

5A.17 Carrizo-Wilcox Aquifer Development

The development of the Carrizo-Wilcox Aquifer option involves transporting groundwater to municipal and industrial users in Williamson County and in Brazos County (Bryan, College Station, and Texas A&M University areas). The required facilities for each of the two areas is a well field, pipelines, pump stations, and storage facilities (Figure 5A.17-1). Water treatment to remove possible iron and manganese constituents may be needed for the Williamson County option.

The Carrizo-Wilcox Aquifer System in Central Texas is capable of producing large quantities of fresh water from the Simsboro and Carrizo Formations.^{1,2,3} On a sustained yield basis, the estimates in counties near Williamson County and in Brazos County are over 46,000 acft/yr. If an allowable depletion from storage is considered, the quantity of available groundwater for development would be considerably larger for the interim period.

The aquifer is primarily used for domestic, livestock, public supplies, and some industrial purposes (mining and power plants). The largest pumpage to date is from the Simsboro for public supply in the Bryan-College Station area. It began 50 years ago. The principal other areas of significant pumping are in Milam and Robertson Counties for mining and power plant purposes. The pumpage is also from the Simsboro, and began in the later 1980s. Water level changes experienced to date are mainly limited to artesian pressure declines centered around pumping centers. Little change in water tables in outcrop (recharge) areas has been noted to date.

The Lost Pines Groundwater Conservation District (Bastrop and Lee Counties) and the Brazos Valley Groundwater Conservation District (Brazos and Robertson Counties) were created in the 76th Texas Legislature, but they require ratification or authorization in the next legislative session to become permanent. Regulations on the development of groundwater and the export of groundwater from the new districts have not been established, and, therefore, are not considered.

¹ Thorkildsen, D. and Price, R. D., "Groundwater Resources of the Carrizo-Wilcox Aquifer in the Central Texas Region," Texas Water Development Board (TWDB) Report 332, 1991.

² Muller, D.A., and Price, R.D., "Groundwater Availability in Texas – Estimates and Projections through 2030," TWDB Report 238, 1979.

³ Espey, Huston & Associates, Inc., "Brazos Valley Long-Range Regional Water Supply Planning Study," consulting report to City of Bryan and City of College Station, 1990.

The options are presented at two delivery capacities. One is for a uniform delivery of water and the other is sized to meet peak day demands. For purposes of this assessment, peak day demand is 2.0 times the average day demand.

5A.17.1 Additional Development of Carrizo-Wilcox Aquifer for Brazos County

5A.17.1.1 Description of Option

The option in Brazos County to be addressed by this alternative includes replacing a 8,009 acft/yr surface water supply in Lake Limestone owned by Texas A&M (6,945 acft/yr) and Wellborn Water Supply Corp. (1,064 acft/yr). Wellborn currently purchases wholesale water from Texas A&M, but no infrastructure is in place to access the Lake Limestone water by either entity. Should the entities not develop that infrastructure, a replacement supply is needed. In addition, this option includes small municipal shortfalls, totaling 207 acft/yr for Bryan, College Station, and Texas A&M, and a manufacturing shortfall of 138 acft/yr. The total of the projected year 2050 shortage and replacement of surface water contracts is 8,354 acft/yr.

5A.17.1.2 Available Yield

Studies^{4,5,6} indicate ample availability from the Simsboro portion of the Carrizo-Wilcox Aquifer for the option. In this area, Simsboro wells average 2,800 feet in depth and commonly yield 3 MGD, or 2,100 gpm. The annual production of water from the Brazos County well field is 8,354 acft/yr. For the uniform water delivery option, four wells would be required to have a contingency of one well. A well field sized to provide a peak day delivery rate would require a production rate up to 15.0 MGD. This demand would require 6 wells. The estimated well spacing would be similar to existing wells in the area (i.e., 2,000 to 2,500 feet). The location of the proposed well field is in Brazos County and is shown in Figure 5A.17-1.

5A.17.1.3 Environmental Issues

Environmental issues associated with development of the Carrizo-Wilcox Aquifer include possible impacts to fish and wildlife habitat, environmental water needs/instream flows, cultural sites and threatened and endangered species. Local impacts could result from the development of well fields, storage facilities, pump stations and pipelines, especially at stream

⁴ Thorkildsen, D. and R.D. Price, Op. Cit., 1991.

⁵ Muller, D.A. and R.D. Price, Op. Cit., 1979.

⁶ Espey, Huston & Associates, Inc., Op. Cit., 1990.

crossings. The impact of declining aquifer water levels on environmental water needs and instream flows should be investigated.

New and/or expanded well fields in the Carrizo-Wilcox Aquifer, including storage facilities, pump stations and pipelines located near Bryan College Station in Brazos County, would pose relatively low environmental impacts. Possible environmental effects include:

- Impact on environmental water needs and instream flows over the Carrizo-Wilcox would possibly be low, if quantity withdrawn is relatively small.
- Potential increase in return flows to Brazos River.
- Possible low impact on fish and wildlife habitat, including one federally listed endangered plant species.
- Possible low impact on cultural resources.

5A.17.1.4 Engineering and Costing

For the Brazos County option, groundwater would be developed from a well field along a north-south line about 2 miles west of Bryan. The location is subject to adjustment, due to future expansions of adjoining well fields.

The major facilities required for these options are:

- Water Collection and Conveyance System:
 - Wells
 - Pipelines
 - Pump Station
 - Storage
- Transmission System:
 - Storage
 - Pipeline
 - Pump Station
- Water Treatment

The approximate location of these facilities are shown in Figure 5A.17-1.

Cost estimates were computed for capital costs, annual debt service, operation and maintenance, power, land, and environmental mitigation for uniform and peak day delivery. These costs are summarized in Table 5A.17-1. As shown, the annual costs, including debt service for a 30-year loan at 6 percent interest and operation and maintenance costs, including power, are estimated to be \$1,251,000 and \$1,791,000 for the uniform and peak day options, respectively. This option produces potable water at an estimated cost of \$150 per acft and \$214 per acft, respectively (Table 5A.17-1) for uniform delivery rate and peak day deliver rate.

**Table 5A.17-1.
Cost Estimate Summary
Carrizo-Wilcox Well Field: Brazos County Option
Second Quarter 1999 Prices**

<i>Item</i>	<i>Uniform Annual Delivery Rate 7.45 MGD</i>	<i>Peak Delivery Rate 14.9 MGD</i>
Capital Costs		
Well Costs	\$5,344,000	\$8,016,000
Collector and Transmission Lines	1,497,000	1,857,000
Booster Station	<u>850,000</u>	<u>2,219,000</u>
Total Capital Cost	\$7,691,000	\$12,092,000
Engineering, Legal Costs, and Contingencies	\$2,617,000	\$4,139,000
Environmental & Archaeology Studies and Mitigation	77,000	85,000
Land Acquisition and Surveying	100,000	108,000
Interest During Construction	<u>210,000</u>	<u>329,000</u>
Total Project Cost	\$10,695,000	\$16,753,000
Annual Costs		
Debt Service	\$776,000	\$1,215,000
Operation and Maintenance:		
Pipeline, Pump Station	85,000	146,000
Well and Pipeline Pumping Energy Costs	390,000	430,000
Purchase of Water	<u>0</u>	<u>0</u>
Total Annual Cost	\$1,251,000	\$1,791,000
Available Project Yield (acft/yr)	8,354	8,354
Annual Cost of Water (\$ per acft)	\$150	\$214
Annual Cost of Water (\$ per 1,000 gallons)	\$0.46	\$0.66

5A.17.1.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 5A.17-2, and the option meets each criterion.

**Table 5A.17-2.
Comparison of Carrizo-Wilcox: Brazos County Option to Plan Development Criteria**

<i>Impact Category</i>	<i>Comment(s)</i>
A. Water Supply: 1. Quantity 2. Reliability 3. Cost	1. Sufficient to meet needs 2. High reliability 3. Low to moderate
B. Environmental factors 1. Environmental Water Needs 2. Habitat 3. Cultural Resources 4. Bays and Estuaries	1. Low impact 2. Low impact; possible affect on one endangered species 3. Low impact 4. 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

The development of additional groundwater in the Carrizo and Simsboro Aquifers in Brazos County must address several issues, including:

- Impact on:
 - Water levels in the aquifer.
 - Baseflow in streams.
 - Wetlands.
- Purchase of groundwater rights.
- Competition for groundwater in the area with others.
- Potential regulations by the newly created groundwater conservation district (Brazos Valley).
- U.S. Army Corps of Engineers Sections 10 and 404 dredge and fill permits for the pipelines impacting wetlands or navigable waters of the United States.
- GLO easement for use of state-owned land (if any) or streambeds.

- TPWD Sand, Gravel, and Marl permit for construction in state-owned streambeds.
- Mitigation requirements would vary depending on impacts, but could include vegetation restoration, wetland creation or enhancement, or additional land acquisition.

5A.17.2 Carrizo-Wilcox Water Supply for Williamson County

5A.17.2.1 Description of Option

This alternative addresses the Williamson County shortfall that begins in 2030 and reaches 36,514 acft/yr by year 2050. Groundwater from the Carrizo-Wilcox Aquifer could be supplied to Williamson County, including the cities of Hutto, Taylor, Round Rock, and Georgetown and Jonah and Chisholm Trail Special Utility Districts.

5A.17.2.2 Available Yield

The proposed well field is southeast of the Mexia-Talco Fault Zone and about midway between the outcrops of the Carrizo Aquifer and the downdip extent of fresh water. At this location, large capacity wells can be developed in both the Simsboro and Carrizo Aquifers. Simsboro wells would be about 2,500 feet deep and are projected to yield 2,100 gpm. Carrizo wells would be about 900 feet deep and are projected to yield about 1,000 gpm. For a uniform delivery rate of the average demand (36,514 acft/yr rate), the well field would have to produce 32.6 MGD. With each well yard, consisting of a Simsboro well and a Carrizo well and producing a total of 4.4 MGD, nine well yards would be required when assuming a contingency of at least 10 percent. For a well field to meet the peak day demand of 65.2 MGD, 17 well yards would be required to have a contingency of 10 percent. The well yards would be spaced at about 0.5-mile intervals. About half of the well field would be in Lee County and the other half would be in Burleson County, as shown in Figure 5A.17-2.

5A.17.2.3 Environmental Issues

New and/or expanded well fields in the Carrizo-Wilcox Aquifer in Lee and Burleson Counties, including storage facilities, pump stations and a 60-mile pipeline to Williamson County could possibly involve low environmental impacts, including:

- Impact on environmental water needs and instream flows over the Carrizo-Wilcox would possibly be low, if quantity withdrawn is relatively small. Potential increase in return flows to Brazos River.

- Possible low beneficial impact on bays and estuaries from increased return flows to Brazos River.
- Probable low impact on fish and wildlife habitat in general, including one amphibian and two plant species, all federally listed.
- Possible low impact on cultural resources.
- Proposed well field is near Houston toad habitat.

5A.17.2.4 Engineering and Costing

For the Williamson County option, the well field would be along a northeast-southwest line between US 77 and TX 21 and straddling the Lee-Burleson County line.

The major facilities required for these options are:

- Water Collection and Conveyance System
 - Wells
 - Pipelines
 - Pump Station
 - Storage
- Transmission System
 - Storage
 - Pipeline
 - Pump Station
- Water Treatment
 - Removal of iron and manganese concentrations may be required for Williamson County.

Cost estimates were computed for capital costs, annual debt service, operation and maintenance, power, land, and environmental mitigation for uniform and peak day delivery. These costs are summarized in Table 5A.17-3. Treatment costs are for removal of iron, manganese, and possibly hydrogen sulfide by aeration and/or oxidation and filtration. The cost of this treatment is less than conventional treatment of surface water. As shown, the annual costs, including debt service for a 30-year loan at 6 percent interest and operation and maintenance costs, including power, are estimated to be \$17,885,000 and \$25,519,000 for the uniform and peak day options, respectively. This option produces potable water at an estimated cost of \$490 per acft (\$1.50 per 1,000 gallons) and \$699 per acft (\$2.14 per 1,000 gallons), respectively (Table 5A.17-3).

**Table 5A.17-3.
Cost Estimate Summary
Carrizo-Wilcox: Williamson County Option
Second Quarter 1999 Prices**

<i>Item</i>	<i>Uniform Annual Delivery Rate 32.6 MGD</i>	<i>Peak Delivery Rate 65.2 MGD</i>
Capital Costs		
Well Field	\$19,759,000	\$34,759,000
Collector and Transmission Lines	46,004,000	60,213,000
Booster Station	6,426,000	9,826,000
Water Treatment Plant	<u>14,159,000</u>	<u>22,571,000</u>
Total Capital Cost	\$86,348,000	\$127,369,000
Engineering, Legal Costs and Contingencies	\$27,922,000	\$41,568,000
Environmental & Archaeology Studies and Mitigation	1,760,000	1,764,000
Land Acquisition and Surveying	4,540,000	4,612,000
Interest During Construction	<u>9,649,000</u>	<u>14,028,000</u>
Total Project Cost	\$130,219,000	\$189,341,000
Annual Costs		
Debt Service	\$9,455,000	\$13,750,000
Operation and Maintenance:		
Wells, Pipeline, Booster Station, Storage Tank	804,000	1,177,000
Water Treatment Plant	2,672,000	5,325,000
Well and Pipeline Pumping Energy Costs	3,128,000	3,441,000
Purchase of Water (\$50 per acft) ¹	<u>1,826,000</u>	<u>1,826,000</u>
Total Annual Cost	\$17,885,000	\$25,519,000
Available Project Yield (acft/yr)	36,514	36,514
Annual Cost of Water (\$ per acft)	\$490	\$699
Annual Cost of Water (\$ per 1,000 gallons)	\$1.50	\$2.14
¹ It is anticipated that acquisition of groundwater for export to areas outside of the aquifer will require payment to landowners for the water. Other entities have marketed groundwater for \$50 per acft and that cost is used here.		

5A.17.2.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 5A.17-4, and the option meets each criterion.

**Table 5A.17-4.
Comparison of Carrizo-Wilcox: Williamson County Option to Plan Development Criteria**

<i>Impact Category</i>	<i>Comment(s)</i>
A. Water Supply: 1. Quantity 2. Reliability 3. Cost	1. Sufficient to meet needs 2. High reliability 3. Low to moderate
B. Environmental factors 1. Environmental Water Needs 2. Habitat 3. Cultural Resources 4. Bays and Estuaries	1. Low impact 2. Low impact; possible affect on several species 3. Low impact 4. 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

The development of additional groundwater in the Carrizo and Simsboro Aquifers in Lee and Burlison Counties must address several issues. Major issues include:

- Impact on:
 - Water levels in the aquifer.
 - Baseflow in streams.
 - Wetlands.
 - Purchase of groundwater rights.
 - Competition for groundwater in the area with others.
 - Potential regulations by the newly created groundwater conservation districts (Lost Pines).
 - U.S. Army Corps of Engineers Sections 10 and 404 dredge and fill permits for the pipelines impacting wetlands or navigable waters of the United States.
 - GLO easement for use of state-owned land.
 - TPWD Sand, Gravel, and Marl permit for construction in state-owned streambeds.
 - Mitigation requirements would vary depending on impacts, but could include vegetation restoration, wetland creation or enhancement, or additional land acquisition.