9 Regional Water Supply Projects

9.1 Bosque County Regional Project

9.1.1 Description of Option

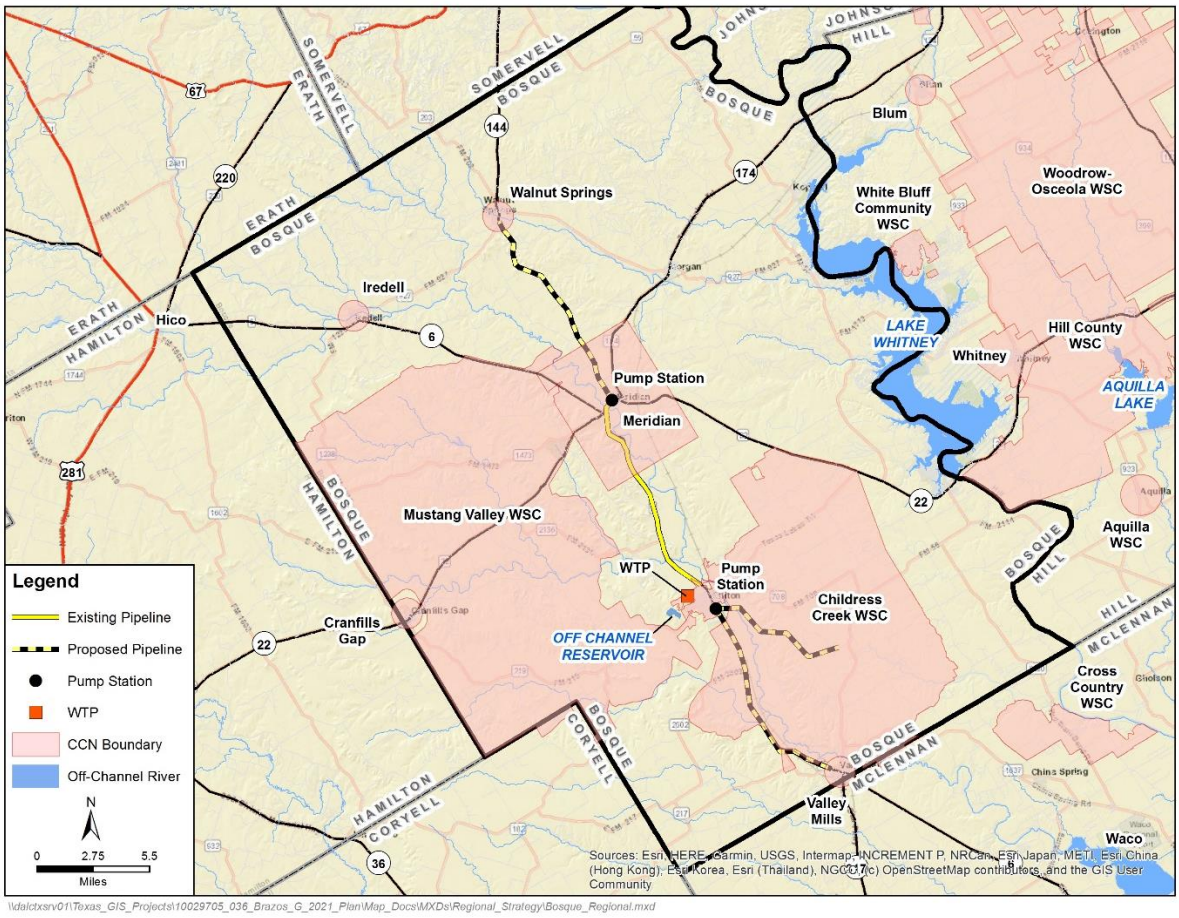
The Bosque County Regional Project has been a recommended water management strategy in both the 2011 and 2016 the regional water plans to address municipal water needs in Bosque County. Groundwater reliability remains a significant concern for the WUGs due to the large groundwater declines anticipated with the Desired Future Conditions (DFC) as developed by the groundwater districts for the Trinity Aquifer in Groundwater Management Area 8 (GMA-8). The project was originally identified through a jointly sponsored study[1] by the Brazos River Authority, Texas Water Development Board, and the Cities of Clifton and Meridian to determine the regional water needs and to evaluate existing and proposed water facilities.

The project envisioned the City of Clifton expanding its water system to provide treated surface water to the cities of Meridian, Valley Mills, Childress Creek Water Supply Corp. (WSC), and Bosque County Other. Bosque County Manufacturing demands could also be partially supplied through this project. The project would consist of expansion of the Clifton off-channel reservoir (OCR), expansion of Clifton's water treatment plant (WTP), and treated water transmission systems to nearby utilities. The 500 acft Clifton OCR was constructed in 1998 as the initial phase of the project with subsequent phases to increase it up to 2,000 acft of storage to meet local and regional water needs.

Figure 9.1-1 shows the planned interconnection of the four water utilities with the regional facility at Clifton. An 11 mile, 8-inch diameter water transmission pipeline has been recently constructed between Clifton and Meridian.

[1] Carter-Burgess, "Bosque County Regional Water Treatment and Distribution Facilities Plan," Final Report to the Brazos River Authority, March 2004.

Figure 9.1-1. Interconnection of Bosque County Systems



9.1.2 Available Yield

The City of Clifton holds two water rights on the North Bosque River. The first right with a priority date of March 14, 1963 allows the City to divert 600 acft/yr for municipal use. The second water right dated December 13, 1996 allows the City to divert and impound 2,000 acft/yr at a maximum rate of 12 cfs. Lake Waco rights are subordinated to Clifton's rights through the 1994 Windup Agreement between BRA and former Lake Bosque project participants. The Windup Agreement provides for 3,340 acft/yr for Clifton and Meridian from the North Bosque River watershed to be senior to rights in Lake Waco.

A previous yield analysis[2] for the Clifton OCR on the North Bosque River subject to instream flow conditions is included in Table 9.1-1.

[2] HDR, February 1997. City of Clifton Water Supply Plan. Preliminary Engineering Report

Table 9.1-1. Summary of Clifton OCR Yield

Reservoir Capacity (acft)	Yield (acft/yr)
500	730
1,150	1,133
2,000	1,523

The yield of the City of Clifton's surface water system (Bosque River diversion into an off-channel reservoir) is currently 730 acft/yr, but future enlargement of the reservoir could increase the yield up to 1,523 acft/yr. Based on projected demands, Clifton would have up to 1,070 acft/yr of supply available to sell in 2070 if its current water treatment plant were expanded and the reservoir were enlarged. This strategy, as formulated, would provide a total of 1,070 acft/yr to the five WUGS (203 acft/yr to Childress WSC; 224 acft/yr to Meridian; 182 acft/yr to Valley Mills; 64 acft/yr to Bosque County Other; and 397 acft/yr to Clifton. New water supplies for WUGs could also be used to meet Bosque County Manufacturing demands. Ongoing groundwater level declines in the Trinity Aquifer could result in a practical reduction in groundwater supplies to any of these entities in the future, necessitating either rehabilitation or replacement of existing wells or implementation of this water supply strategy.

9.1.3 Environmental

The Bosque County Regional Project includes an expansion of the existing Clifton off-channel reservoir and water treatment plant, and the construction of several treated water transmission pipelines and associated accoutrements. Expansion of the City of Clifton water system would allow this system to provide treated surface water to the cities of Meridian, Valley Mills, Childress Creek, and Bosque County Other. Environmental concerns associated with this water management strategy include impacts from expansion of the water treatment plant and ground storage tanks, inundation of habitat resulting from the expansion of the existing reservoir and impacts from the construction of pump stations and transmission pipelines.

With numerous miles of treated water transmission pipelines, four crossings of jurisdictional waters would occur. These crossings include two intermittent tributary streams and two perennial streams including the North Bosque River, and Neils Creek. Impacts to these waters from pipelines would be temporary and occur during construction. Any potential impacts to these areas would be restorable. Avoidance and minimization measures, such as horizontal directional drilling, construction best management practices (BMPs), and avoiding perennial and/or sensitive aquatic habitats would reduce potential impacts to these areas.

Coordination with the U.S. Army Corps of Engineers would be required for construction within waters of the U.S. Impacts from this proposed project resulting in a loss of less than 0.5 acres of waters of the U.S. could be covered under Nationwide Permit 12 for Utility Line Activities unless there are significant impacts to the aquatic environment by other project components.

The Texas Parks & Wildlife Department (TPWD) has identified a number of stream segments throughout the state as ecologically significant on the basis of biological function, hydrologic function, riparian conservation, exceptional aquatic life uses, and/or threatened or endangered species. Neils Creek is considered to be ecologically significant based on high aesthetic value for an ecoregion stream, high water quality, and diverse benthic macroinvertebrate community.[3]

The proposed project would occur in the Cross Timbers Ecoregion of Texas.[4] This ecoregion is a transitional area between the original prairie regions to the west and the low mountains or hills of eastern Oklahoma and Texas. The project area includes two major vegetation types as defined by Texas Parks and Wildlife (TPWD),[5] including Bluestem Grassland and Oak-Mesquite-Juniper Parks/Woods. Bluestem Grassland commonly includes plants such as bushy bluestem (*Andropogon glomeratus*), slender bluestem (*Schizachyrium tenerum*), little bluestem (*Schizachyrium scoparium*), buffalograss (*Bouteloua dactyloides*), southern dewberry (*Rubus trivialis*), live oak (*Quercus virginiana*), mesquite (*Prosopis pubescens*) and huisache (*Acacia farnesiana*). Oak-Mesquite-Juniper Parks/Woods associated plants include post oak (*Q. stellata*), Ashe juniper (*Juniperus ashei*), shin oak (*Q. havardii*), blackjack oak (*Q. marilandica*), cedar elm (*Ulmus crassifolia*), Mexican persimmon (*Diospyros texana*), purple three-awn (*Aristida purpurea*), sideoats grama (*Bouteloua curtipendula*) and curly mesquite (*Hilaria belangeri*).

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Bosque County can be found at https://tpwd.texas.gov/gis/rtest/.

There are no areas of critical habitat designated within or near the project area.[6]

[3] TPWD, "Ecologically Significant River and Stream Segments," https://tpwd.texas.gov/landwater/water/conservation/water_resources/water_quantity/sigsegs/regiong.phtml. Accessed July 18, 2019.

[4] Grifffith, Glenn, Sandy Bryce, James Omernik and Anne Rogers. 2007. Ecoregions of Texas. Texas Commission on Environmental Quality and Environmental Protection Agency, Austin, Texas.

[5] McMahan, Craig A., Roy G. Frye and Kirby L. Brown. 1984. The Vegetation Types of Texas Including Cropland. Texas Parks and Wildlife Department, Austin, Texas.

[6] USFWS. Critical Habitat Portal. Accessed online at http://ecos.fws.gov/crithab/ July 18, 2019.

The project area may provide potential habitat to endangered or threatened species found in Bosque County. A survey of the project area may be required prior to pipeline and facility construction to determine whether populations of or potential habitats used by listed species occur in the area to be affected. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

No designated critical habitat for the endangered golden-cheeked warbler occurs within the project area. The majority of the pipeline for this project will occur in previously disturbed areas such as existing road right-of-way or crop areas, therefore no impacts to these avian species is anticipated from the project.

Populations of the endangered smalleye and sharpnose shiner occur within the upper Brazos River basin above Lake Whitney. Although these shiner species were once found throughout the Brazos River and several of its major tributaries within the watershed, they are currently restricted almost entirely to the contiguous river segments of the upper Brazos River basin in north-central Texas.[7]

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available geographic information systems (GIS) datasets provided by the Texas Historical Commission (TAC), there are four national register properties, eight cemeteries, 17 historical markers, and a total of 20 archeological survey areas within one mile of the proposed pipelines, pump stations or other facilities.

Based on a review of soils, geology, and aerial photographs, there is a high probability for undocumented significant cultural resources within the alluvial deposits and terrace formations associated with waterways, specifically the intermittent and perennial aquatic resources. The probability of pipelines crossing areas which may include cultural resources increases near waterways and associated landforms.

Increasing the amount of water stored by the existing reservoir would inundate a limited amount of habitat; however, this action is not anticipated to result in significant impacts to area species due to the abundance of similar habitat located nearby. Impacts resulting from the construction and maintenance of the associated pipelines, pump stations or water treatment facilities are anticipated to be minimal if avoidance measures are implemented. It is anticipated that the pipelines, pump stations and other necessary facilities will be positioned to avoid impacts to known cultural resources, sensitive habitats, wetlands or stream crossings as much as reasonably possible.

9.1.4 Engineering and Costing

The City of Clifton is the primary supplier used for the Bosque County Regional Project to interconnect its system into a regional and community system. The following facilities

[7] USFWS Ecological Services. Sharpnose and smalleye shiners. Accessed online at http://www.fws.gov/southwest/es/arlingtontexas/shiner.htm, on May 29, 2014.

would be needed to connect the City of Clifton to Childress WSC, Valley Mills, Meridian and Bosque County Other:

- Enlargement of off-channel storage;
- Expansion Clifton's Water Treatment Plant and Ground Storage;
- Treated Water Pump Station at Clifton and Meridian; and
- Treated Water Transmission Pipelines.

The channel dam, off-channel reservoir, and water treatment facilities would form the hub of the regional water system. At Clifton, a central pump station would be built. From here separate pipelines would connect to distribution points in the Childress WSC and Valley Mills, and to a pump station at Meridian. From the Meridian pump station, treated water would be pumped to a distribution point in the Meridian and Bosque County Other systems.

In January 2013, HDR evaluated the costs to expand the Clifton OCR and expand the WTP capacity to 2 million gallons per day (MGD). The off-channel reservoir is designed for staged construction with an initial capacity of 500 acre-feet. Increasing the height of the zoned earthfill dam will increase the storage capacity of the off-channel reservoir. Due to limited availability of on-site borrow material, off-site borrow material will need to be imported to increase the height of the dam. Additional geotechnical studies will be required to investigate the strength and water retention ability of the higher elevation abutments and to determine if pressure grouting will be required. The cost estimate includes modifications to appurtenant structures including the intake tower and emergency spillway to accommodate the increased capacity and height of the off-channel reservoir. No improvements are required for the intake pump station or raw water pipeline. Similarly, upgrades to clearwell storage and the finished water pipeline are not required for expansion of the water supply system.

The water treatment plant is also designed for expansion with a current treatment capacity of 1 MGD. The water treatment plant building is sized to accommodate the equipment required to increase the capacity of the plant to 2 MGD. The principal cost to expand the water treatment plant is the purchase of two additional modular package units. Improvements will also be required to increase the capacity of the chemical feed systems, construct appropriate access platforms, and connect the new treatment units to the plant piping system and plant SCADA and control system.

The costs for four participating communities in Bosque County to connect to the City of Clifton's water system are summarized in Table 9.1-2. The capital and other project costs have been estimated using TWDB's Unified Costing Model for Regional Planning. The total project cost, including capital, engineering, legal costs, contingencies, environmental studies, land acquisition and surveying, for the regional interconnections is $21.8 million. These costs were determined based on dedicated infrastructure to each entity and shared infrastructure costs based on prorated supplies.

Taking into consideration debt service on a 40-year loan for the OCR expansion and 20 year debt service on all other capital costs, operation and maintenance costs, and pumping energy costs, the total annual costs are $3.5 million and by entity: Childress, $708,000;

Valley Mills, $683,000; Meridian, $597,000; Bosque County Other, $447,000; and Clifton, $1,019,000.

9.1.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 9.1-3, and the option meets each criterion.

The participating entities must negotiate a regional water service contract to build and operated the system and to equitably share costs. This would probably include the need for a cost of service study.

Requirements specific to pipelines needed to link existing sources to users will include:

- U.S. Army Corps of Engineers Section 404 permit(s) for pipeline stream crossings; discharges of fill into wetlands and waters of the U.S. for construction; and other activities;
- NPDES Storm Water Pollution Prevention Plan;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

Mitigation requirements would vary depending on impacts, but could include vegetation restoration, wetland creation or enhancement, or additional land acquisition.

Table 9.1-2. Cost Estimate Summary: Bosque County Regional Project

Item	Estimated Costs for Facilities	Childress Creek WSC	Valley Mills	Meridian	Bosque County Other	Clifton
Off-Channel Reservoir Expansion	$9,451,000	$1,793,000	$1,608,000	$1,979,000	$565,000	$3,507,000
Primary Pump Stations	$2,588,000	$491,000	$440,000	$542,000	$155,000	$960,000
Transmission Pipeline (6 in dia., 28 miles)	$5,325,000	$1,330,000	$1,967,000	$0	$2,028,000	$0
Transmission Pump Station(s) & Storage Tank(s)	$1,600,000	$576,000	$141,000	$196,000	$687,000	$0
Water Treatment Plant (2 MGD)	$8,190,000	$1,554,000	$1,393,000	$1,715,000	$490,000	$3,039,000
TOTAL COST OF FACILITIES	**$27,154,000**	**$5,744,000**	**$5,549,000**	**$4,432,000**	**$3,925,000**	**$7,506,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies	$9,238,000	$1,944,000	$1,844,000	$1,551,000	$1,272,000	$2,627,000
Environmental & Archaeology Studies and Mitigation	$980,000		$200,000	$160,000	$142,000	$271,000
Land Acquisition and Surveying (188 acres)	$574,000	$121,000	$117,000	$94,000	$83,000	$159,000
Interest During Construction (4% for 1 years with a 1% ROI)	$1,044,000	$221,000	$213,000	$170,000	$151,000	$289,000
TOTAL COST OF PROJECT	**$38,990,000**	**$8,030,000**	**$7,923,000**	**$6,407,000**	**$5,573,000**	**$10,852,000**
Debt Service (5.5 percent, 20 years)	$1,821,000	$375,000	$370,000	$299,000	$260,000	$507,000
Reservoir Debt Service (5.5 percent, 40 years)	$614,000	$126,000	$125,000	$101,000	$88,000	$171,000
Operation and Maintenance						
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$134,000	$34,000	$36,000	$10,000	$40,000	$14,000
Dam and Reservoir (1.5% of Cost of Facilities)	$142,000	$27,000	$24,000	$30,000	$8,000	$53,000
Water Treatment Plant (2.5% of Cost of Facilities)	$739,000	$140,000	$126,000	$155,000	$44,000	$274,000
Pumping Energy Costs (213654 kW-hr @ 0.09 $/kW-hr)	$17,000	$6,000	$2,000	$2,000	$7,000	$0
TOTAL ANNUAL COST	**$3,467,000**	**$708,000**	**$683,000**	**$597,000**	**$447,000**	**$1,019,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1.5	**1,070**	**203**	**182**	**224**	**64**	**397**
Annual Cost of Water ($ per acft)	**$3,240**	**$3,488**	**$3,753**	**$2,665**	**$6,984**	**$2,567**
Annual Cost of Water ($ per 1,000 gallons)	**$9.94**	**$10.70**	**$11.52**	**$8.18**	**$21.43**	**$7.88**

Table 9.1-3. Comparison of Bosque County Interconnections Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient to meet needs
2. Reliability	2. High reliability
3. Cost	3. High
B. Environmental factors	
1. Environmental Water Needs	1. Low impact
2. Habitat	2. Low impact
3. Cultural Resources	3. Low impact
4. Bays and Estuaries	4. Negligible impact
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	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	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

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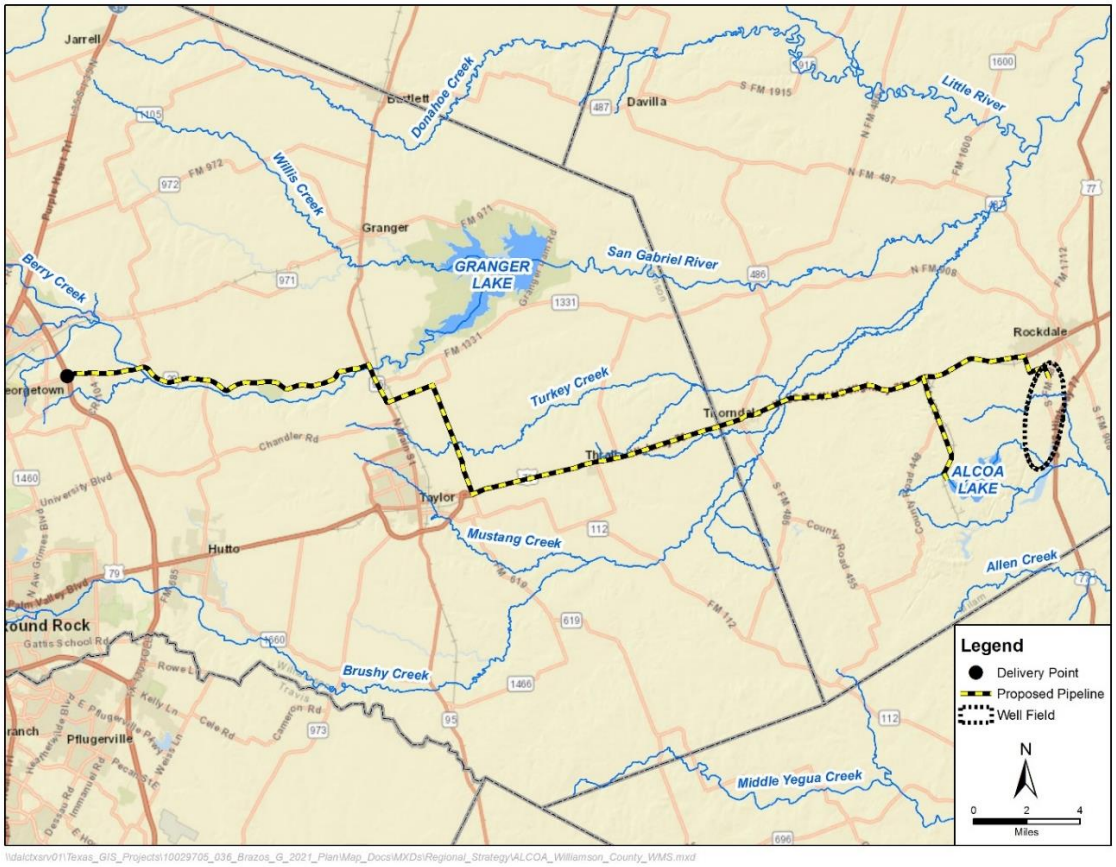
9.2 Milam County Groundwater and Alcoa Supply for Williamson County

9.2.1 Description of Option

In the Milam County area Alcoa has ceased operations and is offering to sell the property and the water rights for Lake Alcoa, Little River diversions rights, and groundwater supply associated with the property near Alcoa's former Rockdale plant. Water at the site has recently been used by Luminant for steam-electric power generation, but the power facilities have been shut down as well. This indicates that water supply dedicated to steam-electric cooling is no longer required for that purpose, which would free up those supplies for other uses. These supplies include the firm yield of Lake Alcoa and associated diversions from the Little River, and Carrizo-Wilcox Aquifer supplies available under the modeled available groundwater (MAG) in Milam County.

This strategy assesses converting the Alcoa surface water supplies and groundwater supplies in Milam County from industrial to municipal water use and delivering the supply to supply municipal water needs in Williamson County. Figure 9.2-1 shows the existing and proposed infrastructure and delivery to a point just west of the State Highway 130 corridor east of Georgetown.

Figure 9.2-1. Proposed Infrastructure of the Milam County Groundwater and Alcoa Water Supply Project



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9.2.2 Available Supply

Alcoa has surface water rights that can supply up to 18,600 acre-feet per year from Lake Alcoa, including a separate water right and an additional contract with the BRA to divert flows from the Little River. The associated groundwater supplies are permitted for up to 33,600 acft/yr, but for regional water planning purposes will supply only between 14,006 to 17,529 acft/yr due to MAG limitations. These supplies are assumed to be available for municipal use in Williamson County, provided that certain existing permit limitations can be amended.

9.2.3 Environmental Issues

There would be limited environmental impacts due to construction of the proposed pipeline from the existing Alcoa well field or Lake Alcoa to the distribution point. Environmental impacts could include:

- Possible impacts to riparian corridors and waters of the U.S., depending on location of the proposed pipeline
- Possible minor impacts to cultural resources
- Other possible minor impacts to vegetation and wildlife habitat due to pipeline development

The impacts of pipeline development will be minimized to the extent possible by following existing roadway corridors and by avoiding environmentally sensitive areas where feasible. A summary of environmental issues is presented in Table 9.2-1. The proposed pipeline can be sited to avoid impacts to any critical wildlife habitat.

Table 9.2-1. Environmental Issues: Milam County Groundwater and Alcoa Supply for Williamson County

Issue	Description
Implementation Measures	A pipeline from the existing Alcoa well field and Lake Alcoa to the distribution point in Williamson County
Environmental Water Needs/Instream Flows	Negligible impact.
Bays and Estuaries	Negligible impact.
Fish and Wildlife Habitat	Possible minor impacts on riparian corridors, depending on specific location of pipelines.
Cultural Resources	Possible low impact.
Threatened and Endangered Species	Possible low impact.

9.2.4 Engineering and Costing

Figure 9.2-1 shows the facilities included in the water management strategy to meet needs in Williamson County. Brazos G considered three options for supplying Williamson County municipal needs:

- 14,000 acft/yr Milam County groundwater supply,
- 18,600 acft/yr Alcoa surface water supply, and
- 32,600 acft/yr combined groundwater and surface water.

Infrastructure for the groundwater supply would include: primary pump station, pipeline route from the well fields to the delivery point, water treatment plant costs for chlorine disinfection, cost to upgrade the wells, and other associated project costs. Infrastructure for the surface water strategy includes: intake, WTP, primary pump station, pipeline route from Lake Alcoa to the delivery point, and other associated project costs. Infrastructure for the combined supplies would include: intake, pump stations, pipeline route from the well fields to the delivery point, pipeline route from Lake Alcoa to the delivery point, water treatment plant costs, cost to upgrade the wells, and other associated project costs. Due to the magnitude of municipal needs in Williamson County, the Brazos G RWPG has recommended the combined supply option. Costs are presented in Table 9.2-3. For a combined supply of 32,600 acft/yr, the total project would be $359,500,000 with an annual cost of $44,328,000.

9.2.5 Implementation Issues

As a large regional water supply project, this evaluation assumes that the Brazos River Authority would be the lead agency, although another regional water provider or private enterprise could also develop the project on behalf of Williamson County entities. Supplies from this project could be used by BRA as the groundwater portion of the Lake Granger Augmentation strategy recommended for the BRA.

Issues that may impede implementation are the required amendments to the surface water rights and groundwater permits. Surface water rights would need to be amended to change the type and place of use. Existing agreements between Luminant and Alcoa likely would need to be modified. The BRA contract would also need to be modified to change the type and place of use. The groundwater permits would need to be amended from on-site industrial use to municipal use off-site. It is likely that when the groundwater permits are modified, they would not retain their historical use status, which offers some level of protection against future reductions in permitted volume. Use of the groundwater in Williamson County would require that the new permit holders obtain export permits authorizing use of the water outside of the Post Oak Savannah Groundwater Conservation District (Milam and Burleson Counties). Table 9.2-4 compares this water management strategy to the plan development criteria.

Table 9.2-2. Cost Estimate Summary for Surface Water Only Option for Delivery to Williamson County

Item	Estimated Costs for Facilities
Intake Pump Stations (17.5 MGD)	$31,910,000
Transmission Pipeline (36 in dia., 42 miles)	$69,313,000
Transmission Pump Station(s) & Storage Tank(s)	$8,802,000
Water Treatment Plant (16.6 MGD)	$64,207,000
TOTAL COST OF FACILITIES	**$174,232,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$57,516,000
Environmental & Archaeology Studies and Mitigation	$1,119,000
Land Acquisition and Surveying (525 acres)	$2,353,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$6,469,000
TOTAL COST OF PROJECT	**$241,689,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$17,005,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$709,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$977,000
Water Treatment Plant	$4,494,000
Pumping Energy Costs (16,563,378 kW-hr @ 0.08 $/kW-hr)	$1,325,000
Purchase of Water (18,600 acft/yr @ 76.5 $/acft)	$1,423,000
TOTAL ANNUAL COST	**$25,933,000**
Available Project Yield (acft/yr)	18,600
Annual Cost of Water ($ per acft), based on PF=1	$1,394
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$480
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$4.28
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.47

Table 9.2-3. Cost Estimate Summary for Combined Surface Water and Groundwater Option for Delivery to Williamson County

Item	Estimated Costs for Facilities
Intake Pump Stations (30.6 MGD)	$38,345,000
Transmission Pipeline (42 in dia., 42 miles)	$82,639,000
Transmission Pump Station(s) & Storage Tank(s)	$16,086,000
Well Fields (Wells, Pumps, and Piping)	$13,913,000
Water Treatment Plant (29.2 MGD)	$105,758,000
TOTAL COST OF FACILITIES	**$258,477,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$86,335,000
Environmental & Archaeology Studies and Mitigation	$2,027,000
Land Acquisition and Surveying (678 acres)	$3,039,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$9,622,000
TOTAL COST OF PROJECT	**$359,500,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$25,295,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$1,005,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$1,306,000
Water Treatment Plant	$7,403,000
Pumping Energy Costs (85,309,616 kW-hr @ 0.08 $/kW-hr)	$6,825,000
Purchase of Water (32,600 acft/yr @ 76.5 $/acft)[1]	$2,494,000
TOTAL ANNUAL COST	**$44,328,000**
Available Project Yield (acft/yr)	32,600
Annual Cost of Water ($ per acft), based on PF=1	$1,360
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$584
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$4.17
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.79

1 - Costs to purchase supply assumed at the BRA System Rate.

Table 9.2-4. Comparison of Milam County Groundwater and Alcoa Supply for Williamson County Project to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Meets some of the needs for Williamson County municipal WUGs
2. Reliability	2. High reliability
3. Cost	3. Relatively high, but reasonable for a regional system
B. Environmental factors	
1. Environmental Water Needs	1. Low impact
2. Habitat	2. Low impact
3. Cultural Resources	3. Low impact
4. Bays and Estuaries	4. Low impact
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	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	• Done
F. Requirements for Interbasin Transfers	• Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	• None

Potential Regulatory Requirements:

Implementation of this water management strategy will require the following permits for pipeline construction:

- Amendment of water right permit authorizing Lake Alcoa.
- Amendment of water right permit authorizing diversions from the Little River.
- Amendment of groundwater permits issued by the Post Oak Savannah Groundwater Conservation District.
- Amendment of contract with the Brazos River Authority.

- U.S. Army Corps of Engineers Section 404 permit for pipeline stream crossings and discharges of fill into wetlands and waters of the U.S. during construction.
    - Stream crossings could be authorized under Nationwide Permit 12 (NWP-12), Utility Line Activities, if all terms and conditions are met, which is likely.
- A TPDES General Permit for Construction Activity is required for construction activities that disturb more than one acre, and a Storm Water Pollution Prevention Plan is required for any project that disturbs five acres or more.
- TP&WD Sand, Shell, Gravel, and Marl permits for construction in state-owned stream beds may be required.
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.
- If the project is completed by a political subdivision of the state of Texas, then the project would be required to comply with the Texas Antiquities Code and a cultural resources survey may be required.
- Appropriate permits will have to be obtained for TxDOT highway crossings.

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9.3 Brushy Creek Regional Utility Authority System

9.3.1 Description of Option

The Lower Colorado River Authority (LCRA) owns and operates five reservoirs which, along with Lake Austin, are known as the Highland Lakes. Two of the Highland Lakes, Lakes Buchanan and Travis, are water supply reservoirs and have dedicated conservation storage. The other four reservoirs in the Highland Lakes chain are constant level lakes and are not considered water supply reservoirs. The LCRA, which supplies water primarily in the Colorado River Basin (Region K), has contracts with two cities in Williamson County to supply raw water from Lake Travis. These contracts include 23,000 acft/yr of raw water to the City of Cedar Park, and 24,000 acft/yr of raw water to the City of Leander. The City of Round Rock has a contract with BRA for supply of 20,928 acft/yr of raw water from the LCRA. Until recently, infrastructure was not in place to transport this water to Round Rock.

The cities of Round Rock, Cedar Park and Leander have entered into agreements to participate in the Brushy Creek Regional Utility Authority (BCRUA) that would ultimately provide 105.8 MGD of treated water capacity and 144.7 MGD of raw water. Portions of this project have been constructed. This project will provide peaking capacity for system demands including 15 MGD to Cedar Park, 40.8 MGD to Round Rock and 50 MGD to Leander. Although, the system will be designed for peaking capacity, average annual supplies from this project will be approximately 50 percent of the peaking capacity. In addition, the project will provide 26.9 MGD of raw water to Cedar Park's existing water treatment plant and 12 MGD to Leander's water treatment plant.

The BCRUA will utilize an existing 17 MGD, expandable to 32.5 MGD, interim floating intake structure located near the Cedar Park WTP, until a deep water 144.7 MGD intake structure can be constructed near Volente. The deep water intake will provide physical access to Lake Travis water during a severe drought. The floating intake conveys raw water through a new pipeline to the regional water treatment plant, with initial and ultimate capacities of 17 MGD and 105.8 MGD, respectively, which is located near the western edge of Cedar Park and Leander. Treated water is delivered to Cedar Park (15 MGD), Leander (50 MGD) and Round Rock (40.8 MGD). The general locations of the facilities are shown in Figure 9.3-1. The allocation of capacity for the proposed regional system is detailed in Table 9.3-1.

9.3.2 Available Yield

Under the provisions of HB 1437[1] and by agreement between the Brazos River Authority (BRA) and LCRA, 25,000 acft/yr of stored water in the Highland Lakes can be sold by LCRA (through the BRA) to entities in Williamson County in addition to the existing contracts with Cedar Park and Leander. Current contracts commit 22,128 acft/yr (20,928 acft/yr to Round Rock and 1,200 acft/yr to Liberty Hill). However, the 25,000 acft/yr available under HB 1437 does not meet the 2070 needs in Williamson County. Uncommitted stored water exists in the Highland Lakes that would be sufficient to meet a large portion of Williamson County's projected 2070 shortages. However, for Williamson

[1] House Bill 1437, 76th Session, Texas Legislature.

County to acquire this water, either HB 1437 has to be amended by the legislature to allow the sale of additional water, or other administrative measures such as a TCEQ interbasin transfer permit would be required to deliver any quantity above 25,000 acft/yr.

HB 1437 also provides that a 25 percent surcharge be added to the cost of water from the Colorado River basin delivered to Williamson County to pay for development of replacement supplies in the Colorado River Basin. This is subject to an adjustment by the LCRA Board of Directors.

Several entities have already committed to purchase the original 25,000 acft/yr designated by HB 1437. Table 9.3-2 presents the projected allocation of water under the original 25,000 acft/yr, and an additional allocation of water of 47,000 acft/yr. Cedar Park and Leander would obtain additional supply above the original HB 1437 amount.

Figure 9.3-1. Brushy Creek Regional Utility Authority System

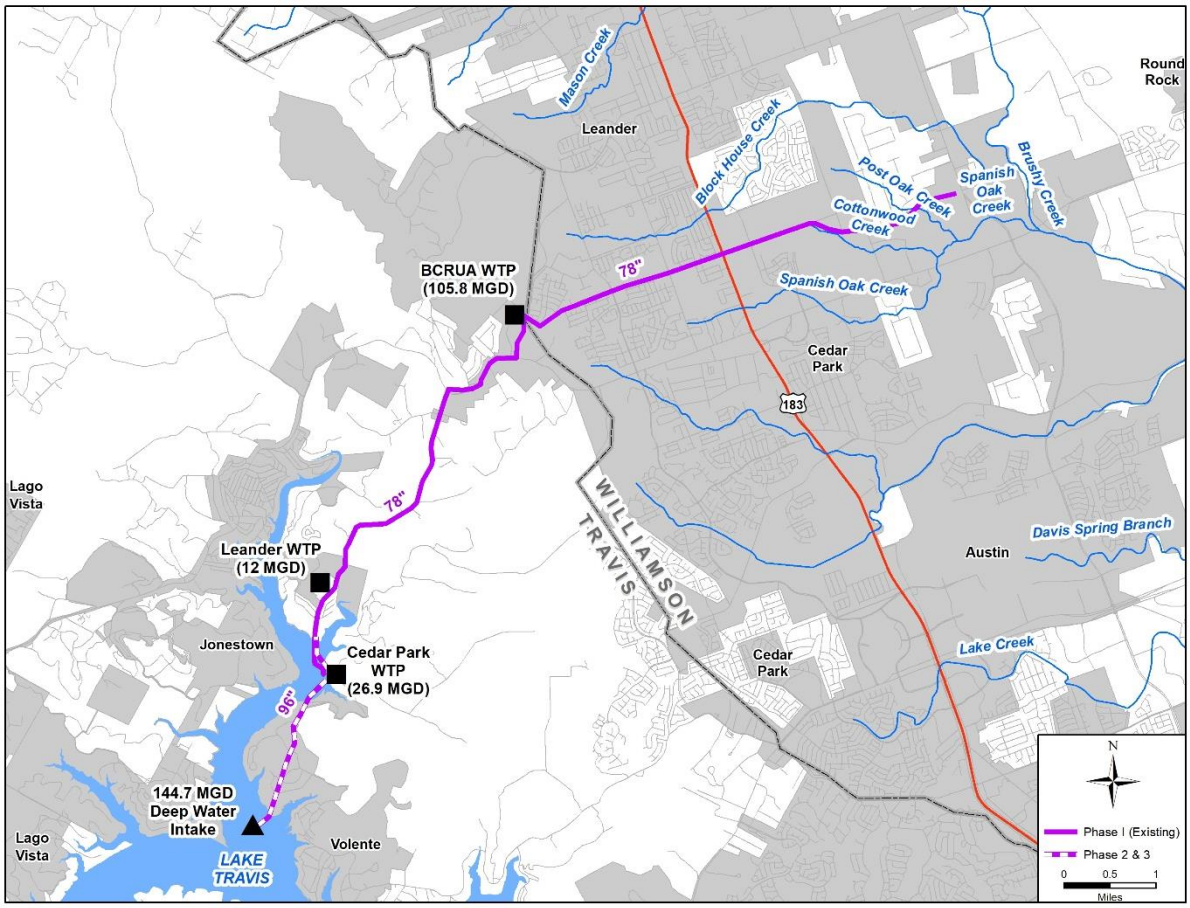

Table 9.3-1. Brushy Creek Regional Utility Authority System Participation with Peaking Capacity

	Cedar Park	*Round Rock*	*Leander*	*Total*
Treated Water Allocation (MGD)	*15*	*40.8*	*50*	*105.8*
Treated Water Allocation (%)	*14.18%*	*38.56%*	*47.26%*	*100%*
With Deep Water Intake (MGD)	*41.9*	*40.8*	*62*	*144.7*
Deep Water Intake Allocation (%)	*28.96%*	*28.20%*	*42.85%*	*100%*

Table 9.3-2. Allocation of New Highland Lakes Supply in Williamson County

Entity	Previous (2010) HB 1437 Allocation (acft/yr)	Current HB 1437 Allocation (acft/yr)	Additional Highland Lakes Supply (acft/yr)	Current Allocation + Additional Highland Lakes Supply (acft/yr)
Cedar Park	0	0	23,000	23,000
Chisholm Trail SUD[1]	2,540	0	0	0
Liberty Hill	600	1,200	0	1,200
Round Rock	11,444	20,928	0	20,928
Leander	0	0	24,000	24,000
Georgetown	6,944	0	0	0
Unallocated	3,472	2,872	0	0
Total	25,000	25,000	47,000	69,128

[1] Chisholm Trail SUD and Georgetown have merged.

9.3.3 Environmental Issues

This alternative includes the construction of a new deep water intake structure on Lake Travis and connection to an existing transmission pipeline to Williamson County. The project contains an intake assembly at the mouth of the Sandy Creek arm of Lake Travis, a maintenance building in the Village of Volente, a pump station adjacent to Sandy Creek Park and a tunneled pipeline from the deep water intake assembly to the pump station and from there to existing Phase 1 facilities on Trails End Road.

The proposed project is not anticipated to impact land use, density, or type of development beyond that already planned in the BCRUA Regional Water system within the project area. Permanent land use impacts in the project area would be limited to the pump station and intake assembly sites. The pump station site is located adjacent to a LCRA public park and an existing industrial facility (the City of Cedar Park WTP). The park will be able to remain open to park users during construction, and the proposed site does not limit any waterfront access to park users. The proposed maintenance building site is located within

the Village of Volente. Construction of the intake assembly would have minimal impacts to area recreational use with the exception of a restricted area which is required around a raw water intake. The pipeline will be bored underground resulting in minimal disturbance to area land use.

Environmental issues for the proposed Regional Surface Water Supply to Williamson County from Lake Travis are described below. An Environmental Assessment submitted to the Brushy Creek Regional Utility Authority was completed for this project in March 2014. The project occurs within the Cross Timbers and Prairies vegetational area[2] and is within the Balconian biotic province.[3] Vegetation within the project area is defined as Live Oak-Ashe Juniper Parks by the Texas Parks and Wildlife Department.[4] Chiefly found on level to gently rolling uplands and ridge tops of the Edwards Plateau, this vegetation type commonly includes trees such as live oak (*Quercus virginiana*), Texas oak (*Q. buckleyi*), shin oak (*Q. havardii*), cedar elm (*Ulmus crassifolia*), and netleaf hackberry (*Celtis reticulata*) in addition to other species including saw greenbrier (*Smilax bona-nox*), little bluestem (*Schizachyrium scoparium*), curly mesquite (*Hilaria belangeri*) and Texas grama (*Bouteloua rigidiseta*). Vegetation impacts would include the clearing of small areas for the construction of the pump station, maintenance building and a portion of the temporary construction easement for construction of the pump station building and tunnel shaft. The raw water pipeline would be tunneled instead of open-cut to avoid vegetation clearing, crossing waters of the U.S., and impacts to endangered species habitat found along the pipeline alignment.

The pipeline would occur underneath or adjacent to Lake Travis and would not impact any existing rivers creeks or tributaries. The deep location of the water intake structure would have minimal impact to existing aquatic resources within the lake. The Federal Emergency Management Administration (FEMA) oversees the delineation of 100-year floodplain zone on the flood insurance rate maps (FIRMs) across the United States. The term 100-year flood refers to areas that have a one percent chance of flooding in any given year. The FEMA 100-year floodplain zones within the project fall along the perimeter of Lake Travis. A small portion of the proposed project including the water intake structure occurs within this zone.

The delineation of wetlands by the National Wetland Inventory indicates that within the project area, the perimeter of Lake Travis is delineated as palustrine, emergent, persistent, seasonally flooded, and diked. Coordination with the U.S. Army Corps of Engineers would be required for construction within waters of the U.S. Impacts from this proposed project resulting in a loss of less than 0.5 acres of waters of the U.S. could be covered under Nationwide Permit #12 for Utility Line Activities.

The TCEQ 2012 *Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)* states that Lake Travis (Segment 1404) is fully supporting of its designated uses and contains no water quality concerns.

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[2] Gould, F.W. 1975. The Grasses of Texas. Texas A&M University Press. College Station, Texas.

[3] Blair, W.F., "The Biotic Provinces of Texas, "Tex. J. Sci. 2:93-117, 1950.

[4] McMahan, C. A., R. G. Frye and K. L. Brown, " The Vegetation Types of Texas -- Including Cropland," Texas Parks and Wildlife Department – PWD Bulletin 7000-120. 1984.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available Geographic Information System (GIS) datasets, there are no cemeteries, historical markers, national register properties or national register districts located within a one-mile buffer of the proposed project area.

A review of archaeological resources in the proposed project area should be conducted during project planning. The owner or controller of the project will be required to coordinate with the Texas Historical Commission regarding impacts to cultural resources.

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Travis County can be found at https://tpwd.texas.gov/gis/rtest/.

The Texas Natural Diversity Database (TXNDD), maintained by TPWD, which documents the occurrence of rare species within the state, was included in this project area analysis. TXNDD shows documented occurrences of the rare Black-capped vireo and endangered golden-cheeked warbler within a one mile buffer of the project area.

The project area may provide potential habitat to endangered or threatened species found in Travis County. A survey of the project area may be required prior to construction to determine whether populations of or potential habitats used by listed species occur in the area to be affected. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

The project area does not include suitable habitat for any of the spring, cave or karst dwelling species listed for Travis County. However, the project could negatively impact terrestrial species like the plains spotted skunk, Texas garter snake and Texas horned lizard by causing these species to relocate to less suitable habitat areas or to compete with other species for remaining habitat. The river water intake has a low potential to have a negative impact on mollusks and other aquatic species although the deep location precludes the occurrence of most species. The pipelines, pump station and maintenance station are anticipated to have a nominal impact on all species due to the small area of construction impact and permanent maintenance.

9.3.4 Engineering and Costing

The project is planned in three phases. The first phase is under construction and assumed complete for purposes of the 2021 Brazos G Plan, and the second phase is currently in design.

The first phase of the project provides 32.5 MGD of treated water. Total projected costs for Phase I is $152,480,000. The major facilities constructed as Phase I of this project are:

- Construction of 17 MGD floating raw water pump station and subsequent pump station expansion;
- Raw water transmission pipeline from Lake Travis to Regional Water Treatment Plant;
- Construction of a new 17 MGD water treatment plant and subsequent expansions to 32.5 MGD treatment capacity; and
- Treated water transmission pipelines to Cedar Park, Leander and Round Rock.

The second phase will be constructed to provide a treated water capacity of 67 MGD. Total projected cost for Phase II is $257,635,000. The major facilities planned for Phase II of the project are:

- Construction of a new deep water intake near Volente and raw water pump station;
- Raw water transmission tunnels from the deep water intake; and
- Two Expansions of the regional water treatment plant; the first expansion will increase treatment plant capacity to 42 MGD; the second expansion following completion of the deep water intake will expand treatment capacity to 67 MGD.

The third and final phase of the project will increase the deep water intake capacity and regional water treatment plant to meet ultimate needs by 2050. Total projected costs for Phase III are $70,362,500. Major facilities include:

- Increase deep water intake capacity to 144.7 MGD; and
- Expansion at the regional water treatment plant by 38.8 MGD, for total capacity of 105.8 MGD.

Costs for the regional system and the share of the facilities costs have been developed from the BCRUA Regional Water Supply Project Environmental Assessment, March 2014.

Table 9.3-3 summarizes the costs for Phase II and Phase III based on September 2018 prices.

9.3.5 Implementation Issues

This water supply option has been compared to the plan development criteria, and the option meets each criterion.

The transfer of water from Lake Travis to Williamson County in excess of the 25,000 acft/yr specified in HB 1437 would constitute an interbasin transfer, but would be exempted from interbasin transfer rules if supplied to Cedar Park. TCEQ permit amendments might be needed to add a point of diversion at Lake Travis.

Requirements Specific to Pipelines

1. Necessary permits:
    A. U.S. Army Corps of Engineers Section 404 dredge and fill permit for stream crossings and lake intake impacting wetlands or navigable water of the United States.
    B. GLO Sand and Gravel Removal permits.
    C. TPWD Sand, Gravel and Marl permit for construction in state-owned streambeds.
    D. Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.
2. Right-of-way and easement acquisition.
3. Crossings:
    A. Highways and Railroads.
    B. Creeks and Rivers.
    C. Other Utilities.
4. Mitigation requirements would vary depending on impacts, but could include vegetation restoration, wetland creation or enhancement, or additional land acquisition.

Table 9.3-3. Summary of Costs for BCRUA Water Supply Project (Phases II- III)

Item	Estimated Costs for Facilities	Cedar Park	Round Rock	Leander[3]
Phase 2 - Deep Water Intake and Pump Station (144.7 MGD)	$145,000,000	$41,986,869	$40,884,589	$62,128,542
Phase 2 - WTP Expansion (42 MGD)	$12,000,000	$1,701,323	$4,627,599	$5,671,078
Phase 2 - WTP Expansion (67 MGD)	$50,000,000	$7,088,847	$19,281,664	$23,629,490
Phase 3 - WTP Expansion (105.8 MGD) and Deep Water Intake Pump Station Expansion (144.7 MGD)	$55,000,000	$9,127,821	$20,276,795	$25,595,385
Total Cost of Facilities	**$262,000,000**	**$59,905,000**	**$85,071,000**	**$117,024,000**
Engineering, Legal Costs and Contingencies	$41,000,000	$9,655,334	$13,115,529	$18,229,137
Land Acquisition and Surveying	$0	$0	$0	$0
Interest During Construction (3 years)[1]	$24,997,500	$3,544,069	$9,639,868	$11,813,563
Total Project Cost	**$327,997,500**	**$73,104,263**	**$107,826,043**	**$147,067,194**
Annual Costs				
Debt Service (3.5 percent, 20 years)[1]	$18,127,476	$4,483,642	$5,648,211	$7,995,623
Operation and Maintenance				
Intake, Pipeline, Pump Station	$3,850,000	$1,114,824	$1,085,556	$1,649,620
Water Treatment Plant	$9,729,433	$1,379,409	$3,751,993	$4,598,031
Pumping Energy Costs (@$0.08/kW-hr)	$15,600,000	$4,517,208	$4,398,618	$6,684,174
Purchase of Water ($157.5/acft)	$3,937,500	$0	$3,843,000	$95,000
Purchase of Water ($126/acft)	$5,292,000	$2,268,000	$0	$3,024,000
Total Annual Cost	**$56,536,409**	**$13,763,083**	**$18,727,378**	**$24,046,448**
Available Project Yield (acft/yr)[2]	**69,128**	**23,000**	**20,928**	**25,200**
Annual Cost of Water ($ per acft)	**$817.85**	**$598.39**	**$894.85**	**$954.22**
Annual Cost of Water ($ per 1,000 gallons)	**$2.51**	**$1.84**	**$2.75**	**$2.93**

Costs developed from BCRUA Regional Water Supply Project Environmental Assessment. March 2014, Phase 1 bid data, Phase 2 Preliminary Engineering Opinion of Probable Construction Cost, and additional cost information provided by BCRUA's design consultant for Phase 2.

1 - Calculated by phase and then summarized.

2 - Yield is limited to the available supply from the Highland Lakes. Treated capacity is 105.8 MGD.

3 – Leander will receive 24,000 acft/yr from the project and wheel another 1,200 acft/yr for Liberty Hill.

Table 9.3-4. Comparison of Brushy Creek Regional Utility Authority System to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient
2. Reliability	2. High reliability
3. Cost	3. Relatively high, but reasonable for a county-wide system
B. Environmental factors	
1. Environmental Water Needs	1. Low impact
2. Habitat	2. Low to medium impact
3. Cultural Resources	3. Low impact
4. Bays and Estuaries	4. Low impact
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. Low to medium 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	• None
E. Equitable Comparison of Strategies	• Done
F. Requirements for Interbasin Transfers	• Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	• None

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9.4 East Williamson County Water Supply Project

9.4.1 Description of Option

Lone Star Regional Water Authority (RWA) has connected a water supply transmission system to deliver supplies from Lake Granger to meet growing demands in Williamson County. The Lone Star RWA was created by the 82nd Legislature and authorized to design, finance, construct and operate wholesale water and wastewater infrastructure projects for public and private retail water providers. Member entities of Lone Star RWA include Sonterra MUD, City of Jarrell, and Williamson County.

The East Williamson County Water Supply Project is a transmission system to convey treated water from the Brazos River Authority East Williamson County Regional Water System water treatment plant at Lake Granger to area water user groups. This infrastructure strategy utilizes current supplies and new supplies that may be delivered at Lake Granger.

Treated supplies from BRA's WTP at Lake Granger will be delivered to Lone Star RWA and customers as indicated in Figure 9.4-1, which includes existing and proposed transmission systems. The proposed transmission system will connect to the existing delivery pipeline near Circleville and deliver supplies northwest to Jarrell.

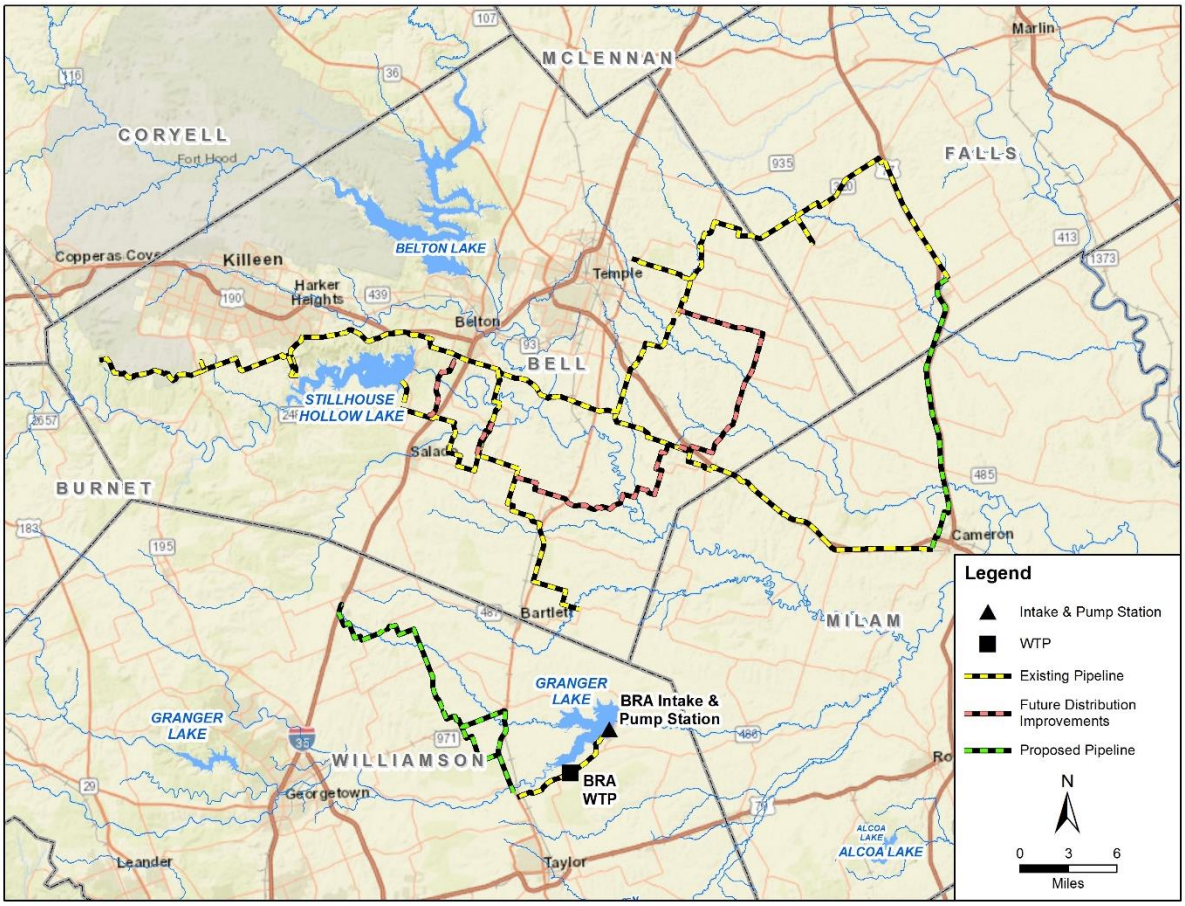
The transmission infrastructure will be designed with a 1.2 peaking factor. Lone Star RWA has contracted with BRA for 11,760 acft/yr (10.5 mgd) of Lake Granger supplies.

9.4.2 Available Supply

The supply for the East Williamson County Water Supply Project is treated Lake Granger water from the 13 MGD East Williamson County Regional Water Treatment Plant (WTP) located near the City of Taylor. The City of Taylor originally built and operated the WTP and sold it to Brazos River Authority in 2004. A new intake and WTP expansion have recently expanded the capacity from 5.5 MGD to 13 MGD to provide for increasing regional demands. Customers currently served through this system include Taylor, Hutto, Thrall, Noack WSC and Jonah Water SUD.

Lake Granger has a projected yield of 14,192 acft/yr under 2070 sediment conditions. This project could be supplied by other potential new supplies developed and delivered to near Lake Granger including the Lake Granger Augmentation strategy, Lake Granger ASR, Williamson County Groundwater Strategies (South Option), and Milam County Groundwater and Alcoa Supply.

Figure 9.4-1. East Williamson County Water Supply Project



9.4.3 Environmental Issues

There would be limited environmental impacts along the transmission system route, provided all terms and conditions of the permits are met. Environmental impacts could include:

- Possible minor impacts to riparian corridors, depending on location of pipelines
- Other possible minor impacts from pipeline development

The impacts of pipeline development will be minimized to the extent possible by following existing roadway corridors and by avoiding environmentally sensitive areas where feasible. A summary of environmental issues is presented in Table 9.4-1. No adverse impacts to federally-listed threatened or endangered species are anticipated.

Table 9.4-1. Environmental Issues: East Williamson County Water Supply Project

Issue	Description
Implementation Measures	Water treatment plant expansion, pump stations, and pipelines
Environmental Water Needs/Instream Flows	Negligible impact.
Bays and Estuaries	Negligible impact.
Fish and Wildlife Habitat	Possible minor impacts on riparian corridors, depending on specific location of pipelines.
Cultural Resources	Possible low impact.
Threatened and Endangered Species	Possible low impact.

9.4.4 Engineering and Costing

Cost estimates were prepared using the TWDB Unified Costing Model. Cost tables were updated to September 2018 with energy cost set at $0.09 per kWh, to be consistent with State regional water planning efforts. Cost projections were prepared using the proposed facilities and alignment described above. The cost summary is included in Table 9.4-2.

The transmission system is sized with a 1.2 peaking factor. Operating and maintenance and energy costs are projected based on the average annual operation of 11,762 acft per year. Entities would need to contract for treated supplies at the BRA WTP, and those purchase costs are not included here. The total project cost for treatment and delivery of 11,762 acft of potable water to the project participants is $30,264,420. The associated debt service and annual operating cost are projected at $2,765,000, yielding a finished water cost of $235 per acft, or $0.72 per thousand gallons.

9.4.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 9.4-3, and the option meets each criterion.

Potential Regulatory Requirements:

Implementation of this water management strategy will require the following permits for pipeline construction:

- U.S. Army Corps of Engineers Section 404 permit for pipeline stream crossings and discharges of fill into wetlands and waters of the U.S. during construction.
    - Stream crossings could be authorized under Nationwide Permit 12 (NWP-12), Utility Line Activities, if all terms and conditions are met, which is likely.
- A TPDES General Permit for Construction Activity is required for construction activities that disturb more than one acre, and a Storm Water Pollution Prevention Plan is required for any project that disturbs five acres or more.
- TP&WD Sand, Shell, Gravel, and Marl permits for construction in state-owned stream beds may be required.

- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.
- Appropriate permits have been and will be obtained for TxDOT highway crossings.

Table 9.4-2 Cost Summary of East Williamson County Water Supply Project

Item	Estimated Costs for Facilities
CAPITAL COST	
Contract No. 1 - 24" Water Line "A"	$6,504,539
Contract No. 2 - 30" San Gabriel River Bore	$870,355
Contract No. 3 - 24" Water Line "A" (Part of) and Water Line "B"	$6,338,515
Contract No. 4 - 10.5 MGD Pump Station No. 1	$2,263,511
Contract No. 5 - 10.5 MGD Pump Station No. 2	$2,440,243
Contract No. 6A - 0.5 MGD Ground Storage Tank No. 1	$749,800
Contract No. 6B - 0.5 MGD Ground Storage Tank No. 2	$648,000
Copntract No. 7 - 0.5 MGD Elevated Tank	$1,229,935
Contract No. 8 - 12" Water Line "C"	$1,376,331
Contract No. 8 - 12" Water Line "D"	$439,614
Contract No. 8 - 12" Water Line "E"	$391,209
TOTAL COST OF FACILITIES	**$23,252,052**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies	$4,771,023
Environmental & Archaeology Studies and Mitigation	$98,000
Land Acquisition and Surveying	$1,119,345
Interest During Construction (4% for 1 years with a 1% ROI)	$1,024,000
TOTAL COST OF PROJECT	**$30,264,420**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$2,533,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$185,000
Intakes and Pump Stations (1% of Cost of Facilities)	$47,000
TOTAL ANNUAL COST	**$2,765,000**
Available Project Yield (acft/yr)	11,762
Annual Cost of Water ($ per acft)	$235
Annual Cost of Water After Debt Service ($ per acft)	$20
Annual Cost of Water ($ per 1,000 gallons)	$0.72
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.06

Table 9.4-3. Comparison of East Williamson County Water Supply Project to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient
2. Reliability	2. High reliability
3. Cost	3. Relatively high, but reasonable for a county-wide system
B. Environmental factors	
1. Environmental Water Needs	1. Low impact
2. Habitat	2. Low impact
3. Cultural Resources	3. Low impact
4. Bays and Estuaries	4. Low impact
5. Threatened and Endangered Species	5. Negligible impact
6. Wetlands	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	• None
E. Equitable Comparison of Strategies	• Done
F. Requirements for Interbasin Transfers	• Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	• None

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9.5 Lake Belton to Lake Stillhouse Hollow Pipeline

9.5.1 Description of Option

A pipeline is proposed to connect Lake Belton to Lake Stillhouse Hollow (Figure 9.5-1) to supplement supplies from Lake Stillhouse Hollow and Lake Georgetown. Lake Belton is on the Leon River in Bell and Coryell Counties. Lake Stillhouse Hollow is on the Lampasas River in Bell County. Both reservoirs are located near the Cities of Killeen, Belton and Temple. The reservoirs are owned by the U.S. Army Corps of Engineers and are part of the Brazos River Authority (BRA) system. The reservoirs provide water for the Cities of Temple, Belton, Killeen, Gatesville, Copperas Cove, Lampasas and a number of other water supply districts and corporations in the area, as well as water to BRA customers downstream. In addition, Lakes Stillhouse Hollow and Georgetown are connected by the Williamson County Regional Raw Water Pipeline, which transfers water from Lake Stillhouse Hollow to Lake Georgetown to be used in the Williamson County area. Table 9.5-1 summarizes storage and diversion authorizations for the reservoirs. Included in the table are the reach diversion limits, which are the maximum volume that can be diverted in a year using the System Operation Permit (Permit No. 5851, priority date October 15, 2004).

The Belton to Stillhouse Hollow pipeline project is primarily designed to delay the need for development of new sources of water by making use of surplus Lake Belton water in the decades prior to 2070. For the purposes of this plan, the proposed pipeline was assumed to transfer up to 30,000 acft/yr to Lake Stillhouse Hollow. From Stillhouse Hollow, some of the Lake Belton water could be transferred to Lake Georgetown via the existing Williamson County Regional Raw Water Pipeline. The Belton to Stillhouse Hollow Pipeline will allow the BRA to operate these three lakes as a system, increasing the reliability of the supplies to the area. In the future, supplementing the supply at Lake Stillhouse Hollow with water transferred from Lake Belton limits drawdowns in Lake Stillhouse Hollow and prevents shortages.

The locations of facilities and a pipeline route for this project have not been established and are not available for this plan. It is expected that the intake and pump station will be located in deep water near the Lake Belton Dam. The outlet structure in Lake Stillhouse Hollow would most likely be located somewhere on the north shore of the lake in the downstream part of the reservoir.

Figure 9.5-1. Connection between Lakes Belton and Stillhouse Hollow

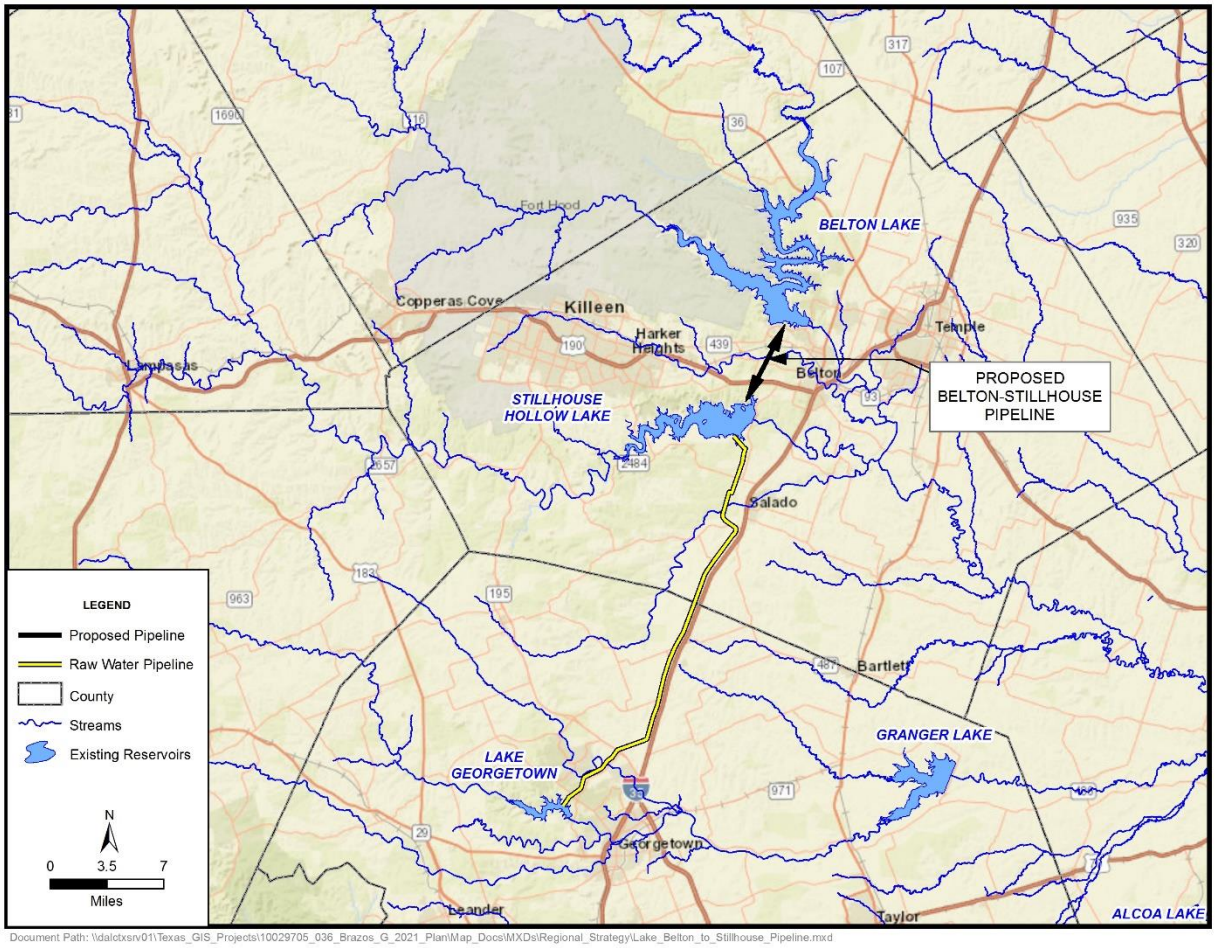


Table 9.5-1. Diversion and Storage Data for Lakes Belton, Stillhouse Hollow and Georgetown

Reservoir Name	Water Right	Authorized Storage (acft)	Authorized Priority Diversion (acft/yr)	Priority Date	SysOps Reach Diversion Limit (acft/yr)
Belton	CA 12-5160	457,600	100,257	12/16/1963	22,523
Stillhouse Hollow	CA 12-5161	235,700	67,768	12/16/1963	12,808
Georgetown	CA 12-5162	37,100	13,610	2/12/1968	10,059

CA – Certificate of Adjudication
Note: The priority date of the System Operations Permit is 3/1/2012

9.5.2 Available Yield

The project is expected to deliver around 30,000 acft/yr from Lake Belton to Lake Stillhouse Hollow based on an estimate of the need in the area served by Lakes Stillhouse Hollow and Georgetown. The primary benefit of the pipeline will be the delay in developing expensive new sources of water to meet anticipated future demands. The supply for this project is authorized under the existing BRA water right for Lake Belton and Lake Stillhouse Hollow. For purposes of planning guidelines, this strategy is considered to make available 5,000 acft/yr of existing supplies.

Under this strategy, the demands at Lake Georgetown can be met by water pumped from Lake Stillhouse Hollow through the Williamson County Regional Raw Water Line that connects Lake Stillhouse to Lake Georgetown and from Lake Belton through the Lake Belton to Lake Stillhouse Hollow pipeline. The proposed Belton to Stillhouse Hollow pipeline would allow the BRA to use supplies from Lake Belton to meet demands at the other two reservoirs.

9.5.3 Environmental Issues

The intake and discharge structures could have low to moderate environmental impacts depending on the final location of the structures. The pipeline route is expected to avoid sensitive areas, so the construction and operation of the pipeline is expected to have low environmental impacts.

The pipeline would have a minimal impact on the frequency of time that these reservoirs are full and spilling because pumping would not occur until Lake Stillhouse Hollow has been drawn down significantly. The project would have minimal impact on instream flows or bays and estuaries because the frequency and volume of spills would be about the same with and without the pipeline.

Lakes Belton and Stillhouse Hollow are located in adjacent watersheds on tributaries of the Little River that join a short distance below the reservoirs. Both reservoirs are expected to have similar biological communities and water quality. There are no anticipated impacts associated with blending water for the two reservoirs, although this may need to be verified by studies.

9.5.4 Engineering and Costing

For the purposes of this plan, it is assumed that the pipeline will be about 7 miles long with a diameter of 48 inches. Table 9.5-2 summarizes the costs for this option. About 12 percent of the pipeline route is assumed to be in a relatively urbanized area. The intake structure and pump station are assumed to be located near the Lake Belton Dam and the discharge structure is located on the north shore of Lake Stillhouse Hollow in the lower portion of the lake. Using these assumptions, the estimated capital cost of the pipeline is about $48.1 million. Total project costs, including engineering, contingencies, permitting, mitigation and interest during construction are an additional $19.9 million for a total project cost of $68.0 million. Annual costs, including debt service, power cost and operation and maintenance are approximately $6.5 million per year. The resulting unit costs are $1,309 per acre-foot or $4.02 per thousand gallons, based on the project increasing supplies to Georgetown by 5,000 acft/yr.

9.5.5 Implementation Issues

This water supply options have been compared to the plan development criteria, as shown in Table 9.5-3, and the option meets each criterion. Implementation steps for the project are presented below.

Potential Regulatory Requirements:

- Texas Commission on Environmental Quality (TCEQ) Water Right and Storage permits
- U.S. Army Corps of Engineers (USACE) 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)
- TCEQ administered Texas Pollution Discharge Elimination System (TPDES) Permit and Storm Water Pollution Prevention Plan
- General Land Office Easement if State-owned land or water is involved
- Texas Parks and Wildlife Department Sand, Shell, Gravel and Marl permit if State-owned streambeds are involved
- Agreement with USACE for discharge into Lake Stillhouse Hollow

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

- Possible analysis of impact of blending Lake Belton water in Lake Stillhouse Hollow
- 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
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.
- Cultural resources studies in coordination with the Texas Historical Commission to determine resources impacts and appropriate mitigation plan that may include cultural resource recovery and cataloging

Land Acquisition Issues:

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

Table 9.5-2. Estimated Costs for the Lake Belton to Lake Stillhouse Hollow Pipeline

Item	Estimated Costs
CAPITAL COSTS	
Intake & Pump Station (33 MGD)	$35,876,000
Pipeline (48 in. dia., 6.8 mi and Discharge Structure)	$12,182,000
TOTAL COST OF FACILITIES	**$48,058,000**
Engineering, Legal Costs and Contingencies	$16,219,000
Environmental & Archeological Studies and Mitigation	$933,000
Land Acquisition	$963,000
Interest During Construction (12 months)	$1,820,000
TOTAL COST OF PROJECT	**$67,993,000**
ANNUAL COSTS	
Debt Service (3.5 percent, 20 years)	$4,784,000
Electricity	$742,000
Operation & Maintenance	$1,019,000
TOTAL ANNUAL COST	**$6,545,000**
Available Project Yield (acft/yr)	**5,000**
Annual Cost of Water ($ per acft)	**$1,309**
Annual Cost of Water ($ per 1,000 gallons)	**$4.02**

Table 9.5-3. Comparison of Lake Belton to Lake Stillhouse Hollow Pipeline to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient to meet needs
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Low to medium impact
2. Habitat	2. Low impact
3. Cultural Resources	3. Low impact
4. Bays and Estuaries	4. Low impact due to distance from coast
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. Low impact
C. Impact on Other State Water Resources	Possible negative impacts on state water resources from water quality changes; 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 and industrial shortages
F. Requirements for Interbasin Transfers	None
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

9.6 Lake Whitney Water Supply Project (Cleburne)

9.6.1 Description of Option

The City of Cleburne has contracts with the BRA totaling 9,700 acre-feet per year with a Lake Whitney diversion location but does not currently have the infrastructure to access this water. A proposed pipeline option would allow Cleburne access to its Lake Whitney water.

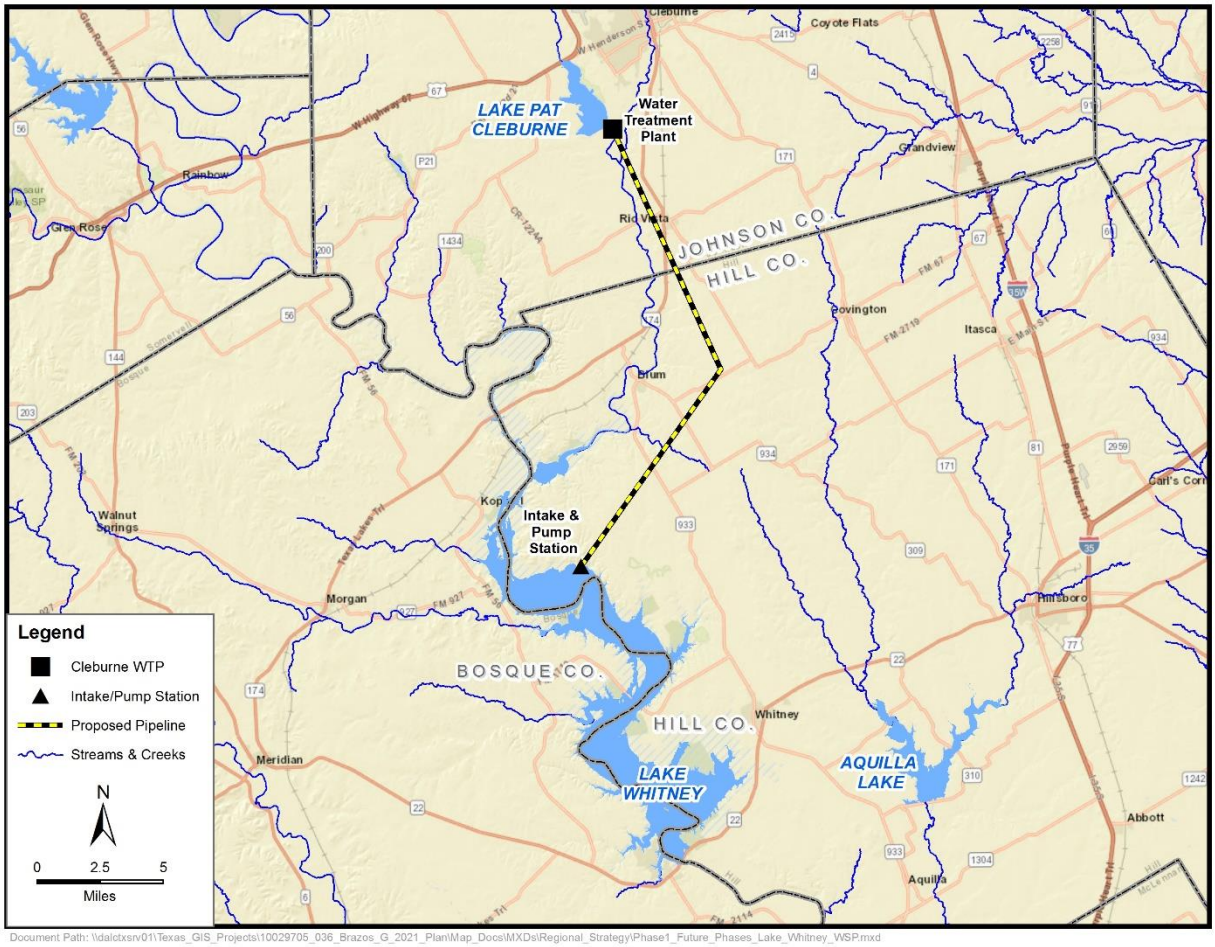
The project would require a deep water intake, diversion pump station to take water out of Lake Whitney, an advanced water treatment facility for the Lake Whitney water, blending tanks, a booster pump station, and a pipeline to Cleburne, and all associated appurtenances for a fully functional and operational water supply delivery and treatment system. This project would supply the City of Cleburne and possibly Johnson County mining, manufacturing, steam electric, and irrigation water though Cleburne.

The main stem of the Brazos River in the vicinity of Lake Whitney has relatively high levels of total dissolved solids (TDS). From 1993 to 2006, Lake Whitney averaged about 845 mg/L TDS, while water in Lake Aquilla averaged about 228 mg/L TDS. The relatively high salt concentration in the main stem water will need to be mitigated either by blending with better quality water (such as Lake Aquilla water) or have the salt concentration reduced by advanced treatment.

The proposed project includes advanced treatment to remove dissolved solids from a portion of the water from Lake Wey. Approximately 70 to 85 percent of the water will need to be treated to remove sufficient salt loads to maintain acceptable water quality. For costing purposes, it was assumed that the brine reject will be discharged back into Lake Whitney.

Previous versions of the Brazos G Plan have included alternatives to this strategy that included bringing water from Lake Whitney to supplement supplies from Lake Aquilla. These options used additional water from the BRA system to meet the needs of other Lake Aquilla users. At this time the City of Cleburne is not considering the joint strategy, so it is not considered in the current plan.

Figure 9.6-1. Lake Whitney Water Supply Project



9.6.2 Available Yield

Although the City of Cleburne holds contracts for 9,700 acft/yr, water diverted from Lake Whitney requires desalination or blending for municipal use. For this strategy, approximately 24 percent of the water will be lost in the desalination process, resulting in an available supply of about 7,400 acft/yr. The water from the project would come from Lake Whitney and other water supply sources in the BRA system.

9.6.3 Environmental Issues

A potential concern is the return of reject brine water resulting from the TDS treatment to Lake Whitney. Lake Whitney is a very large reservoir with more than 550,000 acft of storage and a significant amount of flow-through due to hydropower operations. As a result, the return of reject brine water to this reservoir is anticipated to have minimal impact on the existing water quality. Additional studies may be required to verify this assumption. If it is determined that the reject brine water cannot be returned to the reservoir, deep-well injection or evaporation ponds could be used to dispose of this product. However, the addition of either of these options will result in increased costs to the project and additional environmental concerns.

The specific locations of facilities and pipeline routes have not been identified at this time. It is anticipated that pipelines, pump stations and other necessary facilities will be positioned to avoid impacts to known cultural resources, sensitive habitats, wetlands or stream crossings.

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Bosque, Hill and Johnson counties can be found at https://tpwd.texas.gov/gis/rtest/. There are no areas of critical habitat designated within or near the project area.

The project area may provide potential habitat to endangered or threatened species found in Bosque, Hill or Johnson counties. A survey of the project area may be required prior to pipeline and facility construction to determine whether populations of or potential habitats used by listed species occur in the area to be affected. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

No designated critical habitat for the rare black-capped vireo or endangered golden-cheeked warbler occurs within the project area. Populations of the endangered smalleye and sharpnose shiner occur within the upper Brazos River basin above Lake Whitney. Although these shiner species were once found throughout the Brazos River and several of its major tributaries within the watershed, they are currently restricted almost entirely to the contiguous river segments of the upper Brazos River basin in north-central Texas.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available geographic information systems (GIS) datasets, there are no national register properties, national register district properties, or historical markers located within a 0.5-mile buffer of the proposed pipeline routes, pump stations or other facilities. Several small cemeteries are located within the areas proposed for the pipeline routes and should be avoided during the siting of pipelines, pump stations or other facilities.

Impacts resulting from this project could include changes in salinity of the water within Lake Whitney or impacts from the construction and maintenance of the associated pipelines, pump stations or water treatment facilities. If no reject brine water is returned to Lake Whitney impacts to aquatic species from this project would be anticipated to be minor and associated with the water intake facilities. Changes in TDS levels could result in additional environmental impacts to aquatic species.

Impacts from pipelines, pump stations and water treatment facilities would be anticipated to include temporary construction impacts and maintenance activities if their siting is based on the avoidance of impacts to cultural resources, sensitive habitats, wetlands, or stream crossings.

The project is expected to have low to medium impacts to environmental flows and no impacts to bays and estuaries.

9.6.4 Engineering and Costing

The strategy was evaluated to determine required infrastructure and costs to develop water supplies from Lake Whitney. The strategy includes pretreatment of Lake Whitney water before it is delivered to Cleburne. The project could be implemented in two phases. The first phase delvers an average of 3.8 MGD and includes a lake pump station, desalination plant, booster pump station and main transmission line. The second phase includes expansion of existing pump stations and treatment facilities for an additional supply of 2.8 MGD.

Based on preliminary examination of the Lake Whitney reservoir topography, an intake and pump station from Lake Whitney could be located on the eastern shore of the lake. Other diversion locations may be evaluated, and other future take points identified. Lake Whitney water would be treated at an advanced water treatment plant located on the eastern shore. The water would not be disinfected to meet drinking water standards, but the TDS and chlorides would be reduced to match the target water quality in Lake Pat Cleburne and Lake Aquilla. The partially treated water would then be blended with water from Lake Aquilla or Lake Pat Cleburne before full treatment at the city's water treatment plant. Future options may include full treatment at the take point. The total capital cost for Phase I of the Lake Whitney to Cleburne project is $89.4 million with total annual costs of $10.8 million. The second phase of the project is $32.9 million with total annual cost increase of $6.4 million. A summary of the costs for this option is provided in Table 9.6-1.

Table 9.6-1. Cost Estimate for Phase I and II Lake Whitney Diversion to Cleburne

Item	Estimated Phase I Costs	Estimated Phase II Costs	Estimated Total Costs for Facilities
CAPITAL COST			
Desal to City (24 in dia., 19.2 miles)	$15,599,000	$0	$15,599,000
Primary Pump Stations (9.9 MGD)	$3,154,000	$2,191,000	$5,345,000
Transmission Pump Station(s) & Storage Tank(s)	$3,921,000	$2,334,000	$6,255,000
Intake to desal (30 in dia., 0.4 miles)	$519,000	$0	$519,000
Intake Pump Stations (13 MGD)	$13,211,000	$1,948,000	$15,159,000
Brine discharge (14 in dia., 0.4 miles)	$235,000	$0	$235,000
Primary Pump Stations (3.1 MGD)	$588,000	$390,000	$978,000
Transmission Pump Station(s) & Storage Tank(s)	$1,803,000	$901,000	$2,704,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,544,000	$772,000	$2,316,000
Water Treatment Plant (11 MGD)	$20,108,000	$14,561,000	$34,669,000
TOTAL COST OF FACILITIES	**$60,682,000**	**$23,097,000**	**$83,779,000**

Table 9.6-1. Cost Estimate for Phase I and II Lake Whitney Diversion to Cleburne

Item	Estimated Phase I Costs	Estimated Phase II Costs	Estimated Total Costs for Facilities
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$20,421,000	$8,085,000	$28,506,000
Environmental & Archaeology Studies and Mitigation	$837,000	$0	$837,000
Land Acquisition and Surveying (173 acres)	$2,770,000	$0	$2,770,000
Interest During Construction (3% for 2 years with a 0.5% ROI)	$4,659,000	$1,716,000	$6,375,000
TOTAL COST OF PROJECT	**$89,369,000**	**$32,898,000**	**$122,267,000**
ANNUAL COST			
Debt Service (3.5 percent, 20 years)	$6,288,000	$2,315,000	$8,603,000
Operation and Maintenance			
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$217,000	$27,000	$244,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$472,000	$146,000	$618,000
Water Treatment Plant	$3,088,000	$3,381,000	$6,469,000
Pumping Energy Costs (6,730,780 kW-hr @ 0.08 $/kW-hr)	$288,000	$250,000	$538,000
Purchase of Water (9,700 acft/yr @ 70.5 $/acft)	$397,000	$287,000	$684,000
TOTAL ANNUAL COST	**$10,750,000**	**$6,406,000**	**$17,156,000**
Available Project Yield (acft/yr)	4,300	3,100	7,400
Annual Cost of Water ($ per acft)	$2,500	$2,066	$2,318
Annual Cost of Water After Debt Service ($ per acft)	$1,038	$1,320	$1,156
Annual Cost of Water ($ per 1,000 gallons)	$7.67	$6.34	$7.11
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$3.18	$4.05	$3.55

9.6.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 9.6-2, and the option meets each criterion.

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

- Pilot study to evaluate RO treatment of Lake Whitney water.
- Analysis of potential impact of disposal of brine reject.

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);
- 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;
- Texas Parks and Wildlife Department Sand, Shell, Gravel and Marl permit if state-owned streambed is involved; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

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.

Table 9.6-2. Comparison of Transportation of Raw Water from Lake Whitney to Lake Aquilla to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient to meet needs
2. Reliability	2. High reliability
3. Cost	3. High
B. Environmental factors	
1. Environmental Water Needs	1. Low to medium impact
2. Habitat	2. Low impact
3. Cultural Resources	3. Low impact
4. Bays and Estuaries	4. Low impact due to distance from coast
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. Low impact
C. Impact on Other State Water Resources	Possible negative impacts on state water resources from water quality changes; 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 and industrial shortages
F. Requirements for Interbasin Transfers	None
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

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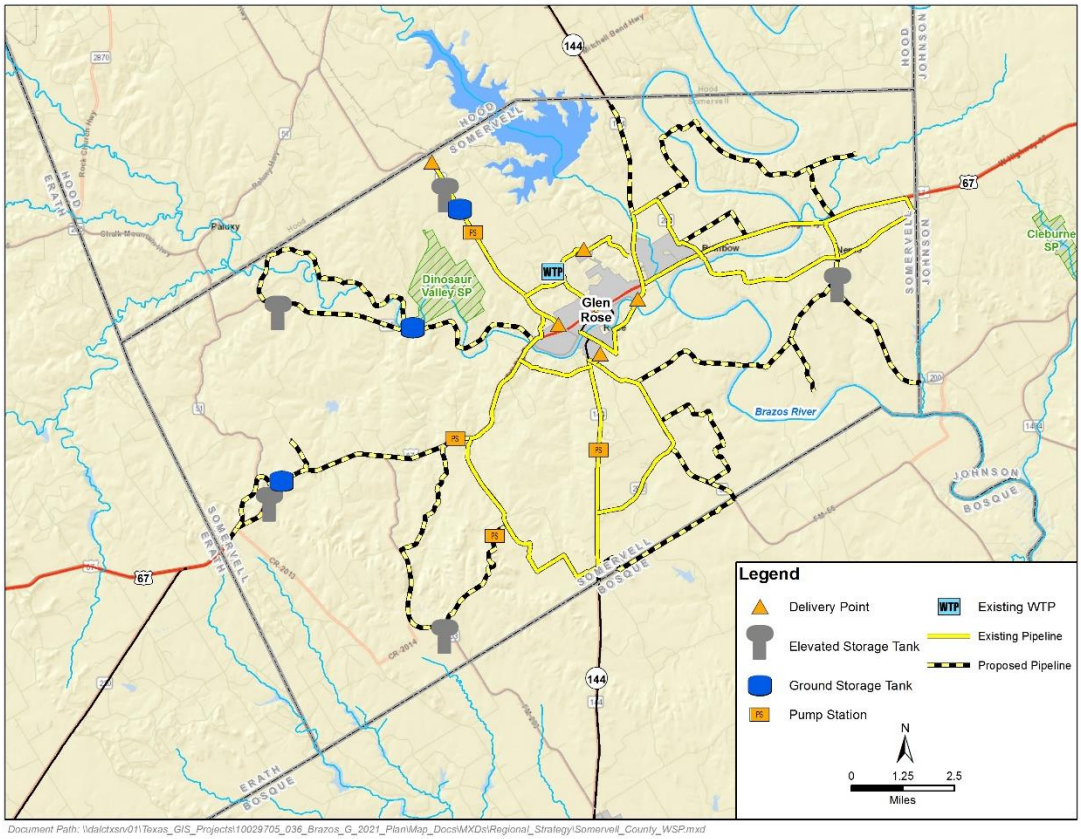
9.7 Somervell County Water Supply Project

9.7.1 Description of Option

The Somervell County Water District (SCWD) completed the first part of their surface water supply system in October 2016. Previously, Somervell County obtained all of its water from the Trinity Aquifer, which was not able to sustain current and future uses. SCWD is currently supplying water to the City of Glen Rose and Comanche Peak Steam Electric Station as wholesale customers and to many retail commercial and residential customers in the county. The components of the project that have been completed include the Paluxy River channel dam and reservoir, the raw water pump station, a 36-inch raw water pipeline, the 4,118 acre-foot off-channel Wheeler Branch Reservoir, a 2.5 MGD membrane filtration water treatment plant, two treated water pump stations and elevated storage tanks, and part of the distribution piping system. A 1.25 MGD water treatment plant expansion and additional distribution system piping will allow SCWD to deliver water to more commercial and residential customers within Somervell County. The SCWD plans to complete the project by 2030. When complete, the project will provide 2,000 acre-feet per year of surface water supplies to water users in Somervell County. Figure 9.7-1 shows SCWD's the existing and proposed infrastructure and major delivery points.

Figure 9.7-1. Proposed Phases of the Somervell County Water Supply Project



9.7.2 Available Supply

The Somervell County Water District has a water right for 2,000 acre-feet per year from the Wheeler Branch Reservoir, which is operated in conjunction with a channel dam on the Paluxy River (CA-12-5744)[1]. The District has an agreement with the Brazos River Authority (BRA) that makes the 2,000 acre-feet per year available on a reliable basis by subordinating BRA's water right in Lake Whitney (CA 12-5157). The existing components of the Somervell County Water Supply Project provide 1,400 acre-feet per year. The planned water treatment plant expansion in 2030 will allow the SCWD to use the full yield of the project[2].

9.7.3 Environmental Issues

There would be limited environmental impacts due to the water treatment plant expansion, provided all terms and conditions of the permits are met. Environmental impacts could include:

- Possible minor impacts to riparian corridors, depending on location of distribution pipelines
- Other possible minor impacts from distribution pipeline development

The impacts of pipeline development will be minimized to the extent possible by following existing roadway corridors and by avoiding environmentally sensitive areas where feasible. A summary of environmental issues is presented in Table 9.7-1. The water treatment plant expansion would occur at the existing plant, which does not provide suitable habitat for the black-capped vireo (in recovery) or the golden-cheeked warbler. The piping plover, red knot and the whooping crane could be present in the project area during migration, but in the past have not been observed in the proposed construction areas. No adverse impacts to federally-listed threatened or endangered species are anticipated[2].

Table 9.7-1. Environmental Issues: Somervell County Water Supply Project

Issue	Description
Implementation Measures	A 1.25 MGD water treatment plant expansion and distribution pipelines
Environmental Water Needs/Instream Flows	Negligible impact.
Bays and Estuaries	Negligible impact.
Fish and Wildlife Habitat	Possible minor impacts on riparian corridors, depending on specific location of pipelines.
Cultural Resources	Possible low impact.
Threatened and Endangered Species	Possible low impact.
Water Management Option	Somervell County Water Supply Project

[1] Certificate of Adjudication 12-5744

[2] Somervell County Water District, Engineering Feasibility Report Phase 5, 6, 8a, and 8b Distribution System. Prepared for TWDB by Freese and Nichols, Inc. Updated March 2013.

9.7.4 Engineering and Costing

Figure 9.7-1 shows the facilities included in the Somervell County Water Project. Water from Wheeler Branch Reservoir is treated at the water treatment plant below the dam and distributed to the county by a system of pump stations, ground and elevated storage tanks, and pipelines. Completed phases include a 2.5 MGD water treatment plant and high service pump station, a raw water pump station, 2 booster pump stations, 4 ground storage tanks, 2 elevated tanks, and 100 miles of pipeline ranging from 6 inches to 18 inches in diameter. Future phases will include expanding the water treatment plant and high service pump station to 3.75 MGD, 3 booster pump stations, 2 ground storage tanks, 3 elevated tanks, and 75 miles of pipeline ranging from 6 inches to 12 inches in diameter.

Financing was identified as a possible implementation issue in the 2011 and 2016 Brazos G Plans. To date, the phases of the Somervell County Water Supply Plan that have been built have been financed through multiple loan requests, including: TWDB's Water Infrastructure Fund (WIF) construction loan ($9.4 million), WIF rural loan ($9.5 million), Economically Distressed Areas Program (EDAP) Rural State Water Plan Grant ($9.5 million), EDAP State Water Plan Grant ($1.3 million), and the EDAP State Water Plan Loan ($1.3 million), among others.

Table 9.7-2 summarizes the capital costs for the phases that have yet to be constructed (i.e., Phases 7A and 9 through 17), which total $26,916,000 in September 2018 dollars. Contingencies, professional services, land costs, and interest during construction will add $9,334,000, for a total project cost of $36,250,000. With 3.5 percent interest and 20-year bonds, the annual debt service is $2,551,000. Operation and maintenance costs for pumping, transmission and treatment add $927,000 per year, for a total annual cost of $3,546,000 for delivery of 600 acre-feet. All costs are for retail, as opposed to wholesale, facilities. The cost of treated water delivered is $5,910 per acre-foot, or $18.13 per thousand gallons. The development of a new surface water supply and retail distribution system in a rural area results in relatively high costs per unit of water. The cost for this strategy is especially high because it is calculated by dividing the total cost for the remainder of the project by the total amount of water made available by the remainder of the project. The WTP expansion in Phase 7A increases the total supply by 600 acft/yr because 1,400 acft/yr was made available by earlier phases and the water right limits the project to 2,000 acft/yr. The costs of Phases 9-17 are associated with a retail distribution system in a rural area where the density of customers is low. Considering the entire project (Phases 1-17) and the full permitted amount of water (2,000 acft/yr), the annual cost of water is about $12.89 per thousand gallons.

Table 9.7-2. Cost Estimate Summary for Somervell County Water Supply Project Phases 7A & 9-17

Item	Estimated Cost for Facilities
Primary Pump Station	$105,000
Transmission Pipeline	$20,271,000
Transmission Pump Station(s) & Storage Tank(s)	$628,000
Storage Tanks (Other Than at Booster Pump Stations)	$4,865,000
Water Treatment Plant (1.3 MGD)	$1,047,000
TOTAL COST OF FACILITIES	**$26,916,000**
Engineering, Legal Costs and Contingencies	$6,081,000
Land Costs	$2,282,000
Interest During Construction (1 year)	$971,000
TOTAL COST OF PROJECT	**$36,250,000**
ANNUAL COST	
Debt Service (3.5 percent for 20 years)	$2,551,000
Operation and Maintenance	$927,000
Energy Costs (852,700 kWh @ $0.08/kWh)	$68,000
TOTAL ANNUAL COST	**$3,546,000**
Available Project Yield (acft/yr)	**600**
Annual Cost of Water ($ per acft)	**$5,910**
Annual Cost of Water ($ per 1,000 gallons)	**$18.13**

Notes:

1. All costs are for retail facilities

2. Total project yield is 2,000 acft/yr; 1,400 acft/yr provided by other phases

9.7.5 Implementation Issues

Four sites with potentially significant cultural resources were identified in the vicinity of the proposed pipeline route[3]. The Somervell County Water District plans to preserve all four sites by completely avoiding each site and following the recommendations specified in the report. No impact to cultural resources is expected. Financing will continue to be an implementation issue, and financing vehicles similar to those used to fund the first part of the project are expected to be used to complete the project. Table 9.7-3 compares this water management strategy to the plan development criteria.

Table 9.7-3. Comparison of Somervell County Water Supply Project to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient to meet needs
2. Reliability	2. High reliability
3. Cost	3. Relatively high, but reasonable for a county-wide system
B. Environmental factors	
1. Environmental Water Needs	1. Low impact
2. Habitat	2. Low impact
3. Cultural Resources	3. Low impact
4. Bays and Estuaries	4. Low impact
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	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	• Done
F. Requirements for Interbasin Transfers	• Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	• None

[3] An Archaeological Survey of the Proposed Somervell County Water District Pipeline Route. Prepared by AR Consultants, Inc. for Somervell County Water District. January 2012.

Potential Regulatory Requirements:

Implementation of this water management strategy will require the following permits for pipeline construction:

- U.S. Army Corps of Engineers Section 404 permit for pipeline stream crossings and discharges of fill into wetlands and waters of the U.S. during construction.
    - Stream crossings could be authorized under Nationwide Permit 12 (NWP-12), Utility Line Activities, if all terms and conditions are met, which is likely.
- A TPDES General Permit for Construction Activity is required for construction activities that disturb more than one acre, and a Storm Water Pollution Prevention Plan is required for any project that disturbs five acres or more.
- TP&WD Sand, Shell, Gravel, and Marl permits for construction in state-owned stream beds may be required.
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.
- Appropriate permits have been and will be obtained for TxDOT highway crossings.

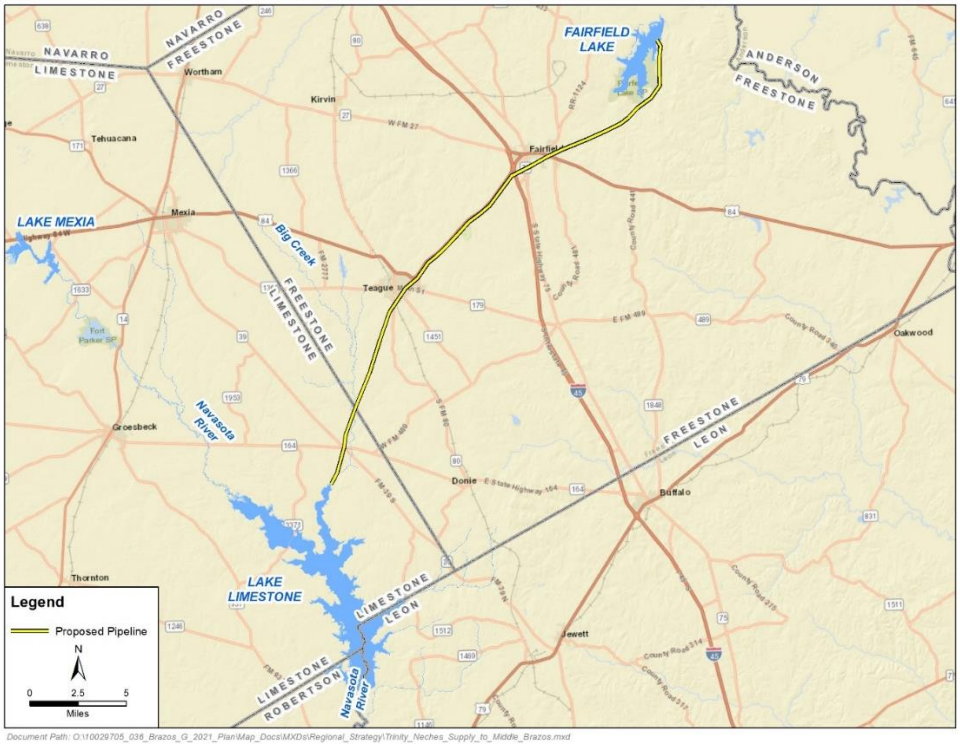
9.8 Trinity Basin Supplies to Middle Brazos

9.8.1 Description of Option

Luminant Power owns Certificates of Adjudication (CA) 08-5040 and CA 08-2388 (collectively referred to as the Luminant water rights) authorizing the use of state water in the Trinity River Basin for industrial purposes associated with steam-electric generation at the Big Brown Power Plant located on Lake Fairfield. CA 08-5040 authorizes the impoundment of streamflow in Lake Fairfield containing 50,600 acft of storage and the consumptive use of up to 14,150 acft/yr of water from the reservoir for industrial (thermal-electric power generation) purposes. Additionally, Lake Livingston is subordinated to authorizations included CA 08-5040. CA 08-2388, as amended, authorizes diversion of up to 3,188 acft/yr of streamflow from the Trinity River near Lake Fairfield. Diversions from the Trinity River are discharged into Lake Fairfield and used for steam-electric generation.

In 2018, Luminant decommissioned the power plant and is no longer utilizing the water rights for steam-electric generation. This strategy assumes Luminant would sell water authorized for use under the water rights to the Brazos River Authority (BRA) for use in the Brazos River Basin. The strategy would require a 30-mile, 24-inch raw water pipeline from Lake Fairfield to Lake Limestone for subsequent delivery to BRA customers. This strategy also requires a new intake and pump station at Lake Fairfield because the existing intake at the power plant has a minimum intake elevation 5 ft below the top of the conservation pool and could not be used during critical drought situations when lake levels will most likely be below this elevation unless upgraded or modified. The location of the new intake and pump station and raw water pipeline route is shown in Figure 9.8-1.

Figure 9.8-1. Trinity Supplies to Middle Brazos River Basin Strategy



9.8.2 Available Yield

The reliability of the Luminant water rights was calculated using the Texas Commission on Environmental Quality (TCEQ) Trinity River Basin Water Availability Model (WAM) Run 3. The WAM assumes surface water rights modeled at full consumptive amounts per certificates of adjudication and permits, and no treated effluent discharges (return flows).

Lake Fairfield was simulated assuming sediment conditions as reported in 1999 TWDB Volumetric Survey. The TWDB report estimates a conservation pool capacity of 44,169 acft (authorized conservation pool capacity is 50,600 acft). The entire conservation pool of Lake Fairfield is assumed to be available for diversion (no dead pool). Note that the existing intake structure at the Big Brown Power Plant has a minimum intake elevation 5 ft below the conservation pool elevation. It is assumed a new intake structure would be constructed to fully utilize the conservation pool. Supplemental diversions from the Trinity River were simulated at the maximum authorized diversion rate (44.56 cfs) until the authorized annual diversion amount was reached (3,188 acft) in each year of the simulation.

The calculated firm yield of Lake Fairfield with the supplemental diversion from the Trinity River is 8,100 acft/yr. Figure 9.8-2 and Figure 9.8-3 illustrate the simulated Lake Fairfield storage levels and storage frequency for the 1940 to 1996 historical period, subject to the firm yield demand of 5,700 acft/yr, and Figure 9.8-4 shows the annual supplemental diversion from the Trinity River to Lake Fairfield. Simulated reservoir contents remain above 80 percent capacity almost 80 percent of the time and above 50 percent capacity more than 90 percent of the time.

Figure 9.8-2. Lake Fairfield Firm Yield Reservoir Storage Trace

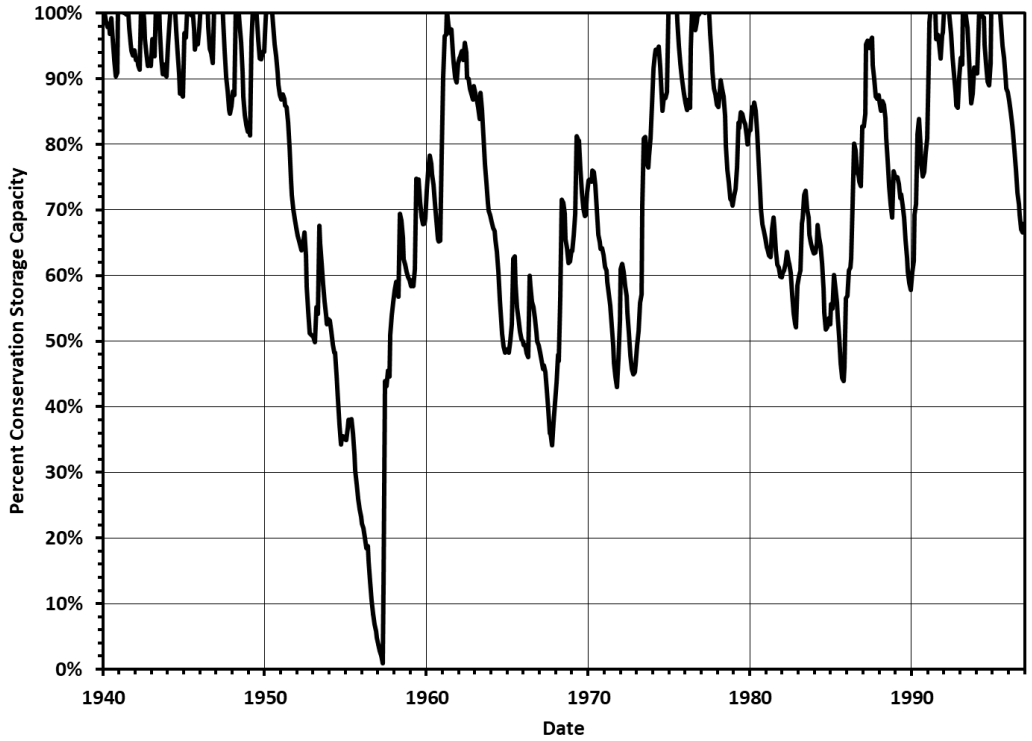


Figure 9.8-3. Lake Fairfield Firm Yield Storage Frequency

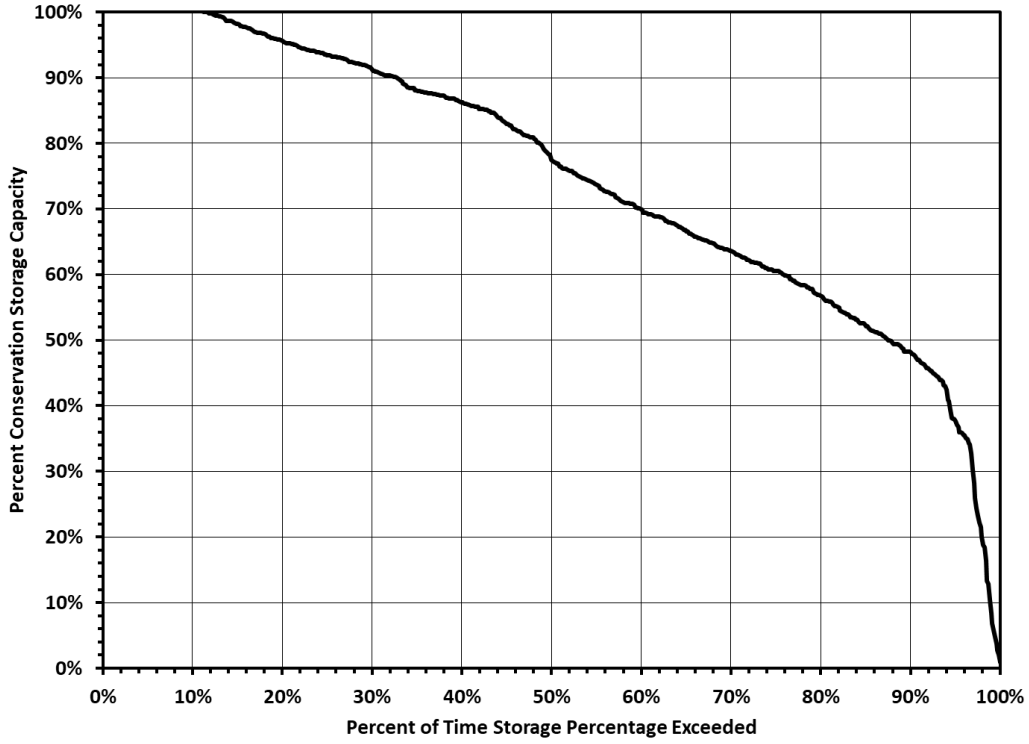
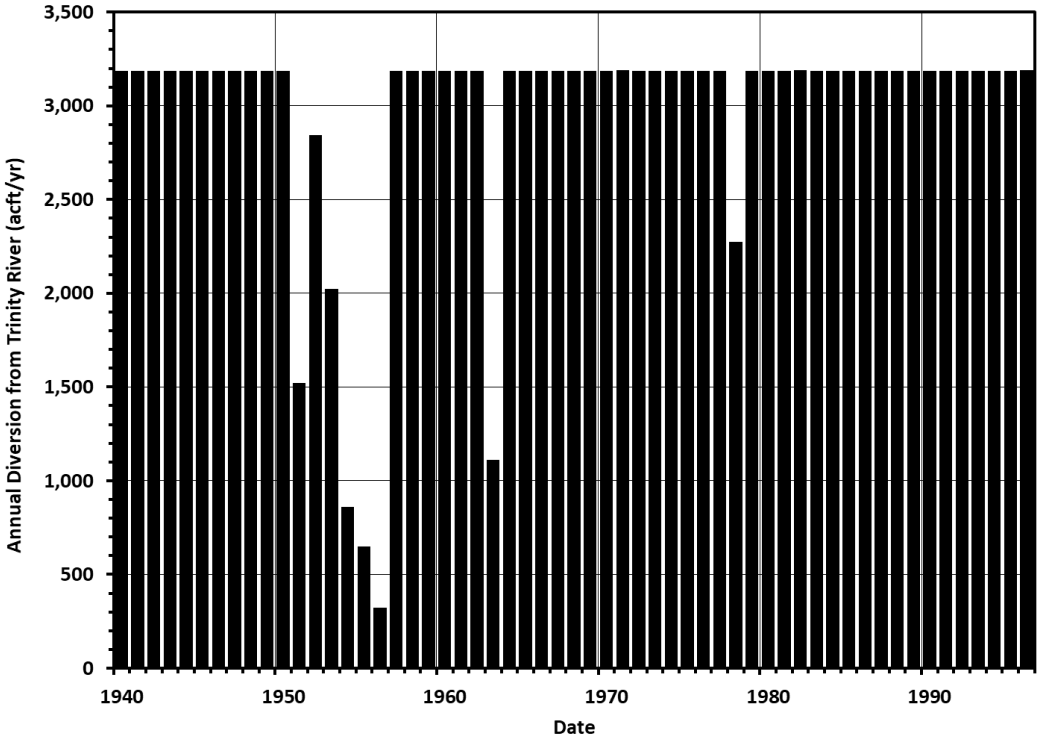


Figure 9.8-4. Supplemental Diversions to Lake Fairfield from Trinity River



9.8.3 Environmental Issues

Existing Environment

The proposed project occurs within the Post Oak Savannah physiographic region of Texas and is within the Texan biotic province[1]. The project components are within an area defined as Post Oak Woods, Forest and Grassland Mosaic vegetation type[2]. This vegetation type commonly includes blackjack oak, eastern redcedar, mesquite, black hickory, yaupon, and live oak. The Ecological Mapping Systems of Texas (EMST) data, more detailed vegetation data recently produced by the Texas Parks and Wildlife Department (TPWD)[3], show the area containing primarily Post Oak Motte and Woodland and Savanna Grassland with scattered urban areas and various other vegetation types.

Potential Impacts

Aquatic Environments including Bays and Estuaries

Hundreds of wetlands including riverine, freshwater ponds, freshwater forested/shrub wetland, freshwater emergent wetlands, and lakes were identified on the National Wetland Inventory (NWI) maps adjacent to the potential pipeline. A Nationwide Permit or coordination with the U.S. Army Corps of Engineers may be required for impacts to waters of the U.S. Seven surface waters (Trinity River [Segment #0804], Tehuacana Creek [Segment #0804F], Big Brown Creek [Segment #0804I], Mims Creek [Segment #0804C], Upper Keechi Creek [Segment #0804H], Lake Limestone [Segment #1252], and Lake Fairfield [Segment #0804J]) were identified on the TCEQ Surface Water Quality Viewer[4] within the proposed project area, or within 5 miles. The Trinity River (Segment #0804) was listed as impaired for dioxins and PCBs in edible tissue. Upper Keechi Creek (Segment #0804H) was listed as impaired for depressed dissolved oxygen, and Lake Limestone (Segment #1252) was classified as impaired due to pH. The remaining surface water segments were fully functioning and not impaired.

FEMA's National Flood Hazard Layer (NFHL) does not have digital data available for most of Freestone County, however, the portion of the project in Limestone County is within flood zone X and is outside the 100-year floodplain.[5]

Threatened & Endangered Species

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state

[1] Blair, W.F., "The Biotic Provinces of Texas, "Tex. J. Sci. 2:93-117, 1950.

[2] McMahan, C.A., R.G. Frye, and K.L. Brown, 1984. The Vegetation Types of Texas. Accessed online https://tpwd.texas.gov/publications/pwdpubs/pwd_bn_w7000_0120/ March 22, 2019.

[3] TPWD, Ecological Mapping Systems of Texas, High Plains. Accessible to download online https://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector

[4] TCEQ, Surface Water Quality Viewer. Accessible online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 accessed January 13, 2020.

[5] FEMA, 2020. FEMA Flood Map Service Center. Accessed online https://www.fema.gov/national-flood-hazard-layer-nfhl February 4, 2020.

listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Freestone and Limestone counties can be found at https://tpwd.texas.gov/gis/rtest/.

According to the Information for Planning and Consultation (IPaC) website[6] maintained by the U.S. Fish & Wildlife Service (USFWS), the Whooping Crane, Least Tern, Texas fawnsfoot, large-fruited sand-verbena, and Navasota ladies' tresses need to be considered for the proposed project. The Piping Plover and Red Knot were also mentioned, but only need to be considered for wind energy projects. There are no critical habitats within the project area.

Based on Texas Natural Diversity Data (TXNDD) obtained from the TPWD, there were seven documented occurrences reported within a 5-mile buffer of the area of proposed improvements (one blackspot shiner, two bald eagle, two small-headed pipewort, one goldenwave tickseed, and one rookery). No other documented occurrences of threatened, endangered or rare species or natural communities were reported within five miles of the project area.

A biological survey of the project area should be conducted to determine whether populations of threatened or endangered species, or potential habitats used by listed species occur in the area to be affected, if this strategy is selected. A determination on whether any impacts or effects to listed species may occur would then be made. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

Cultural Resources

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (P196-515), and the Archeological and Historic Preservation Act (PL93-291). If the owner or controller of the project is a political subdivision of the state of Texas, then they would be required to comply with the Texas Antiquities Code. Based on the review of available GIS datasets, six cemeteries (Limestone Cemetery, Greenwood Cemetery, Driver Cemetery, Fairfield Cemetery, Chancellor Union Cemetery, and Day Cemetery) and 24 historical markers (Personville, Boll Weevil Railway, William Rufus Boyd, Jr., First Baptist Church of Teague, First Presbyterian Church of Teague, Dr. Emmet Headlee, Llewellyn Notley, Teague, Driver Cemetery, Rev. George Washington Baines, Capitain L.D. Bradley, Butler Church Bell, Carter Log House, Fairfield Female College, Fridolin Fischer, Freestone County, Freestone Jail, General John Gregg, David Hall Love, Manahan House, William L. Moody, Potter-Watson Lob Cabin, James Bonner Rogers, and Val Verde Battery), and one NRHP site (Trinity and Brazos Valley Railroad Depot and Office Building) were identified in the datasets within a one-mile buffer of the proposed project area. No State Historic Sites were located within a one-mile buffer of the proposed project area. A review of archeological resources in the proposed project area should be conducted during project planning, and in compliance with the Texas Antiquities Code.

[6] USFWS, 2020. Information for Planning and Consultation. Accessed online https://ecos.fws.gov/ipac/location/2CDHNRFRWZBEFN2BCFV527IIXM/resources January 13, 2020.

Specific project features such as pipelines generally have sufficient design flexibility to avoid most impacts or significantly mitigate potential impacts to geographically limited environmental and cultural resource sites. Field surveys conducted at the appropriate phase of development should be employed to minimize the impacts of project construction and operations on sensitive resources.

9.8.4 Engineering and Costing

This strategy would require additional facilities to divert and deliver water from Lake Fairfield to Lake Limestone. The facilities required for implementation of the project include:

- Raw water intake and pump station at Lake Fairfield with a capacity of 5.4 MGD; and
- 30 miles of raw water pipeline (24-inch diameter) from the pump station at Lake Fairfield to Lake Limestone.

A summary of the total project cost in September 2018 dollars is presented in Table 9.8-1. The total project cost of the strategy is estimated to be $54.2 million for surface water supply facilities. This includes land acquisition, resolution of conflicts, environmental permitting and mitigation, and technical services. The annual project costs are estimated to be $5.1 million. These costs include annual debt service, operation and maintenance, pumping energy costs, and purchase of water from Luminant. The strategy would be able to provide 5,700 acft/yr of raw water to BRA or other entities in the Middle Brazos Basin at a unit cost of $888 per acft or $2.72 per 1,000 gallons.

9.8.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 9.8-2, and the option meets each criterion.

Implementation of the strategy will require permits from various state and federal agencies, land acquisition, and design and construction of the facilities. The strategy will require amending the Luminant water rights to authorize the interbasin transfer of water. A summary of the implementation steps for the project is presented below.

Table 9.8-1. Cost Estimate Summary for Coryell County Off-Channel Reservoir

Item	Estimated Costs for Facilities
Intake Pump Stations (5.4 MGD)	$11,540,000
Transmission Pipeline (24 in dia., 30 miles)	$27,487,000
TOTAL COST OF FACILITIES	**$39,027,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$12,285,000
Environmental & Archaeology Studies and Mitigation	$779,000
Land Acquisition and Surveying (190 acres)	$706,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$1,452,000
TOTAL COST OF PROJECT	**$54,249,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$3,817,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$275,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$289,000
Pumping Energy Cost	$245,000
Purchase of Water (5,700 acft/yr @ 76.5 $/acft)	$436,000
TOTAL ANNUAL COST	**$5,062,000**
Available Project Yield (acft/yr)	5,700
Annual Cost of Water ($ per acft)	$888
Annual Cost of Water ($ per 1,000 gallons)	$2.72

Table 9.8-2. Evaluation of Trinity Supplies to Middle Brazos

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient to meet needs
2. Reliability	2. High reliability
3. Cost	3. Reasonable (moderate to high)
B. Environmental factors	
1. Environmental Water Needs	1. Negligible impact
2. Habitat	2. Negligible impact
3. Cultural Resources	3. Low impact
4. Bays and Estuaries	4. Negligible impact
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. Negligible 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	• Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	• None

Potential Regulatory Requirements:

- Texas Commission on Environmental Quality Water Right amendments;
- 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);
- Texas Commission on Environmental Quality administered Texas Pollutant Discharge Elimination System Storm Water Pollution Prevention Plan;
- 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;
- Assessment of impacts on Federal- and State-listed endangered and threatened species;
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction; 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 acquisition of rights-of-way and/or easements may be required; and
- Possible relocations or removal of residences, utilities, roads, or other structures.

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9.9 West Texas Water Partnership

9.9.1 Description of Option

In December 2010, the cities of Abilene, Midland and San Angelo met to discuss cooperative strategies in response to a developing drought. As the drought intensified a cooperative response could not be timely implemented, and the cities constructed and brought on-line individual strategies to provide adequate water supplies for their customers. Recognizing the benefits of working together to address future water supplies, the three cities continued to meet and evaluate long-term water supplies for the West Texas region. Through an Interlocal Agreement, the cities formed the West Texas Water Partnership (Partnership or WTWP) to pursue water management strategies that could be jointly developed by the Partnership.

The WTWP recently contracted for groundwater from the Edwards-Trinity Plateau Aquifer in Pecos County. The total contracted supply is 28,400 acre-feet per year (acft/yr), allocated as follows: Abilene – 8,400 acft/yr; Midland – 15,000 acft/yr; and San Angelo – 5,000 acft/yr.

To provide 28,400 acft/yr, twelve (12) groundwater supply wells are anticipated to be constructed. Produced groundwater will be transported through a network of well field collector pipes to a single standpipe. Water will then be transported generally north via gravity in a 42-inch transmission pipeline to an intermediate pump station near Monahans, Texas. From this intermediate pump station, water will be transported in a 42-inch transmission pipeline to the T-Bar Ranch, owned by the City of Midland.

Advanced treatment will be required for a portion of the groundwater flow to meet regulatory standards. Preliminary evaluations indicate about 60% of the flow will undergo treatment using ultrafiltration followed by reverse osmosis. Final treatment requirements will be determined during preliminary design. To maximize use of this groundwater source, a recovery stage is proposed for both the ultrafiltration and reverse osmosis processes. Waste from the treatment process is expected to be approximately 5 percent, which is comparable to conventional treatment. Waste will be disposed using evaporation ponds. The treatment plant will be located on Midland's T-Bar Ranch.

From the treatment plant, the Edwards-Trinity Plateau groundwater will be transported to Midland and San Angelo using the City of Midland's T-Bar transmission system and a direct 27-inch pipeline from Midland to San Angelo. No groundwater will be delivered directly to Abilene. Abilene will receive its share of the WTWP through an exchange of contracted supplies in Lake Ivie from Midland and San Angelo. This water will be transported to Abilene through existing infrastructure.

An alternative version is also described in the Region F Plan whereby all of the groundwater would be transported solely to Midland, and both Abilene and San Angelo would receive their shares of the project supply through an exchange of contracted supplies in O.H. Ivie.

9.9.2 Available Yield

The total quantity of supply from this strategy is 28,400 acre-feet. Elevated levels of total dissolved solids, notably chloride, will require a portion of the supply to undergo advanced treatment. The reliability for this source is high.

To minimize the size and cost of the transmission pipeline between Midland and San Angelo, the Partnership anticipates developing a cooperative use strategy for its collective supplies in O.H. Ivie Reservoir (Ivie). Each of the three of the WTWP cities contract with the Colorado River Municipal Water District (CRMWD) for 16.54% of the safe yield from Ivie. Under the anticipated cooperative use strategy, Abilene would utilize Midland's Ivie allocation in exchange for a portion of Abilene's Edwards-Trinity Plateau groundwater allocation. Abilene would also use a portion of San Angelo's Ivie allocation in exchange for a portion of Abilene's Edwards Plateau groundwater to reach their total of 8,400 acre-feet per year supply from the WTWP. This approach reduces the quantity of groundwater to be transported beyond Midland and the associated infrastructure requirements. Abilene's share of the Edwards-Trinity groundwater is then used by Midland and San Angelo to offset the Ivie supplies sent to Abilene. The supplies allocated to each member of the WTWP is shown in Table 9.9-1.

Table 9.9-1. Supply to Each User from the West Texas Water Partnership (acft/yr)

	Supply 2020	Supply 2030	Supply 2040	Supply 2050	Supply 2060	Supply 2070
Midland Ivie Water to Abilene		5,209	5,070	4,930	4,791	4,651
San Angelo Ivie Water to Abilene		3,191	3,330	3,470	3,609	3,749
Total WTWP Supply to Abilene		***8,400***	***8,400***	***8,400***	***8,400***	***8,400***
San Angelo Original Groundwater Share		5,000	5,000	5,000	5,000	5,000
Groundwater to San Angelo to Replace Ivie Water Sent to Abilene		3,191	3,330	3,470	3,609	3,749
Total Groundwater to San Angelo		***8,191***	***8,330***	***8,470***	***8,609***	***8,749***
Midland Original Groundwater Share		15,000	15,000	15,000	15,000	15,000
Groundwater to Midland to Replace Ivie Water Sent to Abilene		5,209	5,070	4,930	4,791	4,651
Total Groundwater to Midland		***20,209***	***20,070***	***19,930***	***19,791***	***19,651***
Total Groundwater Supply		***28,400***	***28,400***	***28,400***	***28,400***	***28,400***

9.9.3 Environmental Issues

The environmental issues associated with this strategy are expected to be low. It is assumed that the new pipelines would be routed around sensitive environmental areas to limit potential impacts. The conceptual design for this project includes evaporation ponds for the disposal of treatment waste stream. A properly designed and maintained facility should have minimal environmental impact.

Because the owner or controller of the project will likely be a political subdivision of the State of Texas (i.e. river authority, municipality, county, etc.), they will be required to coordinate with the Texas Historical Commission prior to project construction. If the project will affect waters of the United States or wetlands, the project sponsor will also be required to coordinate with the U.S. Army Corps of Engineers regarding impacts to these resources.

Field surveys conducted at the appropriate phase of development should be employed to minimize the impacts of construction and operations on sensitive resources. Specific project features, such as well fields, pump stations and pipelines generally have sufficient design flexibility to avoid most impacts or significantly mitigate potential impacts to geographically limited environmental and cultural resource sites.

9.9.4 Engineering and Costing

More detailed information regarding the groundwater, transmission and treatment facilities can be found in the 2021 Region F Regional Water Plan, as all associated facilities will be located in Region F.

The capital cost to fully implement this strategy is $549,093,000. Costs for development and construction of the project are shown in Table 9.9-2. These costs would be allocated based on each participant's share of the supply.

9.9.5 Implementation Issues

Construction of the pipeline may have temporary impacts on agricultural or rural users whose land is temporarily disrupted but no permanent impacts are anticipated. The treatment facility and evaporation ponds are anticipated to be built on the Midland T-Bar Ranch which is property already owned by the City so it will not cause further impacts to agricultural land.

The current conceptual design for this project uses evaporation ponds to dispose of the brine waste stream. If this were to change and the brine was released to a stream, impacts to the receiving water body would need to be evaluated.

This strategy is compared to plan development criteria in Table 9.9-3.

Table 9.9-2. Cost Estimate Summary for the West Texas Water Partnership (from Region F Plan)

Construction Costs	Quantity	Unit	Unit Price	Cost
Well Field				
Water Wells	12	EA	$650,000	$7,800,000
Well Field Piping	1	LS	$3,750,000	$3,750,000
Access Roadways	1	LS	$2,500,000	$2,500,000
Electrical Distribution	1	LS	$3,500,000	$3,500,000
Storage Tank	1	LS	$2,000,000	$2,000,000
Contractor Mob/Demob (3%)				$590,000
Engineering and Contingencies (35%)				$7,050,000
Subtotal Well Field				**$27,190,000**
Pipeline				
Transmission Pipeline - 42"	419,000	LF	$300	$125,700,000
Transmission Pipeline - 27"	610,000	LF	$235	$143,350,000
Right-of-Way Easements	61,600	ROD	$200	$12,320,000
Contractor Mob/Demob (3%)				$8,070,000
Engineering and Contingencies (30%)				$86,830,000
Subtotal Pipeline				**$376,270,000**
Pump Station & Ground Storage				
Pump Station	2	LS	$3,500,000	$7,000,000
Electrical/SCADA	2	LS	$800,000	$1,600,000
Storage Tank	3	LS	$1,300,000	$3,900,000
Contractor Mob/Demob (3%)				$380,000
Engineering and Contingencies (35%)				$4,510,000
Subtotal Pump Station/Ground Storage				**$17,390,000**
Treatment				
Ultrafiltration (Primary/Recovery)	1	LS	$14,800,000	$14,800,000

Table 9.9-2. Cost Estimate Summary for the West Texas Water Partnership (from Region F Plan)

Construction Costs	Quantity	Unit	Unit Price	Cost
Reverse Osmosis (Primary/Recovery)	1	LS	$16,830,000	$16,830,000
Chemical Systems	1	LS	$1,940,000	$1,940,000
Evaporation Pond	1	LS	$9,400,000	$9,400,000
Buildings/Yard Piping	1	LS	$12,930,000	$12,930,000
Electrical/SCADA	1	LS	$10,500,000	$10,500,000
Storage Tanks (Pretreatment/Clearwells)	1	LS	$8,170,000	$8,170,000
Contractor Mob/Demob (3%)				$2,240,000
Engineering and Contingencies (35%)				$26,880,000
Subtotal Treatment				**$103,690,000**
CONSTRUCTION TOTAL				**$524,540,000**
Permitting and Mitigation				$2,800,000
Interest During Construction (3%)				$21,753,000
TOTAL COST				**$549,093,000**
ANNUAL COSTS				
Debt Service (3.5%)				$38,635,000
Operation and Maintenance				$6,320,000
Electricity ($0.08/kwh)				$4,960,000
Total Annual Costs				$49,915,000
UNIT COSTS (Until Amortized)				
Per Acre-Foot of treated water				$1,783
Per 1,000 Gallons				$5.47
UNIT COSTS (After Amortization)				
Per Acre-Foot				$403
Per 1,000 Gallons				$1.24

Table 9.9-3. Comparison of West Texas Water Partnership to Plan Development Criteria

Impact Category	*Comment(s)*
A. Water Supply	
1. Quantity	1. Only Partly Meets Demands
2. Reliability	2. Moderate to High
3. Cost	3. Moderate
B. Environmental factors	
1. Environmental Water Needs	1. None
2. Habitat	2. None
3. Cultural Resources	3. None
4. Bays and Estuaries	4. None
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. None
C. Impact on Other State Water Resources	None
D. Threats to Agriculture and Natural Resources	Moderate
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered in an attempt to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None