# AQUILLA LAKE REALLOCATION STUDY

*Socio-Economics, Appendix F*

# SOCIO-ECONOMICS

## INTRODUCTION

Aquilla Lake is an U.S. Army Corps of Engineers (USACE) reservoir located southwest of the City of Hillsboro in Hill County. The primary inflows into the lake are Aquilla Creek and Hackberry Creek, with discharges form the lake flowing into Aquilla Creek below the dam. As part of the Brazos River Authority (BRA) System, the reservoir provides water for the cities of Hillsboro, Cleburne and Milford and for Brandon-Irene WSC, Files Valley WSC, and Whitney Lake Water Company. The projected yield of Aquilla Lake will not be able to completely supply the future needs of these entities. As a result, the BRA has asked the USACE to conduct a reallocation study within Aquilla Lake, reallocating storage from the flood pool to the conservation pool for municipal and industrial (M&I) water supply.

This appendix will provide relevant information to be used in the planning and evaluation of alternatives for the reallocation study. This information includes a socio-econoic overview of the study area; an analysis and validation of water demand; determination of the user cost of storage for the reallocated space and a test of financial feasibility for reallocation against the least expensive, most likely alternative to reallocation.

The study area is defined as the boundaries of Aquilla Lake to the confluence of Aquilla Creek and the Bazos River.

## STUDY AREA

The study area for the socio-economic and water supply aspects of this study is lies in Hill County, Texas and the City of Cleburne in Johnson County. While Aquilla Lake lies entirely in Hill County, it provides municipal and industrial water supplies for portions of Hill County and the City of Cleburne. For analysis of any impacts of the reallcoations, the study area includes the reservoir and Aquilla Creek downstream to the confludence of the Brazos River.

Aquilla Lake was developed as series of flood risk management projects to reduce flood risk along the mainstem of the Brazos River to the Gulf of Mexico. In the report titled *Interim Review of Reports on Brazos River and Tributaries, Texas Covering Aquilla Reservoir on Aquilla Creek*(1966), it was estimated that $2.8 million (1965 price levels) in agricultural, transportation and utilities properties were in the Aquilla Creek reach of the floodplain (from the dam to the confluence of the river. There were no urban or suburban properties. On the Brazos River, below the confluence with Aquilla Creek, there was an estimated $435million (1965 price levels) of property within the flood plain, including $96 millionof urban and suburban property.

The study area for the reallocation is consistent with Aquilla Creek Reach in the 1966 *Interim Review of Reports*. The flood plain land use remains agricultural pastures and crop fields, with no urban development.

# DEMOGRAPHICS

## POPULATION

Hill County lies in northern central Texas with a total area of 986 square miles and a population (2010) of 35,089. The largest city, Hillsboro, is also the county seat and has a population of 8,456. Hillsboro is approximately 62 miles south of Dallas and 52 miles south of Fort Worth. Interstate 35 passes through the county and splits north of Hillsboro into Interstate 35 W though Fort Worth and Interstate 35E through Dallas.

Johnson County is north of Hill County and in between Tarrant County and Hill County. Its population (2010) is 150,934. Interstate 35W runs through the eastern portion of the county and ast of Cleburn. Burleson is the largest city with a population of 36,690, and Cleburne is the county seat, with a population of 29,377.

Table 1displays the compostion of the populations by race and Hispanic origin. In Hill County, 74 percent of the population is White, 18 percent Hispanic, and 6 percent Black. Johnson County has a similar compositon, with 77 percent White, 18 percent Hispanic, and 3 percent Black. By comparison, the composition for the state of Texas overall is 45 percent White, 38 percent Hispanic, and 12 percent Black.

**Table 1. Populaton by Race and Hispanic Origin (2010)**

| Population Characteristic | Hill County | Johnson County | Texas |
|---|---|---|---|
| Total Population | 35,089 | 150,934 | 25,145,561 |
| White alone | 25,836 | 115,545 | 11,397,345 |
| Black or African American alone | 2,161 | 3,797 | 2,886,825 |
| Hispanic or Lation Origin | 6,427 | 27,319 | 9,460,921 |
| American Indian and Alaska Native alone | 118 | 741 | 80,586 |
| Asian alone | 105 | 951 | 948,426 |
| Native Hawaiian and Other Pacific Islander alone | 20 | 475 | 17,920 |
| Some Other Race alone | 19 | 164 | 33,980 |
| Two or More Races | 403 | 1942 | 319,558 |

Source: U.S. Bureau of the Census

Table 2 displays the projected populations through the year 2060. The projections are based on data used for state water planning by the Texas Water Development Board. For smaller communities, the estimates and projections are based on the communitys served by the water service provider. The Brazos River Authority (BRA) holds the contracts to the conservation pool storage in Aquilla Lake. It sells water to the Aquilla Water Service Disrict (WSD), the City of Cleburne, and the Lake Whitney Water Company. The Aquilla WSD, in turn, provides water to the Brandon-Irene Water Supply Corporation (WSC), Files Valley WSC, City of Hillsboro, Chatt WSC, Hill County WSC, and Menlow WSC. Chatt, Hill County and Menlow WSCs are aggregated under Hill County-Other. The projected annulized growth rates for the communities in the study area are modest, with less than 1 percent growth per year. The Hill County-Other aggregate is projected to have a 1 percent per year rate of growth, Johnson County 1/7 percent and the city of Cleburne, 1.2 percent.

**Table 2. Population Projections**

| Geography | Historical/ Estimate | Projections | | | | | Annualized Growth Rate 2010 - 2060 |
|---|---|---|---|---|---|---|---|
| | 2010* | 2020 | 2030 | 2040 | 2050 | 2060 | |
| Hill County | **35,089** | 35,050 | 36,782 | 38,510 | 40,355 | 40,402 | 0.3% |
| Brandon-Irene WSC | 2,059 | 2,128 | 2,207 | 2,285 | 2,369 | 2,462 | 0.4% |
| Files Valley WSC | 1,997 | 2,045 | 2,100 | 2,154 | 2,212 | 2,277 | 0.3% |
| Hillsboro | **8,456** | 9,284 | 9,696 | 10,009 | 10,534 | 11,017 | 0.5% |
| Lake Whitney Water Company | 5,396 | 5,426 | 5,460 | 5,494 | 5,530 | 5,570 | 0.1% |
| Hill County-Other | 2,074 | 2,305 | 2,556 | 2,827 | 3,104 | 3,411 | 1.0% |
| Johnson County | **150,934** | 200,381 | 238,590 | 268,082 | 304,454 | 346,999 | 1.7% |
| Cleburne | **29,337** | 34,467 | 38,558 | 43,027 | 48,353 | 52,812 | 1.2% |

* - Boldfaced historical data is from the 2010 Census of Population and Housing, U.S. Burea of the census. All other estimates and projections are from the Texas Water Development Board

## EDUCATION

Table 3 displays the percent of the population 25 years old and over by highest educational attainment. The distribution is very similar for Hill and Johnson Counties with approximately one-third of the population having a high school diploma or equivalent. Approximatlely one-quarter of the population has some college, but no degree. Eleven percent of the poplations have a Bachelor's degree, and similarly, appproximatley 11 percent have somehere between a 9$^{th}$ and 12$^{th}$ grade education, but no degree. Hill County has a slightly higher percentage of the population with less than a 9$^{th}$ grade education. Texas is more evenly distributed between high school diploma and some college, but no degree. Texas also has a higher percentage of the population having a Bachelor's degree (18 percent) or graduate degree (9 percent).

**Table 3. Highest Educational Attainment of the Population 25 Years and Over, 2008-2012**

| Educational Attainment | Hill County | Johnson County | Texas |
|---|---|---|---|
| Less than 9th grade | 8.7% | 6.4% | 9.7% |
| 9th grade to 12th grade, no diploma | 11.8% | 11.0% | 9.6% |
| High school diploma or equivalent | 30.9% | 33.5% | 25.3% |
| Some college, no degree | 25.8% | 26.8% | 22.8% |
| Associate's degree | 8.1% | 6.5% | 6.4% |
| Bachelor's degree | 10.5% | 11.2% | 17.5% |
| Graduate or professional degree | 4.1% | 4.7% | 8.7% |

American Fact Finder, American Community Survey, U.S. Bureau of the Census

## INDUSTRY AND EMPLOYMENT

The number of establishments and paid employees by sector is displayed in Table 4. In Hill Conty, the largest employment sector is retail trade with 24 percent of total employment, followed by healthcare and social assistance with 19 percent, accommodation and food services with 15 percent, and manufacturing with 12 percent of total employment. The retail sector also supplies the larget number of establishments, with 25 percent of the total number, followed by accommodation and food services with 11 percent, other services with 10 percent and health care and social services with 8 percent.

In Johnson County, retail trade provides the greatest employment, with 15 percent of total employment, followed by manufacturing with 14 percent, health care and social assistance with 12 percent, accommodation and food services with 10 percent and transportation and warehousing with 8 percent. In terms of number of establishments, retail trade comprises 15 percent of the total number of establishments, followed by construction with 13 percent, other services with 11 percent, health care and social assistance with 9 percent and accommodation and food services with 8 percent.

For the state of Texas, health care and social assistance provides the larges number of jobs, with 15 percent of total employment, followed by retail trade with 13 percent, accommodation and food services and administration and support, each with 10 percent, and manufacturing with 8 percent. Retail trade has the largest number of establishments with 15 percent of the total, followed by professiona, scientific, and technical services and heath care and social services, both with 11 percent, other services amd accommodation and food services, both with 9 percent, and construction with 8 percent.

**Table 4. Number of Establisments and Paid Employees by Sector (2010)**

| | Hill County | | Johnson County | | Texas | |
|---|---|---|---|---|---|---|
| Sector | Number of establishments | Paid employees* | Number of establishments | Paid employees* | Number of establishments | Paid employees* |
| Total for all sectors | 657 | 6,745 | 2,544 | 31,577 | 522,146 | 8,785,238 |
| Agriculture, forestry, fishing and hunting | 3 | 6 | 5 | 20 | 1,053 | 6,419 |
| Mining, quarrying, and oil and gas extraction | 6 | b | 55 | 2,303 | 7,538 | 162,655 |
| Utilities | 14 | c | 12 | c | 1,911 | 47,548 |
| Construction | 50 | 639 | 317 | 2,241 | 39,321 | 539,542 |
| Manufacturing | 40 | 804 | 162 | 4,463 | 19,593 | 730,551 |
| Wholesale trade | 22 | 103 | 139 | 1,311 | 31,526 | 455,290 |
| Retail trade | 165 | 1,587 | 371 | 4,746 | 76,787 | 1,127,032 |
| Transportation and warehousing | 14 | 57 | 102 | 2,653 | 15,745 | 351,410 |
| Information | 8 | 59 | 24 | 378 | 8,911 | 230,235 |
| Finance and insurance | 43 | 194 | 167 | 780 | 37,731 | 452,435 |

| Sector | Hill County | | Johnson County | | Texas | |
|---|---|---|---|---|---|---|
| | Number of establishments | Paid employees* | Number of establishments | Paid employees* | Number of establishments | Paid employees* |
| Real estate and rental and leasing | 30 | 90 | 113 | 574 | 26,238 | 169,123 |
| Professional, scientific, and technical services | 35 | c | 190 | 672 | 59,757 | 565,564 |
| Management of companies and enterprises | 1 | b | 6 | b | 4,182 | 257,114 |
| Administrative and support and waste management and remediation services | 23 | 228 | 130 | 1,572 | 25,295 | 830,284 |
| Educational services | 3 | a | 18 | 355 | 5,633 | 150,414 |
| Health care and social assistance | 53 | 1,256 | 221 | 3,696 | 59,193 | 1,280,332 |
| Arts, entertainment, and recreation | 9 | b | 25 | 108 | 6,101 | 113,755 |
| Accommodation and food services | 69 | 1,021 | 211 | 3,150 | 46,045 | 908,665 |
| Other services (except public administration) | 67 | 329 | 271 | 2,351 | 48,097 | 405,132 |
| Industries not classified | 2 | a | 5 | a | 1,489 | 1,738 |

Source: 2010 County Business Patterns, American FactFinder, U.S. Bureau of the Census
* Paid employees for pay period including March 12
(a) 0-19 employees; (b) 20-29 employees (c) 100 to 249 employees; (D) Data withheld to avoid disclosing information for individual companies

According to the Texas Workforce Commission, the April 2014 unemployment rate for Hill County was 4.7 percent. The Johnson County unemployment rate was 4.5 percent. The unemployment rate for Texas was 6.0 percent.

## INCOME

The percent of households by income ranges is displayed in Table 5. Hill County shows to more households in lower income ranges, with most of the households having incomes between $15,000 and $74,999. For Johnson County and the state overall, most households fall between $25,000 and $149,999.

**Table 5. Household Income (2012 Dollars)**

| Household Income | Hill County | Johnson County | Texas |
|---|---|---|---|
| Less than $10,000 | 7.7% | 4.6% | 7.4% |
| $10,000 to $14,000 | 7.6% | 3.5% | 5.4% |
| $15,000 to $24,999 | 15.7% | 9.0% | 11.0% |
| $25,000 to $34,999 | 13.9% | 10.5% | 10.9% |
| $45,000 to $49,999 | 15.0% | 15.5% | 13.9% |
| $50,000 to $74,999 | 18.5% | 21.0% | 18.0% |
| $75,000 to $99,999 | 9.1% | 14.8% | 11.8% |
| $100,000 to $149,999 | 8.8% | 14.3% | 12.4% |
| $150,000 to $199,999 | 2.5% | 4.3% | 4.6% |
| $200,000 or more | 1.3% | 2.4% | 4.5% |

American Fact Finder, U.S. Bureau of the Census

The median household income for Hill County is $39,450, for Johnson County, $57,016, and for Texas, $51,563. In Hill County, approximately 17 percent of population is below the poverty level, compared to 11.0 percent for Johnson County and 17 percent for Texas.

## HOUSING

There are 16,098 housing units in Hill County with 84 percent occupied. Of those, 73 percent are owner occupied. Johnson County has 56,573 housing units with a 91 percent occupancy rate, of which 75 percent are owner occupied. Texas has almost 10 million housing units, with 88 percent being occupied. Of those, 64 percent are owner occupied. The average household size is similar among the three areas, with 2.6 persons per household for Hill County, 2.8 for Johnson County, and 2.8 for Texas.

**Table 6. Housing Characteristics 2008-2012**

| Housing Characteristic | Hill County | Johnson County | Texas |
|---|---|---|---|
| Housing Units | 16,098 | 56,573 | 9,978,137 |
| Occupied | 83.9% | 91.3% | 88.0% |
| Vacant | 16.1% | 8.7% | 12.0% |
| Owner Occupied | 72.5% | 75.0% | 63.9% |
| Household size | 2.59 | 2.84 | 2.75 |

American Fact Finder, U.S. Bureau of the Census

# WATER DEMAND AND SUPPLY

The water demand and supply analysis is taken from the 2016 Brazos G Regional Water Plan prepared for the Water for Texas 2017 State Water Plan. Currenty, the Brazos River Authority (BRA) holds contracts for the storage in Aquilla Lake. It sales untreated water to the City of Cleburne, Lake Whitney Water Company and the Aquilla Water Supply District (WSD). The Aquilla WSD in turn supplies water to the city of Hillsboro and five water supply corporations.

## WATER DEMAND

Municipal and commercial demands are based on the projected population estimates multiplied by gallons per capita per day (gpcd) water use projections. Two sets of per capita projections for the city of Cleburne were evaluated for this analysis.

2016 Brazos G Regional Water Plan – Base year 2011 per capita = 172 gpcd. For regional planning the TWDB selected 2011 as a baseline per capita year since it was one of the hottest and driest years recorded for many parts of Texas. This does not take into account that many municipalities, Cleburne included, had implemented their drought contingency plans.

LRWSP – Base year per capita 2006 = 180 gpcd. This year was chosen since it represents the highest recent demand year without drought restrictions in place.

The Brazos G projections assume a level of "passive" savings based on gradual replacement of water-inefficient plumbing fixtures with more efficient models due to plumbing code restrictions. They are also based on drought-year water use and accordingly incorporate Stage 2 or 3 drought water use restrictions on a perpetual basis. Most cities consider these types of drought restrictions to be an atypical response to unusual weather patterns, not a standard way of life. As a result, they incorporate a higher degree of water conservation than is felt to be sustainable. However, these per capita use projections form the basis of the State's water supply planning effort and as such, are utilized in this analysis.

In contrast, the Cleburne LRWSP per capita projections are based on Cleburne's historical use, which includes drought restrictions on outdoor use only during drought conditions. However, historical use does not fully reflect the effect of water savings associated with recent plumbing code changes. Because these savings were felt to be substantially certain to occur, this analysis integrates the "passive" water use reductions into historical per capita use rates to present a second scenario of per capita use. Table 7 compares both sets of per capita projections.

**Table 7. City of Cleburne Municipal and Commercial per Capita**

| GPCD Scenario | Baseline | 2020 | 2030 | 2040 |
|---|---|---|---|---|
| **a (2016 Brazos G)** | 172 | 163 | 159 | 156 |
| **b (LRWSP w conservation)** | 180 | 171 | 167 | 164 |

The City of Cleburne residential and commercial demand was calculated using this equation:

$$Annual\ Residential\ and\ Commercial\ Demand\ (AF\ per\ yr) = \frac{GPCD \times Population \times 365}{325{,}851\ gallons\ per\ AF}$$

The three projected population scenarios were multiplied by the two per capita scenarios to create six municipal and commercial demand scenarios that are labeled by (#) for population and (a or b) for per capita. The municipal and commercial demand for each scenario is included in Table 8. The 2016 Brazos G municipal and commercial demand projections were included for comparison purposes. Cleburne's municipal and commercial demand by 2040 ranges from approximately 19,000 acre-feet per year with the Cleburne Comp Plan population and LRWSP per capita to 7,700 acre-feet per year with the NCTCOG population and 2016 Brazos G per capita.

**Table 8. City of Cleburne Municipal and Commercial Demand (Values in AF per/YR)**

| Municipal Demand Scenario | 2020 | 2030 | 2040 |
|---|---|---|---|
| **2016 Brazos G** | 5,927 | 6,446 | 7,010 |
| **1 (NCTCOG) a (2016 Brazos G)** | 6,252 | 6,987 | 7,741 |
| **1 (NCTCOG) b (LRWSP w conservation)** | 6,559 | 7,338 | 8,137 |

| | | | |
|---|---|---|---|
| **2 (LRWSP) a (2016 Brazos G)** | 6,786 | 9,125 | 12,361 |
| **2 (LRWSP) b (LRWSP w conservation)** | 7,119 | 9,584 | 12,994 |
| **3 (Comp Plan) a (2016 Brazos G)** | 8,175 | 12,199 | 18,339 |
| **3 (Comp Plan) b (LRWSP w conservation)** | 8,576 | 12,812 | 19,277 |

Industrial demands were estimated as part of the Long-Range Water Supply Plan based on discussions with existing industries in the city of Cleburne. The 2016 Brazos G estimates were based on surveys of actual use by industrial users. The difference between these two sets of industrial demands was minimal so a consensus was reached by BRA and the Fort Worth District Corps of Engineers that industrial demands would be based on the 2016 Brazos G Plan. All freshwater and reuse demands for manufacturing and steam electric power in the 2016 Brazos G Plan were placed on the city of Cleburne. Table 9 includes the total manufacturing and steam electric demands, which are slightly more than 9,100 acre-feet per year in 2020 and increase to over 9,600 acre-feet per year by 2040.

**Table 9. 2016 Brazos G Manufacturing and Steam Electric Demand Projections for Cleburne**

**(Values in AF per YR)**

| | **2020** | **2030** | **2040** |
|---|---|---|---|
| **Total Manufacturing and Steam Electric Demand** | 9,119 | 9,364 | 9,615 |

The combined demand on the City of Cleburne by 2040 ranges from 17,300 acre-feet per year to almost 29,000 acre-feet per year as shown in Table 10.

**Table 10. City of Cleburne Total Demand (Values in AF per YR)**

| **Demand Scenario** | **2020** | **2030** | **2040** |
|---|---|---|---|
| **2016 Brazos G** | 15,046 | 15,810 | 16,625 |
| **1 (NCTCOG) a (2016 Brazos G)** | 15,371 | 16,351 | 17,356 |
| **1 (NCTCOG) b (LRWSP w conservation)** | 15,678 | 16,702 | 17,752 |
| **2 (LRWSP) a (2016 Brazos G)** | 15,905 | 18,489 | 21,976 |
| **2 (LRWSP) b (LRWSP w conservation)** | 16,238 | 18,948 | 22,609 |
| **3 (Comp Plan) a (2016 Brazos G)** | 17,294 | 21,563 | 27,954 |
| **3 (Comp Plan) b (LRWSP w conservation)** | 17,695 | 22,176 | 28,892 |

# WATER SUPPLY AND EXISTING WATER CONTRACTS

The supply analysis was based on supply amounts from the 2016 Region G Plan. Cleburne's supplies include the Trinity Aquifer, Lake Pat Cleburne, Lake Aquilla and currently connected reuse supplies. The supplies from the Trinity Aquifer are based on models of the available groundwater that can be reliably pumped while the surface water supplies are based on the modeled yield, reduced over time for sedimentation. Aquilla Lake supplies for Cleburne were based on the BRA contracted amount. Currently available supply for the city of Cleburne is approximately 12,700 acre-feet per year in 2020 decreasing to 12,600 acre-feet per year by 2040. Table 11 shows the current connected supplies associated with the City of Cleburne.

**Table 11. City of Cleburne Currently Connected Supplies (Values in AF per YR)**

| | 2020 | 2030 | 2040 |
|---|---|---|---|
| **Trinity Aquifer** | 1,292 | 1,292 | 1,292 |
| **Lake Pat Cleburne** | 4,838 | 4,769 | 4,700 |
| **Lake Aquilla** | 5,300 | 5,300 | 5,300 |
| **Reuse (Johnson County SE)** | 1,344 | 1,344 | 1,344 |
| **Cleburne Connected Supply** | **12,774** | **12,705** | **12,636** |

## *NEED ANALYSIS*

The needs analysis for the City of Cleburne is based on the difference between the demand and the currently connected supplies. Table 12 shows that all scenarios indicate an immediate need in 2020 ranging from approximately 2,500 acre-feet per year to almost 5,000 acre-feet per year. Additionally, the need in 2040 ranges from approximately 4,700 acre-feet per year to over 16,000 acre-feet per year depending on the demand scenario.

**Table 12. City of Cleburne Need**

-Values in AF per Year-

| Demand Scenario | 2020 | 2030 | 2040 |
|---|---|---|---|
| **2016 Brazos G** | -2,272 | -3,105 | -3,989 |
| **1 (NCTCOG) a (2016 Brazos G)** | -2,597 | -3,646 | -4,720 |
| **1 (NCTCOG) b (LRWSP w conservation)** | -2,904 | -3,997 | -5,116 |
| **2 (LRWSP) a (2016 Brazos G)** | -3,131 | -5,784 | -9,340 |
| **2 (LRWSP) b (LRWSP w conservation)** | -3,464 | -6,243 | -9,973 |
| **3 (Comp Plan) a (2016 Brazos G)** | -4,520 | -8,858 | -15,318 |
| **3 (Comp Plan) b (LRWSP w conservation)** | -4,921 | -9,471 | -16,256 |

As mentioned previously the City of Cleburne has recently been connected directly to downtown Fort Worth through the construction of the CTP. While growth is expected to occur along the CTP and in the City of Cleburne as a result, the magnitude and timing of the growth is uncertain.

At the February 17, 2016, in-person Project Deliver Team (PDT) meeting, the results of the demand scenario and need analysis were reviewed and discussed by BRA, the Fort Worth District Corps of Engineers and Freese and Nichols. In each scenario there is an immediate need in 2020 for the City of Cleburne ranging from approximately 2,500 acre-feet per year to almost 5,000 acre-feet per year. After discussion, it was decided that since the 2016 Brazos G Plan needs and the NCTCOG scenarios were comparable that the 2016 Brazos G Plan would represent one scenario in the purpose and need. This discussion continued with which scenario best represented a high growth scenario. It was decided that scenario 2a) LRWSP with the 2016 Region G per capita use was representative of a high growth scenario and would be used alongside the 2016 Brazos G Plan projections for the purpose and need.

Table 13 shows the demand, supply and need for each BRA customer contracted for water from Aquilla Lake from 2020 through 2070. Projections from the 2016 Brazos G Regional Water Plan were used to define the demand, contracted Aquilla Lake supply, and need for AWSD. The result of this analysis indicates that the City of Cleburne is driving the need for additional water supplies due to projected population growth.

**Table 13. Demands, Supplies, and Needs for each BRA Customer at Aquilla Lake**

| | **Demand** | | | | | |
|---|---|---|---|---|---|---|
| | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
| Aquilla Water Supply District | 6,512 | 5,952 | 5,952 | 5,952 | 5,952 | 5,952 |
| City of Cleburne | | | | | | |
| 2016 Brazos G | 15,046 | 15,810 | 16,625 | 17,643 | 18,756 | 19,968 |
| 2 (LRWSP) a (2016 Brazos G) | 15,905 | 18,489 | 21,976 | 26,844 | 33,507 | 42,611 |
| Hilco United | 150 | 150 | 150 | 150 | 150 | 150 |
| **Total demand** | | | | | | |
| **2016 Brazos G** | **21,708** | **21,912** | **22,727** | **23,745** | **24,858** | **26,070** |
| **2 (LRWSP) a (2016 Brazos G)** | **22,567** | **24,591** | **28,078** | **32,946** | **39,609** | **48,713** |
| | | | | | | |
| | **Supply** | | | | | |
| | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
| Aquilla Water Supply District | 5,953 | 5,953 | 5,953 | 5,953 | 5,953 | 5,953 |
| City of Cleburne | | | | | | |
| Trinity Aquifer | 1,292 | 1,292 | 1,292 | 1,292 | 1,292 | 1,292 |
| Lake Pat Cleburne | 4,838 | 4,769 | 4,700 | 4,631 | 4,562 | 4,493 |
| BRA Lake Aquilla | 5,300 | 5,300 | 5,300 | 5,300 | 5,300 | 5,300 |
| Reuse (Johnson County SE) | 1,344 | 1,344 | 1,344 | 1,344 | 1,344 | 1,344 |
| *Cleburne Connected Supply* | *12,774* | *12,705* | *12,636* | *12,567* | *12,498* | *12,429* |
| Hilco United | 150 | 150 | 150 | 150 | 150 | 150 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Aquilla Supply | 11,403 | 11,403 | 11,403 | 11,403 | 11,403 | 11,403 |
| **Total Supply** | **18,877** | **31,513** | **31,375** | **31,237** | **31,099** | **30,961** |
| | | | | | | |
| | **Surplus/Need** | | | | | |
| | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
| Aquilla Water Supply District | -559 | 0 | 0 | 0 | 0 | 0 |
| City of Cleburne | | | | | | |
| 2016 Brazos G | -2,272 | -3,105 | -3,989 | -5,076 | -6,258 | -7,539 |
| 2 (LRWSP) a (2016 Brazos G) | -3,131 | -5,784 | -9,340 | -14,277 | -21,009 | -30,182 |
| Hilco United | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Need** | | | | | | |
| **2016 Brazos G** | **-2,831** | **-3,105** | **-3,989** | **-5,076** | **-6,258** | **-7,539** |
| **2 (LRWSP) a (2016 Brazos G)** | **-3,690** | **-5,784** | **-9,340** | **-14,277** | **-21,009** | **-30,182** |

## WATER SUPPLY MEASURES

Measures considered to resolve the forecasted water supply shortage include conservation, use of other water supply sources, and reallocation of storage in Aquilla Lake. These were formulated into the preliminary alternatives documented in this section. The array of alternatives was built from a combination of the management measures identified below.

- Conservation Strategies – Conservation happens by either reducing demand for water supply or increasing the efficiency of the available water supply. It is usually not capital intensive and as such is typically the first recommendation made by State agencies to any water supply entity. A variety of conservation strategies were considered in development of the 2016 Brazos G Regional Water Plan. These strategies and their current levels of implementation were reviewed as part of the Aquilla Reallocation study.
- Construct a pipeline from Whitney Lake to Cleburne – The USACE Middle Brazos Systems Assessment conducted from 2005-2008 explored the use of other water supply sources within the Brazos River Basin including but not limited to building new reservoirs, construction of pipelines to move water from one area to another, purchasing additional water through contracts with major water providers, obtaining additional water rights, and changing the operational framework for the system of reservoirs managed by BRA and/or USACE. Of those, the most cost effective and therefore most likely alternative to reallocation at Aquilla Lake is to construct a pipeline to transfer water from Whitney Lake to Cleburne.
- Reallocate storage in Aquilla Lake from the flood pool to the conservation pool.

# REALLOCATION

The proposed project would reallocate storage form the flood pool to the conservation pool. Currently, the top of the conservation pool is 537.5 feet and has a storage capacity of 44,577 acre-feet. The top of the flood pool is 556 feet, with a spillway crest of 556 feet.

The proposed action would be to increase the top of conservation pool 4.5 feet into the flood storage pool, making the top of conservation pool at 542 feet. This will reallocate approximately 15,073 acre-feet of storage from the flood pool to the conservation pool, as shown in Table 14. The estimated increase in yield with this reallocation is 2,483 acre-feet per year.

**Table 14. Existing and With Project Elevations and Storage**

| | Existing Conditions | | 4.5 ft. Pool Raise | |
|---|---|---|---|---|
| **Pool** | **Elevation** | **Acre-Ft** | **Elevation** | **Acre-Ft** |
| Bottom of Conservation Pool | 503 | 106 | | |
| (Sediment Pool) | | | | |
| Top of Conservation Pool | 537.5 | 44,577.0 | 542.0 | 59,650 |
| Top of Flood Pool | 564.5 | 136,910.0 | 556.0 | 136,910 |
| Spillway Crest | 564.5 | 204,644.0 | | |
| Maximum Design Water Surface | 577.5 | 350,978.0 | | |
| Gain in Conservation Pool | | | 4.5 | 15,073 |

The proposed reallocation would require placement of 2-foot thick rock riprap to protect the dam embankment, but no changes in the dam or spillway height. Some current recreation features, including restrooms, boat ramps and picnic tables, will need to be moved, as described in the recreation appendix. Costs for these changes are included as part of the cost estimate.

# COST OF REALLOCATED STORAGE

As described in the Planning and Guidance Notebook, ER 1105-2-100, the cost allocated to the non-Federal sponsor will normally be established as the highest of : (i) benefits forgone; (ii) revenues forgone; (iii) replacement cost; or (iv) the updated cost of storage.

## BENEFITS FOREGONE

Based on a review of aerial imagery, there is no significant development in the floodplain. Any potential loss of downstream flood risk management (FRM) benfits would be agricultural. Analysis conducted by the Fort Worth District Hydrology and Hydraulics section indicate that there would be no increase in spillway overtopping below a 300 year event. At the 300 year event, the flows would less than the downstream control, and would not reduce FRM benfits. At the 500 year event, flows would exceed the down stream control. However, the flows from intermittent tributaries, primarily Cobb Creek, would surpass the flows from Aquilla Lake. Therefore any damages would be attributable to the flows from the tributaries, and not those from Aquilla Lake. The implication of these results is that there would be no significant forgone flood risk management benefits within the defined study area. Additionally, there will be no loss of recreation benefits.

## REVENUES FORGONE

There are no hydropower resources at Aquilla Lake. No revenues from hydropower or other sources will be forgone with the reallocation from the flood pool.

## REPLACMENT COSTS

There are seven USACE operated recreation areas and one outgranted area at Aquilla Lake. With the pool raise, several boat ramps and parking lots will need to be modified and fencing, picnic areas, and toilet facilities will have to be relocated. A detailed analysis is presented in the recreation appendix. The cost of these replacements and modifications is estimated at $1,236,189.

## UPDATED COST OF STORAGE

Updating the cost of storage requires three elements:

- Determining the cost of reallocated storage
- Identifying the construction phase
- Indexing the construction costs based on the appropriate index

Table 15 below shows the joint use costs at the completion of construction in April 1983 using the "Use of Facilities" method, the cost index values, and updated construction costs to complete elements 2 and 3.

The date of the first land acquisitions (beginning of the construction phase) was identified as June 1978. The date of the initiation of the deliberate impounding of water was April 1983, and the end of that fiscal year, September 1983, is the construction completed date of the construction phase. The midpoint of the construction phase, January 1981, is the base year from which costs will be indexed to the current year.

Using the appropriate index for each feature, as outlined in the Water Supply Handbook, update factors were determined by dividing the October 2015 value by the January 1981 value. The update factors were then used to update the appropriate feature costs, the sum of which represents the updated construction cost for the project. The index factor used for each project feature is set in bold-face.

**Table 15. Derivation of Updated Facility Costs**

| Project Feature | Actual Joint Use Cost as of April 1983 | Mid-point January 1981 ENR Index | Mid-point January 1981 CWCCIS Index | October 2015 ENR Index | October 2015 CWCCIS Index* | ENR Update Factor | CWCCIS Update Factor | October 2013 Joint Use Costs |
|---|---|---|---|---|---|---|---|---|
| Lands and damages | $12,017,503.13 | 3372 | 303.91 | 10128 | 801.98 | | **2.639** | $31,712,668.75 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Relocations | 7,733,152.69 | 3372 | 301.18 | 10128 | 823.57 | **3.004** | 2.734 | 23,226,978.19 |
| Reservoir | 2,151,580.51 | 3372 | 305.39 | 10128 | 926.31 | 3.004 | **3.033** | 6,526,181.41 |
| Dam and spillway | 22,938,781.26 | 3372 | 297.99 | 10128 | 809.72 | 3.004 | **2.717** | 62,330,917.02 |
| Roads | 156,867.92 | 3372 | 301.18 | 10128 | 823.57 | 3.004 | **2.734** | 428,951.83 |
| Cultural resource preservation | 237,934.17 | 3372 | 298.07 | 10128 | 773.55 | 3.004 | **2.595** | 617,485.75 |
| Buildings, grounds, and utilities | 1,005,531.86 | 3372 | 298.07 | 10128 | 773.55 | **3.004** | 2.595 | 3,020,173.99 |
| Permanent operating equipment | 441,102.43 | 3372 | 298.07 | 10128 | 773.55 | **3.004** | 2.595 | 1,324,877.05 |
| **Total** | **$46,682,453.97** | | | | | | | **$129,188,233.99** |

* EM 1110-2-1304 Revised as of 31 Mar 2016

The updated cost of storage is then determined by the following equation:

$$C_{rs} = (C_t - C_s) \times \frac{S_r}{S_t - (S_s + S_h)}$$

Where
$C_{rs}$ = Cost of reallocated storage
$C_t$ = Total cost
$C_s$ = Cost of specific facilities
$S_r$ = Reallocated storage
$S_t$ = Total storage
$S_s$ = Sediment storage
$S_h$ = Hydropower head storage

The constants for each of the alternatives are:

$C_t$ = $129,188,233.99
$C_s$ = $0
$S_t$ = 136,910 acre-ft
$S_s$ = 106 acre-ft
$S_h$ = 0, since there is no hydropower plant

Table 16 below shows the reallocated storage for each alternative and the resulting Updated Cost of Storage using the equation and constants above.

**Table 16. Updated Cost of Storage (October 2013 Prices)**

| Alternative | Storage Reallocation (acre-ft) | Updated Cost of Storage |
|---|---|---|
| 4.5 Ft Pool Raise | 15,073 | $14,233,898.50 |

Therefore the highest of the three criteria used to determine the non-Federal sponsor's cost would be the updated cost of storage of $14,233,899.

# TEST OF FINANCIAL FEASIBLITY

As outlined in ER 1105-2-100, a test of financial feasibility must be made to demonstrate the realocation alternative is cost effective. The annual cost of the reallocation alternative is compared to the annual cost of the most likely, least costly alternative that would provide an equivalent quantity and quality of whater which the local interest would undertake in the absence of utilizing the Federal project. The alternative identified as the most likely and least costly to reallocation is a pipeline transferring water from Whitney Lake to Aquilla Lake.

# NON-REALLOCATION ALTERNATIVE

The pipeline alternative requires an intake and pump station at Whitney Lake, approximately nine miles of 24-inch pipe, and membrane treatment facilities for pre-treatment of saline lake water. Reject water from the membrane treatment would be returned to Whitney Lake. The estimated yield is 4,260 AF per year. Estimated first costs were presented in the City of Cleburne LRWSP and have been updated to October 2015 prices. The first cost is $47,723,238 and annual OMRR&R costs are estimated at $2,696,000.

The sizing of this alternative is based on the existing capacity of the Barkman pipeline that transfers water from Aquilla Lake to Lake Pat Cleburne within the City of Cleburne. Water would be transferred through a new pipeline from Whitney Lake to the existing Barkman pipeline (Figure 8). While this alternative results in approximately twice as much water as the 4.5 foot Aquilla Lake reallocation, it was necessary to have a larger supply to reach economies of scale for the construction of the intake, transmission and treatment facilities. Based on the needs analysis Cleburne has a need in excess of what this project can supply. This alternative is compared to the reallocation alternative on a per AF basis.

# FINANCIAL FEASIBILTIY

The pipeline alternative first cost is at $47,723,238 and annual OMR&R costs are estimated at $2,696,000.

Costs for the reallocation alternative were prepared by the Fort Worth Disctrict Cost Estimating section and are detlaied in the MCASEs report in the cost appendix. The first cost of the reallocation alternative is estimated at $10,140,555. Along with the updated cost of storage of $14,233,599 the total economic cost for the reallocation alternative is $24,374,454. Since there is little change to the dam, spillway and recreation features, OMR&R costs are expected to be similar to the without project costs. Using information provided by the Operations section, annual OMR&R costs are estimated at $403,000.

Table 17 shows the calcuation of annual costs of the pipleline and reallocation alternative using a 50 year period of analysis and a 3.125% Federal discount rate. The annual costs for the pipline alternative are $4,685,468, and for the reallocation alternative, they are $1,435,152.

Using the annual cost of the pipleline alternative as the comparison metric, it can be seen the annual net benefit (annual savings in cost) of the reallocation alternative is $3,250,316. Therefore the reallocation is the most cost efficient of the two.

**Table 17. Derivation of Annual Costs for Financial Feasibility (October 2015 Prices)**

| Investment | Pipeline | Reallocation |
|---|---|---|
| Estimated First Cost | $47,723,238 | $10,140,555 |
| Updated Cost of Storage | $0 | $14,233,899 |
| Economic Costs | $47,723,238 | $24,374,454 |
| Annual Interest Rate | 3.125% | 3.125% |
| Period of Analysis (years) | 50 | 50 |
| Construction Period (months) | 36 | 48 |
| Compound Interest Factor | 37.69 | 51.06 |
| Capital Recovery Factor | 0.039793 | 0.039793 |
| Interest During Construction | $2,272,189 | $1,563,587 |
| Investment Costs | $49,995,427 | $25,938,041 |
| **Annual Charges** | | |
| Interest | $1,562,357 | $810,564 |
| Amortization | $427,111 | $221,589 |
| Operations & Maintenance ($/yr) | $2,696,000 | $403,000 |
| Total Annual Charges | $4,685,468 | $1,435,152 |
| **Annual Benefits** | | |
| Total Annual Benefits | $4,685,468 | $4,685,468 |
| **Net Benefits** | **$0** | **$3,250,316** |
| **Benefit-to-Cost Ratio** | **1-to-1** | **3.26-to-1** |

Table 18 provides the annual cost per acre foot of water provided by both alternatives. The pipeline alternative would cost $1,100 per acre foot of water per year, while the reallocation would cost $583 per acre foot of water per year.

**Table 18. Calculation of Annual Cost per Acre/Foot (October 2015 Prices)**

| | Alternative | |
|---|---|---|
| Element | Pipeline | Reallocation |
| Yield (ac/ft/yr) | 4,260 | 2,463 |
| Annual Investment Cost | $1,989,468 | $1,032,152 |
| OMRR&R | $2,696,000 | $403,000 |
| Total Annual Cost | $4,685,468 | $1,435,152 |
| Annual Cost Per Acft/YR | $1,100 | $583 |