

**APPENDIX F**  
**HYDRAULIC STUDY REPORT**

## **Appendix F – Hydraulic Study Report**

### **1. Introduction**

Regional planning has identified long-term water supply deficiencies for many water systems in West Central Texas. A number of small municipalities and rural water systems are expected to fall short of necessary water supplies based on forty to sixty year supply projections. Many of these systems rely on small local lakes or unreliable groundwater for their current demands. Also, during the recent drought, some systems experienced emergency shortages.

The Brazos River Authority requested that the most at-risk entities described above be identified. With this information in hand, at least six water systems were identified through which water could be transported to the at-risk entities. Hydraulic analyses performed on these six entities included improvements which would allow sufficient supplies to be moved.

The approach to the hydraulic study was to identify systems that could move adequate quantities of water between entities with the least amount of upgrade and greatest impact on the region. Each system was modeled using Haestad Methods WaterCad v. 6.0 software. Generally, the analyses were run using peak supply flow conditions for wholesale supplies and peak hourly and peak day (supply flow) conditions for direct service by retail suppliers. Alternate demand alternatives were also investigated.

### **2. Identification of Deficient Supplies and Potential Suppliers**

Water supply and demand projections developed as part of this study using long term projections by the Texas Water Development Board and Region G Water Planning Group along with input from local sources were considered in identifying systems with water needs in the area. Additionally, experience of local personnel during the recent drought was considered. Some of the systems were grouped geographically to facilitate identification of potential suppliers.

A number of criteria were used to analyze available systems as possible sources of supply to serve the identified entities. First, it was determined whether or not the water which would be moved through the system could meet an identified need. Second, it had to be determined whether or not the system had capacity available to deliver sufficient water with a minimum

amount of improvements. Also, each system would have to be capable of being connected to other systems to increase the reliability of supply in the study area and with the greatest impact. The identified systems were selected based on these criteria as they related to the at-risk systems.

A hydraulic analysis was performed for each of the selected systems. A discussion of each hydraulic analysis is attached including assumptions, existing projects that may impact the system and results of the analysis.

**Abilene to North Central Texas MWA**

North Central Texas MWA (NCTMWA) is a water supply entity which provides wholesale service to several systems in the northern part of the study area. These systems include direct service to the Cities of Haskell, Munday, Benjamin, Goree, Knox City, Rochester, O'Brien, Rule and Aspermont, Rhineland and Paint Creek WSCs. NCTMWA takes water from Millers Creek Reservoir located east of the City of Munday. During the recent drought, the lake became very low and the water authority investigated drilling wells. Millers Creek is the sole source of potable water for many entities, placing the entire area at risk.

The City of Abilene serves a large number of water supply systems in the region. The city's primary source of raw water is Lake Fort Phantom Hill. This source is supplemented by scalping operations off of the Brazos River when possible; however, the city has had to rely on other sources to supplement the Fort Phantom Hill supply. The city is also a member of the West Central Texas Municipal Water District and takes water out of Hubbard Creek Reservoir. The city is nearing completion of an O.H. Ivie supply line and treatment facilities. This supply is expected to take care of the City's needs for the foreseeable future, however, Lake Ivie is still in drought record conditions and the reliability of its long-term supply is unknown.

The City of Hamlin has a project under design to run a treated water supply line from Abilene. This proposed line opens up a number of possibilities for providing water to several systems north of Abilene. There are existing water lines connecting Hamlin to Stamford and Haskell to North Central Texas MWA. The proposed Hamlin line will run in close proximity to the City of Anson. This could potentially provide a means to move additional supply to NCTMWA as well as to systems in between. There is also the potential to move a small amount of water back to Abilene.

The City of Hamlin has received funding from TWDB for the installation of approximately 39 miles of 14-inch water line from the Abilene Northeast Water Treatment Plant to the treated water storage facility adjacent to the City of Hamlin's water treatment plant. Hamlin currently receives untreated water from the City of Stamford through approximately 21 miles of 12-inch CSC pipe. The City of Haskell receives treated water from the NCTMWA. NCTMWA owns Miller's Creek reservoir, a water treatment plant, and several miles of treated water lines for serving its 4 member cities and several non-member cities. Haskell's treated water line consists of approximately 18 miles of 14-inch CSC water line. This line segment runs



from the NCTMWA pump station south of Munday for the 18 miles to the Haskell storage tanks on the north side of Haskell.

NCTMWA, the City of Haskell, and the City of Stamford have expressed interest in having a treated water line connecting the NCTMWA system with the Stamford treated water system. Since Hamlin will no longer be treating raw water, Hamlin could convert its 12-inch water line to a treated water line and a new water line between Haskell and Stamford would technically tie NCTMWA to the City of Abilene's system.

If a 14-inch water line were installed over the 16.5 miles between Haskell and Stamford, the NCTMWA to Abilene connection would be complete. Small amounts of treated water could possibly be shared in a variety of scenarios, with the treated water supply originating with Abilene, Stamford, or NCTMWA. For this study, the proposed 14-inch Hamlin water line is designed with an initial capacity of 1.5 mgd, and an ultimate capacity of 2.0 mgd with the aid of an in-line pump station. The most limiting line segment is the 21 miles of 12-inch water line between Hamlin and Stamford; however, this line should furnish about 1.2 mgd to Stamford from Hamlin, and about 1.3 mgd in a reverse flow scenario from Stamford to Hamlin. The pumping head required to supply 1.2 mgd to Stamford would be 200 feet. The pumping head required to supply 1.3 mgd to Hamlin would be 370 feet.

The new 14-inch line between Abilene and Hamlin should furnish 1.5 to 2.0 mgd to Hamlin, and about 1.0 to 1.5 mgd from Hamlin to Abilene in the reverse flow scenario. Hamlin's current peak day usage is about 1.0 mgd. A new 14-inch water line between Haskell and Stamford could furnish about 2.0 mgd either direction from Stamford to Haskell or from Haskell to Stamford. The existing 14-inch water line between Haskell and the NCTMWA Munday pump station should furnish at least 1.5 mgd to Munday from Haskell, and about 1.8 mgd to Haskell from Munday.

An interconnection of Stamford and Haskell would provide a certain measure of treated water backup supply for Hamlin, Stamford, Haskell, and NCTMWA. The amount of water available to Abilene (1.5 mgd) would be inconsequential to Abilene; however, during an emergency, the amount available to NCTMWA could be as much as 2.0 mgd, which includes the amount transported from Haskell plus the amount NCTMWA would have provided to Haskell.

An alternate to this scenario would include providing a connection to Anson along with the Abilene-Hamlin line. The City of Anson could take approximately 1.4 mgd from Abilene if the 14-inch water line between the two cities was upgraded to 18-inch (approximately 21.5 miles) and approximately 4 miles of 14-inch water line were installed between the Hamlin line and Anson.

The improvements and upgrades necessary to provide these supplies as indicated by the hydraulic analyses are summarized in Figures F.1 through F.3. Cost estimates for the improvements with and without Anson are provided in Tables F.1 and F.2.





**SCENARIO #2**

REVERSE FLOW  
SUPPLY FROM ABILENE

Supply from NCTMWD and all flow is South.  
Demands as follows:  
Abilene-2.1 MGD  
Hamlin-1.2 MGD  
Haskell-1.8 MGD

**PIPELINE IMPROVEMENTS**

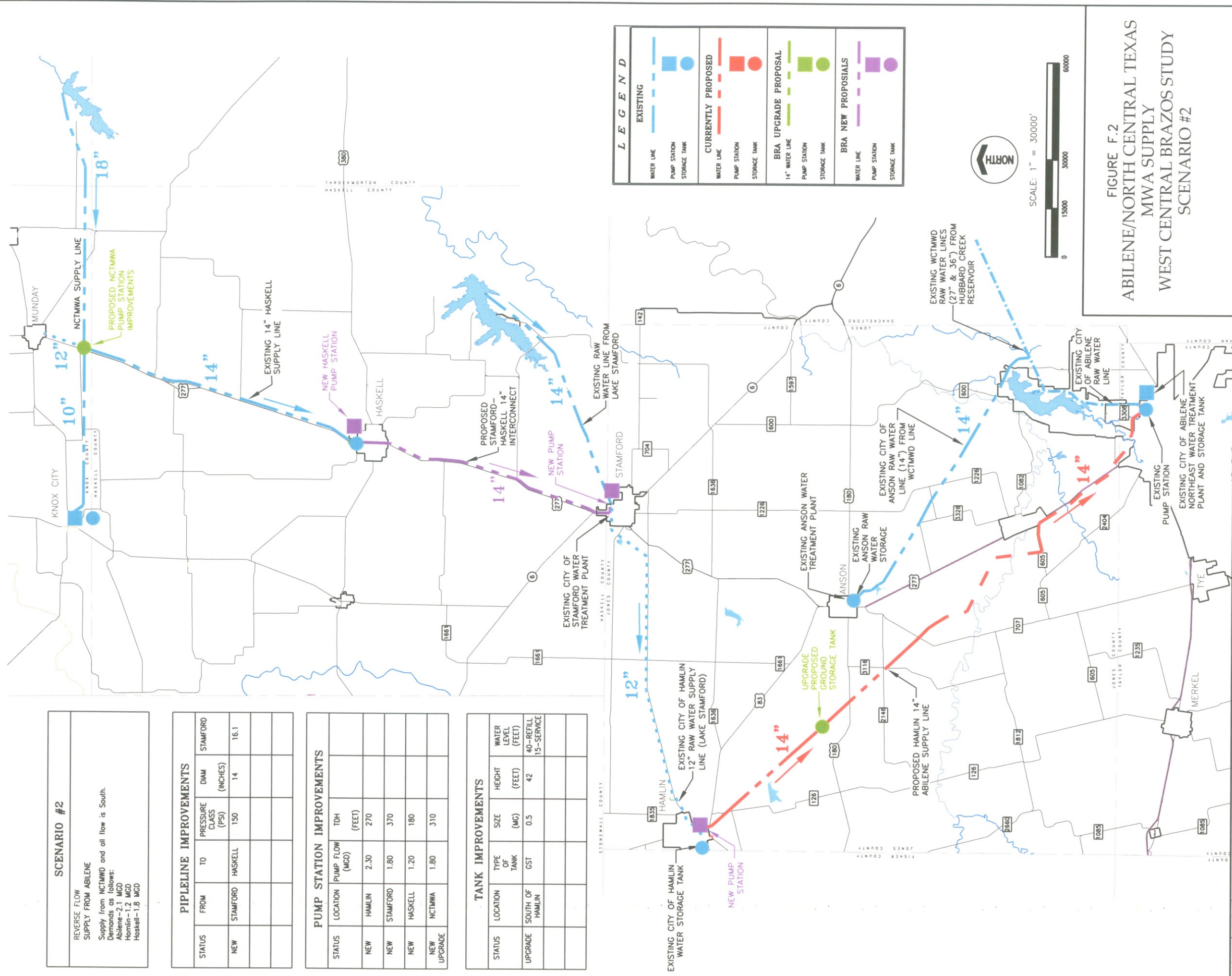
STATUS	FROM	TO	PRESSURE CLASS (PSI)	DIAM (INCHES)	STAMFORD
NEW	STAMFORD	HASKELL	150	14	16.1

**PUMP STATION IMPROVEMENTS**

STATUS	LOCATION	PUMP FLOW (MGD)	TDH (FEET)
NEW	HAMLIN	2.30	270
NEW	STAMFORD	1.80	370
NEW	HASKELL	1.20	180
NEW UPGRADE	NCTMWA	1.80	310

**TANK IMPROVEMENTS**

STATUS	LOCATION	TYPE OF TANK	SIZE (MG)	HEIGHT (FEET)	WATER LEVEL (FEET)
UPGRADE	SOUTH OF HAMLIN	GST	0.5	42	40-REFILL 15-SERVICE



**LEGEND**

EXISTING		
Water Line	(Blue dashed line)	
Pump Station	(Blue square)	
Storage Tank	(Blue circle)	
CURRENTLY PROPOSED		
Water Line	(Red dashed line)	
Pump Station	(Red square)	
Storage Tank	(Red circle)	
BRA UPGRADE PROPOSAL		
14" Water Line	(Green dashed line)	
Pump Station	(Green square)	
Storage Tank	(Green circle)	
BRA NEW PROPOSALS		
Water Line	(Purple dashed line)	
Pump Station	(Purple square)	
Storage Tank	(Purple circle)	



SCALE: 1" = 30000'



**FIGURE F.2**  
**ABILENE/NORTH CENTRAL TEXAS**  
**MWA SUPPLY**  
**WEST CENTRAL BRAZOS STUDY**  
**SCENARIO #2**



**SCENARIO #3**

ANSON SUPPLY

Supply from Abilene and all is north.

Demands as follows:

- Stamford-1.4 MGD
- Haskell-1.2 MGD
- NCTMWA-2.0 MGD
- Anson-1.37 MGD

**PIPELINE IMPROVEMENTS**

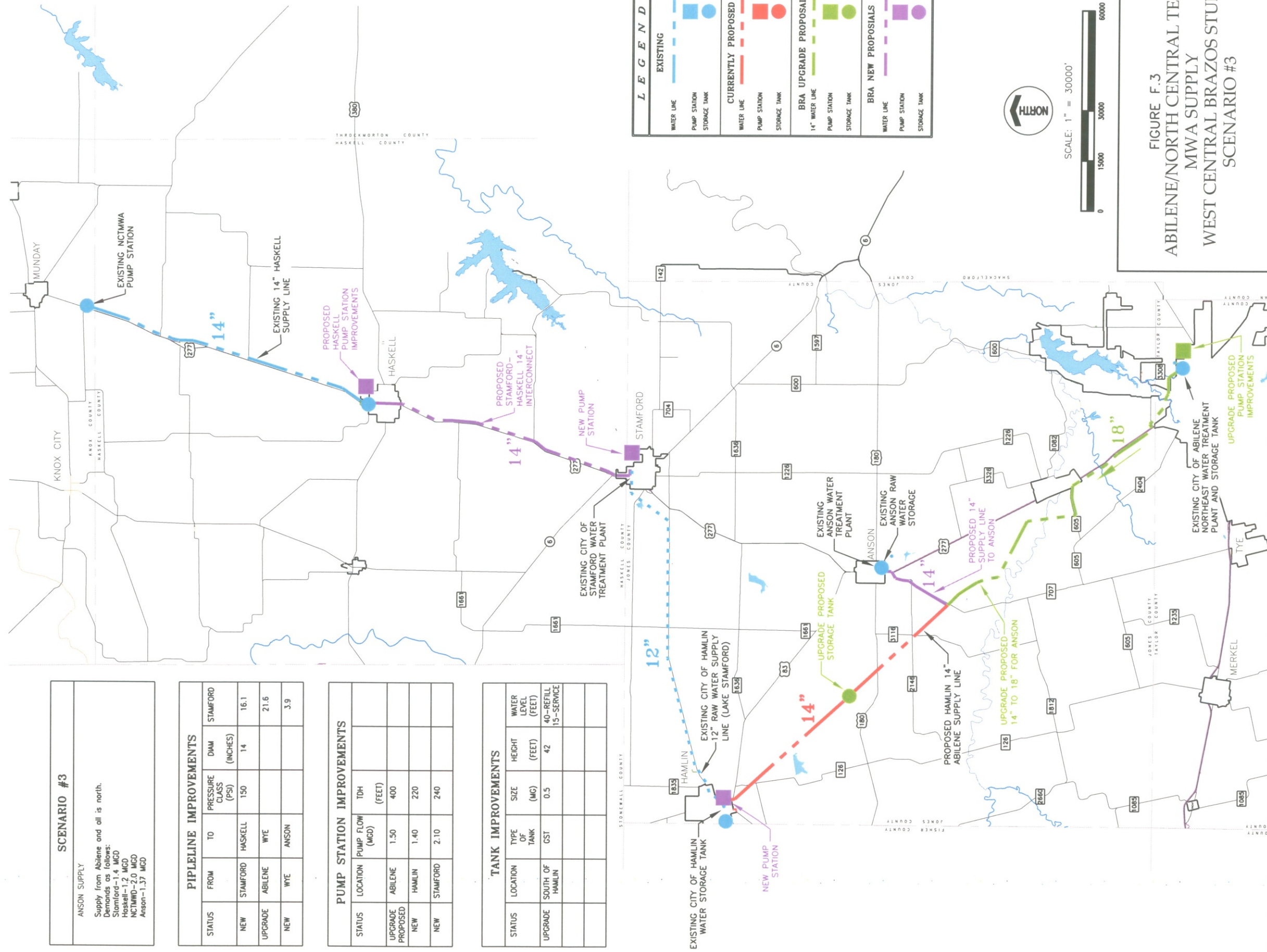
STATUS	FROM	TO	PRESSURE CLASS (PSI)	DIAM (INCHES)	STAMFORD
NEW	STAMFORD	HASKELL	150	14	16.1
UPGRADE	ABILENE	WYE			21.6
NEW	WYE	ANSON			3.9

**PUMP STATION IMPROVEMENTS**

STATUS	LOCATION	PUMP FLOW (MGD)	TDH (FEET)
UPGRADE PROPOSED	ABILENE	1.50	400
NEW	HAMLIN	1.40	220
NEW	STAMFORD	2.10	240

**TANK IMPROVEMENTS**

STATUS	LOCATION	TYPE OF TANK	SIZE (MG)	HEIGHT (FEET)	WATER LEVEL (FEET)
UPGRADE	SOUTH OF HAMLIN	GST	0.5	42	40-REFILL 15-SERVICE



**FIGURE F.3**  
**ABILENE/NORTH CENTRAL TEXAS**  
**MWA SUPPLY**  
**WEST CENTRAL BRAZOS STUDY**  
**SCENARIO #3**

ACAD Rel 15.06s (LMS Tech) User: CAM  
 [BRA02372]N:\WR\JM-REPORT\BRASSTUDY\BRAZOS-STUDIES\MWA-SCENARIO3.DWG LAYOUT: 11x17  
 FEB 10, 2004 7:12:17 A.M. LTS: 10000.00 PSLTS: 0 TWIST: 0.0, 0.0, 0.0

**TABLE F.1  
BRAZOS RIVER AUTHORITY  
WEST CENTRAL BRAZOS STUDY  
ABILENE TO NORTH CENTRAL TEXAS MWA  
REGIONAL IMPROVEMENTS WITH ANSON  
2003**

**CONSTRUCTION COSTS**

1	Upsize 14" PVC Water Line to 18"	114,000 LF @ \$10.00/LF	\$1,140,000
2	14" PVC Water Line	106,000 LF @ \$32.00/LF	\$3,392,000
3	Valves	Lump Sum	\$110,000
4	Bore & Encasement	Lump Sum	\$150,000
5	Pump Station Improvements	3 EACH @ \$50,000	\$150,000
6	Pump Station	2 EACH @ \$200,000	\$400,000
7	Upsize 0.5 MG GST to 1.0 MG	1 EACH @ \$200,000	\$200,000
8	Master Meter & Regulator	4 EACH @ \$10,000	\$40,000
9	SCADA System	6 EACH @ \$20,000	\$120,000
10	Project Contingencies		\$408,000
			<b><u>\$4,970,000</u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$50,000
Basic Engineering	\$300,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$150,000
Surveying	\$100,000
Testing, Permitting, Etc.	\$50,000
<b><u>\$680,000</u></b>	
<b><u>\$5,650,000</u></b>	

**TABLE F.2**  
**BRAZOS RIVER AUTHORITY**  
**WEST CENTRAL BRAZOS STUDY**  
**ABILENE TO NORTH CENTRAL TEXAS MWA**  
**REGIONAL IMPROVEMENTS**  
**2003**

**CONSTRUCTION COSTS**

1	14" PVC Water Line	85,100 LF @ \$32.00/LF	\$2,723,200
2	Valves	Lump Sum	\$60,000
3	Bore & Encasement	Lump Sum	\$114,000
4	Pump Station Improvements	3 EACH @ \$50,000	\$150,000
5	Pump Station	2 EACH @ \$200,000	\$400,000
6	Upsize 0.5 MG GST to 1.0 MG	1 EACH @ \$200,000	\$200,000
7	Master Meter & Regulator	3 EACH @ \$10,000	\$30,000
8	SCADA System	6 EACH @ \$20,000	\$120,000
9	Project Contingencies		\$266,000
			<b><u>\$4,063,200</u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$50,000
Basic Engineering	\$285,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$122,000
Surveying	\$82,000
Testing, Permitting, Etc.	\$30,000
	<b><u>\$599,000</u></b>
	<b><u>\$4,662,200</u></b>

**Steamboat Mountain WSC**

The City of Lawn currently takes its raw water supply out of Lake Coleman and treats it at its own water treatment plant on the north side of Lake Coleman. The City is currently under enforcement by TCEQ for treatment violations and finds it increasingly difficult to meet ever changing compliance regulations. The City also was recently in danger of running out of water due to dwindling lake levels. Lawn resolved the issue by installing a temporary intake, however, this temporary solution was also in jeopardy before the lake was finally replenished. The City has filed an application with USDA-Rural Development to install facilities to take a treated water supply from Abilene. This would be accomplished either through an interconnection with Steamboat Mountain Water Supply Corporation or a direct connection to the City of Abilene.

Lawn serves approximately 300 connections including the connections along its 5-inch treated water supply line from Lake Coleman to Lawn. Lawn is too small to continue operating a water treatment plant, and the City has decided to pursue the purchasing of treated water from the City of Abilene. The existing Steamboat Mountain WSC system is located in close proximity to the City of Lawn and water from Abilene could possibly be transported through the Steamboat Mountain WSC system.

Steamboat Mountain Water Supply Corporation currently provides treated water to most of southern Taylor County including the cities of Tuscola and Buffalo Gap. Steamboat purchases treated water from the City of Abilene through a single connection at a maximum rate of about 1.0 mgd. Steamboat has received funding for another connection to Abilene from which another 1.0 mgd will be available.

In order to meet TCEQ water supply requirements of 0.6 gpm per connection, Lawn's 300 connections would need a supply of 180 gpm. The hydraulic calculations assume a water supply flow rate of 250 gpm for the City of Lawn through the Steamboat system. This will allow for future growth. The required improvements to Steamboat's system include the addition of an in-line pump station, an elevated ground storage tank, and approximately 10.5 miles of 10-inch and 8-inch water line generally following Hwy 83/84 and CR 146 to the existing City of Lawn supply line. These improvements are summarized in Figure F.4. Costs for the upgrades are estimated in Table F.3.



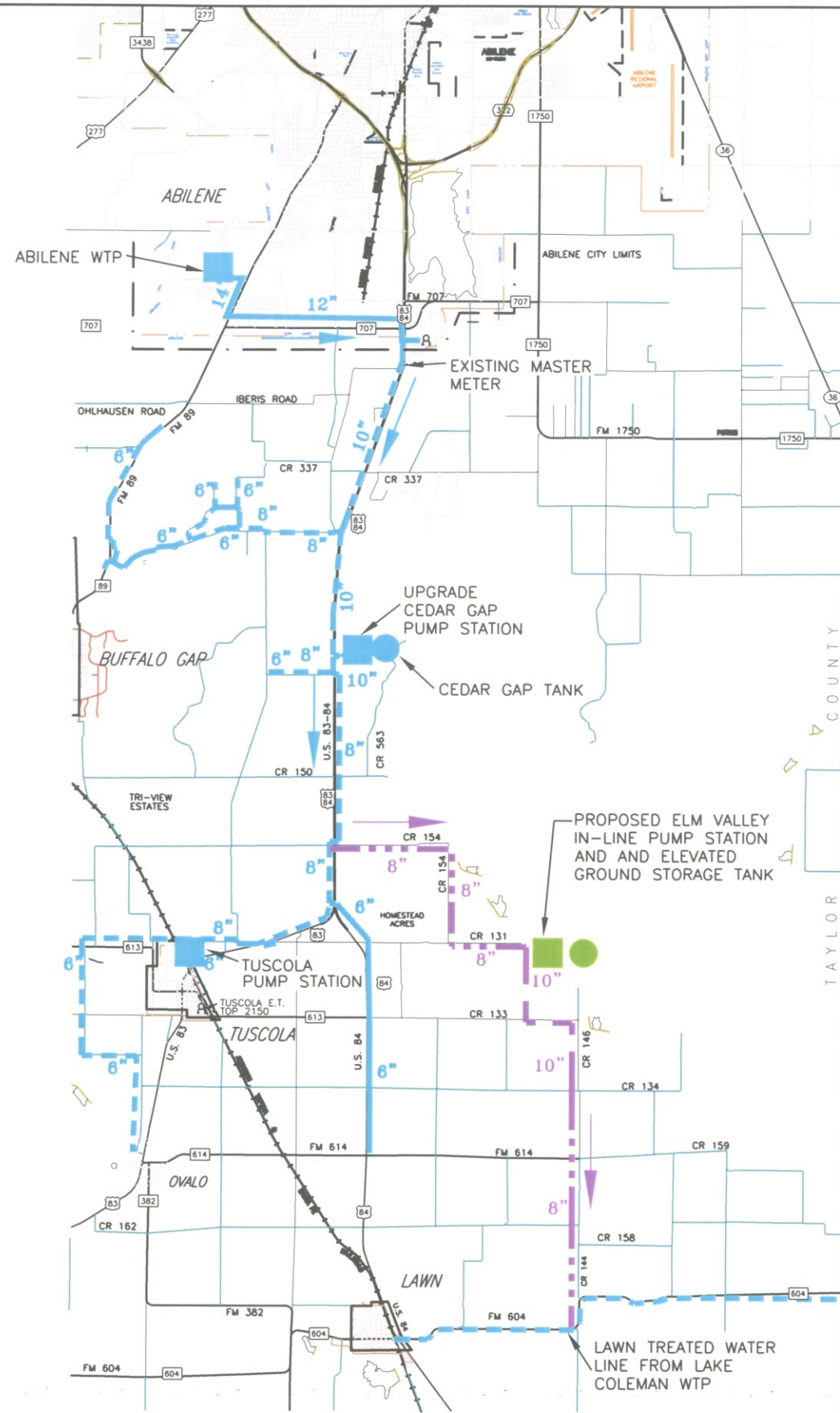
The scenario was modeled for both peak hourly demands and peak day demands in Steamboat Mountain WSC's distribution system. Steamboat is required to maintain a peak day capability of 0.6 gpm per connection (supply flow). The system must also maintain 35 psi throughout the system during peak hourly demands of 1.5 gpm per connection (peak hourly demand). If the City of Lawn lays a water line directly to the new Abilene South Side water treatment plant, approximately 13 miles of water line and a pump station will be required. It might be more economical for Lawn to lay their own pipeline instead of going through the Steamboat system since buying water directly from Abilene should provide significant savings.

ACAD Rel 15.06s (LMS Tech) User: CAM  
 [BRAO2372]N:\WR\JM--REPORT\BRASTUDY\BRAZOS--STUDIES\STEAMBOAT--SCENARIO1AND2.DWG LAYOUT: 11X17  
 FEB.10.2004 7:26:34 A.M. LTS: 5000.00 PS: 0 TWIST: 0.0 0.0 0.0 0.0 0.0 0.0

PIPELINE IMPROVEMENTS				
TYPE OF UPGRADE	FROM	TO	LENGTH (MILES)	
NEW 8"	US 83/84 & CR 154	EGST @ CR 131	2.65	
NEW 10"	EGST & CR 131	CR 134 @ CR 144	2.74	
NEW 8"	CR 134 & CR 144	FM 604 @ CR 144	3.7	

PUMP STATION IMPROVEMENTS				
TYPE OF UPGRADE	LOCATION	PUMP FLOW (MGD)	TDH (FEET)	
UPGRADE PROPOSED	ELM VALLEY	0.55	170	
UPGRADE PROPOSED	CEDAR GAP	?	?	

TANK IMPROVEMENTS					
TYPE OF UPGRADE	LOCATION	TYPE OF TANK	SIZE (MG)	HEIGHT (FEET)	WATER LEVEL (FEET)
UPGRADE PROPOSED	ELM VALLEY	ELEVATED GST	0.10	30	10



**LEGEND**

**EXISTING**

WATER LINE: Blue dashed line

PUMP STATION: Blue square

STORAGE TANK: Blue circle

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**CURRENTLY PROPOSED**

WATER LINE: Red dashed line

PUMP STATION: Red square

STORAGE TANK: Red circle

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**BRA UPGRADE PROPOSAL**

14" WATER LINE: Green dashed line

PUMP STATION: Green square

STORAGE TANK: Green circle

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**BRA NEW PROPOSALS**

WATER LINE: Purple dashed line

PUMP STATION: Purple square

STORAGE TANK: Purple circle



SCALE: 1" = 12000'



FIGURE F.4  
 PROPOSED SUPPLY TO THE CITY OF LAWN  
 FROM STEAMBOAT MOUNTAIN WSC  
 WEST CENTRAL BRAZOS STUDY  
 SCENARIOS #1 AND #2

**TABLE F.3**  
**BRAZOS RIVER AUTHORITY**  
**WEST CENTRAL BRAZOS STUDY**  
**SUPPLY TO LAWN FROM STEAMBOAT-MOUNTAIN WSC**  
**2003**

**CONSTRUCTION COSTS**

1	10" PVC Water Line	14,400 LF @ \$23.00/LF	\$331,200
2	8" PVC Water Line	41,000 LF @ \$20.00/LF	\$820,000
3	Valves	Lump Sum	\$30,000
4	Bore & Encasement	Lump Sum	\$50,000
5	Pump Station	1 EACH @ \$175,000	\$175,000
6	Pump Station Improvements	1 EACH @ \$75,000	\$75,000
7	New Elevated GST	1 EACH @ \$175,000	\$175,000
8	Master Meter & Regulator	1 EACH @ \$10,000	\$10,000
9	SCADA System	2 EACH @ \$20,000	\$40,000
10	Project Contingencies		\$120,000
			<b><u>\$1,826,200</u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$20,000
Basic Engineering	\$130,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$60,000
Surveying	\$40,000
Testing, Permitting, Etc.	\$20,000
	<b><u>\$300,000</u></b>
	<b><u>\$2,126,200</u></b>

**Westbound WSC**

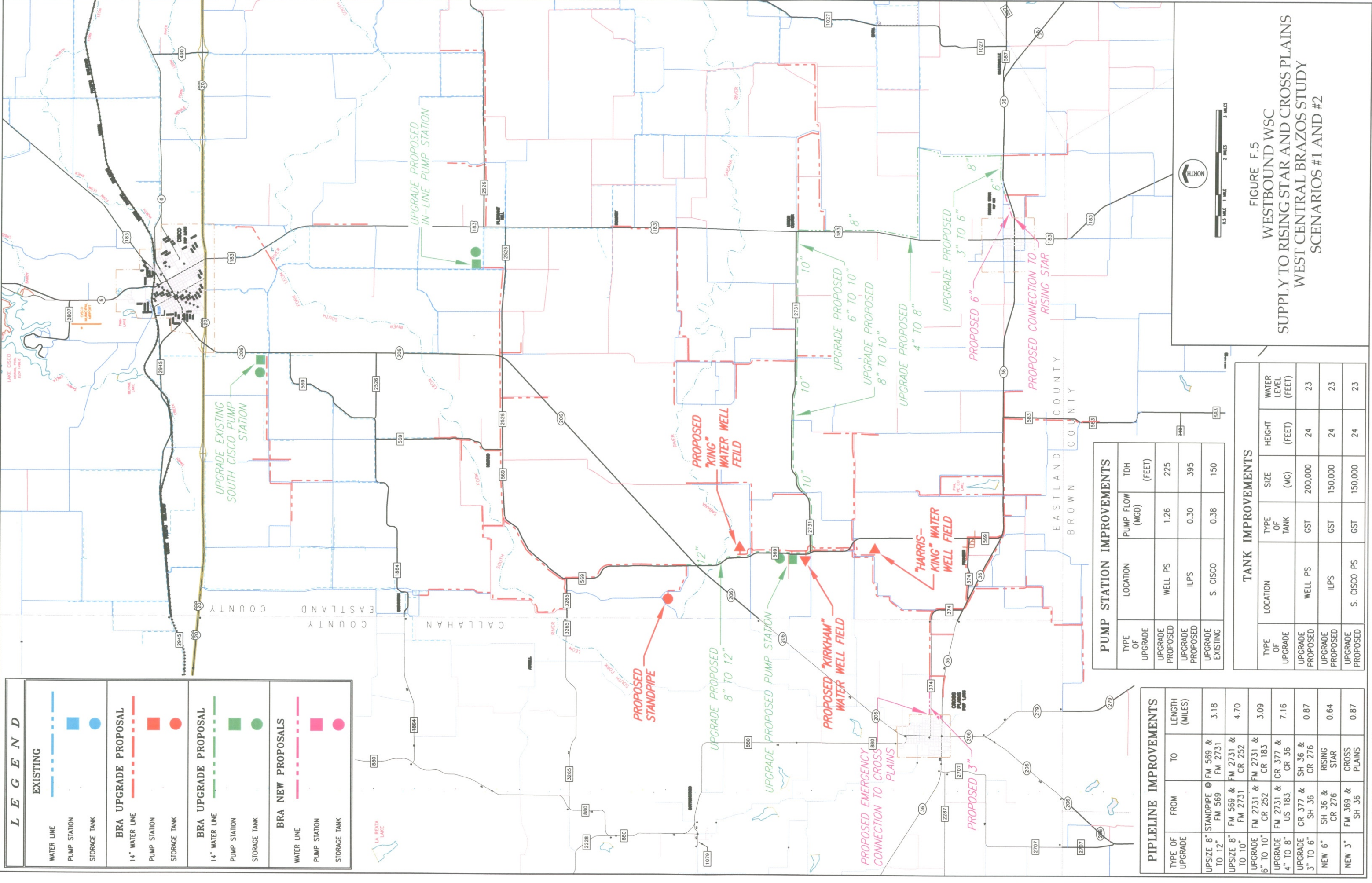
The City of Rising Star currently uses groundwater as its sole source. Groundwater has elevated nitrates, which will require additional treatment. While the current supply appears to be sufficient to fulfill the City's current needs, considerable growth is expected in the area which could affect the reliability of groundwater supply. Treatment of the groundwater would require some type of advanced process such as reverse osmosis, which would increase the demand on this source.

Westbound WSC operates a water system in Eastland and Callahan Counties. Westbound WSC currently obtains its water supply from the Cities of Cisco and Eastland. The Corporation provides treated water to most of Eastland County. The WSC has an ongoing project through USDA-Rural Development to drill wells and lay several miles of water lines throughout the southern portion of the system. The WSC currently takes its supply from the Cities of Cisco and Eastland. The proposed water lines will be very close to the Cities of Cross Plains and Rising Star and could potentially be upgraded to provide water to both of these entities. Cross Plains has not been identified as having a deficient supply; however, groundwater is the sole source of water and an alternate supply may be advisable. The City of Rising Star has been identified as potentially needing an alternate supply.

The WSC proposes to drill at least two water wells northeast of Cross Plains and install piping which would allow the Corporation to serve additional customers in the southern portion of the county. The City of Rising Star would require a supply of 200 gpm (0.29 mgd) to satisfy the TCEQ requirement of 0.6 gpm per connection (supply flow). Additional improvements necessary to serve Rising Star with water up to .29 mgd consist of upsizing approximately 3.5 miles of 8-inch water line to 12-inch, approximately 4.75 miles of 8-inch to 10-inch, approximately 3.25 miles of 6-inch to 10-inch and approximately 8.75 miles of 4-inch to 8-inch between the proposed well field and Rising Star. All of these lines are proposed as part of the Rural Development Project and are shown in Table 4.3. Upsizing of the WSC's proposed Well Field pump station, the proposed FM 169 in-line pump station and the existing south Cisco pump station would also be necessary. No additional improvements are necessary to provide Cross Plains with a supply of 0.14 mgd.

The regional scenario was modeled for both peak hourly demands and peak daily demands in the Westbound WSC proposed distribution system. Westbound is also required to maintain the 0.6 gpm and 1.5 gpm per connection capabilities. The regional improvements suggested for this system are as indicated in Figure F.5. The estimated costs associated with the improvements are shown in Table F.4.





**LEGEND**

EXISTING	
WATER LINE	
PUMP STATION	
STORAGE TANK	

BRA UPGRADE PROPOSAL	
14" WATER LINE	
PUMP STATION	
STORAGE TANK	

BRA UPGRADE PROPOSAL	
14" WATER LINE	
PUMP STATION	
STORAGE TANK	

BRA NEW PROPOSALS	
WATER LINE	
PUMP STATION	
STORAGE TANK	

**PUMP STATION IMPROVEMENTS**

TYPE OF UPGRADE	LOCATION	PUMP FLOW (MGD)	TDH (FEET)
UPGRADE PROPOSED	WELL PS	1.26	225
UPGRADE PROPOSED	ILPS	0.30	395
UPGRADE EXISTING	S. CISCO	0.38	150

**TANK IMPROVEMENTS**

TYPE OF UPGRADE	LOCATION	TYPE OF TANK	SIZE (MG)	HEIGHT (FEET)	WATER LEVEL (FEET)
UPGRADE PROPOSED	WELL PS	GST	200,000	24	23
UPGRADE PROPOSED	ILPS	GST	150,000	24	23
UPGRADE PROPOSED	S. CISCO PS	GST	150,000	24	23

**PIPELINE IMPROVEMENTS**

TYPE OF UPGRADE	FROM	TO	LENGTH (MILES)
UPSIZE 8" TO 12"	STANDPIPE @ FM 569 & FM 569	FM 569 & FM 2731	3.18
UPSIZE 8" TO 10"	FM 569 & FM 2731	FM 2731 & CR 252	4.70
UPGRADE 6" TO 10"	FM 2731 & CR 252	FM 2731 & CR 183	3.09
UPGRADE 4" TO 8"	FM 2731 & US 183	CR 377 & CR 36	7.16
UPGRADE 3" TO 6"	CR 377 & SH 36	SH 36 & CR 276	0.87
NEW 6"	SH 36 & CR 276	CR 276 & STAR	0.64
NEW 3"	FM 369 & SH 36	CROSS PLAINS	0.87

**FIGURE F.5**  
**WESTBOUND WSC**  
**SUPPLY TO RISING STAR AND CROSS PLAINS**  
**WEST CENTRAL BRAZOS STUDY**  
**SCENARIOS #1 AND #2**

**TABLE F.4  
BRAZOS RIVER AUTHORITY  
WEST CENTRAL BRAZOS STUDY  
SUPPLY TO RISING STAR AND CROSS PLAINS  
FROM WESTBOUND WSC  
2003**

**CONSTRUCTION COSTS**

1	Upsize 8" to 12" Water Line	16,800 LF @ \$8.00/LF	\$134,400
2	Upsize 8" to 10" Water Line	24,800 LF @ \$3.00/LF	\$74,400
3	Upsize 6" to 10" Water Line	16,300 LF @ \$8.00/LF	\$130,400
4	Upsize 4" to 8" Water Line	37,800 LF @ \$5.00/LF	\$189,000
5	Upsize 3" to 6" Water Line	4,600 LF @ \$4.00/LF	\$18,400
6	6" PVC Water Line	3,400 LF @ \$15.00/LF	\$51,000
7	3" PVC Water Line	4,600 LF @ \$11.00/LF	\$50,600
8	Valves	Lump Sum	\$60,000
9	Bore & Encasement	Lump Sum	\$120,000
10	Pump Station Improvements	3 EACH @ \$100,000	\$300,000
11	Master Meter & Regulator	2 EACH @ \$10,000	\$20,000
12	SCADA System	2 EACH @ \$20,000	\$40,000
13	Project Contingencies		\$84,000
			<b><u>\$1,272,200</u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$20,000
Basic Engineering	\$90,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$40,000
Surveying	\$30,000
Testing, Permitting, Etc.	\$20,000
	<b><u>\$230,000</u></b>
	<b><u>\$1,502,200</u></b>

**Eastland County WSD**

The City of Cisco takes water from Lake Cisco and supplements this supply from diversion operations on Battle Creek. Lake Cisco has historically been a reliable supply and appears to be less susceptible to drought conditions than most lakes due to its depth. However, the City was recently forced to implement drought contingency measures. The City currently has no alternate water supply available.

The City of Strawn currently treats raw water from a local community lake. The reliable yield of this lake is unknown. As is the case with many small communities, the cost of treatment is becoming too high to maintain. New drinking water regulations require ever increasing expense to maintain compliance. An alternate source of treated water could easily reduce capital and operating costs involved in treatment.

Eastland County WSD currently provides treated water to the Cities of Eastland and Ranger and Staff WSC. The system is in relative close proximity to the Cities of Cisco and Strawn. The District's existing water treatment plant is also fairly close to the termination point of one leg of the West Central Brazos Water Distribution System (ACBWDS) pipeline. This pipeline transports raw water from Possum Kingdom Reservoir, which could possibly be used to supplement supply to Eastland County WSD or other area entities. The only other nearby entity which could benefit from a supply from Eastland County WSD is the City of Gorman. Although Gorman appears to have an adequate supply from Upper Leon MWD, it was decided to include this alternative to be evaluated as a second source.

Eastland County Water Supply District currently takes raw water from Lake Leon and operates a water treatment plant on FM 2461 north of the lake. The District transports treated water to the City of Eastland through a 14-inch reinforced concrete supply line. A booster station approximately one mile east of Eastland fills a 118 feet tall standpipe located near the center of the city. The district fills a ground storage tank in Ranger through a 14-inch reinforced concrete supply line with pressure from a pump station at the water treatment plant. The existing WCBWDS 27-inch pipeline ends at the Northridge facility approximately 5 miles northwest of the Eastland County WSD water treatment plant.

The City of Cisco currently uses approximately 1.5 mgd of treated water. The Eastland County WSD system was modeled to provide a supply to Cisco through the City of Eastland. The system was capable of supplying 950 gpm (1.4 mgd) for Cisco without modification. A 14-



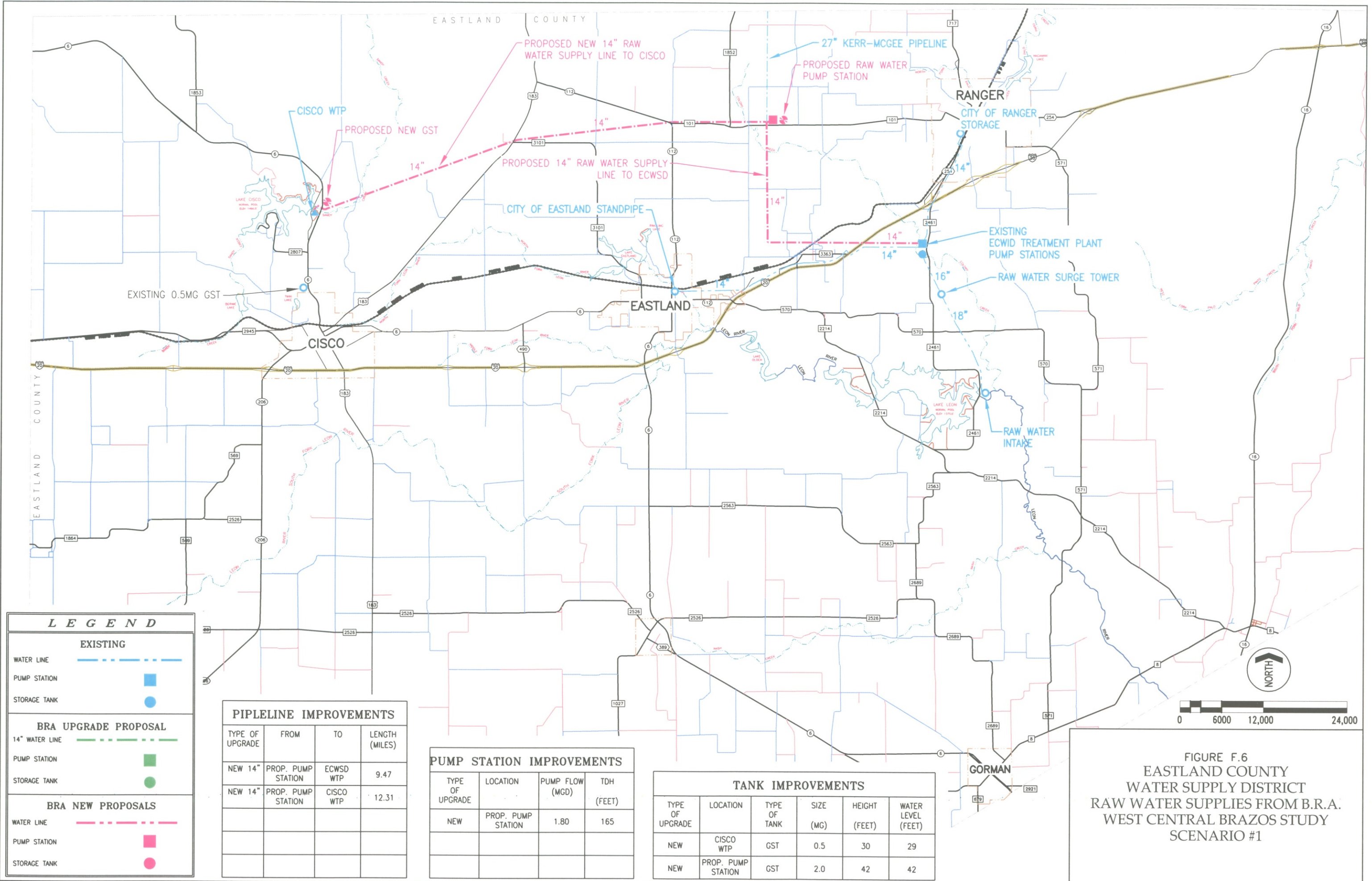
inch line was required between the City of Eastland standpipe and the City of Cisco's College Hill Pump Station. No additional head pressure would be required from the District's water treatment plant. Cisco could also take raw water directly off of the WCBWDS pipeline and treat it at its own water treatment plant on Lake Cisco. The water could be blended with the city's current supply.

The City of Strawn operates a water treatment plant on Lake Tucker. Based on TCEQ requirements, the City is required to maintain a minimum water supply of approximately 0.25 mgd. The Eastland County WSD system was modeled to provide a supply of 200 gpm to the City of Strawn. Approximately 13 miles of 6-inch line would be required from the Ranger supply line on the south side of Interstate 20 to the City of Strawn. A pressure reducing valve was also required, using existing head pressure, due to the elevation of Ranger Hill to the east of the connection point. No other modifications to the District's system were necessary.

The model included a supply from Eastland County WSD to Gorman as an alternate source. To provide Gorman with approximately 200 gpm, 19 miles of 8-inch line would be required from the District's water treatment plant. No additional head pressure was required at the plant.

The improvements specific to each of these supply scenarios are summarized in Figures F.6 and F.7. The costs associated with each scenario are presented in Tables F.5 through F.9.

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**LEGEND**

**EXISTING**

WATER LINE: ————

PUMP STATION: ■

STORAGE TANK: ●

**BRA UPGRADE PROPOSAL**

14" WATER LINE: - - - -

PUMP STATION: ■

STORAGE TANK: ●

**BRA NEW PROPOSALS**

WATER LINE: - - - -

PUMP STATION: ■

STORAGE TANK: ●

**PIPELINE IMPROVEMENTS**

TYPE OF UPGRADE	FROM	TO	LENGTH (MILES)
NEW 14"	PROP. PUMP STATION	ECWSD WTP	9.47
NEW 14"	PROP. PUMP STATION	CISCO WTP	12.31

**PUMP STATION IMPROVEMENTS**

TYPE OF UPGRADE	LOCATION	PUMP FLOW (MGD)	TDH (FEET)
NEW	PROP. PUMP STATION	1.80	165

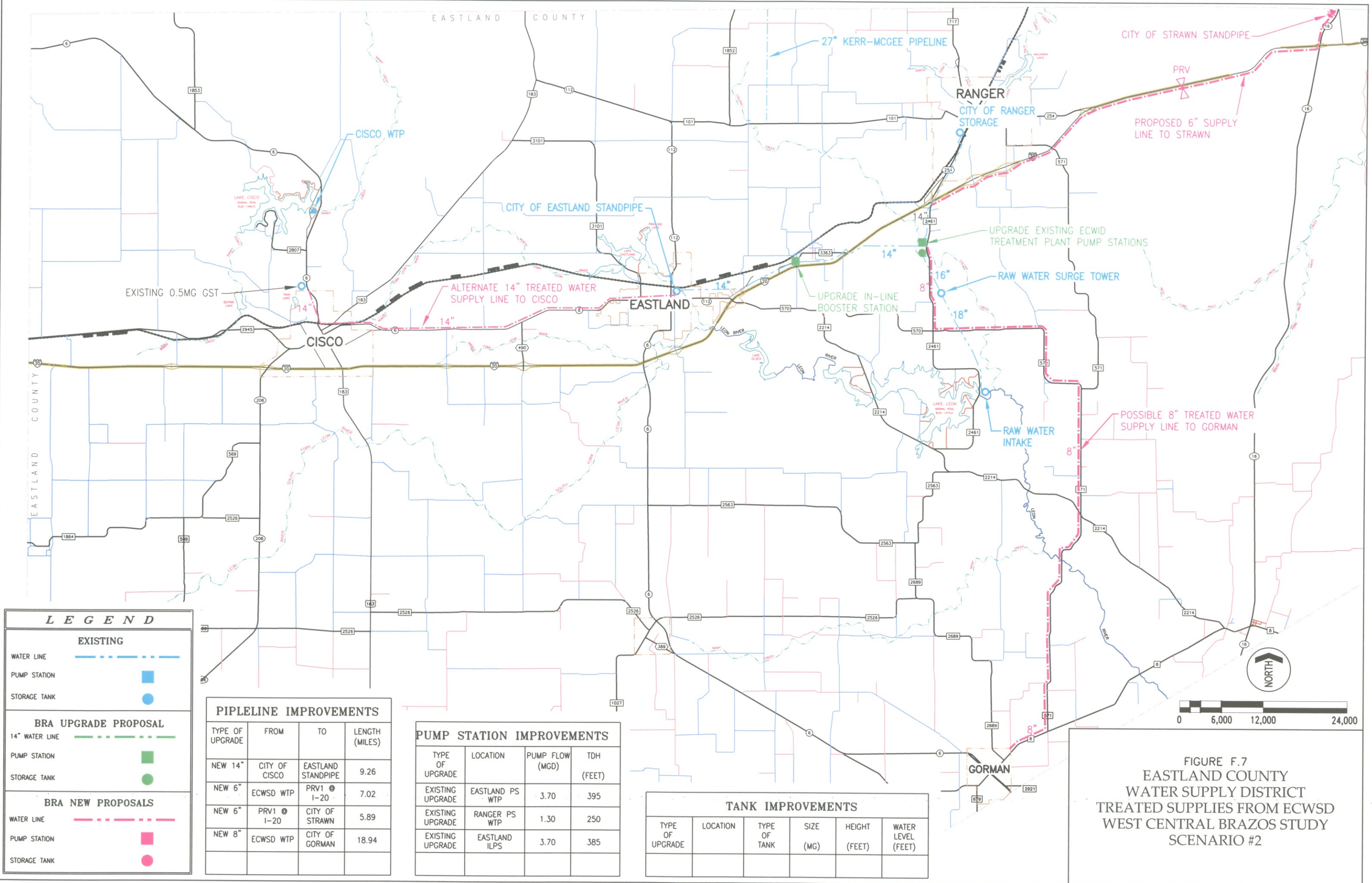
**TANK IMPROVEMENTS**

TYPE OF UPGRADE	LOCATION	TYPE OF TANK	SIZE (MG)	HEIGHT (FEET)	WATER LEVEL (FEET)
NEW	CISCO WTP	GST	0.5	30	29
NEW	PROP. PUMP STATION	GST	2.0	42	42

**FIGURE F.6**  
**EASTLAND COUNTY**  
**WATER SUPPLY DISTRICT**  
**RAW WATER SUPPLIES FROM B.R.A.**  
**WEST CENTRAL BRAZOS STUDY**  
**SCENARIO #1**



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**LEGEND**

**EXISTING**

WATER LINE: - - - - -

PUMP STATION: [Blue Square]

STORAGE TANK: [Blue Circle]

**BRA UPGRADE PROPOSAL**

14" WATER LINE: - - - - -

PUMP STATION: [Green Square]

STORAGE TANK: [Green Circle]

**BRA NEW PROPOSALS**

WATER LINE: - - - - -

PUMP STATION: [Pink Square]

STORAGE TANK: [Pink Circle]

**PIPELINE IMPROVEMENTS**

TYPE OF UPGRADE	FROM	TO	LENGTH (MILES)
NEW 14"	CITY OF CISCO	EASTLAND STANDPIPE	9.26
NEW 6"	ECWSD WTP	PRV1 @ 1-20	7.02
NEW 6"	PRV1 @ 1-20	CITY OF STRAWN	5.89
NEW 8"	ECWSD WTP	CITY OF GORMAN	18.94

**PUMP STATION IMPROVEMENTS**

TYPE OF UPGRADE	LOCATION	PUMP FLOW (MGD)	TDH (FEET)
EXISTING UPGRADE	EASTLAND PS WTP	3.70	395
EXISTING UPGRADE	RANGER PS WTP	1.30	250
EXISTING UPGRADE	EASTLAND ILPS	3.70	385

**TANK IMPROVEMENTS**

TYPE OF UPGRADE	LOCATION	TYPE OF TANK	SIZE (MG)	HEIGHT (FEET)	WATER LEVEL (FEET)

FIGURE F.7  
 EASTLAND COUNTY  
 WATER SUPPLY DISTRICT  
 TREATED SUPPLIES FROM ECWSD  
 WEST CENTRAL BRAZOS STUDY  
 SCENARIO #2

**TABLE F.5**  
**BRAZOS RIVER AUTHORITY**  
**WEST CENTRAL BRAZOS STUDY**  
**RAW WATER SUPPLY TO EASTLAND COUNTY WSD FROM BRA**  
**2003**

**CONSTRUCTION COSTS**

1	14" PVC Water Line	50,000 LF @ \$32.00/LF	\$1,600,000
2	Valves	Lump Sum	\$40,000
3	Bore & Encasement	Lump Sum	\$50,000
4	Pump Station & GST	1 EACH @ \$800,000	\$800,000
5	Master Meter & Regulator	1 EACH @ \$10,000	\$10,000
6	SCADA System	2 EACH @ \$20,000	\$40,000
7	Project Contingencies		\$178,000
			<b><u>\$2,718,000</u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$30,000
Basic Engineering	\$200,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$90,000
Surveying	\$60,000
Testing, Permitting, Etc.	\$30,000
	<b><u>\$440,000</u></b>
	<b><u>\$3,158,000</u></b>

**TABLE F.6  
BRAZOS RIVER AUTHORITY  
WEST CENTRAL BRAZOS STUDY  
SUPPLY TO CISCO DIRECT FROM BRA  
2003**

**CONSTRUCTION COSTS**

1	14" PVC Water Line	65,000 LF @ \$32.00/LF	\$2,080,000
2	Valves	Lump Sum	\$50,000
3	Bore & Encasement	Lump Sum	\$50,000
4	Pump Station & GST	1 EACH @ \$800,000	\$800,000
5	0.5 MG GST at Cisco WTP	1 EACH @ \$300,000	\$300,000
6	Master Meter & Regulator	1 EACH @ \$10,000	\$10,000
7	SCADA System	2 EACH @ \$20,000	\$40,000
8	Project Contingencies		\$234,000
			<b><u>\$3,564,000</u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$40,000
Basic Engineering	\$250,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$110,000
Surveying	\$80,000
Testing, Permitting, Etc.	\$40,000
	<b><u>\$550,000</u></b>
	<b><u>\$4,114,000</u></b>

**TABLE F.7  
BRAZOS RIVER AUTHORITY  
WEST CENTRAL BRAZOS STUDY  
SUPPLY TO CISCO FROM ECWSO  
2003**

**CONSTRUCTION COSTS**

1	14" PVC Water Line	48,900 LF @ \$32.00/LF	\$1,564,800
2	Valves	Lump Sum	\$80,000
3	Bore & Encasement	Lump Sum	\$200,000
4	Pump Station Improvements	2 EACH @ \$75,000	\$150,000
5	Master Meter & Regulator	2 EACH @ \$10,000	\$20,000
6	SCADA System	4 EACH @ \$20,000	\$80,000
7	Project Contingencies		\$147,000
			<b><u>\$2,241,800</u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$30,000
Basic Engineering	\$150,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$70,000
Surveying	\$50,000
Testing, Permitting, Etc.	\$30,000
	<b><u>\$360,000</u></b>
	<b><u>\$2,601,800</u></b>

**TABLE F.8  
BRAZOS RIVER AUTHORITY  
WEST CENTRAL BRAZOS STUDY  
SUPPLY TO STRAWN FROM EASTLAND COUNTY WSD  
2003**

**CONSTRUCTION COSTS**

1	6" PVC Water Line	68,200 LF @ \$15.00/LF	\$1,023,000
2	Valves	Lump Sum	\$60,000
3	Bore & Encasement	Lump Sum	\$40,000
4	Master Meter & Regulator	1 EACH @ \$10,000	\$10,000
5	SCADA System	2 EACH @ \$20,000	\$40,000
6	Project Contingencies		\$83,000
			<b><u>\$1,256,000</u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$20,000
Basic Engineering	\$110,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$40,000
Surveying	\$30,000
Testing, Permitting, Etc.	\$20,000
	<b><u>\$250,000</u></b>
	<b><u>\$1,506,000</u></b>

**TABLE F.9**  
**BRAZOS RIVER AUTHORITY**  
**WEST CENTRAL BRAZOS STUDY**  
**SUPPLY TO GORMAN FROM EASTLAND COUNTY WSD**  
**2003**

**CONSTRUCTION COSTS**

1	8" PVC Water Line	100,000 LF @ \$20.00/LF	\$2,000,000
2	Valves	Lump Sum	\$100,000
3	Bore & Encasement	Lump Sum	\$45,000
4	Master Meter & Regulator	1 EACH @ \$10,000	\$10,000
5	SCADA System	2 EACH @ \$20,000	\$40,000
6	Project Contingencies		\$154,000
			<b><u>\$2,349,000</u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$30,000
Basic Engineering	\$180,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$80,000
Surveying	\$50,000
Testing, Permitting, Etc.	\$30,000
	<b><u>\$400,000</u></b>
	<b><u>\$2,749,000</u></b>



**Shackelford WSC and Stephens County Rural WSC**

Shackelford WSC currently serves the eastern half of Shackelford County, the area in Stephens County on the west shore of Hubbard Creek Reservoir and the far southern territory of Throckmorton County. The WSC currently takes its supply from the City of Albany and has also signed a raw water purchase agreement with the BRA. Shackelford has submitted an application for funding to USDA-Rural Development to extend service north into Throckmorton County and make improvements to the existing system. Shackelford has also signed a letter of commitment to enter into a water purchase agreement with the City of Throckmorton and has been negotiating with Paint Creek WSC for a potential emergency connection. Stephens County Rural WSC (SCRWSC) serves most of Stephens County including the City of Woodson. SCRWSC currently takes its supply from the City of Breckenridge and is negotiating with the BRA for a raw water purchase contract. SCRWSC also has an application on file with USDA-Rural Development. Stephens County Rural and Shackelford WSC have several potential points of interconnection in close proximity. Both of these entities could be interconnected to provide a supply to the City of Throckmorton and Paint Creek WSC.

Shackelford WSC operates a water system in Shackelford, Stephens and Throckmorton Counties. The Corporation currently purchases treated water from the City of Albany on the north side of town and distributes the water from there throughout the system. The Corporation has applied for funding to expand their system throughout the southern portion of Throckmorton County as well as upgrade their existing system. In order to accomplish this expansion, the WSC has contracted with the Brazos River Authority to purchase raw water. The water is proposed to be treated near Breckenridge and pumped across Hubbard Creek Reservoir. The proposed project would place the Shackelford system in close proximity to the City of Throckmorton. The WSC would also be within a few miles of Paint Creek WSC. The City of Throckmorton has experienced extreme water shortages in the recent past and is in need of a backup supply. Paint Creek WSC has limited supply as well and is looking for a backup supply to serve an area of existing customers in eastern Haskell County.

The proposed Shackelford system will terminate at the City of Throckmorton corporation limits. Upsizing the main lines between Shackelford WSC's proposed in-line pump station and the City would allow a considerable supply of water to be brought to Throckmorton. The WSC

is also proposing to extend lines west of Throckmorton to the Haskell County line. Paint Creek WSC is within 10 miles of this point.

Stephens County Rural WSC provides treated water to most of Stephens County. The WSC purchases treated water from the city of Breckenridge through four master meters located on each side of the city. The City has an existing 6-inch water line running to the City of Woodson in southeastern Throckmorton County. This line feeds an in-line pump station which in turn fills an elevated tank located in Woodson. SCRWSC has also applied for funds through USDA-Rural Development to make improvements to the existing system. These improvements include installing a new line along Highway 183 parallel to the existing 6-inch line. The WSC is negotiating with the BRA for a supply through the WCBWDS pipeline. A joint project with Shackelford WSC for treatment of the water has been considered as well. The SCRWSC will be within 8.5 miles of Shackelford WSC's proposed supply lines in Throckmorton County. A possible interconnection would allow additional water to be transferred to Throckmorton or Paint Creek WSC at less cost.

The water for Shackelford WSC would be taken south of Breckenridge and transported through the system to a proposed in-line pump station on Highway 180. The water would then be conveyed to the WSC's office pump station where it could be blended with water from the City of Albany and transported to the Shackelford WSC existing booster pump station near Ft. Griffin. This would require approximately 3.5 miles of 8-inch and 3.0 miles of 6-inch water line parallel to the WSC's existing 6-inch line. The booster station would have to be converted to a hydropneumatic pump station and upgraded to push additional water north. From this station, the water would be pumped to a proposed in-line booster station located at the intersection Highways 283 and 183. From there, approximately 2.7 miles of 10-inch water line would convey the water to the City of Throckmorton and 1 mile of 6-inch line would run to the WSC's proposed elevated storage south of Throckmorton. An additional 18 miles of line (4-inch to 6-inch) would be required as well as pump station and storage upgrades to convey water to the Haskell County Line to the northwest. These improvements are already proposed to serve retail customers of Shackelford WSC. Additional upgrades to the proposed pump station west of Throckmorton would be required to serve Paint Creek WSC with approximately 50 gpm. This could serve approximately 83 customers in the eastern portion of the Paint Creek system based on TCEQ regulations.

In order to supply Throckmorton with approximately 200 gpm (enough to serve the community in times of water shortage) and 50 gpm (to serve a portion of Paint Creek System near Haskell County line), upgrades to Stephens County's already proposed improvements will also be required. Approximately 6.6 miles of 6-inch water line will be required parallel to SCRWSC's existing 6-inch line along Highway 183. The existing in-line booster station in Woodson would have to be upgraded as well. A new 6.2 mile, 6-inch water line would have to be installed between the Woodson station and Shackelford WSC's proposed lines on Highway 183. Shackelford WSC's proposed 3-inch lines along Highway 183 to the proposed in-line booster station at Highway 283 would have to be upsized to 6-inches (approximately 2.4 miles).

The option of supplying the total needs of Throckmorton would require new line all the way from Breckenridge to Throckmorton. Utilizing Shackelford or Stephens County Rural WSC's systems in this scenario would hold little benefit.

The regional scenario was modeled for both peak hourly demands and supply flow demands in the WSCs' distribution systems. Shackelford and Stephens County Rural WSC are each required to maintain a supply of 0.4 gpm per connection. Peak hourly requirements are the same as for other retail suppliers. A summary for the improvements proposed in this model is provided in Figure F.8. The associated costs are estimated in Table F.10.

**TABLE F.10**  
**BRAZOS RIVER AUTHORITY**  
**WEST CENTRAL BRAZOS STUDY**  
**SUPPLY TO THROCKMORTON**  
**FROM SHACKELFORD STEPHENS COUNTY RURAL WSC's**  
**2003**

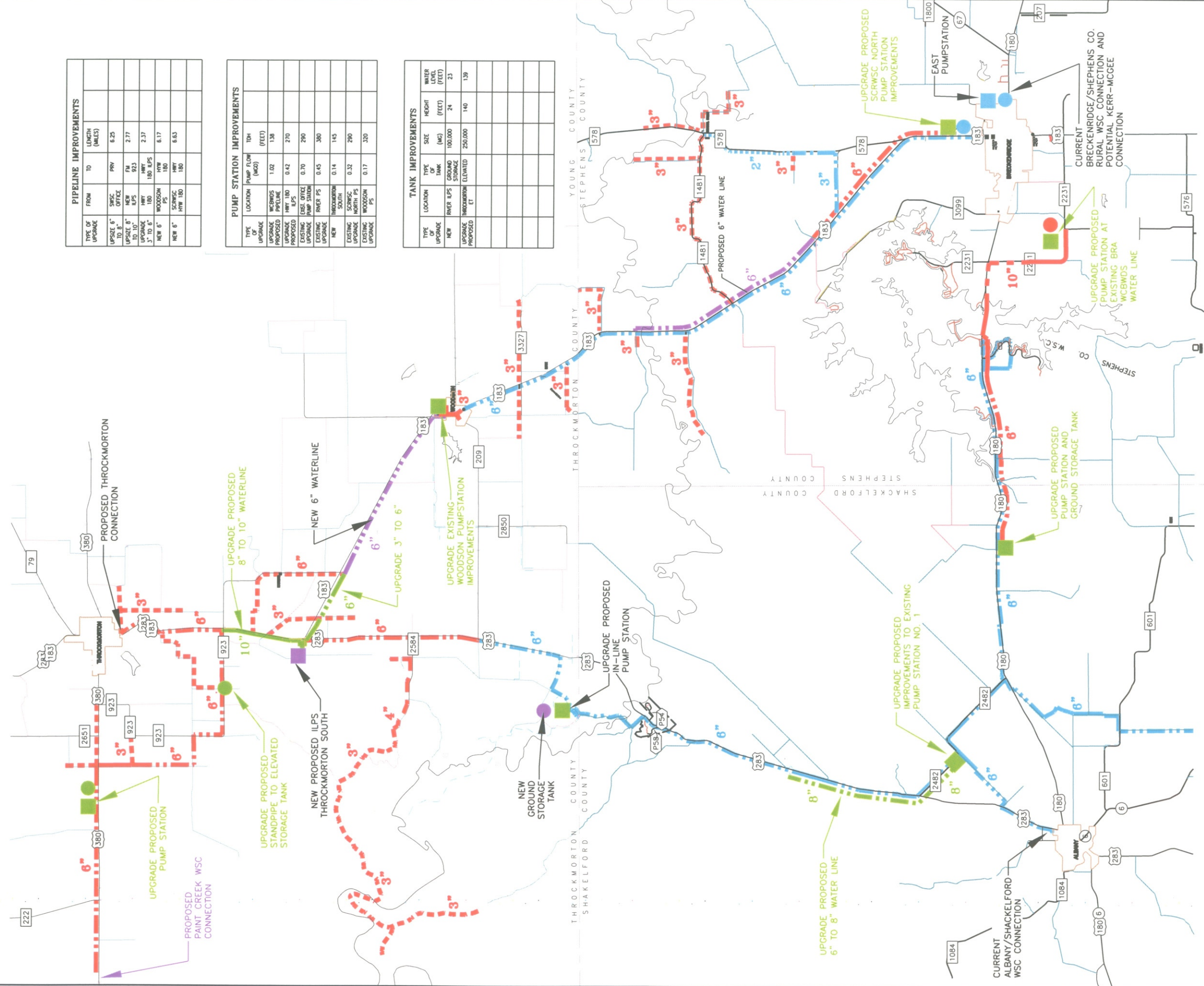
**CONSTRUCTION COSTS**

1	Upsize 8" to 10" Water Line	15,000 LF @ \$3.00/LF	\$45,000
2	Upsize 6" to 8" Water Line	33,000 LF @ \$5.00/LF	\$165,000
3	Upsize 3" to 6" Water Line	13,000 LF @ \$4.00/LF	\$52,000
4	6" PVC Water Line	68,000 LF @ \$15.00/LF	\$1,020,000
5	Valves	Lump Sum	\$110,000
6	Bore & Encasement	Lump Sum	\$100,000
7	Pump Station Improvements	7 EACH @ \$100,000	\$700,000
8	Upsize Elevated Tank	1 EACH @ \$75,000	\$75,000
9	In-line Pump Station	1 EACH @ \$150,000	\$150,000
10	Master Meter & Regulator	2 EACH @ \$10,000	\$20,000
11	SCADA System	10 EACH @ \$20,000	\$200,000
12	Project Contingencies		\$185,000
			<b><u>\$2,822,000</u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$30,000
Basic Engineering	\$200,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$90,000
Surveying	\$60,000
Testing, Permitting, Etc.	\$30,000
	<b><u>\$440,000</u></b>

**\$3,262,000**



TYPE OF UPGRADE	FROM	TO	LENGTH (MILES)
UPGRADE 6" TO 8"	SMSC OFFICE	PNV	6.25
UPGRADE 8" TO 10"	NEW ILPS	FM	2.77
UPGRADE 10" TO 14"	HWY 180	HWY 923	2.37
UPGRADE 3" TO 6"	WOODSON	HWY 180 ILPS	6.17
NEW 6"	SMWSC HWY 180	HWY 180	6.63

TYPE OF UPGRADE	LOCATION	PUMP FLOW (MGD)	TEN (FEET)
UPGRADE PROPOSED	WCBWDS PIPELINE	1.02	138
UPGRADE PROPOSED	HWY 180 ILPS	0.42	270
EXISTING UPGRADE	DES. OFFICE PUMP STATION	0.70	290
EXISTING UPGRADE	RIVER PS	0.45	300
NEW UPGRADE	THROCKMORTON SOUTH	0.14	145
EXISTING UPGRADE	SCRWSC NORTH PS	0.32	290
EXISTING UPGRADE	WOODSON PS	0.17	320

TYPE OF UPGRADE	LOCATION	TYPE OF TANK	SIZE (MG)	HEIGHT (FEET)	WATER MAIN (FEET)
NEW UPGRADE	RIVER ILPS	GROUND STORAGE	100,000	24	23
UPGRADE PROPOSED	THROCKMORTON ET	ELEVATED	250,000	140	139

EXISTING	BRA UPGRADE PROPOSAL	BRA NEW PROPOSALS
WATER LINE: Solid blue line	14" WATER LINE: Dashed green line	WATER LINE: Solid purple line
PUMP STATION: Blue square	PUMP STATION: Green square	PUMP STATION: Purple square
STORAGE TANK: Blue circle	STORAGE TANK: Green circle	STORAGE TANK: Purple circle
CURRENTLY PROPOSED		
WATER LINE: Dashed red line		
PUMP STATION: Red square		
STORAGE TANK: Red circle		



FIGURE F.8  
 SHACKELFORD W.S.C.  
 AND STEPHENS COUNTY  
 RURAL W.S.C. SUPPLY TO THROCKMORTON  
 WEST CENTRAL BRAZOS STUDY  
 SCENARIOS #1 AND #2

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**Zephyr WSC Supply to Northeast Brown County**

There is a large area in northeast Brown County which does not have an adequate water supply. The area consists of rural communities, the largest of which is the May community. Growth along the east side of Lake Brownwood also contributes to water demand in the area. The area depends mainly on groundwater for its potable water supply with the exception of one development on Lake Brownwood which utilizes a surface water treatment plant. The nearest treated water supply system in the area is Zephyr Water Supply Corporation which has water lines within approximately seven miles of the May community. Many rural residents in this area have approached Zephyr WSC to request service. The number of customers expected in this area is 140 and the expected demand is 170 acre-feet per year.

Zephyr WSC obtains treated water from the City of Early and serves most of eastern Brown County. The Corporation has approved funding from USDA-Rural Development to make improvements to and expand its system. Much of these improvements are located in the north portion of the system which will make it possible for the Corporation to provide water to the northeast portion of Brown County. In order to serve the May community and other rural residents in the area approximately 6.9 miles of 6-inch, 12 miles of 4-inch, 3.7 miles of 3-inch and 3.7 miles of 2-inch water lines will be required from the end of the proposed Zephyr WSC improvements. A new hydropneumatic pump station will also be necessary.

This proposal was modeled for peak hourly demands and supply flow demands throughout the WSC's system. A summary for the improvements proposed in this model is provided in Figure F.9. The associated costs are estimated in Table F.11.

**TABLE F.11  
 BRAZOS RIVER AUTHORITY  
 WEST CENTRAL BRAZOS STUDY  
 ZEPHYR WATER SUPPLY CORPORATION  
 SUPPLY TO NORTHEAST BROWN COUNTY  
 2003**

**CONSTRUCTION COSTS**

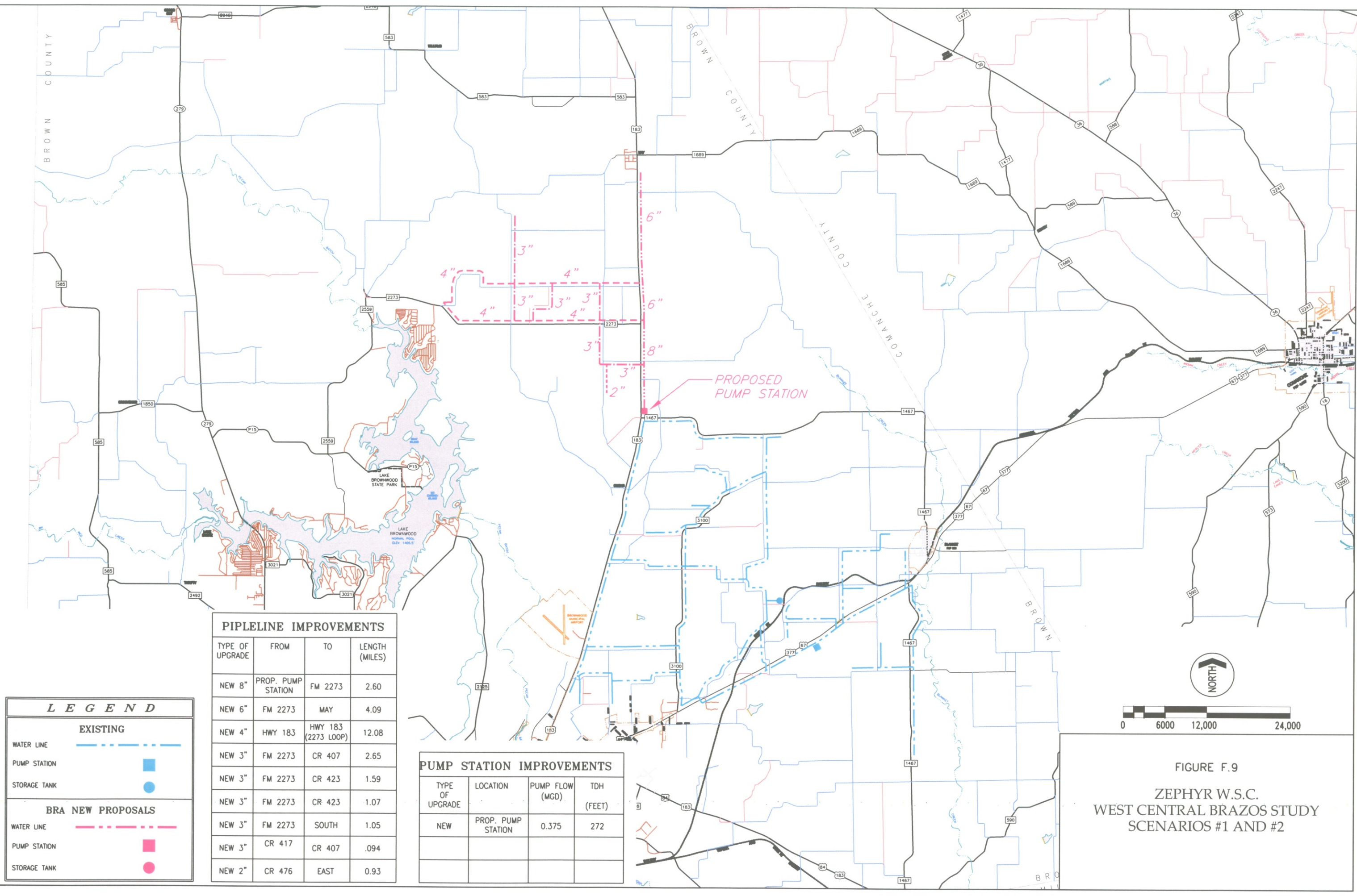
1	8" PVC Water Line	13,700 LF @ \$20.00/LF	\$274,000
2	6" PVC Water Line	21,600 LF @ \$15.00/LF	\$324,000
3	4" PVC Water Line	63,800 LF @ \$13.00/LF	\$829,400
6	3" PVC Water Line	38,600 LF @ \$11.00/LF	\$424,600
7	2" PVC Water Line	4,900 LF @ \$8.00/LF	\$39,200
8	Valves	Lump Sum	\$160,000
9	Bore & Encasement	Lump Sum	\$120,000
10	Pump Station Improvements	3 EACH @ \$100,000	\$300,000
11	Master Meter & Regulator	2 EACH @ \$10,000	\$20,000
12	SCADA System	2 EACH @ \$20,000	\$40,000
13	Project Contingencies		\$178,000
			<b><u>\$2,709,200</u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$30,000
Basic Engineering	\$190,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$90,000
Surveying	\$60,000
Testing, Permitting, Etc.	\$30,000
	<b><u>\$430,000</u></b>
	<b><u>\$3,139,200</u></b>



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LEGEND	
<b>EXISTING</b>	
WATER LINE	
PUMP STATION	
STORAGE TANK	
<b>BRA NEW PROPOSALS</b>	
WATER LINE	
PUMP STATION	
STORAGE TANK	

PIPELINE IMPROVEMENTS			
TYPE OF UPGRADE	FROM	TO	LENGTH (MILES)
NEW 8"	PROP. PUMP STATION	FM 2273	2.60
NEW 6"	FM 2273	MAY	4.09
NEW 4"	HWY 183	HWY 183 (2273 LOOP)	12.08
NEW 3"	FM 2273	CR 407	2.65
NEW 3"	FM 2273	CR 423	1.59
NEW 3"	FM 2273	CR 423	1.07
NEW 3"	FM 2273	SOUTH	1.05
NEW 3"	CR 417	CR 407	.094
NEW 2"	CR 476	EAST	0.93

PUMP STATION IMPROVEMENTS			
TYPE OF UPGRADE	LOCATION	PUMP FLOW (MGD)	TDH (FEET)
NEW	PROP. PUMP STATION	0.375	272

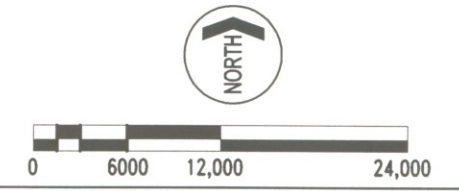


FIGURE F.9  
 ZEPHYR W.S.C.  
 WEST CENTRAL BRAZOS STUDY  
 SCENARIOS #1 AND #2



**West Central Brazos Water Distribution System Pipeline**

The Midway Water Group consists of a number of water supply entities in the central portion of the study area which have requested water from the BRA. The group currently consists of Shackelford Water Supply Corporation, Stephens County Rural Water Supply Corporation, the City of Throckmorton and the City of Breckenridge. Other entities which have been involved with the group to some extent include Westbound WSC, Callahan County WSC, Eastland County WSD, the City of Albany, the City of Graham and Ft. Belknap WSC. The individual members of the Midway Water Group have requested raw water supplies from the BRA through Possum Kingdom Reservoir. The members of the group take their current supplies from various sources. Most supplies come from either Hubbard Creek Reservoir or local community lakes. Each of the current members has experienced supply shortages during the drought, as have many of the other entities that have been involved with the group. Most notably, the City of Throckmorton ran out of water and was forced to construct an emergency supply pipeline to take a supply from the City of Graham. The contract for this supply will expire within two years and the renewal is not certain. Based on current projections, it is not expected that the current supplies will serve the long term needs of the area.

The West Central Brazos Water Distribution System (WCBWDS) pipeline facilities consist of an intake and pump station on Possum Kingdom reservoir, several miles of 8-inch through 36-inch pipeline and an intermediate pump station east of Breckenridge. The facilities currently provide raw water for industrial use throughout the area west of Possum Kingdom. Abilene, Albany, Breckenridge, Eastland County WSD, Graham, Shackelford WSC, Stephens County Rural WSC and West Central Texas MWD have all requested water from the BRA which could potentially be transferred through the WCBWDS. There is significant potential for transporting water to a very large area through this system.

The BRA has recently obtained water supply facilities previously owned by Kerr-McGee Oil & Gas Onshore L.L.C. The system consists of an intake at Possum Kingdom Reservoir which feeds a 36-inch pipeline to FM 717. From there, a 24" line continues to a pump station east of Breckenridge. A 24-inch lateral line runs north to Eliasville at FM 717.

From the pump station a 24-inch line runs south to a filter plant in northern Eastland County. A network of 8-inch through 16-inch lines runs west from the pump station to feed demands west of Breckenridge. The existing pipeline, intake pump station at Possum Kingdom

Reservoir and Veale Park Pump Station were analyzed for various demand scenarios and proposed improvements were included as necessary. The facilities were modeled for four basic demand scenarios including: the existing system with existing contracted supply demands with Kerr-McGee, Statex Operating LLC and North Ridge Corporation; short term outlook of the facilities for the existing demands and those entities that are currently negotiating contracts or are expected to soon and those that have contacts but are not currently using water (Shackelford WSC, Stephens County Rural WSC, Breckenridge, Throckmorton and LCS Production Company). Long term outlook for the facilities include the addition of Albany, West Central Texas MWD, Eastland County WSD and Graham each of which are not expected to use Possum Kingdom water in the near future; and long term outlook with the addition of Abilene. In addition, scenarios were modeled to determine the capacities of the existing 36-inch line between the intake and Veale Park and the 24-inch line between Veale Park and the Northridge treatment plant and to determine the amount of flow that could be moved through a 36-inch line west of Veale Park independent of the existing lines. In each run a Hazen-Williams C value of 110 for concrete pipe was used. Proposed demands were located at the most likely connection point for each individual entity.

#### Existing System with Current Demands

The existing system was modeled for the current demands indicated under Item 1 (current) of Table F.12. These demands were based on the yearly contracted amounts for the individual entities. The Kerr-McGee demand is located west of Breckenridge. The Statex demand is located near Eliasville and the North Ridge demand is located in Eastland County. The assumption was made that both pump stations are operational for this run. The designed total dynamic head (TDH) available at each pump station was used to model the system. The output from the computer model indicates that the existing system has more than enough capacity for the current demands. One pump is currently in operation at the Veale Park Pump Station to serve the Northridge facility and the other demands on the existing system can be served directly from the intake.

**TABLE F.12**  
**WEST CENTRAL BRAZOS WATER DISTRIBUTION SYSTEM**  
**PROJECTED DEMANDS**

<u>Customer/Utility</u>	<u>Peak Flow</u> (GPM)	<u>Peak Flow</u> (MGD)	<u>Water Loss</u> (%)	<u>Jct Node#</u>
1 Current (Per Letter 12/12/2002)			20	
Kerr-McGee Oil & Gas Onshore	930	1.34		25
Statex Operating LLC	310	0.45		31
North Ridge Corporation	228	0.33		13
2 Requests Short Term (Per Letter 12/12/2002 + Report 7/2002)			20	
Shackelford WSC	639	0.92		25
LCS Production Company	631	0.91		23
Breckenridge	2,036	2.93		23
Throckmorton	524	0.75		25
Stephens County Rural WSC	635	0.91		23
3 Requests Long Term (Per Letter 12/12/2002 + Report 7/2002)			10	
Albany	2,715	3.91		36
WCTMWD	4,063	5.85		36
Eastland County WSD	2,480	3.57		13
Graham	2,715	3.91		31
Stephens County Rural WSC	1,195	1.72		23
4 Abilene	18,598	26.78	10	36

Notes: 1. The demands are additive for each successive run.

2. Water loss was based on a percentage of known demands. The loss was decreased for higher use scenarios.

### Short Term Outlook – Scenario 1

The system was modeled for the current demands as well as short term expected demands as described in Item 2 of Table F.12. The demands are based on TCEQ required peak daily supplies for retail providers of 0.6 gpm per connection (0.4 gpm in some cases) corresponding to the yearly supply requested by each entity. The Shackelford WSC and Throckmorton demands are located west of Breckenridge. The demands for Breckenridge, LCS Production Company and Stephens County Rural WSC are located just south of the Breckenridge Water Treatment Plant. The current demands are included as in the first scenario. Some additional demand was included along the 36-inch pipeline to account for water loss and agricultural taps. In order to meet the demands of the system west of Veale Park a new 20-inch line was modeled between Veale Park and the Breckenridge water treatment plant. The TDH for Veale Park was not changed from the existing scenario.

### Long Term Outlook – Scenario 2

The system was modeled for the current demands, short term demands and long term demands that are not expected for some time. As before, the demands were based on TCEQ peak daily supply requirements for the retail providers. Peak demands for wholesale providers are based on a peaking factor of 2.0. This was determined from historical annual production and peak day use for the wholesale entities. The demands for each entity are shown in Item 3 on Table F.12. The Albany and West Central Texas MWD demands are located on the existing WCTMWD supply line which intersects the existing WCBWDS lines. The demand for Eastland County WSD is located at the Northridge facility and the Graham demand is located at the end of the Eliasville line. The current and short term demands are located as before. In order to serve the proposed demands improvements were necessary to the intake and Veale Park pump stations. A new intermediate pump station was also necessary between the intake and Veale Park and a new 24" line is required between these locations as well. The proposed 20-inch line included as in the previous run was upsized to a 27-inch and an additional 27-inch line was required the rest of the way to the WCTMWD line.

Long Term Outlook with Abilene – Scenario 3

The system was also modeled for the long term scenario with the addition of the City of Abilene. A peaking factor of 1.5 times the daily average was used for Abilene based on the yearly request. This demand was added on the existing WCTMWD line west of Hubbard Creek Reservoir. All other demands were as before. In order to supply the full 20,000 acre-feet request of Abilene at peak flow in addition to the other demands, extensive improvements were necessary. Improvements to the intake and Veale Park pump stations were required as well as the intermediate pump station between the two. A parallel 36-inch line was also required between each pump station and between Veale Park and Breckenridge. A 42-inch pipeline to the West Central Texas MWD line from Breckenridge was required.

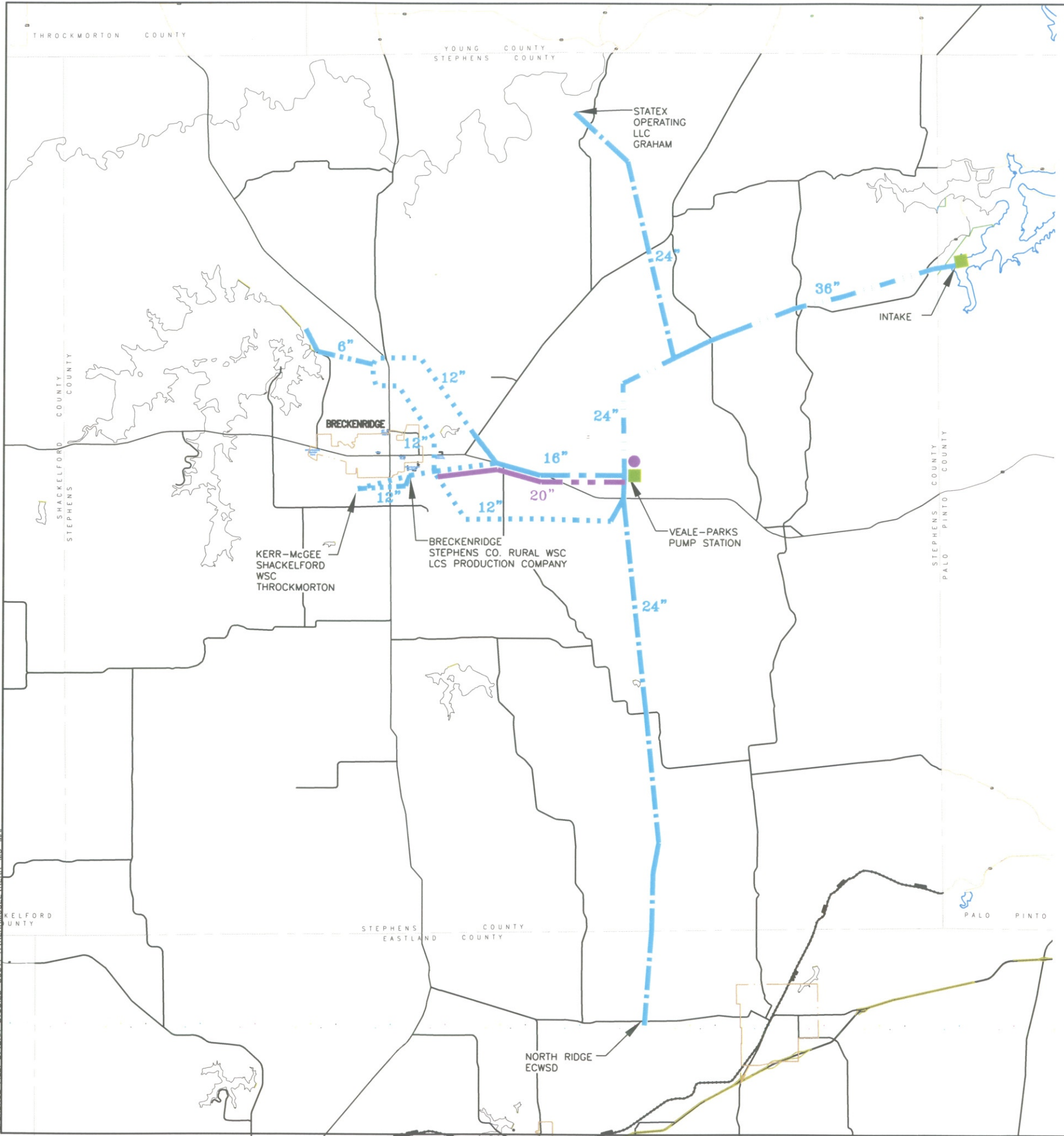
The capacities of the 36-inch and 24” lines from the intake to Veale Park and the 27-inch line from Veale Park to Northridge were also determined. These capacities were based on maximum TDH from the existing pump stations as determined by the pressure classifications of the pipe. No intermediate pump stations or parallel lines were included in order to determine the current maximum capacity of the lines. It was determined that a maximum of 9,000 gpm could be delivered to Veale Park through the 36-inch and 24” lines with no other improvements. A maximum of 5,000 gpm could be delivered to Northridge without other improvements.

A scenario was also run to determine the amount of water that could be transferred from Veale Park to Breckenridge if the existing lines were replaced with a 36-inch line and the Kerr-McGee demand was served from the existing 10-inch and 12-inch lines to the south. The proposed system was capable of supplying 15,000 gpm to Breckenridge under this scenario.

A summary of the demand alternatives is included as Table F.12 and hydraulic summaries for each scenario are included in Figures F.10 through F.12. Cost estimates are provided in Tables F.13 through F.15.



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**SCENARIO #1**

SHORT TERM DEMANDS  
 SEE TABLE 4.6 FOR DEMAND SCENARIOS

**PIPELINE IMPROVEMENTS**

TYPE OF UPGRADE	FROM	TO	LENGTH (MILES)
NEW 20"	VEALE-PARK PS	W. BRECKENRIDGE	6.84

**PUMP STATION IMPROVEMENTS**

TYPE OF UPGRADE	LOCATION	PUMP FLOW (MGD)	TDH (FEET)
EXISTING UPGRADE	INTAKE	10.26	440
EXISTING UPGRADE	VEALE-PARKS	2.00	371

**TANK IMPROVEMENTS**

TYPE OF UPGRADE	LOCATION	TYPE OF TANK	SIZE (MG)	HEIGHT (FEET)	WATER LEVEL (FEET)
NEW	VEALE-PARKS	GST	5.0	40	39

**LEGEND**

**EXISTING**

WATER LINE: [Blue solid line]

PUMP STATION: [Blue square]

STORAGE TANK: [Blue circle]

**CURRENTLY PROPOSED**

WATER LINE: [Red solid line]

PUMP STATION: [Red square]

STORAGE TANK: [Red circle]

**BRA UPGRADE PROPOSAL**

14" WATER LINE: [Green solid line]

PUMP STATION: [Green square]

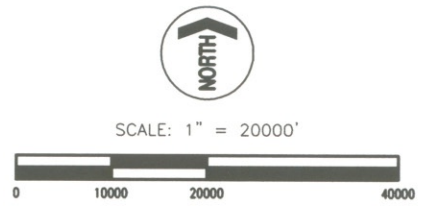
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**BRA NEW PROPOSALS**

WATER LINE: [Purple solid line]

PUMP STATION: [Purple square]

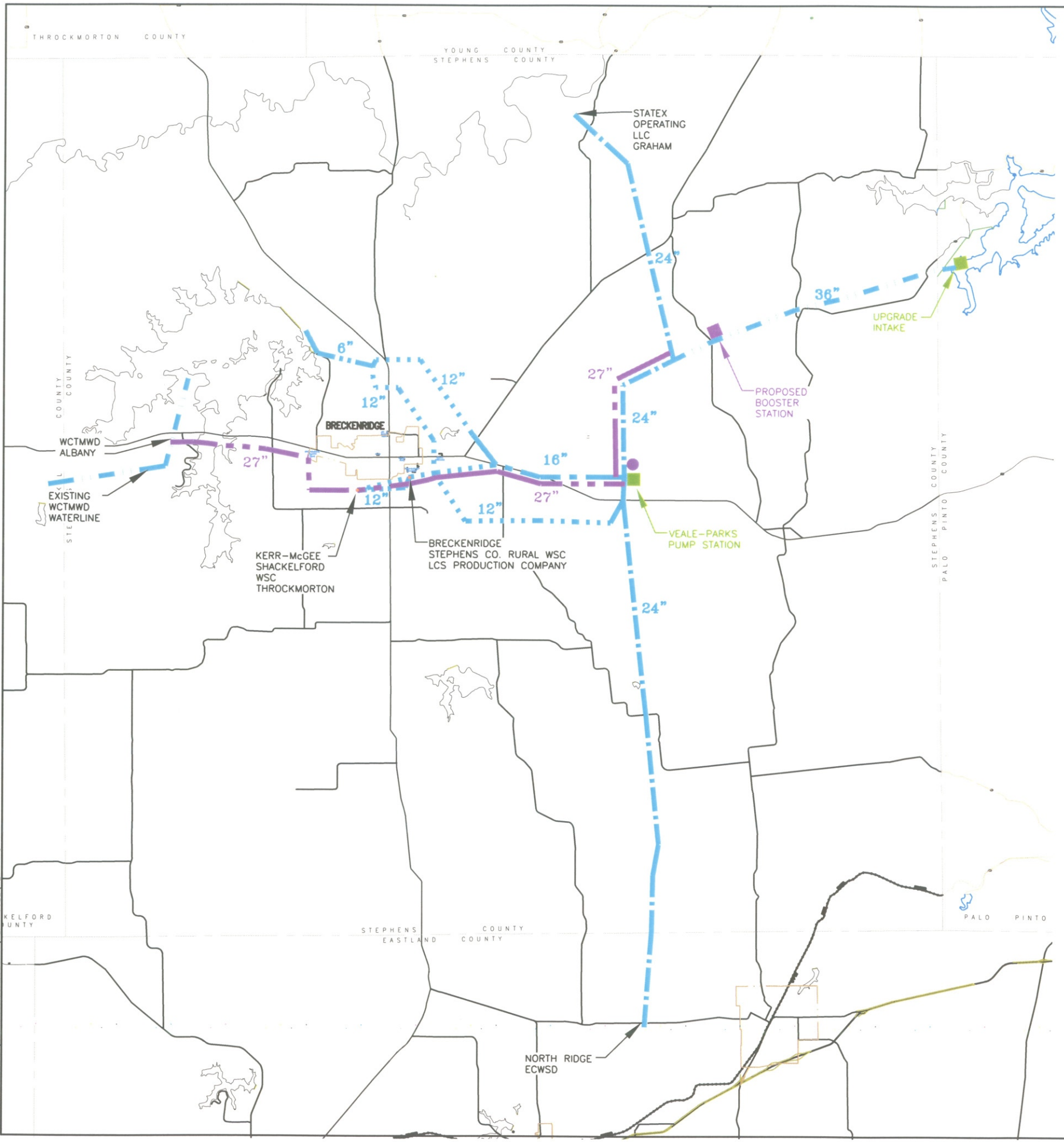
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**FIGURE F.10**  
 WEST CENTRAL BRAZOS  
 WATER DISTRIBUTION SYSTEM  
 WEST CENTRAL BRAZOS STUDY  
 SCENARIO #1



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SCENARIO #2					
LONG TERM DEMANDS					
SEE TABLE 4.6 FOR DEMAND SCENARIOS					

PIPELINE IMPROVEMENTS					
TYPE OF UPGRADE	FROM	TO	LENGTH (MILES)		
NEW 27"	VEALE-PARK PS	W. BRECKENRIDGE	6.84		
NEW 27"	W. BRECKENRIDGE	WCTMWD	9.41		
NEW 27"	STATEX SPLIT	VEALE PARK PS	5.62		

PUMP STATION IMPROVEMENTS					
TYPE OF UPGRADE	LOCATION	PUMP FLOW (MGD)	TDH (FEET)		
EXISTING UPGRADE	INTAKE	32.24	577		
NEW	INTERMEDIATE BOOSTER	58.04	350		
EXISTING UPGRADE	VEALE-PARKS	51.47	465		

TANK IMPROVEMENTS					
TYPE OF UPGRADE	LOCATION	TYPE OF TANK	SIZE (MG)	HEIGHT (FEET)	WATER LEVEL (FEET)
NEW	VEALE-PARKS	GST	5.0	40	39

**LEGEND**

**EXISTING**

WATER LINE: Blue dashed line

PUMP STATION: Blue square

STORAGE TANK: Blue circle

**CURRENTLY PROPOSED**

WATER LINE: Red solid line

PUMP STATION: Red square

STORAGE TANK: Red circle

**BRA UPGRADE PROPOSAL**

14" WATER LINE: Green dashed line

PUMP STATION: Green square

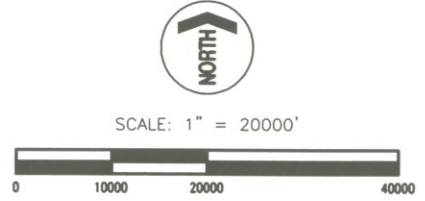
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**BRA NEW PROPOSALS**

WATER LINE: Purple solid line

PUMP STATION: Purple square

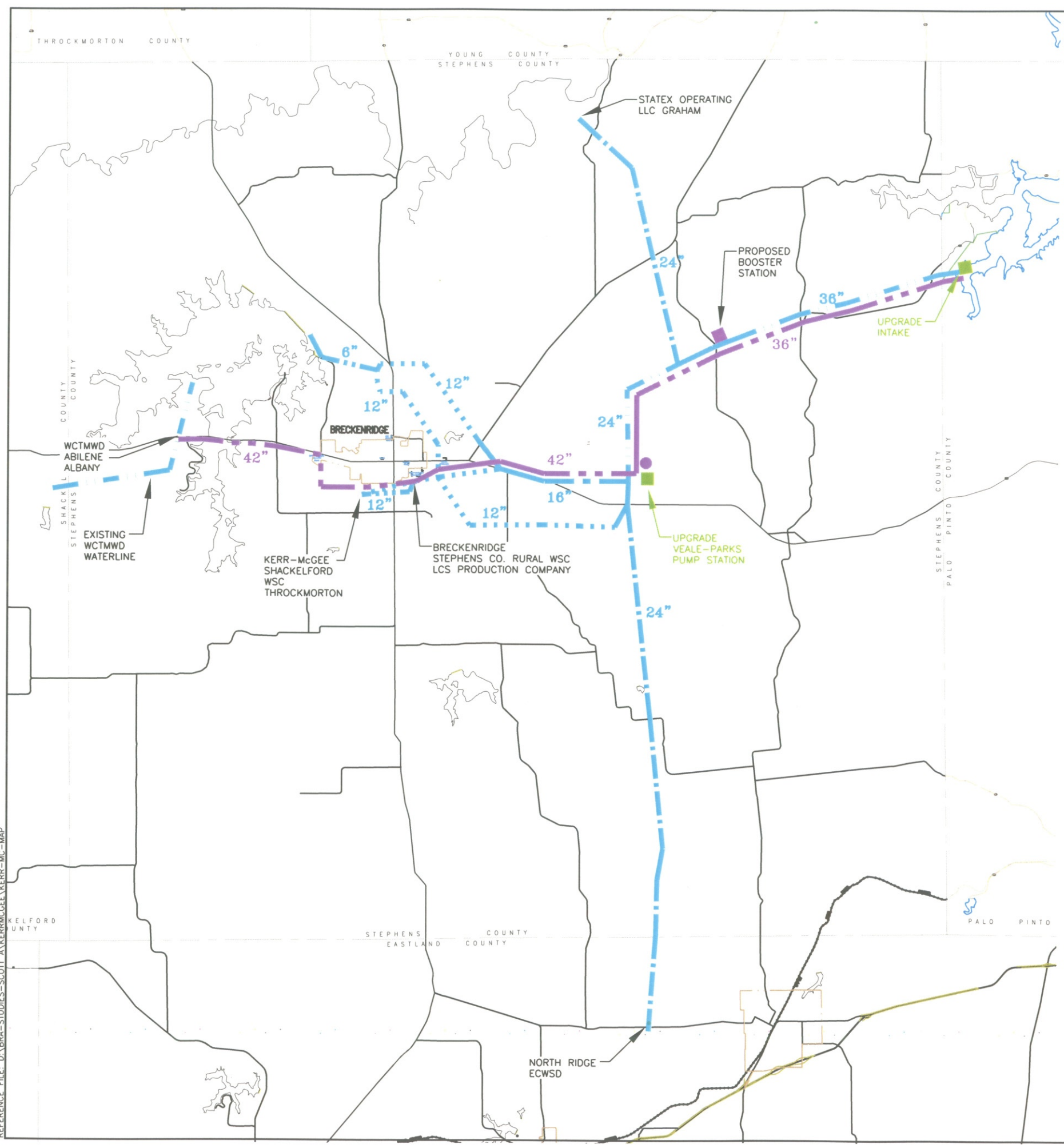
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**FIGURE F.11**  
**WEST CENTRAL BRAZOS**  
**WATER DISTRIBUTION SYSTEM**  
**WEST CENTRAL BRAZOS STUDY**  
**SCENARIO #2**



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**SCENARIO #3**

LONG TERM DEMANDS W/ ABILENE  
 SEE TABLE 4.6 FOR DEMAND SCENARIOS

**PIPELINE IMPROVEMENTS**

TYPE OF UPGRADE	FROM	TO	LENGTH (MILES)
NEW 36"	INTAKE	ILPS	8.65
NEW 36"	ILPS	STATETX SPLIT	1.24
NEW 36"	STATETX SPLIT	J7	2.70
NEW 36"	J7	VEALE-PARK PS	2.92
NEW 42"	VEALE-PARK PS	W. BRECKENRIDGE	6.84
NEW 42"	W. BRECKENRIDGE	WCTMWD	9.41

**PUMP STATION IMPROVEMENTS**

TYPE OF UPGRADE	LOCATION	PUMP FLOW (MGD)	TDH (FEET)
EXISTING UPGRADE	INTAKE	56.04	577
NEW	INTERMEDIATE BOOSTER	56.04	350
EXISTING UPGRADE	VEALE-PARKS	56.04	465

**TANK IMPROVEMENTS**

TYPE OF UPGRADE	LOCATION	TYPE OF TANK	SIZE (MG)	HEIGHT (FEET)	WATER LEVEL (FEET)
NEW	VEALE-PARKS	GST	5.0	40	39

**LEGEND**

**EXISTING**

WATER LINE: Blue solid line

PUMP STATION: Blue square

STORAGE TANK: Blue circle

**CURRENTLY PROPOSED**

WATER LINE: Red solid line

PUMP STATION: Red square

STORAGE TANK: Red circle

**BRA UPGRADE PROPOSAL**

14" WATER LINE: Green dashed line

PUMP STATION: Green square

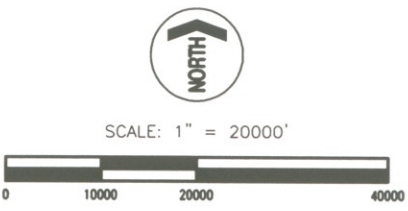
STORAGE TANK: Green circle

**BRA NEW PROPOSALS**

WATER LINE: Purple solid line

PUMP STATION: Purple square

STORAGE TANK: Purple circle



**FIGURE F.12**  
 WEST CENTRAL BRAZOS  
 WATER DISTRIBUTION SYSTEM  
 WEST CENTRAL BRAZOS STUDY  
 SCENARIO #3

**TABLE F.13**  
**BRAZOS RIVER AUTHORITY**  
**WEST CENTRAL BRAZOS STUDY**  
**WEST CENTRAL BRAZOS WATER DISTRIBUTION SYSTEM**  
**SHORT TERM IMPROVEMENTS**  
**2003**

**CONSTRUCTION COSTS**

1	20" PVC Water Line	36,100 LF @ \$51.00/LF	\$1,841,100
2	Valves	Lump Sum	\$100,000
3	Bore & Encasement	Lump Sum	\$150,000
4	Pump Station Improvements	2 EACH @ \$100,000	\$200,000
5	Master Meter & Regulator	2 EACH @ \$10,000	\$20,000
6	SCADA System	4 EACH @ \$20,000	\$80,000
7	Project Contingencies		\$39,000
			<b><u>\$2,430,100</u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$20,000
Basic Engineering	\$180,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$80,000
Surveying	\$50,000
Testing, Permitting, Etc.	\$20,000
	<b><u>\$380,000</u></b>
	<b><u>\$2,810,100</u></b>

**TABLE F.14**  
**BRAZOS RIVER AUTHORITY**  
**WEST CENTRAL BRAZOS STUDY**  
**WEST CENTRAL BRAZOS WATER DISTRIBUTION SYSTEM**  
**LONG TERM IMPROVEMENTS**  
**2003**

**CONSTRUCTION COSTS**

1	27" PVC Water Line	121,800 LF @ \$73.00/LF	\$8,891,400
2	Valves	Lump Sum	\$150,000
3	Bore & Encasement	Lump Sum	\$200,000
4	Pump Station Improvements	2 EACH @ \$150,000	\$300,000
5	In-line Pump Station	1 EACH @ \$200,000	\$200,000
6	Master Meter & Regulator	7 EACH @ \$10,000	\$70,000
7	SCADA System	4 EACH @ \$20,000	\$80,000
8	Project Contingencies		\$693,000
			<b><u>\$10,584,400</u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$110,000
Basic Engineering	\$640,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$320,000
Surveying	\$220,000
Testing, Permitting, Etc.	\$50,000
	<b><u>\$1,370,000</u></b>
	<b><u>\$11,954,400</u></b>



**TABLE F.15**  
**BRAZOS RIVER AUTHORITY**  
**WEST CENTRAL BRAZOS STUDY**  
**WEST CENTRAL BRAZOS WATER DISTRIBUTION SYSTEM**  
**LONG TERM IMPROVEMENTS WITH ABILENE**  
**2003**

**CONSTRUCTION COSTS**

1	42" PVC Water Line	86,000 LF @ \$110.00/LF	\$9,460,000
2	36" PVC Water Line	82,000 LF @ \$98.00/LF	\$8,036,000
3	Valves	Lump Sum	\$820,000
4	Bore & Encasement	Lump Sum	\$500,000
5	Pump Station Improvements	2 EACH @ \$100,000	\$200,000
6	Pump Station Improvements	1 EACH @ \$200,000	\$200,000
7	Master Meter & Regulator	8 EACH @ \$10,000	\$80,000
8	SCADA System	4 EACH @ \$20,000	\$80,000
9	Project Contingencies		\$1,357,000
			<b><u>\$20,733,000</u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$110,000
Basic Engineering	\$1,040,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$630,000
Surveying	\$420,000
Testing, Permitting, Etc.	\$210,000
	<b><u>\$2,440,000</u></b>
	<b><u>\$23,173,000</u></b>

### **3. Conclusions**

Various factors affect the feasibility of each of the possible regional projects discussed. The cost involved in implementing the proposed regional projects compared to the level of need is certainly the most important consideration. The likelihood of other sources becoming available at less cost compared to those proposed must also be considered. Other factors specific to each system could affect the feasibility of the plan as well.

#### **Abilene to North Central Texas MWA**

The proposed supply line between the City of Abilene and Hamlin is under design and will be installed within a relatively short period of time. There are few feasible alternatives for providing an alternate source of water to either North Central Texas MWA or the city of Haskell. Groundwater has been investigated, however, only small quantities of water with poor quality are available. Also, providing the interconnection between Haskell and Stamford would have a much greater impact on the region. No other alternative could provide additional water to so many entities. The proposed line between Haskell and Stamford has been discussed in the past and has had support from the communities. The City of Anson currently takes raw water from Hubbard Creek Reservoir. Another potential source is a well field east of the City. The quality of this water is very poor and advanced treatment such as reverse osmosis would be necessary to utilize any significant quantity. The City of Anson has no other viable source of potable water and the proximity of the Hamlin line to Anson provides the city with an economical alternative. The city would only have to upsize the portion of the Hamlin line back to Abilene and run another line the short distance to the Anson treatment plant. This scenario is feasible and is beneficial for each entity.

#### **Steamboat Mountain Water Supply Corporation**

The City of Lawn is currently seeking a new treated water supply in order to abandon the city's existing water treatment plant. The city of Abilene can make water available, but Lawn would have to run a line approximately 13 miles in order to connect. Steamboat Mountain WSC has water lines and pressure facilities that run from Abilene to near the City of Lawn. These facilities could be upgraded to convey additional water from Abilene for Lawn. The amount of

upgrades would be marginally less extensive than required to run a water line directly from Abilene; however, the cost of water from Abilene would likely be considerably less than that from Steamboat Mountain WSC. Considering both factors, it appears that a direct connection would be more feasible.

### **Westbound Water Supply Corporation**

As stated, Westbound Water Supply Corporation has been awarded a grant by USDA Rural Development to make extensive improvements to its water distribution system. These improvements will be installed in close proximity to the cities of Cross Plains and Rising Star. Only relatively minor improvements would be necessary to provide both entities with an alternate water supply. The City of Cross Plains' current water supply appears to be adequate and the improvements that Westbound WSC is making will allow some water to be transported to the City without any upgrades. Therefore, the cost of upgrading the Westbound project may not be justified for Cross Plains. The City of Rising Star's water supply appears to be less secure. The quality of groundwater in the area is questionable. The quantity is not certain either especially with other entities in the area turning to the use of groundwater. There is no other potential supply for the City of Rising Star and the cost of treatment of the groundwater would likely be high due to the advanced form of treatment required. Further review is needed regarding advanced treatment, but an interconnection with Westbound WSC is a feasible alternative for the City of Rising Star.

### **Eastland County Water Supply District**

The south leg of the existing WCBWDS pipeline ends in northern Eastland County and Ranger. This 24-inch pipeline provides raw water for the North Ridge Corporation. Enough water could be transferred through the line to provide an additional source to several entities in the area. Eastland County WSD currently provides service to most of the entities in the area. The City of Cisco to the west treats water from Lake Cisco at its existing water treatment plant. A possible supplement to this supply could be through the WCBWDS line. Eastland County WSD has requested water from the BRA through this line and could treat the water and transport it to Cisco through its existing facilities. However, the City of Cisco could take raw water at the end of the West Central Brazos WDS line and treat it at the city's own plant. Alternatively,

Eastland County WSD could supply Cisco with treated water from Lake Leon through the city of Eastland. Pending agreements with the city of Eastland and Eastland County WSD, this is a feasible alternative.

The City of Gorman currently takes water from Upper Leon Municipal Water District and appears to have a sufficient supply. The cost of running a water line from the Eastland County treatment plant as proposed would be very high. This does not appear to be a feasible option for Gorman.

The City of Strawn currently treats water from a local city lake. The city may not be able to finance the types of improvements that will be necessary to keep up with ever more stringent regulations. The cost of these improvements also may not be justifiable for a limited source such as this city lake. The city could potentially connect to the Eastland County WSD system and take treated water. Both capital costs and on-going costs would be comparable and possibly less than maintaining the current supply. Eastland County WSD appears to have excess capacity out of Lake Leon. It may not be necessary, therefore, for the District to purchase water off of the WCBWDS pipeline unless a number of additional customers are added. The District could provide water to Strawn with water currently permitted in Lake Leon.

### **Shackelford WSC and Stephens County Rural WSC**

The Midway Group has been attempting to secure additional water sources for some time. This group includes the City of Throckmorton and other entities with uncertain water supplies. These entities have made requests of the BRA for water supplies from Possum Kingdom Lake using WCBWDS. Shackelford WSC and Stephens County Rural WSC systems are between the WCBWDS pipeline and the City of Throckmorton. Both systems also have applied for funding through Rural Development to finance extensive system improvements. These improvements could be upgraded to provide a supply to the city of Throckmorton equal to approximately one-third of its current peak needs. The city recently was restricted to this amount due to severe drought. In light of the recent water shortage in Throckmorton and the uncertainty of the City's contract with Graham, this potential source may be necessary even though it would not provide all of the City's needs. Other than installing facilities all the way to the WCBWDS line, there are few other sources available to the city at this time. The proposed system upgrades could allow water to be transported to the Haskell/Throckmorton county line for a possible

interconnection with Paint Creek WSC. The Paint Creek WSC could use this supply to serve the southeastern portion of its system or approximately 50 customers. The improvements necessary to provide this amount of water would not be extensive. In all, the proposed scenario would interconnect at least nine systems including: Albany, Breckenridge, Ft. Belknap WSC, Graham, Paint Creek WSC, Stamford, Stephens County Rural WSC, Shackelford WSC and Throckmorton.

### **Zephyr Water Supply Corporation**

Zephyr Water Supply Corporation has completed plans for water system improvements through a grant by USDA Rural. These improvements will make it possible for the Corporation to move water into the northeast portion of Brown County. The number of potential water users in this portion of the County would justify additional improvements to provide service in the area. The proposed project would provide a potable water supply to an area where extension of service has not been previously feasible. No further upgrade to Zephyr WSC's existing system or proposed improvements will be necessary; therefore, the cost should not be prohibitive.

### **West Central Brazos Water Distribution System Pipeline**

The WCBWDS pipeline is a relatively unused system which could potentially provide water to a large portion of the study area. The BRA has received requests from numerous area water suppliers including the Midway Group for water which could be conveyed through the WCBWDS facilities. With only pump station improvements and minor pipeline repairs, the facilities have enough capacity to serve the existing customers and the Midway Group's current needs. With the addition of a booster station and some pipeline, the facilities could serve the additional requests of West Central Texas MWD, Eastland County WSD, the City of Graham, and the City of Albany. Extensive improvements would be necessary to provide the requested supply to the City of Abilene, although facilities are in place from the WCBWDS intake all the way to Abilene. Without considering Abilene, the WCBWDS pipeline could impact 20 or more entities.



**TABLE F.11**  
**BRAZOS RIVER AUTHORITY**  
**WEST CENTRAL BRAZOS STUDY**  
**ZEPHYR WATER SUPPLY CORPORATION**  
**SUPPLY TO NORTHEAST BROWN COUNTY**  
**2003**

**CONSTRUCTION COSTS**

1	8" PVC Water Line	13,700 LF @ \$20.00/LF	\$274,000
2	6" PVC Water Line	21,600 LF @ \$15.00/LF	\$324,000
3	4" PVC Water Line	63,800 LF @ \$13.00/LF	\$829,400
6	3" PVC Water Line	38,600 LF @ \$11.00/LF	\$424,600
7	2" PVC Water Line	4,900 LF @ \$8.00/LF	\$39,200
8	Valves	Lump Sum	\$160,000
9	Bore & Encasement	Lump Sum	\$120,000
10	Pump Station Improvements	3 EACH @ \$100,000	\$300,000
11	Master Meter & Regulator	2 EACH @ \$10,000	\$20,000
12	SCADA System	2 EACH @ \$20,000	\$40,000
13	Project Contingencies		\$178,000
			<b><u>\$2,709,200</u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$30,000
Basic Engineering	\$190,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$90,000
Surveying	\$60,000
Testing, Permitting, Etc.	\$30,000
	<b><u>\$430,000</u></b>
	<b><u>\$3,139,200</u></b>

**TABLE F.15**  
**BRAZOS RIVER AUTHORITY**  
**WEST CENTRAL BRAZOS STUDY**  
**WEST CENTRAL BRAZOS WATER DISTRIBUTION SYSTEM**  
**LONG TERM IMPROVEMENTS WITH ABILENE**  
**2003**

**CONSTRUCTION COSTS**

1	42" PVC Water Line	86,000 LF @ \$110.00/LF	\$9,460,000
2	36" PVC Water Line	82,000 LF @ \$98.00/LF	\$8,036,000
3	Valves	Lump Sum	\$820,000
4	Bore & Encasement	Lump Sum	\$500,000
5	Pump Station Improvements	2 EACH @ \$100,000	\$200,000
6	Pump Station Improvements	1 EACH @ \$200,000	\$200,000
7	Master Meter & Regulator	8 EACH @ \$10,000	\$80,000
8	SCADA System	4 EACH @ \$20,000	\$80,000
9	Project Contingencies		\$1,357,000
			<b><u><u>\$20,733,000</u></u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$110,000
Basic Engineering	\$1,040,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$630,000
Surveying	\$420,000
Testing, Permitting, Etc.	\$210,000
	<b><u><u>\$2,440,000</u></u></b>
	<b><u><u>\$23,173,000</u></u></b>

**TABLE F.14**  
**BRAZOS RIVER AUTHORITY**  
**WEST CENTRAL BRAZOS STUDY**  
**WEST CENTRAL BRAZOS WATER DISTRIBUTION SYSTEM**  
**LONG TERM IMPROVEMENTS**  
**2003**

**CONSTRUCTION COSTS**

1	27" PVC Water Line	121,800 LF @ \$73.00/LF	\$8,891,400
2	Valves	Lump Sum	\$150,000
3	Bore & Encasement	Lump Sum	\$200,000
4	Pump Station Improvements	2 EACH @ \$150,000	\$300,000
5	In-line Pump Station	1 EACH @ \$200,000	\$200,000
6	Master Meter & Regulator	7 EACH @ \$10,000	\$70,000
7	SCADA System	4 EACH @ \$20,000	\$80,000
8	Project Contingencies		\$693,000
			<b><u>\$10,584,400</u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$110,000
Basic Engineering	\$640,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$320,000
Surveying	\$220,000
Testing, Permitting, Etc.	\$50,000
<b><u>\$1,370,000</u></b>	
<b><u>\$11,954,400</u></b>	

**TABLE F.13**  
**BRAZOS RIVER AUTHORITY**  
**WEST CENTRAL BRAZOS STUDY**  
**WEST CENTRAL BRAZOS WATER DISTRIBUTION SYSTEM**  
**SHORT TERM IMPROVEMENTS**  
**2003**

**CONSTRUCTION COSTS**

1	20" PVC Water Line	36,100 LF @ \$51.00/LF	\$1,841,100
2	Valves	Lump Sum	\$100,000
3	Bore & Encasement	Lump Sum	\$150,000
4	Pump Station Improvements	2 EACH @ \$100,000	\$200,000
5	Master Meter & Regulator	2 EACH @ \$10,000	\$20,000
6	SCADA System	4 EACH @ \$20,000	\$80,000
7	Project Contingencies		\$39,000
			<b><u><u>\$2,430,100</u></u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$20,000
Basic Engineering	\$180,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$80,000
Surveying	\$50,000
Testing, Permitting, Etc.	\$20,000
	<b><u><u>\$380,000</u></u></b>
	<b><u><u>\$2,810,100</u></u></b>

**TABLE F.6  
BRAZOS RIVER AUTHORITY  
WEST CENTRAL BRAZOS STUDY  
SUPPLY TO CISCO DIRECT FROM BRA  
2003**

**CONSTRUCTION COSTS**

1	14" PVC Water Line	65,000 LF @ \$32.00/LF	\$2,080,000
2	Valves	Lump Sum	\$50,000
3	Bore & Encasement	Lump Sum	\$50,000
4	Pump Station & GST	1 EACH @ \$800,000	\$800,000
5	0.5 MG GST at Cisco WTP	1 EACH @ \$300,000	\$300,000
6	Master Meter & Regulator	1 EACH @ \$10,000	\$10,000
7	SCADA System	2 EACH @ \$20,000	\$40,000
8	Project Contingencies		\$234,000
			<b><u>\$3,564,000</u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$40,000
Basic Engineering	\$250,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$110,000
Surveying	\$80,000
Testing, Permitting, Etc.	\$40,000
	<b><u>\$550,000</u></b>
	<b><u>\$4,114,000</u></b>



**TABLE F.9**  
**BRAZOS RIVER AUTHORITY**  
**WEST CENTRAL BRAZOS STUDY**  
**SUPPLY TO GORMAN FROM EASTLAND COUNTY WSD**  
**2003**

**CONSTRUCTION COSTS**

1	8" PVC Water Line	100,000 LF @ \$20.00/LF	\$2,000,000
2	Valves	Lump Sum	\$100,000
3	Bore & Encasement	Lump Sum	\$45,000
4	Master Meter & Regulator	1 EACH @ \$10,000	\$10,000
5	SCADA System	2 EACH @ \$20,000	\$40,000
6	Project Contingencies		\$154,000
			<b><u>\$2,349,000</u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$30,000
Basic Engineering	\$180,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$80,000
Surveying	\$50,000
Testing, Permitting, Etc.	\$30,000
	<b><u>\$400,000</u></b>
	<b><u>\$2,749,000</u></b>

**TABLE F.8**  
**BRAZOS RIVER AUTHORITY**  
**WEST CENTRAL BRAZOS STUDY**  
**SUPPLY TO STRAWN FROM EASTLAND COUNTY WSD**  
**2003**

**CONSTRUCTION COSTS**

1	6" PVC Water Line	68,200 LF @ \$15.00/LF	\$1,023,000
2	Valves	Lump Sum	\$60,000
3	Bore & Encasement	Lump Sum	\$40,000
4	Master Meter & Regulator	1 EACH @ \$10,000	\$10,000
5	SCADA System	2 EACH @ \$20,000	\$40,000
6	Project Contingencies		\$83,000
			<b><u><u>\$1,256,000</u></u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$20,000
Basic Engineering	\$110,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$40,000
Surveying	\$30,000
Testing, Permitting, Etc.	\$20,000
	<b><u><u>\$250,000</u></u></b>
	<b><u><u>\$1,506,000</u></u></b>

**TABLE F.5**  
**BRAZOS RIVER AUTHORITY**  
**WEST CENTRAL BRAZOS STUDY**  
**RAW WATER SUPPLY TO EASTLAND COUNTY WSD FROM BRA**  
**2003**

**CONSTRUCTION COSTS**

1	14" PVC Water Line	50,000 LF @ \$32.00/LF	\$1,600,000
2	Valves	Lump Sum	\$40,000
3	Bore & Encasement	Lump Sum	\$50,000
4	Pump Station & GST	1 EACH @ \$800,000	\$800,000
5	Master Meter & Regulator	1 EACH @ \$10,000	\$10,000
6	SCADA System	2 EACH @ \$20,000	\$40,000
7	Project Contingencies		\$178,000
			<b><u><u>\$2,718,000</u></u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$30,000
Basic Engineering	\$200,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$90,000
Surveying	\$60,000
Testing, Permitting, Etc.	\$30,000
	<b><u><u>\$440,000</u></u></b>
	<b><u><u>\$3,158,000</u></u></b>

**TABLE F.10**  
**BRAZOS RIVER AUTHORITY**  
**WEST CENTRAL BRAZOS STUDY**  
**SUPPLY TO THROCKMORTON**  
**FROM SHACKELFORD STEPHENS COUNTY RURAL WSC's**  
**2003**

**CONSTRUCTION COSTS**

1	Upsize 8" to 10" Water Line	15,000 LF @ \$3.00/LF	\$45,000
2	Upsize 6" to 8" Water Line	33,000 LF @ \$5.00/LF	\$165,000
3	Upsize 3" to 6" Water Line	13,000 LF @ \$4.00/LF	\$52,000
4	6" PVC Water Line	68,000 LF @ \$15.00/LF	\$1,020,000
5	Valves	Lump Sum	\$110,000
6	Bore & Encasement	Lump Sum	\$100,000
7	Pump Station Improvements	7 EACH @ \$100,000	\$700,000
8	Upsize Elevated Tank	1 EACH @ \$75,000	\$75,000
9	In-line Pump Station	1 EACH @ \$150,000	\$150,000
10	Master Meter & Regulator	2 EACH @ \$10,000	\$20,000
11	SCADA System	10 EACH @ \$20,000	\$200,000
12	Project Contingencies		\$185,000
			<b><u>\$2,822,000</u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$30,000
Basic Engineering	\$200,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$90,000
Surveying	\$60,000
Testing, Permitting, Etc.	\$30,000
	<b><u>\$440,000</u></b>

**\$3,262,000**

**TABLE F.4**  
**BRAZOS RIVER AUTHORITY**  
**WEST CENTRAL BRAZOS STUDY**  
**SUPPLY TO RISING STAR AND CROSS PLAINS**  
**FROM WESTBOUND WSC**  
**2003**

**CONSTRUCTION COSTS**

1	Upsize 8" to 12" Water Line	16,800 LF @ \$8.00/LF	\$134,400
2	Upsize 8" to 10" Water Line	24,800 LF @ \$3.00/LF	\$74,400
3	Upsize 6" to 10" Water Line	16,300 LF @ \$8.00/LF	\$130,400
4	Upsize 4" to 8" Water Line	37,800 LF @ \$5.00/LF	\$189,000
5	Upsize 3" to 6" Water Line	4,600 LF @ \$4.00/LF	\$18,400
6	6" PVC Water Line	3,400 LF @ \$15.00/LF	\$51,000
7	3" PVC Water Line	4,600 LF @ \$11.00/LF	\$50,600
8	Valves	Lump Sum	\$60,000
9	Bore & Encasement	Lump Sum	\$120,000
10	Pump Station Improvements	3 EACH @ \$100,000	\$300,000
11	Master Meter & Regulator	2 EACH @ \$10,000	\$20,000
12	SCADA System	2 EACH @ \$20,000	\$40,000
13	Project Contingencies		\$84,000
			<b><u><u>\$1,272,200</u></u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$20,000
Basic Engineering	\$90,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$40,000
Surveying	\$30,000
Testing, Permitting, Etc.	\$20,000
	<b><u><u>\$230,000</u></u></b>

**\$1,502,200**



**TABLE F.3**  
**BRAZOS RIVER AUTHORITY**  
**WEST CENTRAL BRAZOS STUDY**  
**SUPPLY TO LAWN FROM STEAMBOAT-MOUNTAIN WSC**  
**2003**

**CONSTRUCTION COSTS**

1	10" PVC Water Line	14,400 LF @ \$23.00/LF	\$331,200
2	8" PVC Water Line	41,000 LF @ \$20.00/LF	\$820,000
3	Valves	Lump Sum	\$30,000
4	Bore & Encasement	Lump Sum	\$50,000
5	Pump Station	1 EACH @ \$175,000	\$175,000
6	Pump Station Improvements	1 EACH @ \$75,000	\$75,000
7	New Elevated GST	1 EACH @ \$175,000	\$175,000
8	Master Meter & Regulator	1 EACH @ \$10,000	\$10,000
9	SCADA System	2 EACH @ \$20,000	\$40,000
10	Project Contingencies		\$120,000
			<b><u><u>\$1,826,200</u></u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$20,000
Basic Engineering	\$130,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$60,000
Surveying	\$40,000
Testing, Permitting, Etc.	\$20,000
<b><u><u>\$300,000</u></u></b>	
<b><u><u>\$2,126,200</u></u></b>	

**TABLE F.1**  
**BRAZOS RIVER AUTHORITY**  
**WEST CENTRAL BRAZOS STUDY**  
**ABILENE TO NORTH CENTRAL TEXAS MWA**  
**REGIONAL IMPROVEMENTS WITH ANSON**  
**2003**

**CONSTRUCTION COSTS**

1	Upsize 14" PVC Water Line to 18"	114,000 LF @ \$10.00/LF	\$1,140,000
2	14" PVC Water Line	106,000 LF @ \$32.00/LF	\$3,392,000
3	Valves	Lump Sum	\$110,000
4	Bore & Encasement	Lump Sum	\$150,000
5	Pump Station Improvements	3 EACH @ \$50,000	\$150,000
6	Pump Station	2 EACH @ \$200,000	\$400,000
7	Upsize 0.5 MG GST to 1.0 MG	1 EACH @ \$200,000	\$200,000
8	Master Meter & Regulator	4 EACH @ \$10,000	\$40,000
9	SCADA System	6 EACH @ \$20,000	\$120,000
10	Project Contingencies		\$408,000
			<b><u>\$4,970,000</u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$50,000
Basic Engineering	\$300,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$150,000
Surveying	\$100,000
Testing, Permitting, Etc.	\$50,000
	<b><u>\$680,000</u></b>
	<b><u>\$5,650,000</u></b>

**TABLE F.2**  
**BRAZOS RIVER AUTHORITY**  
**WEST CENTRAL BRAZOS STUDY**  
**ABILENE TO NORTH CENTRAL TEXAS MWA**  
**REGIONAL IMPROVEMENTS**  
**2003**

**CONSTRUCTION COSTS**

1	14" PVC Water Line	85,100 LF @ \$32.00/LF	\$2,723,200
2	Valves	Lump Sum	\$60,000
3	Bore & Encasement	Lump Sum	\$114,000
4	Pump Station Improvements	3 EACH @ \$50,000	\$150,000
5	Pump Station	2 EACH @ \$200,000	\$400,000
6	Upsize 0.5 MG GST to 1.0 MG	1 EACH @ \$200,000	\$200,000
7	Master Meter & Regulator	3 EACH @ \$10,000	\$30,000
8	SCADA System	6 EACH @ \$20,000	\$120,000
9	Project Contingencies		\$266,000
			<b><u><u>\$4,063,200</u></u></b>

**NON-CONSTRUCTION COSTS**

Legal & Filing Fees	\$50,000
Basic Engineering	\$285,000
Preliminary Engineering & Environmental Assessment	\$30,000
Inspection	\$122,000
Surveying	\$82,000
Testing, Permitting, Etc.	\$30,000
	<b><u><u>\$599,000</u></u></b>

**\$4,662,200**

**TABLE F.12**  
**WEST CENTRAL BRAZOS WATER DISTRIBUTION SYSTEM**  
**PROJECTED DEMANDS**

<u>Customer/Utility</u>	<u>Peak Flow</u> (GPM)	<u>Peak Flow</u> (MGD)	<u>Water Loss</u> (%)	<u>Jct Node#</u>
1 Current (Per Letter 12/12/2002)			20	
Kerr-McGee Oil & Gas Onshore	930	1.34		25
Statex Operating LLC	310	0.45		31
North Ridge Corporation	228	0.33		13
2 Requests Short Term (Per Letter 12/12/2002 + Report 7/2002)			20	
Shackelford WSC	639	0.92		25
LCS Production Company	631	0.91		23
Breckenridge	2,036	2.93		23
Throckmorton	524	0.75		25
Stephens County Rural WSC	635	0.91		23
3 Requests Long Term (Per Letter 12/12/2002 + Report 7/2002)			10	
Albany	2,715	3.91		36
WCTMWD	4,063	5.85		36
Eastland County WSD	2,480	3.57		13
Graham	2,715	3.91		31
Stephens County Rural WSC	1,195	1.72		23
4 Abilene	18,598	26.78	10	36

Notes: 1. The demands are additive for each successive run.

2. Water loss was based on a percentage of known demands. The loss was decreased for higher use scenarios.