage in the reservoir extends up to an elevation of 556.0 feet.

**Table 4B.18.2.1-1
Lake Aquilla Characteristics⁴**

Owner	U.S. Army Corps of Engineers
Water Supply Contract	
Owner	Brazos River Authority
Storage amount	52,400 acft
Texas Water Right	
Number	CA 12-5158
Owner	Brazos River Authority
Diversion	13,896 acft/yr
Storage	52,400 acft
Priority date	October 25, 1976
Flood Pool	
Top elevation	556 ft
Storage	93,634 acft
Conservation Pool	
Top elevation	537.5 ft
Surface area	3,066 ac
Storage	44,566ac-ft
Sediment Pool	
Top elevation	503 ft
Storage	106 ac-ft

In 2009, the USACE updated the yield available from Lake Aquilla with reallocation using the 2008 volumetric survey⁵. The 2009 yield study used slightly different reallocation

³ Texas Water Development Board, *Volumetric Survey of Aquilla Lake March 2008 Survey*, April 2009.

⁴ Certificate of Adjudication 12-5158.

⁵ United States Army Corps of Engineers, *Aquilla Lake Reallocation Study Critical Period Dependable Yield Determination (Current sedimentation conditions), DRAFT version 1.1*, March 2009.

scenarios than those used in the 2008 USACE study and did not include an evaluation using the TCEQ Brazos WAM.

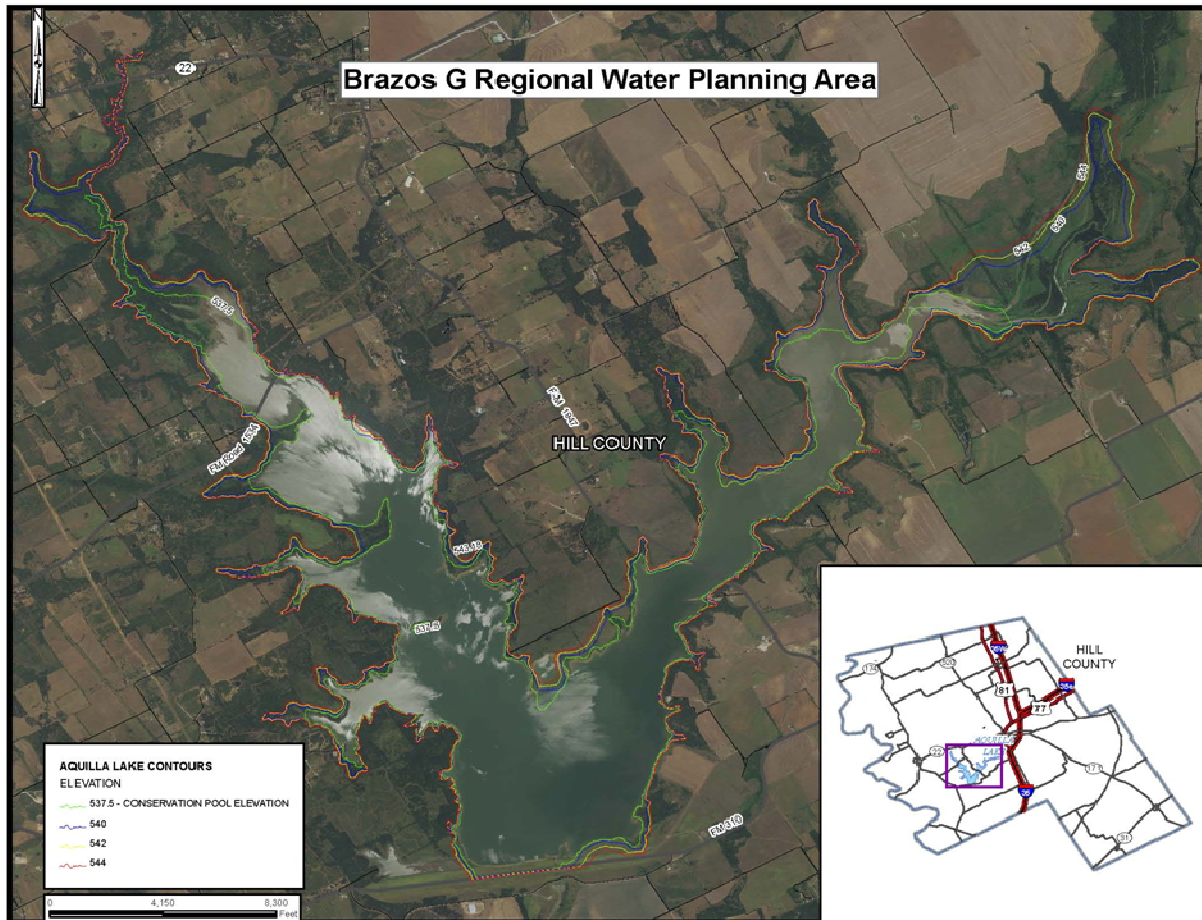


Figure 4B.18.2.1-1 Aerial map of Lake Aquilla

4B.18.2.2 Available Yield

As part of this plan, updated yields using the Brazos G WAM were performed using the same storage elevations as the 2009 USACE study as shown below:

- Existing – Current conservation storage elevation of 537.5 ft-msl;
- Scenario 1 – Raise conservation elevation to 540.0 feet, an increase of 2.5 ft-msl;
- Scenario 2 – Raise conservation elevation to 542.0 feet, an increase of 4.5 ft-msl; and
- Scenario 3 – Raise conservation elevation to 544.0 feet, an increase of 6.5 ft-msl.

Figure 4B.18.2.1-1 shows the elevation contours for the four proposed conservation storage elevations. Table 4B.18.2.2-1 is a summary of the yield studies, and Figure 4B.18.2.2-1 shows the relationship of yield to conservation storage elevation.

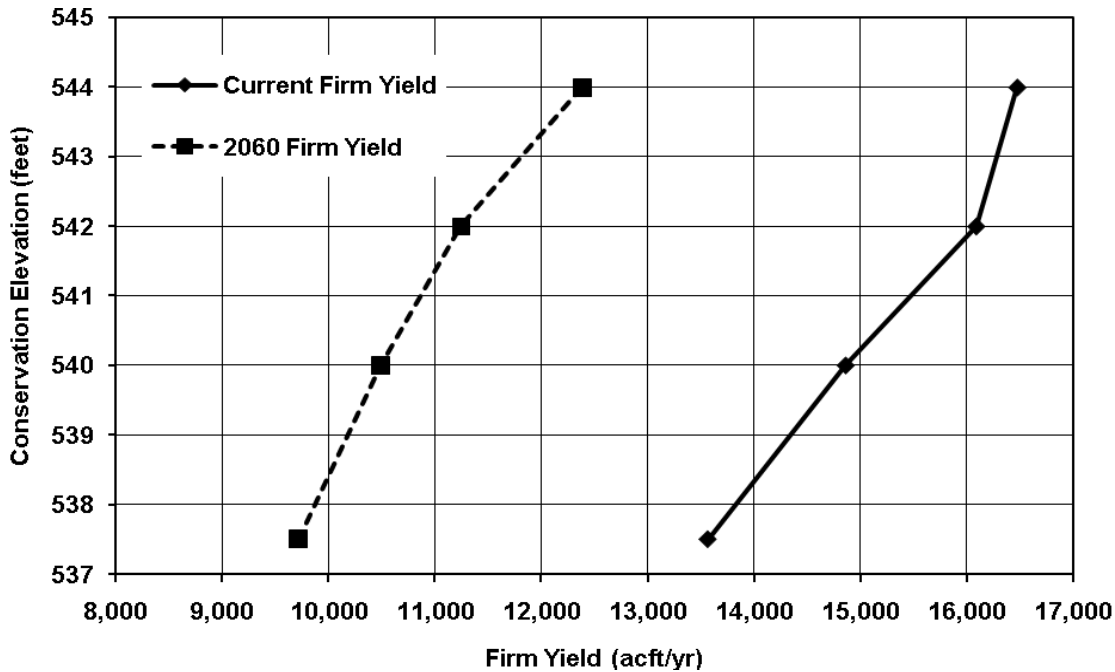


Figure 4B.18.2.2-1. Current and 2060 Yield vs. Storage Elevation for Lake Aquilla

Currently the USACE has the discretion to reallocate up to 50,000 acft or 15 percent of the total authorized storage, whichever is less. In the case of Lake Aquilla, this discretionary authority corresponds to about 14,000 acft. The yield increase of the reservoir with only the discretionary authority is currently about 2,300 acft/yr declining to 1,400 acft/yr in 2060. Additional reallocation of flood storage to conservation storage requires the approval of the U.S. Congress. Scenario 1 is within the discretionary authority of the USACE. Scenario 2 corresponds to the discretionary authority of rounding up to the nearest whole foot, and would probably require congressional approval. Scenario 3 is well above the discretionary authority and would require the approval of Congress.

By 2060 the estimated storage of Lake Aquilla decreases to 20,437 acft - slightly less than half of the current storage.⁶ The calculated firm yield in 2060 from the Brazos G WAM at the current conservation storage of elevation 537.5 ft-msl is 9,713 acft/yr. In Scenario 2 (elevation 542.0 ft-msl) the yield of Lake Aquilla is 11,248 acft/yr, resulting in 1,535 acft of additional yield in 2060. This is a 16 percent increase over the current yield. Figure 4B.18.2.2-2

⁶ The estimated 2060 storage does not account for recently-revised sedimentation rates based on updated 2008 TWDB volumetric survey.

and Figure 4B.18.2.2-3 show the storage trace in the year 2060 for Lake Aquilla under existing conditions and with Scenario 2, respectively.

**Table 4B.18.2.2-1
Comparison of Firm Yield of Lake Aquilla with Flood Storage Reallocation using Brazos G WAM for Current and 2060 Conditions**

Scenario	Top of Conservation Elevation (feet)	Current Conditions			2060 Conditions		
		Storage (acft)	Firm Yield (acft/yr)	Yield Increase (acft/yr)	Storage (acft)	Firm Yield (acft/yr)	Yield Increase (acft/yr)
Existing	537.50	44,566	13,565		20,437	9,713	-
Scenario 1	540.00	52,659	14,861	1,296	28,530	10,488	775
Scenario 2	542.00	59,650	16,086	2,521	35,521	11,248	1,535
Scenario 3	544.00	68,144	16,472	2,907	44,011	12,392	2,679

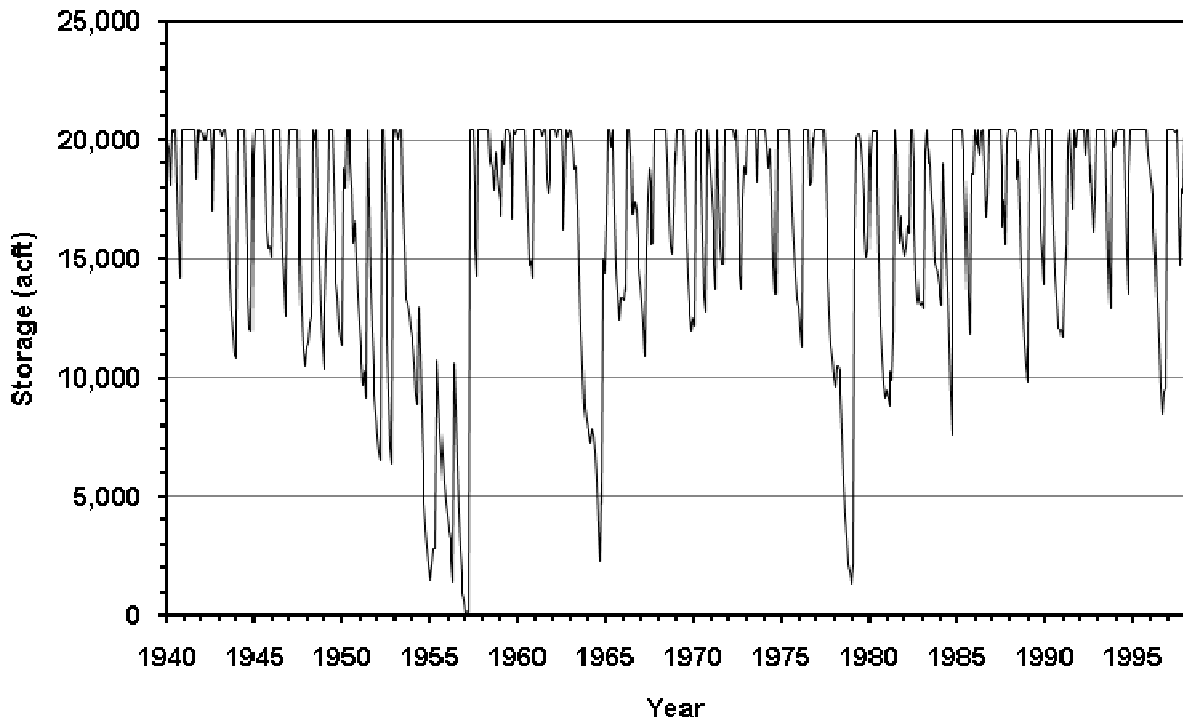


Figure 4B.18.2.2-2. 2060 Lake Aquilla Storage Trace, Current Conservation Elevation (537.5 ft-msl)

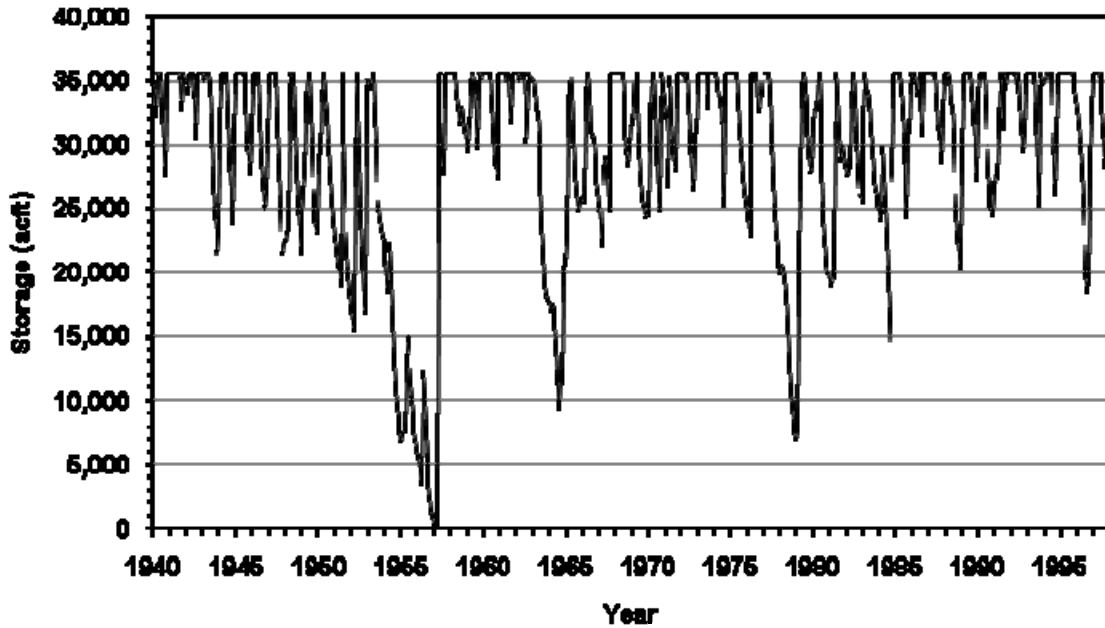


Figure 4B.18.2.2-3. 2060 Lake Aquilla Storage Trace, Alternative 2 (Conservation Elevation at 542 ft-msl)

4B.18.2.3 Environmental Issues

The greatest impact on the environment from the reallocation of storage in Lake Aquilla is the loss of terrestrial habitat due to higher lake levels. Table 4B.18.2.3-1 compares the water surface area at conservation elevation under current conditions to the three storage alternatives described above. In Alternative 3, the maximum reallocation scenario considered for this strategy, the reservoir will inundate an additional 947 acres at conservation. All of the land up to the flood pool elevation around Lake Aquilla is owned by the USACE. The USACE manages the area around the lake as a wildlife management area.

**Table 4B.18.2.3-1
Comparison of Water Surface Areas with Reallocation**

Scenario	Elevation (feet)	Surface Area (ac)	Change in Surface Area (ac)
Existing	537.5	3,066	–
Alternative 1	540.0	3,388	322
Alternative 2	542.0	3,613	547
Alternative 3	544.0	4,013	947

Wetlands and bottomland hardwoods located in the upper reaches of the lake will be impacted by raising the conservation elevation. Endangered and threatened species reported in Hill County include the whooping crane, black-capped vireo, and golden-cheeked warbler. Species which are candidates for listing are the smalleye shiner and sharpnose shiner. The USACE did not encounter any habitats that appeared suitable for the black-capped vireo or golden-cheeked warbler in the affected area. It is possible that whooping cranes may temporarily use the affected habitat during their annual migration, but an encounter would be rare. The USACE did not find evidence of either the smalleye shiner or sharpnose shiner within the study area.

4B.18.2.4 Engineering and Costing

Very few recreational facilities are located at Lake Aquilla, so the reallocation of flood storage will have a low impact on recreation. Other infrastructure that may be affected and needing relocation are three telephone lines, seven electric lines, three water lines, two petroleum product pipelines and 18 roads. Another cost is the mitigation of the loss of terrestrial habitat, which is potentially high for this project. Studies on the slope stability, seepage, flood impacts and environmental impacts are included in the estimate. Improvements to Lake Aquilla dam to store the additional capacity may be identified in these studies, and an estimate of the cost of these improvements is included in the estimate. The capital costs for the reallocation of storage to an elevation of 542 ft-msl is \$4.04 million. Detailed costs are shown in Table 4.B.18.2.4-1.

4B.18.2.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 4B.18.2.5-1, and the option meets each criterion.

Seepage concerns have been expressed in the past for Lake Aquilla dam. For the re-allocation of storage to take place an evaluation of foundation seepage, slope stability and instrumentation may be required. The studies along with additional instrumentation are included in the cost estimate. The habitat lost to inundation will need to be mitigated and securing mitigation property may be an issue. If Alternatives 2 or 3 are chosen, Congressional authorization for the project will be required.

Table 4B.18.2.4-1
Cost Estimate Summary for Lake Aquilla Pool Reallocation
(September 2008 Prices)

<i>Item</i>	<i>Estimated Costs for Facilities</i>
Capital Costs	
Improvements to Dam	\$1,550,000
Relocations	\$2,490,000
Total Capital Cost	\$4,040,000
Engineering, Legal Costs and Contingencies	\$1,414,000
Environmental & Archaeology Studies and Mitigation	\$5,325,000
Slope stability, seepage and geotechnical studies	\$210,000
Interest During Construction (12 months)	<u>\$458,000</u>
Total Project Cost	\$11,447,000
Annual Costs	
Debt Service (6 percent, 30 years)	\$832,000
Total Annual Cost	\$832,000
Available Project Yield (acft/yr)	2,050
Annual Cost of Water (\$ per acft)	\$406
Annual Cost of Water (\$ per 1,000 gallons)	\$1.25

Table 4B.18.2.5-1
Comparison of Reallocation of Storage in Lake Aquilla Option to
Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply 1. Quantity 2. Reliability 3. Cost	1. Sufficient to meet needs 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 due to frequent hydropower releases from Lake Whitney 2. Low (540 ft) to moderate (544 ft) impacts on bottomland hardwood and fish and wildlife resources. Lake sedimentation may create significant amounts of shallow wetlands that might benefit migratory water fowl. 3. Low impact 4. Low impact due to distance from coast 5. Low impact 6. Low (540 ft) to moderate (544 ft) impacts on wetlands
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	• Low to none
E. Equitable Comparison of Strategies Deemed Feasible	• Option is considered to meet municipal shortages
F. Requirements for Interbasin Transfers	• None
G. Third Party Social and Economic Impacts from Voluntary Redistribution	• None

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

Potential Regulatory Requirements:

- Texas Commission on Environmental Quality Water Right and Storage permits
- U.S. Army Corps of Engineers Permits will be required for discharges of dredge or fill into wetlands and waters of the U.S. for dam construction, and other activities (Section 404 of the Clean Water Act);
- U.S. Army Corps of Engineers Section 404 permits for pipeline stream crossings, discharges of fill into wetlands and waters of the U.S. for construction, and other activities
- Texas Commission on Environmental Quality administered Texas Pollutant Discharge Elimination System Storm Water Pollution Prevention Plan;
- Texas General Land Office Easement if State-owned land or water is involved; and

- Texas Parks and Wildlife Department Sand, Shell, Gravel and Marl permit if state-owned streambed is involved.

State and Federal Permits may require the following studies and plans:

- Environmental impact or assessment studies;
- Wildlife habitat mitigation plan that may require acquisition and management of additional land;
- Flow releases downstream to maintain aquatic ecosystems;
- Assessment of impacts on Federal- and State-listed endangered and threatened species; and
- Cultural resources studies to determine resources impacts and appropriate mitigation plan that may include cultural resource recovery and cataloging; requires coordination with the Texas Historical Commission.

Land Acquisition Issues:

- Land acquired for reservoir and/or mitigation plans could include market transactions or other local landowner agreements;
- Additional acquisition of rights-of-way and/or easements may be required; and
- Possible relocations or removal of residences, utilities, roads, or other structures.