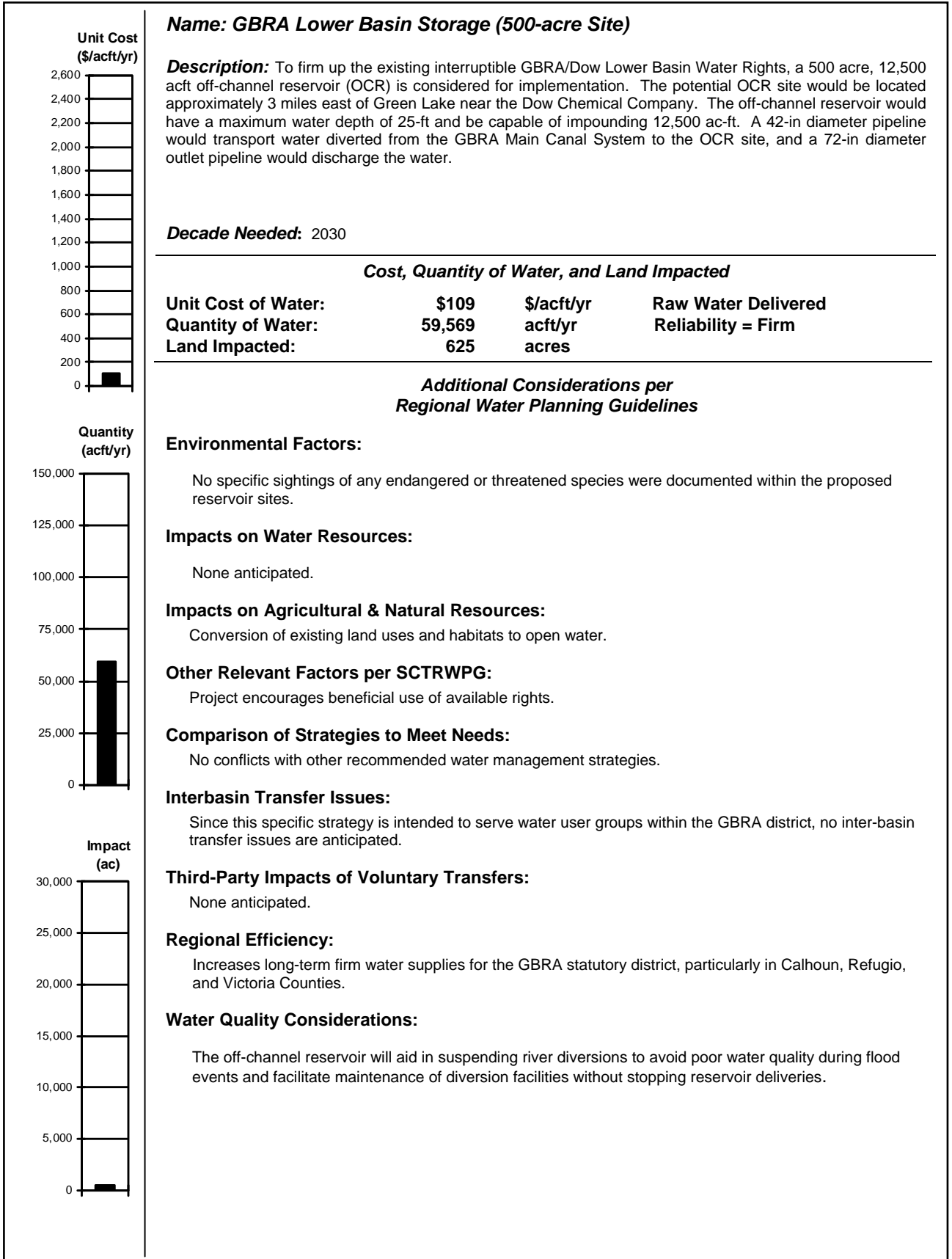


2011 South Central Texas Regional Water Plan Water Management Strategy Summary Sheet

	<p>Name: GBRA Lower Basin Storage (100-acre Site)</p> <p>Description: To firm up the existing interruptible GBRA/Dow Lower Basin Water Rights, a 100 acre, 2,500 acft off-channel reservoir (OCR) is recommended for implementation. The potential OCR site would be located approximately 3 miles east of Green Lake near the Dow Chemical Company. The off-channel reservoir would have a maximum water depth of 25-ft and be capable of impounding 2,500 ac-ft. A 42-in diameter pipeline would transport water diverted from the GBRA Main Canal System to the OCR site, and a 72-in diameter outlet pipeline would discharge the water.</p> <p>Decade Needed: 2030</p> <hr/> <p style="text-align: center;">Cost, Quantity of Water, and Land Impacted</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">Unit Cost of Water:</td> <td style="width: 16.5%; text-align: center;">\$104</td> <td style="width: 16.5%; text-align: center;">\$/acft/yr</td> <td style="width: 33.5%;">Raw Water Delivered</td> </tr> <tr> <td>Quantity of Water:</td> <td style="text-align: center;">28,369</td> <td style="text-align: center;">acft/yr</td> <td>Reliability = Firm</td> </tr> <tr> <td>Land Impacted:</td> <td style="text-align: center;">125</td> <td style="text-align: center;">acres</td> <td></td> </tr> </table> <hr/> <p style="text-align: center;">Additional Considerations per Regional Water Planning Guidelines</p> <p>Environmental Factors:</p> <p style="padding-left: 40px;">No specific sightings of any endangered or threatened species were documented within the proposed reservoir sites.</p> <p>Impacts on Water Resources:</p> <p style="padding-left: 40px;">None anticipated.</p> <p>Impacts on Agricultural & Natural Resources:</p> <p style="padding-left: 40px;">Conversion of existing land uses and habitats to open water.</p> <p>Other Relevant Factors per SCTRWPG:</p> <p style="padding-left: 40px;">Project encourages beneficial use of available rights.</p> <p>Comparison of Strategies to Meet Needs:</p> <p style="padding-left: 40px;">No conflicts with other recommended water management strategies.</p> <p>Interbasin Transfer Issues:</p> <p style="padding-left: 40px;">Since this specific strategy is intended to serve water user groups within the GBRA district, no inter-basin transfer issues are anticipated.</p> <p>Third-Party Impacts of Voluntary Transfers:</p> <p style="padding-left: 40px;">None anticipated.</p> <p>Regional Efficiency:</p> <p style="padding-left: 40px;">Increases long-term firm water supplies for the GBRA statutory district, particularly in Calhoun, Refugio, and Victoria Counties.</p> <p>Water Quality Considerations:</p> <p style="padding-left: 40px;">The off-channel reservoir will aid in suspending river diversions to avoid poor water quality during flood events and facilitate maintenance of diversion facilities without stopping reservoir deliveries.</p>	Unit Cost of Water:	\$104	\$/acft/yr	Raw Water Delivered	Quantity of Water:	28,369	acft/yr	Reliability = Firm	Land Impacted:	125	acres	
Unit Cost of Water:	\$104	\$/acft/yr	Raw Water Delivered										
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Land Impacted:	125	acres											

2011 South Central Texas Regional Water Plan Water Management Strategy Summary Sheet



4C.13 GBRA Lower Basin Storage Project

4C.13.1 Description of Water Management Strategy

The Guadalupe-Blanco River Authority (GBRA) and Dow Chemical Company (Dow), individually and collectively, own surface water rights in the lower Guadalupe – San Antonio River Basin (the GBRA Lower Basin Water Rights) authorizing diversions totaling 175,501 acre-feet per year (acft/yr). Table 4C.13-1 lists the individual water rights owned by GBRA and Dow and provides their individual permit number, certificate of adjudication number, priority date, annual diversion, authorized uses, and ownership. Water available for diversion under these rights is governed by the complex interactions of natural, anthropogenic, and legal factors including rainfall, runoff, springflow, evaporation, aquifer recharge, diversions by other water right owners, reservoir operations, off-channel storage, treated effluent from municipal and industrial water users, terms and conditions of the water rights, and the prior appropriation doctrine as enforced by the South Texas Watermaster of the Texas Commission on Environmental Quality (TCEQ). Given that the GBRA Lower Basin Water Rights point of diversion near Tivoli is below the San Antonio River confluence and that they are senior in priority to most upstream water rights, it is recognized that they are quite reliable but not firm.

**Table 4C.13-1.
GBRA Lower Basin Water Rights**

<i>Certificate of Adjudication</i>	<i>Priority Date</i>	<i>Annual Diversion (acft/yr)</i>	<i>Authorized Uses</i>	<i>Ownership</i>
18-5173	2/3/1941	2,500	Irrigation/Industrial	GBRA/Dow
18-5174	6/15/1944	1,870	Irrigation/Industrial	GBRA/Dow
18-5175	2/13/1951	940	Irrigation/Industrial/ Mining/Livestock	GBRA/Dow
18-5176	6/21/1951	9,944	Irrigation/Industrial/ Municipal	GBRA/Dow
18-5177	1/3/1944	10,000	Irrigation/Industrial/ Municipal	Dow
	1/3/1944	32,615	Irrigation/Industrial/ Municipal	GBRA/Dow
	1/26/1948	8,632	Irrigation/Industrial	GBRA/Dow
18-5178	1/7/1952	106,000	Irrigation/Industrial/ Municipal	GBRA/Dow
18-3863	3/1/1951	3,000	Irrigation/Industrial/ Municipal	GBRA
18-5484	5/15/1964	N/A	Diversion Dam & Salt Water Barrier	GBRA

To firm up the existing interruptible GBRA Lower Basin Water Rights, a 100 acre or 500 acre off-channel reservoir (OCR) is considered for implementation. Two potential OCR sites are located approximately 3 miles east of Green Lake adjacent to Dow facilities. The locations of the two sites are illustrated in Figure 4C.13-1. The off-channel reservoirs have an assumed maximum water depth of 25-ft and would be capable of impounding 2,500 ac-ft and 12,500 ac-ft of water at the 100 acre and 500 acre OCR sites, respectively. A 42-in diameter pipeline would transport water diverted from the GBRA Main Canal System to the OCR sites and a 72-in diameter outlet pipeline would discharge the water.

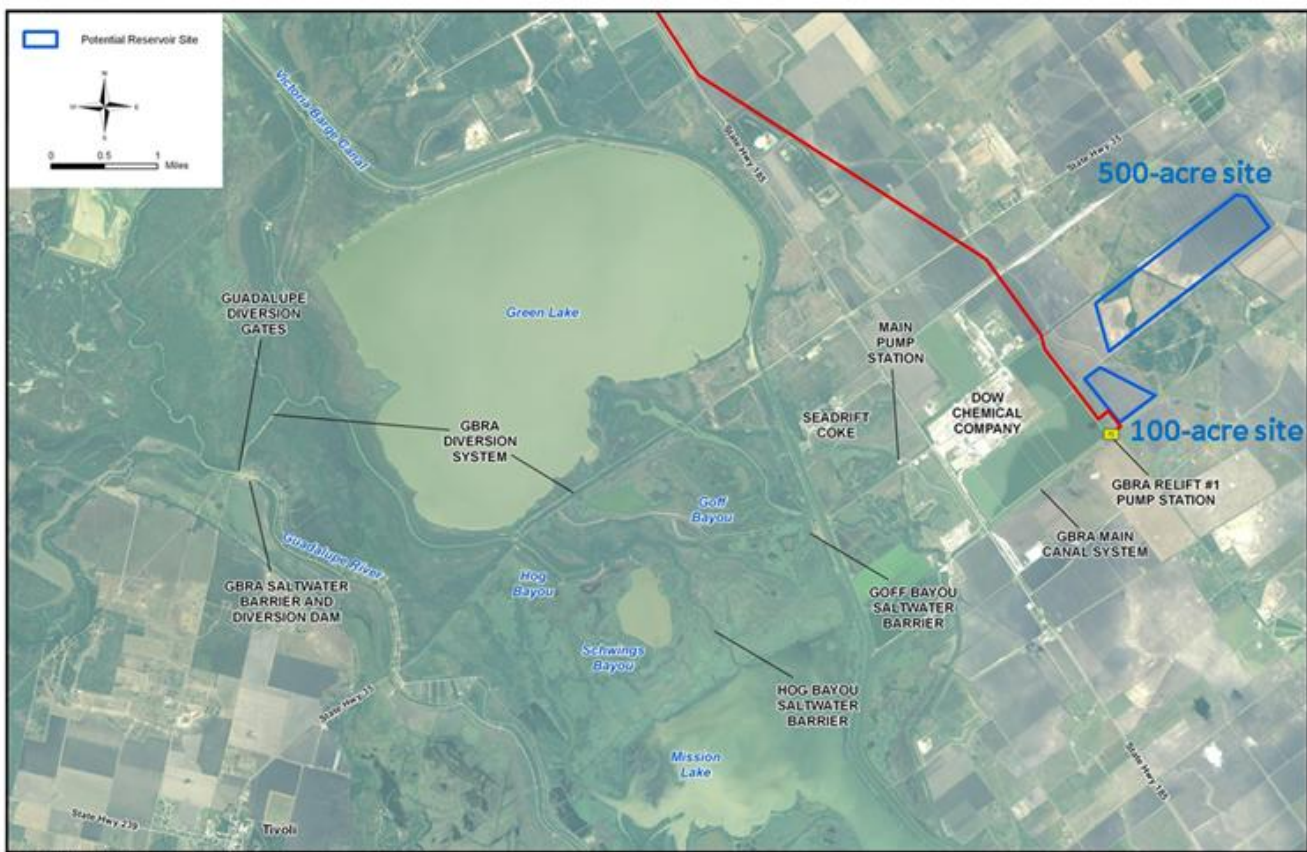


Figure 4C.13-1. GBRA Lower Basin Storage Off-Channel Storage Locations

4C.13.2 Water Availability

4C.13.2.1 Technical Assumptions for Water Availability Calculations

Initial water availability calculations were performed using the Guadalupe – San Antonio River Basin Water Availability Model (GSA WAM)¹ as modified and refined for use in development of the 2001, 2006, and 2011 South Central Texas Regional Water Plans^{2,3} and water supply analyses for a proposed nuclear power plant in Victoria County.⁴ The GSA WAM is a monthly time-step computer model used to estimate regulated streamflow and water available for diversion under existing water rights on a priority basis subject to technical assumptions regarding natural, anthropogenic, and legal factors. Technical assumptions used for the applications of the GSA WAM summarized herein include:

- a) Surface water rights modeled at full consumptive amounts per certificates of adjudication and permits.
- b) Permitted Edwards Aquifer pumpage of 572,000 acft/yr with critical period withdrawal reductions as outlined in SB3 of the 80th Texas Legislature.
- c) Subordination of all senior Guadalupe River hydropower water rights to Canyon Reservoir.
- d) 1934-2006 historical simulation period for the GSA WAM using simplified approximation techniques to extend basic hydrologic data from 1990 through 2006.⁵
- e) Treated effluent quantities throughout the river basin reported for calendar year 1997 after accounting for San Antonio Water System (SAWS) direct reuse contracts under their recycled water program. These effluent quantities were used in surface water availability analyses for the 2006 South Central Texas Regional Water Plan and differ very little from those for the 2011 Plan.
- f) Multiple regulated streamflow extractions from each GSA WAM simulation were necessary to account for the effects of diversions by Invista/DuPont (CA# 18-3861) on firm supply available to the GBRA Lower Basin Water Rights on a daily basis. The only large non-GBRA water right in the lower basin having a priority date senior to some (and junior to other) GBRA Lower Basin Water Rights is held by Invista/DuPont.

¹ HDR Engineering, Inc., “Water Availability in the Guadalupe – San Antonio River Basin,” Texas Natural Resource Conservation Commission (Contract# 9880059200), December 1999.

² South Central Texas Regional Water Planning Group, “South Central Texas Regional Water Planning Area, 2001 Regional Water Plan,” Texas Water Development Board, San Antonio River Authority, HDR Engineering, Inc., et al., January 2001.

³ South Central Texas Regional Water Planning Group, “South Central Texas Regional Water Planning Area, 2006 Regional Water Plan,” Texas Water Development Board, San Antonio River Authority, HDR Engineering, Inc., et al., January 2006.

⁴ HDR Engineering, Inc., “Simplified Extension of Hydrologic Data in the Guadalupe – San Antonio River Basin and Approximate Daily Estimates of Water Availability,” Guadalupe-Blanco River Authority, Exelon Generation Company, February 12, 2009.

⁵ Ibid.

4C.13.2.2 Monthly Assessments of Reliability and Water Available

The combined annual water available under the GBRA Lower Basin Water Rights calculated by the GSA WAM is summarized in Figure 4C.13-2. As shown in Figure 4C.13-2, the full annual amount of 175,501 acft/yr is reliable in 85 percent of the years during the simulation period and the minimum annual amount of water available under the GBRA Lower Basin Water Rights is 145,665 acft/yr in 1956. The reliability of the GBRA Lower Basin Water Rights is summarized in Figure 4C.13-3 in terms of the percentage of time (months during the simulation period) that a percentage of the desired monthly amount of the total 175,501 acft/yr authorized diversion is available. As shown in Figure 4C.13-3, desired diversions are available in more than 97 percent of the months during the simulation period.

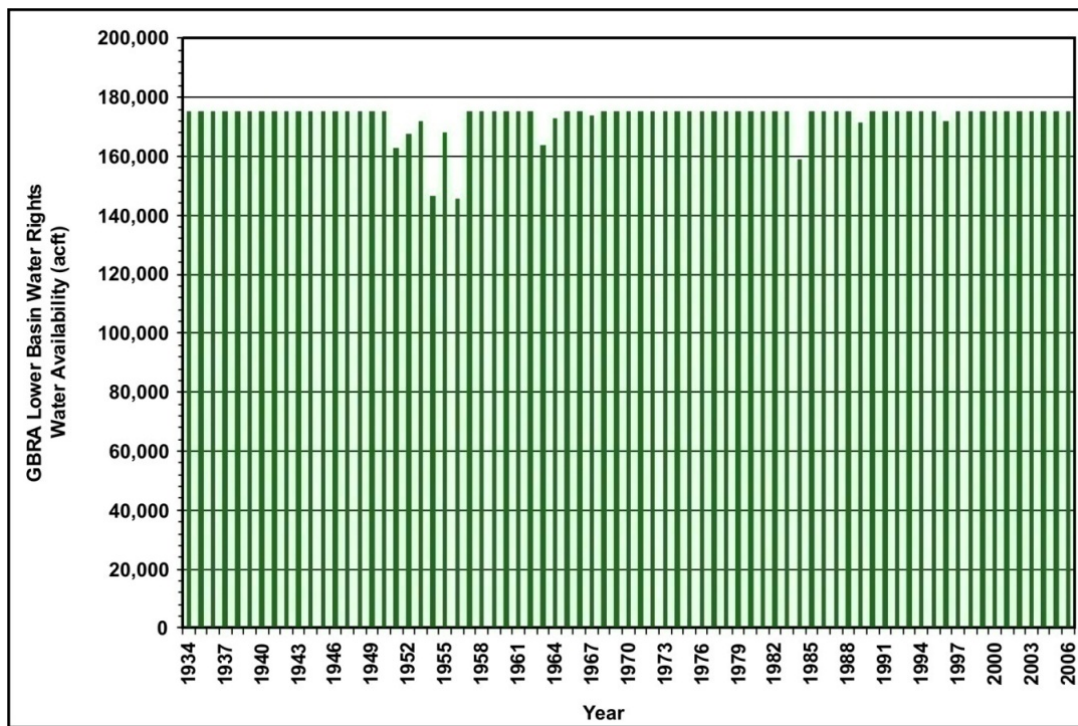


Figure 4C.13-2. GBRA Lower Basin Water Rights Annual Water Availability

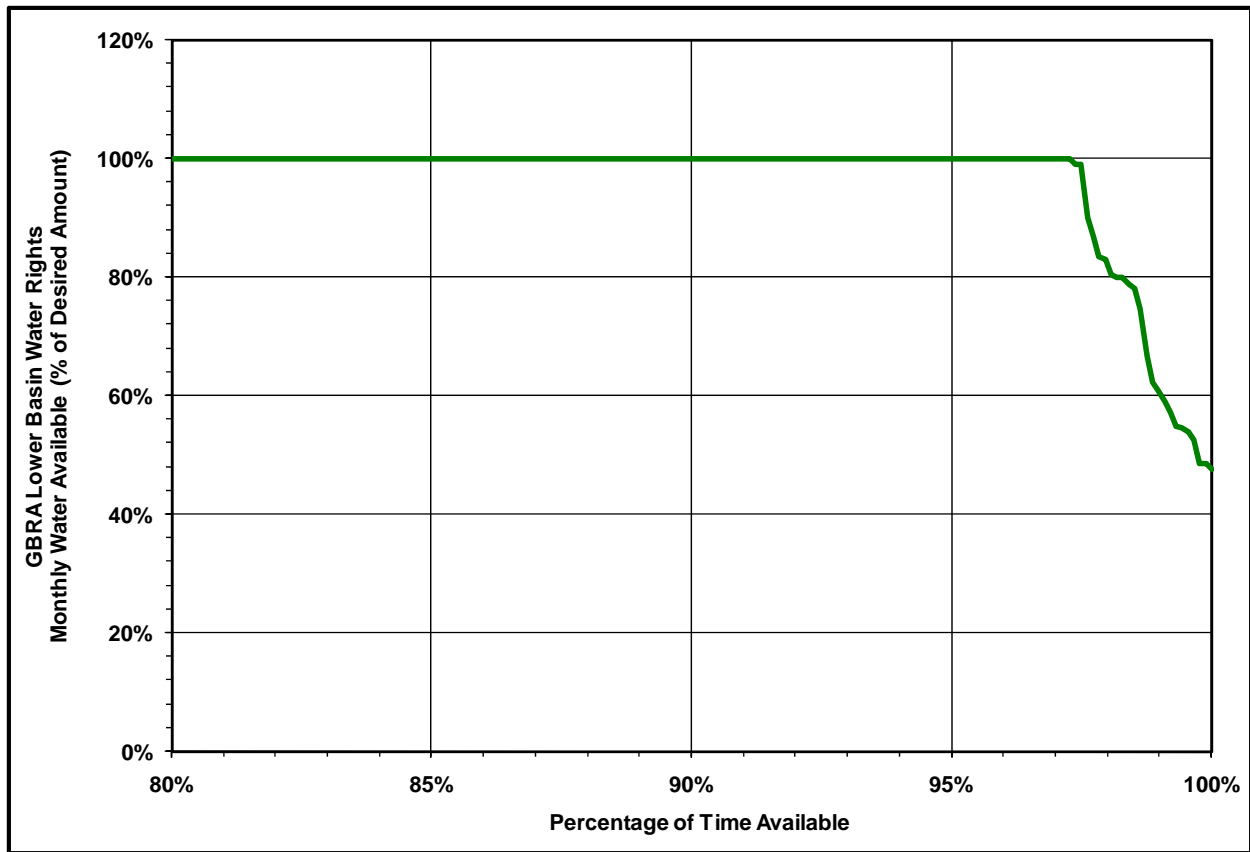


Figure 4C.13-3. GBRA Lower Basin Water Rights Monthly Reliability

4C.13.2.3 Firm Water Supply

As the GSA WAM is a monthly time-step model and flows in the lower Guadalupe River can, at times, be quite variable from day to day, it is important for GBRA planning purposes to refine the monthly estimates of water availability presented in Section 4C.13.2.2 and quantify water supplies that are reliable or firm on a daily basis. A specially-designed Microsoft Excel workbook was developed and applied to disaggregate monthly regulated streamflow values from the GSA WAM to daily values using historical daily streamflow patterns and obtain estimates of firm water supply available under the GBRA Lower Basin Water Rights on a daily basis. Historical daily streamflow patterns representative of the Guadalupe River near Tivoli are based on flows for the Guadalupe River at Victoria (USGS# 08176500), Coletto Creek near Victoria (USGS# 08177500), and the San Antonio River at Goliad (USGS# 08188500) during the 1990

through 2006 period and obtained from project files for a 1998 study⁶ for the 1934 through 1989 period. These daily streamflow values were then used, along with applicable seasonal diversion patterns associated with type of use, to determine the firm supply available under the GBRA Lower Basin Water Rights on a daily basis. The firm water supply that is reliable on a daily basis throughout the most severe drought on record is shown in Figure 4C.13-4, along with comparable annual and monthly amounts based solely on monthly GSA WAM output. It is important to note that the firm supply in Figure 4C.13-4 does not account for any storage between diversion from the Guadalupe River and ultimate users. Dow, Seadrift Coke, Ineous Nitriles, and the Port Lavaca Water Treatment Plant do, however, have on-site storage that could be drawn upon for relatively short periods during which water from the river is limited or unavailable. Hence, firm water supply on a daily basis is actually incrementally greater than the amount shown in Figure 4C.13-4.

4C.13.2.4 Firm Water Supply Enhancement with Off-Channel Storage

Firm water supplies available on a daily basis under the GBRA Lower Basin Water Rights can be enhanced with development and integration of off-channel storage. Analyses of potential enhancement of firm water supplies with off-channel storage are based on:

- a) Water availability calculated on a daily basis.
- b) Simplified off-channel reservoir operations simulations assuming maximum and minimum water depths of 25 feet and 3.5 feet, respectively.
- c) Delivery of water into the off-channel reservoir at a maximum rate of 50 cfs.
- d) Historical net evaporation from the GSA WAM.

Firm water supply could be increased from 41,548 acft/yr to 69,917 acft/yr (28,369 acft/yr increase) with the addition of the 100 acre, 2,500 acft off-channel storage reservoir. The 500 acre, 12,500 acft off-channel reservoir could increase the firm water supply from 41,548 acft/yr to 101,117 acft/yr (59,569 acft/yr increase).

⁶ HDR Engineering, Inc., "Guadalupe - San Antonio River Basin Model Modifications & Enhancements," Trans-Texas Water Program, West Central Study Area, Texas Water Development Board, San Antonio River Authority, et. al., March 1998.

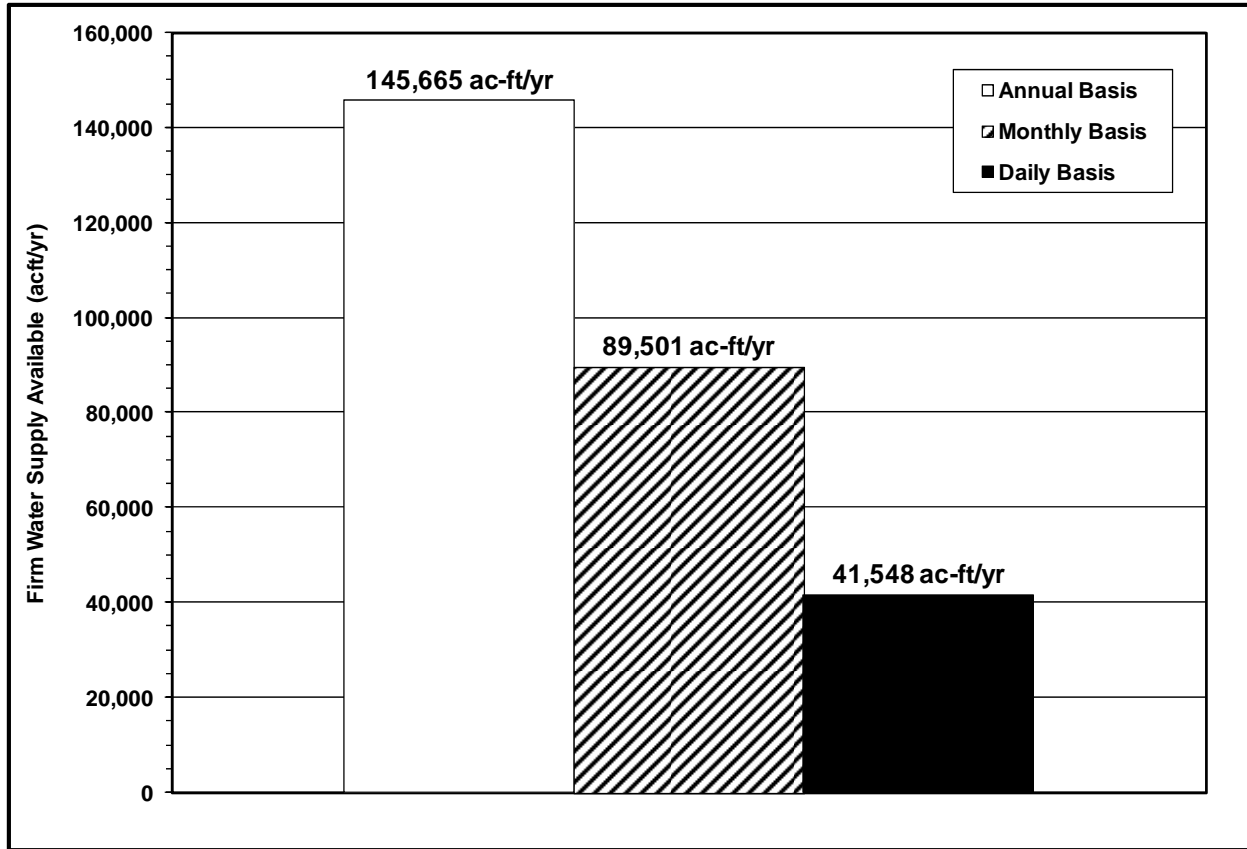


Figure 4C.13-4. Firm Water Supply on a Time-Step Basis

4C.13.3 Environmental Issues

The potential off-channel storage reservoir sites are located in Calhoun County, approximately two miles east of the intersection of State Highway (SH) 35 and SH 185. The approximate surface areas of these reservoirs are 100 and 500 acres. The total areas disturbed by the reservoir, embankments, and appurtenant facilities are approximately 125 and 625 acres, respectively.

Land uses found within the project areas include primarily farm, pasture, and range areas. U.S. Geological Survey land use and land cover data indicates that the project area contains approximately 65 percent cropland and pasture, and 35 percent shrub and brush rangeland.

The potential reservoir sites are located in the Gulf Coastal Plains of Texas Physiographic Province, specifically in the subprovince of the Coastal Prairies. This area is locally characterized as a nearly flat prairie composed of deltaic sands and muds which terminates at the

Gulf of Mexico and includes topography changes of less than one foot per mile. Elevation levels in the Coastal Prairies range from 0 to 300 feet above mean sea level.

4C.13.3.1 Vegetation

The potential reservoir sites are located within the Gulf Prairies and Marshes Vegetational Area. Gulf Prairies have slow surface drainage and elevations that range from sea level to 250 feet. These areas include nearly level and virtually undissected plains. Originally the Gulf Prairies were composed of tallgrass prairie and post oak savannah. However, tree species such as honey mesquite, and acacia, along with other trees and shrubs have increased in this area forming dense thickets in many places. Typical oak species found in this area include live oak (*Quercus virginiana*) and post oak (*Q. stellata*), in addition to huisache (*Acacia smallii*), black-brush (*A. rigidula*), and a dwarf shrub; bushy sea-ox-eye (*Borrichia frutescens*). Principal climax grasses of the Gulf Prairies include gulf cordgrass (*Spartina spartinae*), indiangrass (*Sorghastrum nutans*), and big bluestem (*Andropogon gerardii* var. *gerardii*). Prickly pear (*Opuntia*) are common within this area along with forbs including asters (*Aster sp.*), poppy mallows (*Callirhoe sp.*), bluebonnets (*Lupinus sp.*), and evening primroses (*Oenothera sp.*). Gulf Marshes range from sea level to a few feet in elevation, and include low, wet marshy coast areas commonly covered with saline water. These salty areas support numerous species of sedges (*Carex* and *Cyperus sp.*), bulrushes (*Scirpus sp.*), rushes (*Juncus sp.*), and grasses. Aquatic forbs found in these areas generally include pepperweeds (*Lepidium sp.*), smartweeds (*Polygonum sp.*), cattails (*Typha domingensis*) and spiderworts (*Tradescantia sp.*) among others. Upland game and waterfowl find these low marshy areas to be excellent natural wildlife habitat.

4C.13.3.2 Threatened and Endangered Species

The Federal Endangered Species Act of 1973, as amended, prohibits the “take” of any threatened or endangered species. The term “take” under the ESA means “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct.” The term “harm” was further defined to include “significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.” Designation of critical habitat areas has been established for the public knowledge where the publishing of such information would not cause harm to the species. Additional federal protection is extended to migratory

birds, and bald and golden eagles under the Migratory Bird Treaty Act (MBTA) as amended, and the Bald and Golden Eagle Protection Act. Protection is also afforded to Texas state-listed species. The Texas Parks and Wildlife Department (TPWD) enforces the state regulations.

The MBTA protects most bird species, including, but not limited to, cranes, ducks, geese, shorebirds, hawks, and songbirds. Migratory bird pathways, stopover habitats, wintering areas, and breeding areas may occur within and adjacent to the proposed reservoir sites, and may be associated with wetlands, ponds, shorelines, riparian corridors, fallow fields and grasslands, and woodland and forested areas. Construction activities could disturb migratory bird habitats and/or species' activities.

Reasonable and prudent measures should be taken to avoid and minimize the potential effects of project activities on threatened and endangered species as well as bald eagles. Species' locations, activities, and habitat requirements should be considered based on U.S. Fish and Wildlife Service and TPWD recommendations.

4C.13.3.3 County-Listed Species

In Calhoun County, there may occur 32 state-listed endangered or threatened species and 17 federally-listed endangered or threatened wildlife species, according to the county lists of rare species published by the TPWD. A list of these species, their preferred habitat, and potential occurrence in Calhoun County is provided in Table 4C.13-2.

Inclusion in Table 4C.13-2 does not imply that a species will occur within the project area, but only acknowledges the potential for occurrence in Calhoun County. A more intensive field reconnaissance would be necessary to confirm and identify specific suitable habitat that may be present in the project area. In addition to county lists, HDR also reviewed the Texas Natural Diversity Database (TXNDD) map data for known occurrences of listed species within or near the proposed reservoir sites. This information indicated that there were reported sightings of the bald eagle (*Haliaeetus leucocephalus*), listed as a threatened species by the State within the surrounding area. No specific sightings of any endangered or threatened species were documented within the proposed reservoir sites. The presence or absence of potential habitat within an area does not confirm the presence or absence of a listed species. No species specific surveys were conducted in the project area for this report.

**Table 4C.13-2.
Endangered, Threatened, and Species of Concern for Calhoun County**

Common Name	Scientific Name	Impact Value	Multiplier Based on Status	Adjusted Impact	Summary of Habitat Preference	Listing Entity		Potential Occurrence in County
						USFWS	TPWD	
AMPHIBIANS								
Black-spotted newt	<i>Notophthalmus meridionalis</i>	1	2	2	Usually found in wet or sometimes wet areas in the Gulf Coastal Plain south of the San Antonio River.		T	Resident
Sheep frog	<i>Hypopachus variolosus</i>	1	2	2	Found in grassland and savanna; moist sites in arid areas.		T	Resident
BIRDS								
Bald eagle	<i>Haliaeetus leucocephalus</i>	0	2	0	Found primarily near rivers and large lakes.	DL	T	Possible Migrant
Brown pelican	<i>Pelecanus occidentalis</i>	0	3	0	Largely coastal and near shore areas.	DL	E	Resident
Eskimo curlew	<i>Numenius borealis</i>	0	3	0	Historic, nonbreeding.	LE	E	Historic Resident
Henslow's Sparrow	<i>Ammodramus henslowii</i>	1	1	1	Found in weedy fields or cut-over areas			Resident
Mountain Plover	<i>Charadrius montanus</i>	1	1	1	Non-breeding, shortgrass plains and fields			Nesting/Migrant
Northern Aplomado Falcon	<i>Falco femoralis septentrionalis</i>	0	3	0	Found in open country, especially savanna and open woodland.	LE	E	Resident
American Peregrine Falcon	<i>Falco peregrinus anatum</i>	0	2	0	Migrant and local breeder in West Texas.	DL	T	Possible Migrant
Arctic Peregrine Falcon	<i>Falco peregrinus tundrius</i>	0	1	0	Migrant throughout the state.	DL		Possible Migrant
Piping plover	<i>Charadrius melodus</i>	0	2	0	Wintering migrant along the Texas Gulf Coast.	LT	T	Migrant
Reddish Egret	<i>Egretta rufescens</i>	1	2	2	Resident of Texas Gulf coast.		T	Resident
Snowy Plover	<i>Charadrius alexandrinus</i>	0	1	0	Potential migrant, winters along coast			Migrant
Sooty Tern	<i>Sterna fuscata</i>	1	2	2	Usually flies or hovers over water.		T	Resident
Southeastern Snowy Plover	<i>Charadrius alexandrinus tenuirostris</i>	0	1	0	Wintering migrant along the Texas Gulf Coast.			Migrant
Western Burrowing Owl	<i>Athene cunicularia hypugaea</i>	1	1	1	Open grasslands, especially prairie, plains and savanna			Resident
White-faced Ibis	<i>Plegadis chihi</i>	1	2	2	Prefers freshwater marshes.		T	Resident
White-tailed Hawk	<i>Buteo albicaudatus</i>	0	2	0	Found near the coast on prairies.		T	Resident
Whooping Crane	<i>Grus americana</i>	1	3	3	Potential migrant	LE	E	Potential Migrant

Table 4C.13-2 (Continued)

Common Name	Scientific Name	Impact Value	Multiplier Based on Status	Adjusted Impact	Summary of Habitat Preference	Listing Entity		Potential Occurrence in County
						USFWS	TPWD	
Wood Stork	<i>Mycteria americana</i>	1	2	2	Forages in prairie ponds, ditches, and shallow standing water formerly nested in TX		T	Migrant
FISH								
American eel	<i>Anguilla rostrata</i>	1	1	1	Coastal waterways below reservoirs to gulf.			Resident
Opossum pipefish	<i>Microphis brachyurus</i>	1	2	2	Adults found in fresh or low salinity waters.		T	Resident
Smalltooth sawfish	<i>Pristis pectinata</i>	1	3	3	Found in bays, estuaries or river mouths.	LE	E	Resident
MAMMALS								
Black Bear	<i>Ursus americanus</i>	0	2	0	Inhabits bottomland hardwoods	T/SA;NL	T	Historic Resident
Jaguarundi	<i>Herpailurus yaguarondi</i>	0	3	0	Found in thick brushlands near water.	LE	E	Resident
Louisiana black bear	<i>Ursus americanus luteolus</i>	0	2	0	Possible transient.	LT	T	Transient
Ocelot	<i>Leopardus pardalis</i>	0	3	0	Found in dense chaparral thickets; mesquite-thorn scrub and live oak motts.	LE	E	Resident
Plains Spotted Skunk	<i>Spilogale putorius interrupta</i>	1	1	1	Prefers wooded, brushy areas.			Resident
Red Wolf	<i>Canis rufus</i>	0	3	0	Extirpated.	LE	E	Historic Resident
West Indian manatee	<i>Trichechus manatus</i>	0	3	0	Gulf and bay systems.	LE	E	Resident
MUSSELS								
Creeper (squawfoot)	<i>Strophitus undulatus</i>	1	1	1	Small to large streams			Resident
Pistolgrip	<i>Tritogonia verrucosa</i>	1	1	1	Aquatic, stable substrate. Red through San Antonio river basins.			Resident
PLANTS								
Threeflower broomweed	<i>Thurovia triflora</i>	1	1	1	Endemic: near coast.			Resident
REPTILES								
Atlantic hawksbill sea turtle	<i>Eretmochelys imbricate</i>	0	3	0	Found in Gulf and bay systems.	LE	E	Resident
Green sea turtle	<i>Chelonia mydas</i>	0	2	0	Gulf and bay systems.	LT	T	Resident
Gulf Saltmarsh snake	<i>Nerodia clarkii</i>	1	1	1	Found on saline flats.			Resident
Kemp's Ridley sea turtle	<i>Lepidochelys kempii</i>	0	3	0	Found in gulf and bay systems.	LE	E	Resident
Leatherback sea turtle	<i>Dermochelys coriacea</i>	0	3	0	Gulf and bay systems.	LE	E	Resident
Loggerhead sea turtle	<i>Caretta caretta</i>	0	2	0	Gulf and bay systems for juveniles, ocean for adults.	LT	T	Resident

Table 4C.13-2 (Concluded)

Common Name	Scientific Name	Impact Value	Multiplier Based on Status	Adjusted Impact	Summary of Habitat Preference	Listing Entity		Potential Occurrence in County
						USFWS	TPWD	
Texas diamondback terrapin	<i>Malaclemys terrapin littoralis</i>	1	1	1	Found in coastal marshes and tidal flats.			Resident
Texas Horned Lizard	<i>Phrynosoma cornutum</i>	1	2	2	Varied, sparsely vegetated uplands.		T	Resident
Texas scarlet snake	<i>Cemophora coccinea lineri</i>	1	2	2	Mixed hardwood scrub on sandy soils.		T	Resident
Texas Tortoise	<i>Gopherus berlandieri</i>	1	2	2	Open brush w/ grass understory.		T	Resident
Timber/Canebrake Rattlesnake	<i>Crotalus horridus</i>	1	2	2	Floodplains, upland pine, deciduous woodlands, riparian zones.		T	Resident

Source: TPWD, Annotated County List of Rare Species, Calhoun County, Updated May 4, 2009.

- DL Delisted
- PDL Proposed for Delisting
- LE Federally listed endangered
- LT Federally listed threatened
- T/SA;NL Threatened by similarity of appearance but not listed
- Not Federally or State Listed but considered a species of concern
- E State Endangered
- T State Threatened

4C.13.3.4 Cultural Resources

A review of the Texas Historical Commission Texas Historic Sites Atlas data base indicated that there are no historical markers, National Register Properties, or cemeteries listed within 500 feet of or within the proposed reservoir sites.

A request was made for archeological site records recorded within 500 feet of the proposed reservoir sites from the Texas Historical Commission’s (THC) restricted Texas Archeological Sites Atlas. Information received from the THC indicates that there are no recorded sites found within the project area on the Green Lake, or Port Lavaca West quad maps. Although no sites have been recorded within the project area, this does not necessarily mean that sites are not present.

4C.13.4 Engineering and Costing

The cost estimates for the two off-channel reservoir sites of this water management strategy are shown in Tables 4C.13-3 and 4C.13-4. Included in the costs for the off-channel

Table 4C.13-3.
Cost Estimate Summary
GBRA Lower Basin Storage Project for 100 acre, 2,500 ac-ft OCR
September 2008 Prices

<i>Item</i>	<i>Estimated Costs for Facilities (September 2008)</i>
Capital Costs	
Off-Channel Reservoir (2,500 acft, 100 acres)	\$12,938,000
Intake and Pump Station (360 HP, 34 MGD)	\$7,897,000
Transmission Pipeline (42-in dia., 994 ft)	\$1,566,000
Outlet Pipeline (72-in dia., 994 ft)	<u>\$786,000</u>
Total Capital Cost	\$23,187,000
Engineering, Legal Costs and Contingencies	\$7,998,000
Environmental & Archaeology Studies and Mitigation	\$317,000
Land Acquisition and Surveying (100 acres)	\$ 304,000
Interest During Construction (2 years)	<u>\$1,994,000</u>
Total Project Cost	\$33,800,000
Annual Costs	
Debt Service (6 percent, 20 years)	\$1,249,000
Reservoir Debt Service (6 percent, 40 years)	\$1,294,000
Operation and Maintenance	
Intake, Pipeline, Pump Station	\$221,000
Off-Channel Reservoir	\$194,000
Pumping Energy Costs (46,592 kW-hr @ 0.09 \$/kW-hr)	\$4,000
Total Annual Cost	\$ 2,962,000
Available Project Yield (acft/yr)	28,369
Annual Cost of Water (\$ per acft)	\$104
Annual Cost of Water (\$ per 1,000 gallons)	\$0.32

Table 4C.13-4.
Cost Estimate Summary
GBRA Lower Basin Storage Project for 500 acre, 12,500 ac-ft OCR
September 2008 Prices

<i>Item</i>	<i>Estimated Costs for Facilities (September 2008)</i>
Capital Costs	
Off-Channel Reservoir (12,500 acft, 100 acres)	\$34,230,000
Intake and Pump Station (360 HP, 34 MGD)	\$7,897,000
Transmission Pipeline (42-in dia., 6,979 ft)	\$5,440,000
Outlet Pipeline (72-in dia., 994 ft)	<u>\$4,660,000</u>
Total Capital Cost	\$52,227,000
Engineering, Legal Costs and Contingencies	\$17,774,000
Environmental & Archaeology Studies and Mitigation	\$1,473,000
Land Acquisition and Surveying (100 acres)	\$1,520,000
Interest During Construction (2 years)	<u>\$4,882,000</u>
Total Project Cost	\$77,876,000
Annual Costs	
Debt Service (6 percent, 20 years)	\$2,172,000
Reservoir Debt Service (6 percent, 40 years)	\$3,520,000
Operation and Maintenance	
Intake, Pipeline, Pump Station	\$298,000
Off-Channel Reservoir	\$513,000
Pumping Energy Costs (46,592 kW-hr @ 0.09 \$/kW-hr)	\$16,000
Total Annual Cost	\$6,519,000
Available Project Yield (acft/yr)	59,569
Annual Cost of Water (\$ per acft)	\$109
Annual Cost of Water (\$ per 1,000 gallons)	\$0.34

reservoirs are raw water intakes and pump stations, transmission pipelines, and outlet pipelines. The OCR options also include cost of the reservoir and dam. Depending upon the location(s) and type(s) of use for water supplies associated with the off-channel reservoir, additional facilities and costs could include pipelines to customers and treatment. Inundated land and mitigation land acquisition and operation and maintenance costs were developed in accordance with the standard cost estimating procedures summarized in Appendix A.

The costs presented in Tables 4C.13-3 and 4C.13-4 are based on the firm yield increase associated with the implementation of each off-channel reservoir. The total project and annual costs, including debt service and operation and maintenance are \$33,800,000 and \$2,962,000 for the 2,500 acft OCR and \$77,876,000 and \$6,519,000 for the 12,500 acft OCR, respectively. These annual costs translate to unit costs of \$104 per acft and \$109 per acft for the 2,500 acft and 12,500 acft off-channel reservoirs, respectively.

4C.13.5 Implementation Issues

An institutional arrangement may be needed to implement this project including financing on a regional basis.

1. It will be necessary to obtain this permit:
 - a. TCEQ storage permit.
2. Permitting, at a minimum, will require these studies:
 - a. Habitat mitigation plan.
 - b. Environmental studies.
 - c. Cultural resources.
3. Land will need to be acquired through either negotiations or condemnation.
4. Relocations for these reservoir sites are expected to minimal, if any.

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