The Consensus Criteria for Environmental Flow Needs (CCEFN) (TWDB, August 1997), a three-staged criteria that uses percentages of reservoir capacity as triggers for determining the pass-through requirement, is used for modeling of the Cedar Ridge Reservoir. Pass-through flows are the monthly naturalized median flow when reservoir storage is greater than 80 percent of capacity, the monthly naturalized 25th percentile flow when the reservoir is between 50 and 80 percent of capacity, and the published 7Q2 when reservoir capacity is less than 50 percent of conservation capacity. The CCEFN values used include the median and quartile flows in Table 3.4.4-1 and the 7Q2 value of 1.5 cfs published in the Texas Surface Water Quality Standards. Cedar Ridge Reservoir is located well in excess of 200 river miles from the coast, so freshwater inflow needs for bays and estuaries are not explicitly considered herein, but are assumed to be sufficiently addressed by CCEFN.

The firm yield of the Cedar Ridge Reservoir is calculated using the Brazos WAM. The Brazos WAM simulates a repeat of the natural streamflows over the 58-year period of 1940 through 1997 accounting for the appropriated water rights of the Brazos River Basin with respect to location, priority date, diversion amount, diversion pattern, storage, and special conditions including instream flow requirements.

For the purposes of this study, Possum Kingdom Reservoir is assumed to be subordinated to Cedar Ridge Reservoir. Specific terms of such subordination are the subject of negotiations between reservoir sponsors and the Brazos River Authority (BRA). Estimates of Cedar Ridge Reservoir firm yield reported herein include no passage of inflow for senior water rights associated with Possum Kingdom Reservoir.

Four potential conservation storage capacities were modeled for the Cedar Ridge Reservoir. These conservation storage capacities are associated with 1410 ft-msl, 1420 ft-msl, 1430 ft-msl, and 1440 ft-msl conservation pool elevations. Table 3.4.4-2 includes the conservation storage capacities associated with these four conservation elevations.

Firm yield estimates for Cedar Ridge Reservoir for all four conservation pool elevations are shown in Table 3.4.4-3. Current planning initiatives envision a conservation pool elevation of 1430 ft-msl for the Cedar Ridge Reservoir, thereby yielding a firm supply of 36,891 acft/yr. For comparison purposes, the firm yield of the Cedar Ridge Reservoir at conservation pool elevation 1430 ft-msl without an environmental flow requirement is 39,225 acft/yr. Figure 3.4.4-4 shows the relationship between firm yield and conservation storage capacity for Cedar Ridge Reservoir.

Cedar Ridge Reservoir was most recently studied by HDR (HDR, January 2006) for the 2006 Brazos G Water Plan. The safe yield of Cedar Ridge Reservoir as reported therein is 31,910 acft/yr at conservation pool elevation 1430 ft-msl.

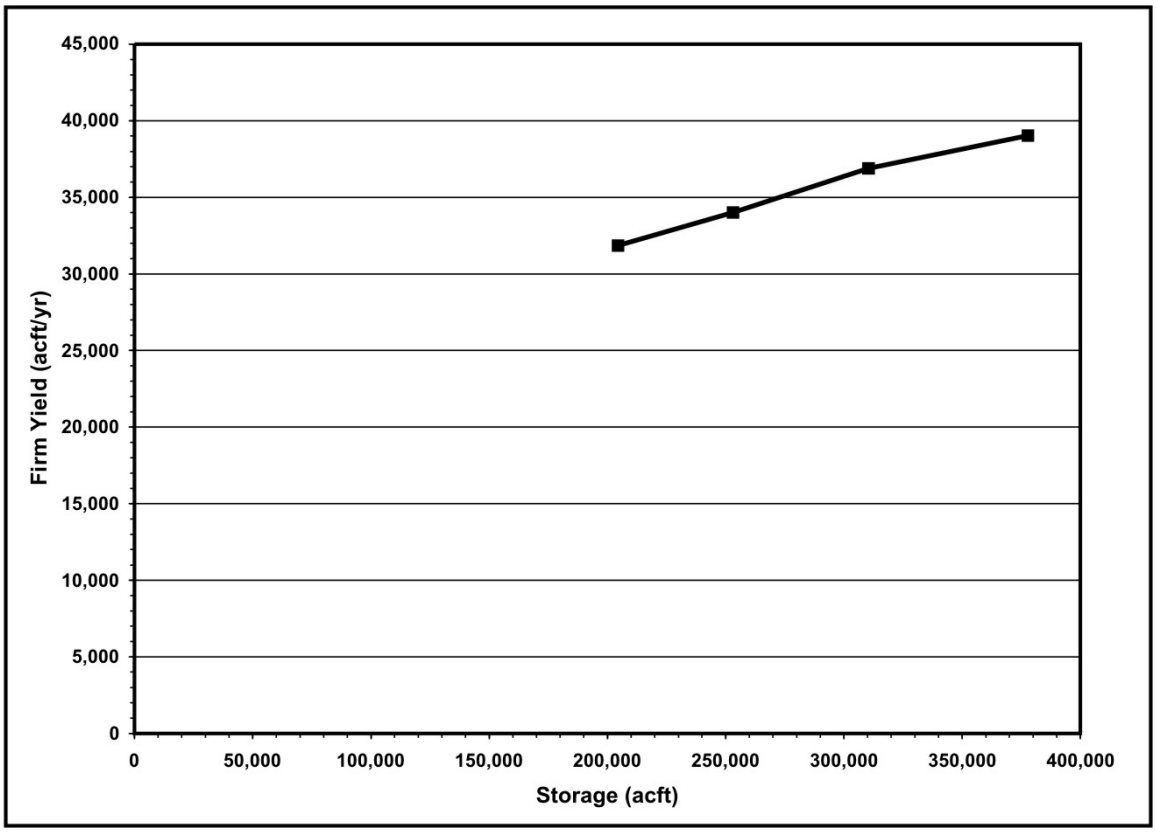

Figure 3.4.4-4. Firm Yield vs. Conservation Storage for Cedar Ridge Reservoir

Table 3.4.4-3.
Firm Yield vs. Conservation Storage for Cedar Ridge Reservoir

Conservation Pool Elevation (ft-msl)	*Conservation Storage (acft)*	*Environmental Bypass Criteria*	*Yield (acft/yr)*
1410.0	204,399	CCEFN	31,860
1420.0	253,125	CCEFN	34,000
1430.0*	310,383	CCEFN	36,891
		None	39,225
1440.0	377,727	CCEFN	39,033
*Proposed conservation storage.			

Figure 3.4.4-5 illustrates storage fluctuations through time for Cedar Ridge Reservoir subject to firm yield diversions and CCEFN. The reservoir storage frequency curve shown in Figure 3.4.4-5 indicates that the reservoir would be full approximately 4 percent of the time and more than half full about 64 percent of the time.

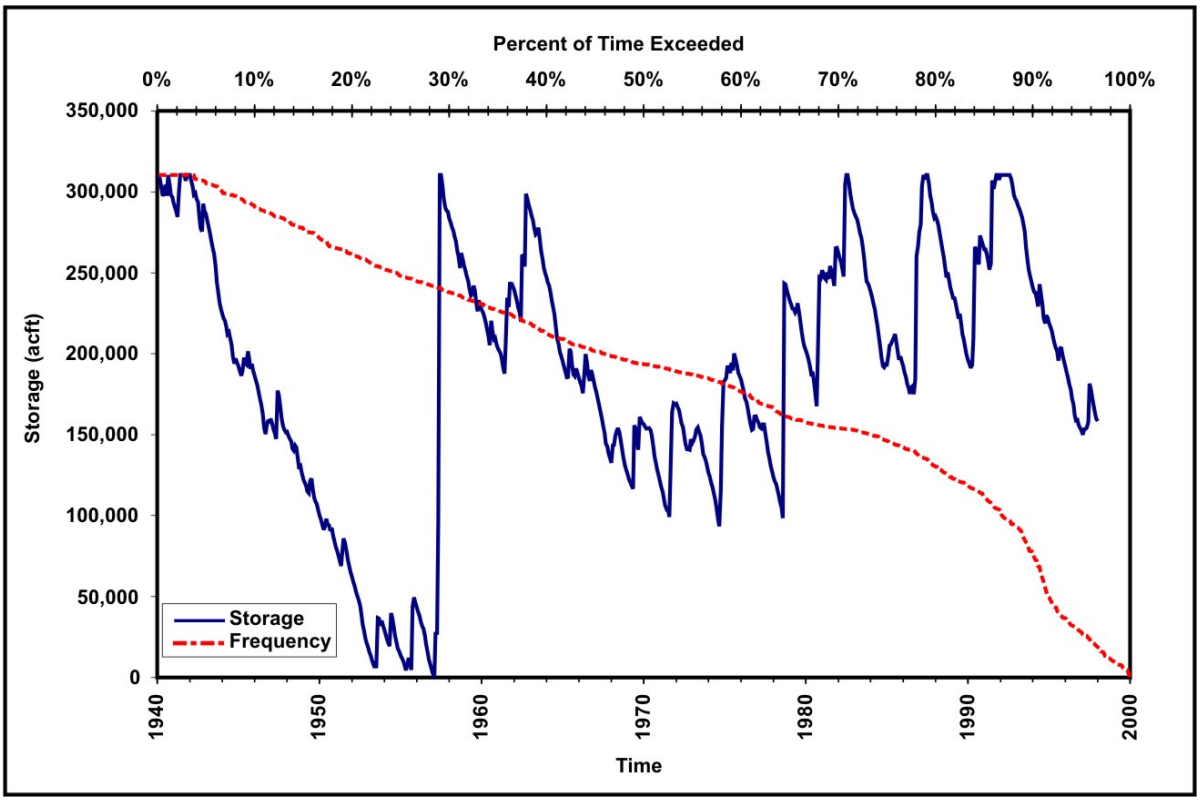

Figure 3.4.4-5. Simulated Storage in Cedar Ridge Reservoir (Conservation Elevation = 1430 ft-msl, Diversion = 36,891 acft/yr)

3.4.4.3 Reservoir Project Cost Estimates

The Cedar Ridge Reservoir includes the construction of an earth dam, principal spillway, emergency spillway, and appurtenant structures. The length of the dam is estimated at approximately 3,500 feet with a maximum height of 175 feet. The service spillway would include a Morning Glory intake; a 14-foot diameter outlet pipe, a stilling basin, and an outlet channel to convey up to 5,000 cfs. A summary cost estimate for Cedar Ridge Reservoir at elevation 1430 ft-msl is shown in Table 3.4.4-4. Dam and reservoir costs total about $62.4 million, while relocations add $18.7 million. Land, which includes mitigation lands, costs an additional $17.1 million. Annual costs for Cedar Ridge Reservoir are approximately

$8.5 million during the 40-year debt service period, giving the project a unit cost of raw water at the reservoir of $230/acft ($0.71 per 1,000 gallons).

Figure 3.4.4-6 shows the major conflicts within a 1-mile buffer of Cedar Ridge Reservoir. Major conflicts include oil and gas wells, and a power transmission line. According to TNRIS, there are 65 oil and gas wells within the conservation storage level (1430 ft-msl) of the reservoir. Resolution of facility conflicts represents approximately 17 percent of the total construction cost and could be less if the reservoir is constructed after economical recovery of oil and gas reserves is completed.

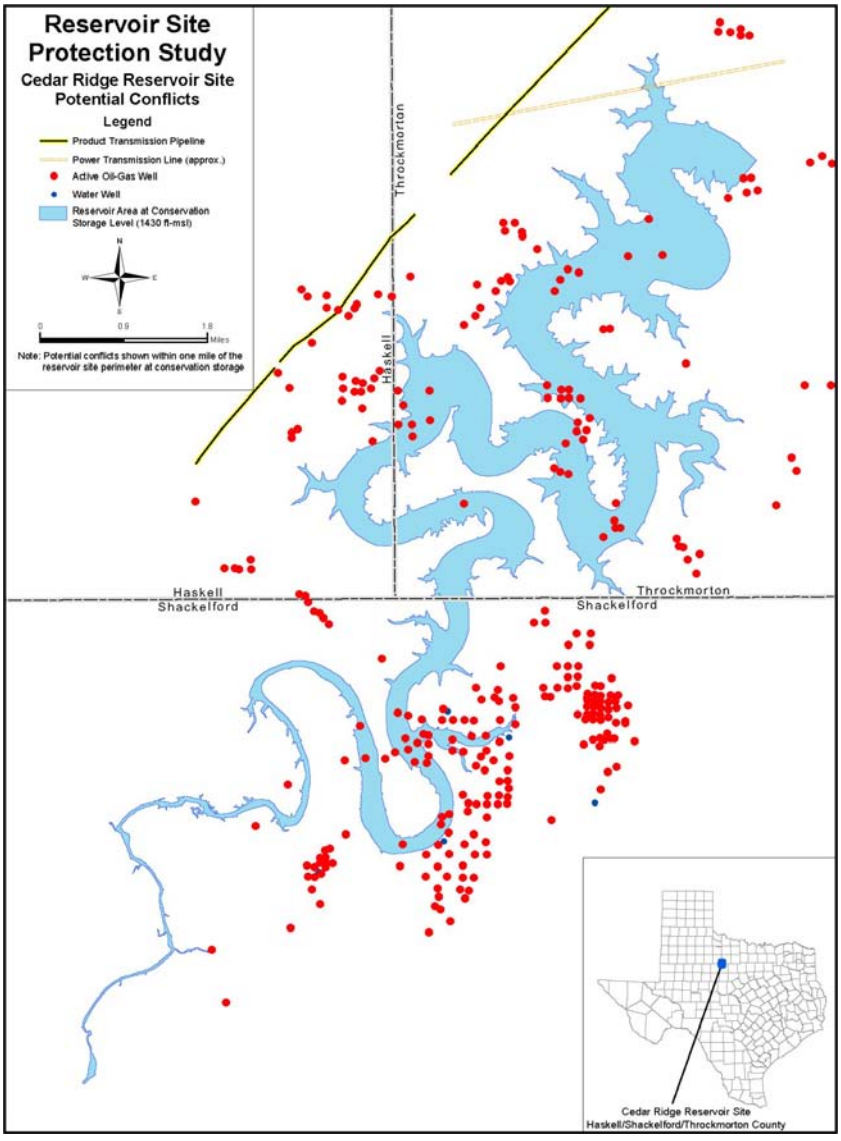

Figure 3.4.4-6. Potential Major Conflicts for Cedar Ridge Reservoir

Table 3.4.4-4.
Cost Estimate — Cedar Ridge Reservoir @ Elevation 1,430 ft-msl

	Quantity	*Unit*	*Unit Price*	*Cost*
Dam & Reservoir				
Mobilization (5%)		LS		$2,170,125
Clearing and Grubbing	100	AC	$2,000	$200,000
Care of Water During Construction (1%)		LS		$434,025
Required Excavation	998,000	CY	$2.50	$2,495,000
Borrow Excavation	4,378,000	CY	$2.00	$8,756,000
Random Compacted Fill	5,126,000	CY	$2.50	$12,815,000
Cut-Off Trench	37,000	SF	$15.00	$555,000
Rock Riprap	64,000	SY	$115.00	$7,360,000
Sand Filter Drain	4,900	CY	$35.00	$171,500
Outlet Works Tower and Conduit	1	LS	$6,200,000	$6,200,000
Power Drop	1	LS	$250,000	$250,000
Instrumentation	1	LS	$550,000	$550,000
Emergency Spillway	1	LS	$4,250,000	$4,250,000
Engineering Contingencies (35%)				$16,172,328
Subtotal Dam & Reservoir				**$62,378,978**
Conflicts				
Roads	1	LS	$10,980,000	$10,980,000
Existing Structures	1	LS	$1,250,000	$1,250,000
Oil and gas Wells	65	EA	$25,000	$1,620,000
Engineering Contingencies (35%)				$4,849,500
Subtotal Conflicts				**$18,704,500**
Land				
Land Acquisition	10,066	AC	$850	$8,556,100
Environmental Studies and Mitigation Lands	10,066	AC	$850	$8,556,100
Subtotal Land				**$17,112,200**
CONSTRUCTION TOTAL				**$98,195,428**
Interest During Construction (36 months)				$11,783,451
TOTAL COSTS				**$109,978,879**
ANNUAL COSTS				
Debt Service (6% for 40 Years)				$7,309,196
Operations & Maintenance				$935,685
Purchase of Water (BRA)	5,000	acft/yr	45.75	$228,750
Total Annual Costs				**$8,473,631**
Firm Yield (acft/yr)				**36,891**
Unit Costs of Water ($/acft/yr)				**$230**

Units: AC = Acre; CY = Cubic Yard; EA = Each; LB = Pound; LF = Linear Foot; LS = Lump Sum; SF = Square Foot; and SY = Square Yard.

3.4.4.4 Environmental Considerations

Cedar Ridge Reservoir would inundate a portion of TCEQ classified stream segment Number 1232. This segment is not listed by Texas Parks and Wildlife Department (TPWD) as an Ecologically Significant Stream Segment.

Cedar Ridge Reservoir will inundate 6,190 acres of land at conservation storage capacity. Table 3.4.4-5 and Figure 3.4.4-7 summarize existing landcover for the Cedar Ridge Reservoir site as determined by TPWD using methods described in Appendix C. Existing landcover within this reservoir site is dominated by shrubland (42 percent), grassland (31 percent), and upland deciduous forest (21 percent). The remainder of the site is classified as open water (6 percent).

Table 3.4.4-5.
Acreage and Percent Landcover for Cedar Ridge Reservoir

Landcover Classification	*Acreage*[1]	*Percent*
Shrubland	2,598	42.0%
Grassland	1,896	30.6%
Upland Deciduous Forest	1,314	21.3%
Open Water	379	6.1%
Total	6,187	100.0%

[1] Acreage based on approximate GIS coverage rather than calculated elevation-area-capacity relationship.

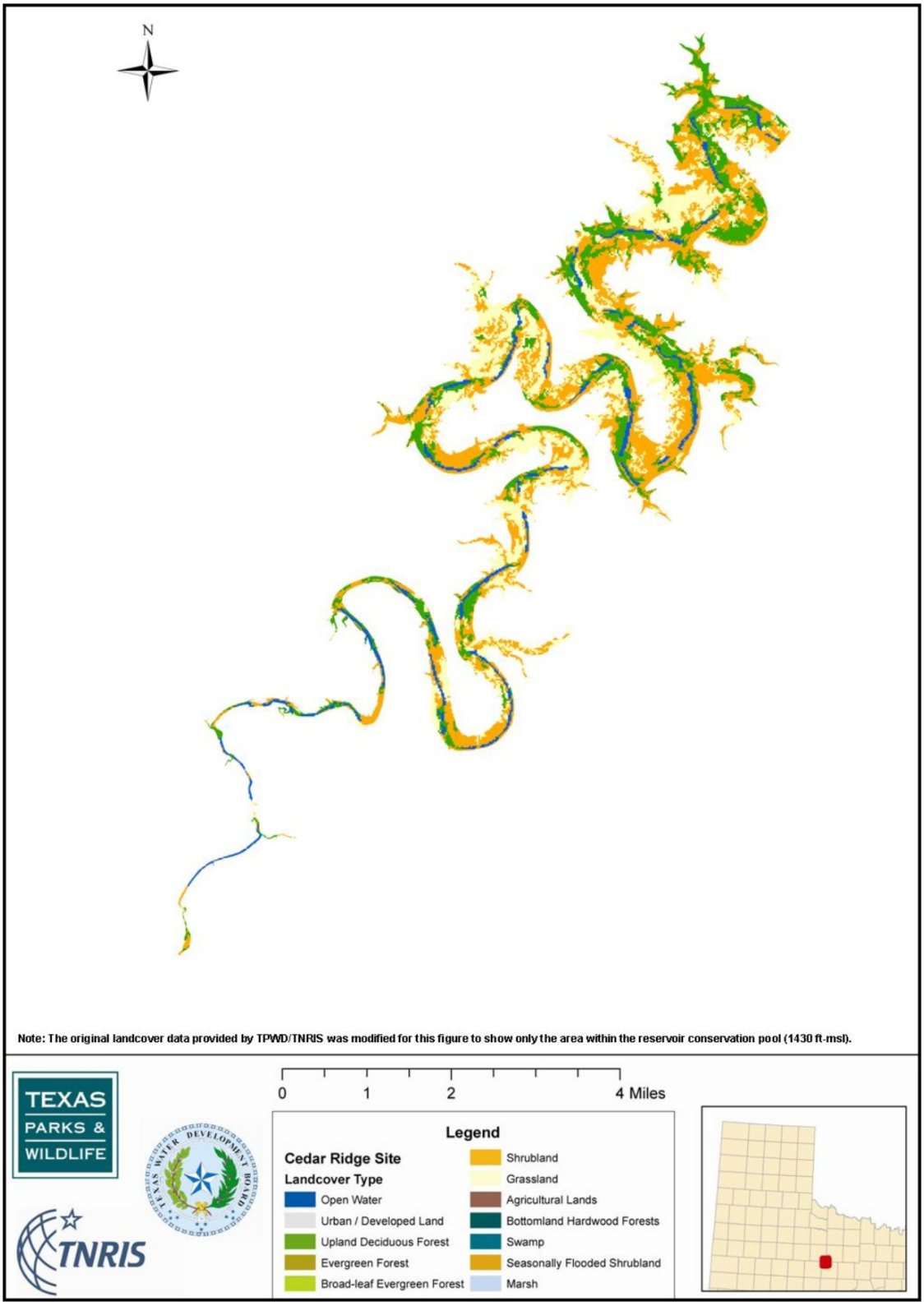

Figure 3.4.4-7. Existing Landcover for Cedar Ridge Reservoir

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3.4.5 Cuero II Reservoir (Sandies Creek Reservoir or Lindenau Reservoir)

3.4.5.1 Project Description

Cuero II Reservoir, also known as Sandies Creek Reservoir or Lindenau Reservoir in previous studies, is a proposed reservoir located on Sandies Creek, a tributary of the Guadalupe River in DeWitt and Gonzales Counties. The project would impound water from the Sandies Creek watershed as well as water diverted from the Guadalupe River during periods of flow in excess of downstream needs. This reservoir was proposed as a water supply for in-basin needs as part of the Texas Basins Project (USBR, February 1965) in the mid-1960s. Subsequent studies of the reservoir were performed (TWDB, July 1966), the latest of which was in the 2001 South Central Texas Regional Water Plan. The reservoir location is shown in Figure 3.4.5-1.

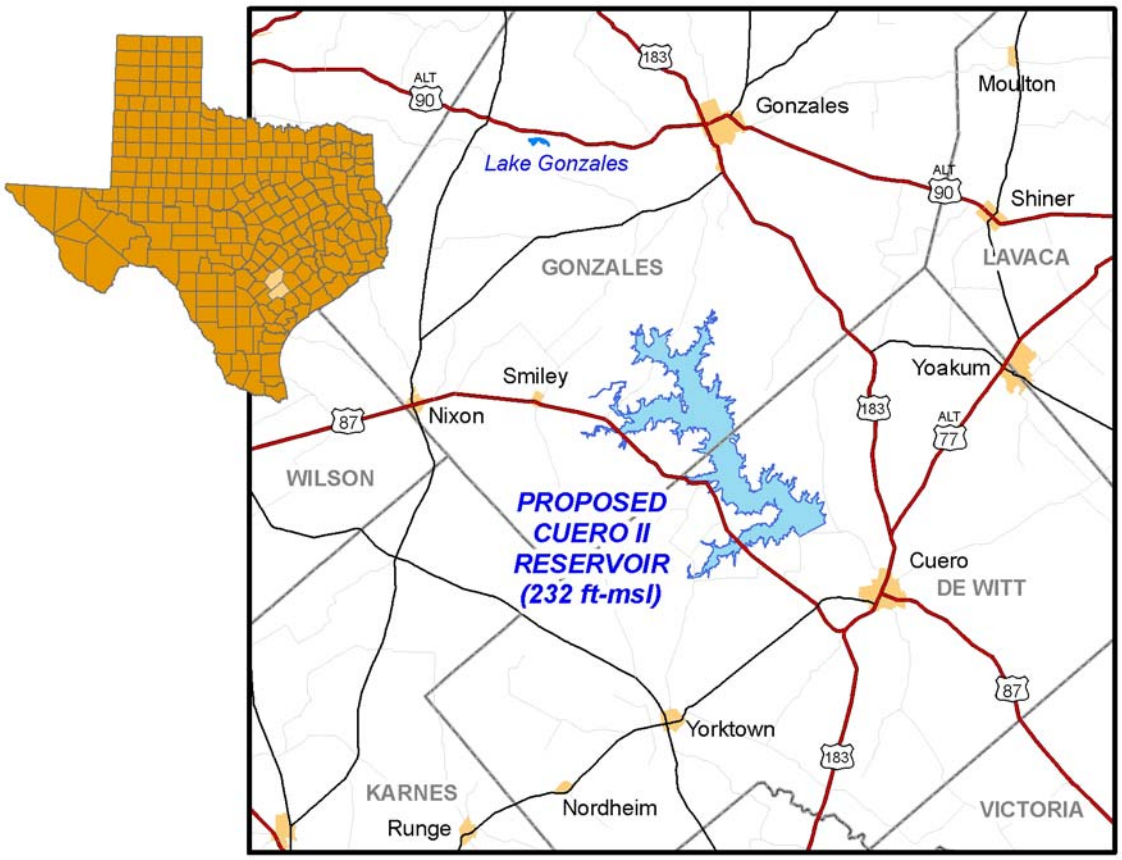

Figure 3.4.5-1. Location Map of Cuero II Reservoir

The dam would be an earthfill embankment with a roller-compacted concrete spillway to impound runoff from the 678 square mile watershed. The dam would extend about 2 miles across the Sandies Creek valley, and provide a conservation storage capacity of 583,975 acft,

inundating 28,154 acres. The spillway design flood elevation would be 240.5 ft-msl and inundate approximately 36,967 acres.

Projected municipal, industrial (including manufacturing), and steam-electric needs for additional water supply prior to year 2060 total 346,140 acft/yr for counties within a 50-mile radius of the Cuero II Reservoir site. The nearest major population and water demand centers to the Cuero II Reservoir site are San Antonio (71 miles) and Austin (83 miles).

3.4.5.2 Reservoir Yield Analyses

The elevation-area-capacity relationship for Cuero II Reservoir is presented in Figure 3.4.5-2 and Table 3.4.5-1 and was developed from 10-ft contour, digital hypsography data from the Texas Natural Resources Information System (TNRIS). These data are derived from the 1:24,000-Scale (7.5-minute) quadrangle maps developed by the USGS. The total area inundated at each 10-ft elevation contour is shown in Figure 3.4.5-3. Surface areas and capacities associated with 232 ft-msl are computed by linear interpolation between values for 230 ft-msl and 240 ft-msl and are subject to future refinement based on more detailed topographic information. At the conservation storage pool elevation of 232 ft-msl, Cuero II Reservoir would inundate 28,154 acres and have a capacity of 583,975 acft.

Table 3.4.5-1.
Elevation-Area-Capacity Relationship for
Cuero II Reservoir

Elevation (feet)	*Area (acres)*	*Capacity (acft)*
155	0	0
160	67	112
170	295	1,786
180	1,516	10,053
190	2,981	32,134
200	5,927	75,842
210	11,310	160,590
220	17,673	304,326
230	26,080	521,735
232	28,154	583,975
240	36,448	832,937

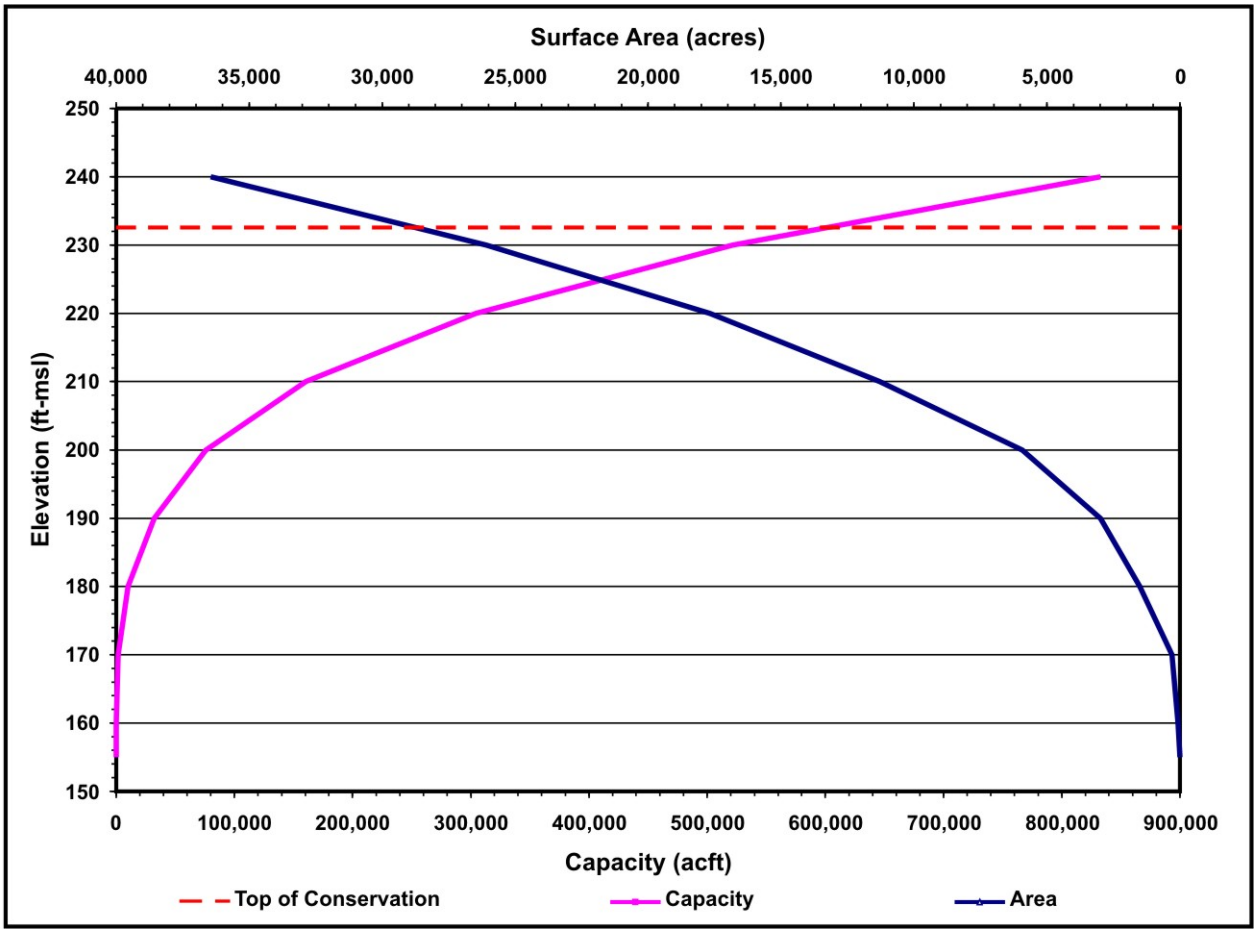

Figure 3.4.5-2. Elevation-Area-Capacity Relationship for Cuero II Reservoir

The Consensus Criteria for Environmental Flow Needs (CCEFN) (TWDB, August 1997), a three-staged criteria that uses percentage of reservoir capacity as a trigger for determining the pass-through requirement, is used for the modeling of Cuero II Reservoir. Pass-through flows are the monthly naturalized median flow when reservoir storage is greater than 80 percent of capacity, the monthly naturalized 25th percentile flow when the reservoir is between 50 and 80 percent of capacity, and the published 7Q2 when reservoir capacity is less than 50 percent of conservation capacity. The CCEFN values used include the median and quartile flows in Table 3.4.5-2 and the 7Q2 value of 3.5 cfs published in the Texas Surface Water Quality standards (Texas Administrative Code).

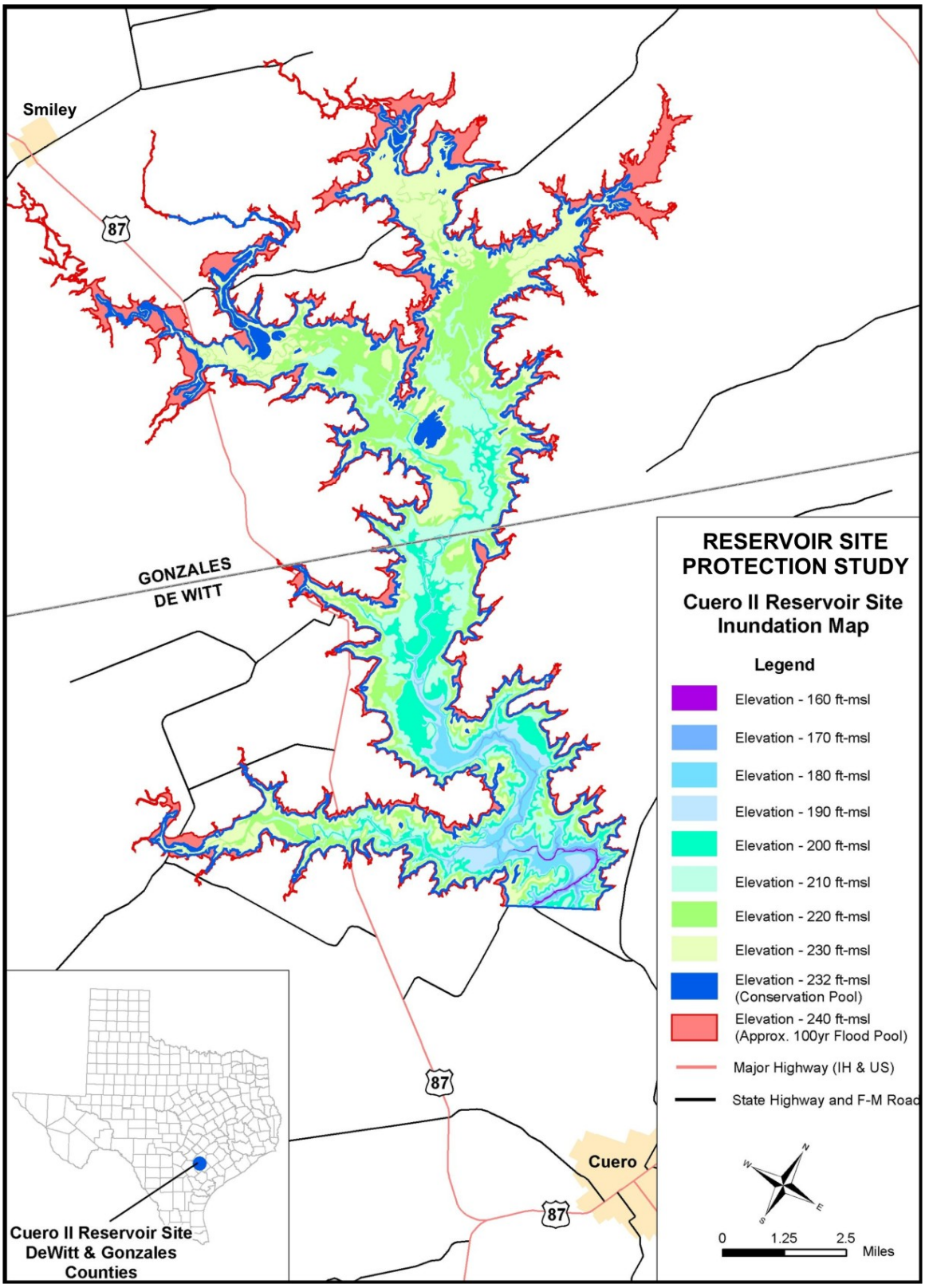

Figure 3.4.5-3. Inundation Map for Cuero II Reservoir

Table 3.4.5-2.
Consensus Criteria for Environmental Flow Needs for Cuero II Reservoir

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Median (cfs)	16.6	19.7	17.1	16.1	20.2	17.1	9.6	7.1	10.6	11.6	14.1	15.1
Median (acft/mo)	1,023	1,092	1,054	960	1,240	1,020	589	434	630	713	840	930
Quartile (cfs)	10.6	11.1	10.6	8.1	7.6	7.1	3.5	3.5	4.0	5.0	7.1	9.1
Quartile (acft/mo)	651	616	651	480	465	420	215	215	240	310	420	558
7Q2 (cfs)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
7Q2 (acft/mo)	215	194	215	208	215	208	215	215	208	215	208	215
Note: The 7Q2 value is used when it exceeds the value of the median and/or quartile												

In addition, the waters diverted from the Guadalupe River to supplement runoff into Cuero II Reservoir are subject to CCEFN. Triggers for run-of-river diversions are based on streamflow passing the diversion point. Table 3.4.5-3 lists the median and quartile flows for the Guadalupe River at Cuero. The 7Q2 value published in the Texas Surface Water Quality Standards for this segment of the Guadalupe River is 317.1 cfs.

Table 3.4.5-3.
Consensus Criteria for Environmental Flow Needs for Guadalupe River Diversions

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Median (cfs)	944	1,015	1,015	1,042	1,241	1,120	845	660	729	838	851	881
Median (acft)	58,032	56,392	62,403	62,010	76,291	66,660	51,956	40,610	43,350	51,522	50,640	54,188
Quartile (cfs)	590	641	619	608	671	604	477	349	416	485	536	568
Quartile (acft)	36,301	35,616	38,037	36,150	41,261	35,940	29,326	21,452	24,750	29,822	31,890	34,937
7Q2 (cfs)	317.1	317.1	317.1	317.1	317.1	317.1	317.1	317.1	317.1	317.1	317.1	317.1
7Q2 (acft)	19,498	17,611	19,498	18,869	19,498	18,869	19,498	19,498	18,869	19,498	18,869	19,498

The firm yield of Cuero II Reservoir is estimated using the TCEQ Guadalupe-San Antonio River Basin Water Availability Model (GSA WAM) (HDR, 1999) data sets and the Water Rights Analysis Package (WRAP) (TCEQ, 2004) The GSA WAM simulates a repeat of the natural streamflows over the 56-year period of 1934 through 1989 accounting for the appropriated water rights of the Guadalupe-San Antonio River Basin with respect to location, priority date, diversion amount, diversion pattern, storage, and special conditions including instream flow requirements.

Four potential conservation storage capacities are modeled for Cuero II Reservoir. These conservation storage capacities are associated with 240 ft-msl, 232 ft-msl, 225 ft-msl, and 220 ft-msl conservation pool elevations. Table 3.4.5-4 includes the storage capacities associated with these four conservation pool elevations. For the purposes of this study, one maximum diversion rate of 786 cfs from the Guadalupe River to Cuero II Reservoir has been assumed for all four conservation storage capacities.

Table 3.4.5-4.
Firm Yield vs. Conservation Storage for Cuero II Reservoir

Conservation Pool Elevation (ft-msl)	*Conservation Storage (acft)*	*Environmental Bypass Criteria*	*Yield (acft/yr)*
220.0	304,326	CCEFN	49,418
225.0	413,030	CCEFN	58,367
232.0*	583,975	CCEFN	71,437
		None	83,498
240.0	832,937	CCEFN	85,223
*Proposed conservation storage.			

Cuero II Reservoir is simulated with a priority date junior to all existing water rights in the Guadalupe-San Antonio River Basin. Firm yield estimates for Cuero II Reservoir for all four conservation pool elevations are shown in Table 3.4.5-4. At a conservation pool elevation of 232 ft-msl, the firm yield is 71,437 acft/yr. Figure 3.4.5-4 shows the relationship between firm yield and conservation storage capacity for Cuero II Reservoir.

Cuero II (Sandies Creek) Reservoir was most recently evaluated by Region L in the 2001 South Central Texas Regional Water Plan (HDR et al., 2001). The firm yield of Cuero II Reservoir was reported as 80,836 acft/yr at conservation pool elevation 232 ft-msl. The firm yield estimate in the current study differs from the 2001 Region L Water Plan because SIMDLY (a daily reservoir simulation model) and an alternative Guadalupe-San Antonio River Basin Model were used for regional planning. In addition, the refined elevation-area-capacity relationship in the current study has reduced the conservation capacity at elevation 232 ft-msl from 606,280 acft to 583,975 acft.

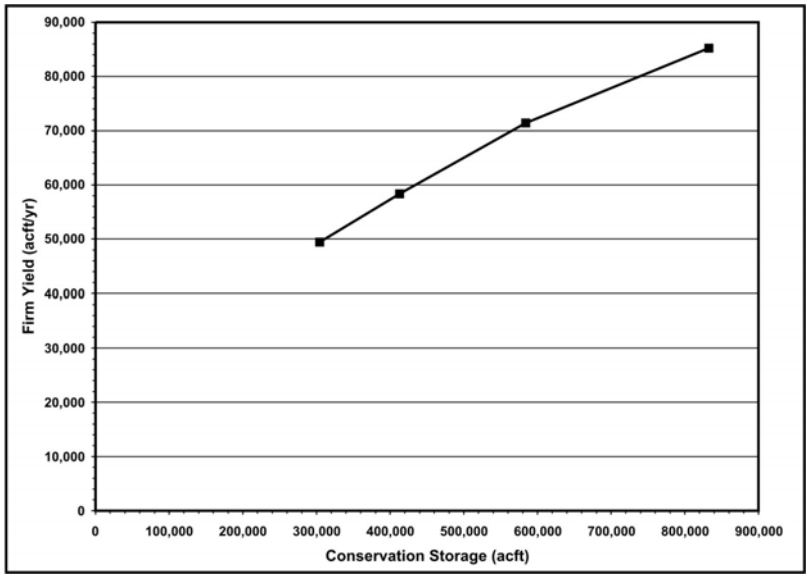

Figure 3.4.5-4. Firm Yield vs. Conservation Storage for Cuero II Reservoir

Figure 3.4.5-5 illustrates storage fluctuations through time for Cuero II Reservoir subject to firm yield diversions and CCEFN. The reservoir storage frequency curve in Figure 3.4.5-5 indicates that the reservoir would be full about 30 percent of the time and more than half full about 94 percent of the time.

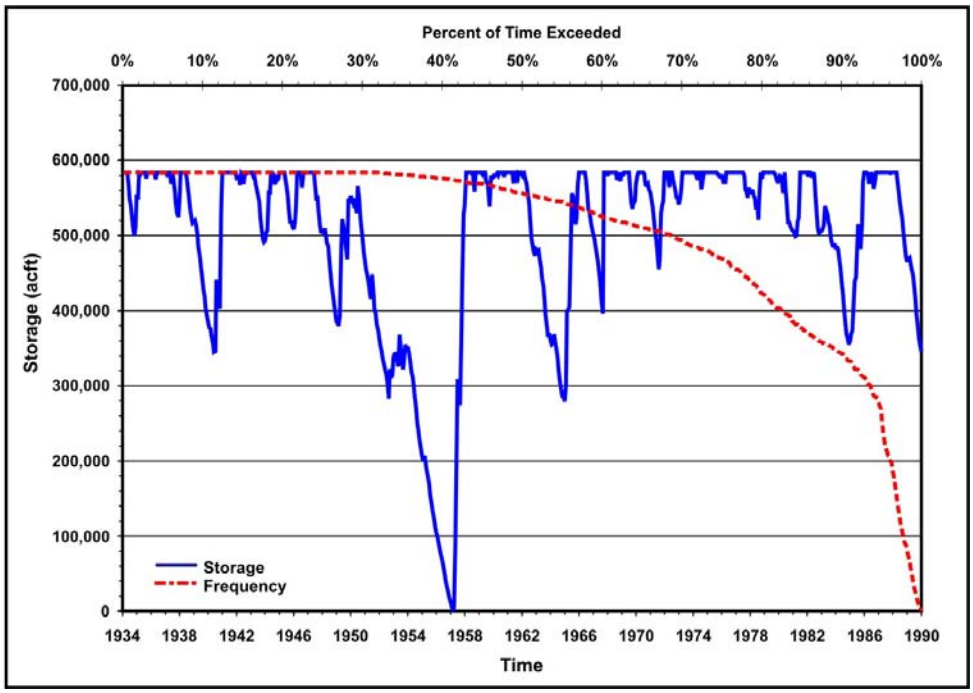

Figure 3.4.5-5. Simulated Storage in Cuero II Reservoir (Conservation Elevation = 232 ft-msl, Diversion = 71,437 acft/yr)

3.4.5.3 Reservoir Project Cost Estimates

The Cuero II Reservoir includes the construction of an earth dam, principal spillway, emergency spillway, and appurtenant structures. The length of the dam is estimated at 10,640 feet with a maximum height of 101 feet. The service spillway would include an uncontrolled ogee spillway, a hydraulic jump stilling basin, and 2- 5-foot by 8-foot low flow sluiceway outlets. The diversion from the Guadalupe River near Cuero includes a 510 MGD intake and pump station, two 1.48 mile, 120-inch pipelines, and a stilling basin.

A summary cost estimate for Cuero II Reservoir at elevation 232 ft-msl is shown in Table 3.4.5-5. Detailed quantities for Cuero II Reservoir are from a report entitled Water Availability Study for the Guadalupe and San Antonio River Basins (Espey, Huston & Associates, 1986). Dam and reservoir costs total about $121 million, while relocations total another $34 million. Land, which includes mitigation lands, totals about $229 million. The diversion intake, pump station, and pipeline from the Guadalupe River to Cuero II Reservoir adds another $60 million. Annual costs for Cuero II Reservoir are approximately $35.8 million during the 40-year debt service period, giving the project a unit cost of raw water at the reservoir of $501/acft/yr ($1.54 per 1,000 gallons).

Figure 3.4.5-6 shows the major conflicts within the conservation pool of Cuero II Reservoir. Potential major conflicts include oil and gas wells, water wells, product transmission pipelines, power transmission lines, and relocation of State Highway 87, as well as several other minor roads. Resolution of facility conflicts represents approximately 8 percent of the total construction cost.

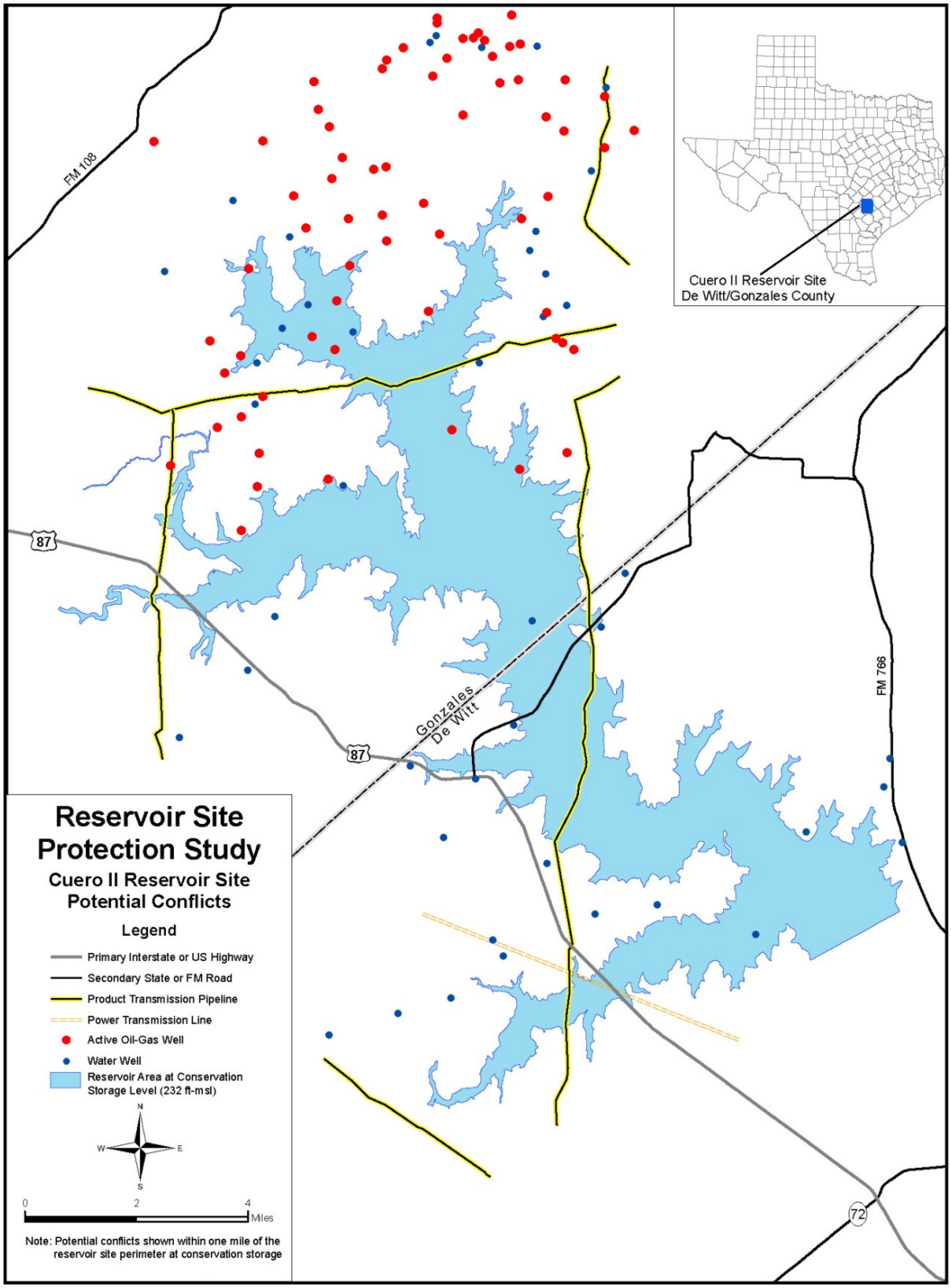

Figure 3.4.5-6. Potential Major Conflicts for Cuero II Reservoir

Table 3.4.5-5.
Cost Estimate — Cuero II Reservoir @ Elevation 232 ft-msl

	Quantity	*Unit*	*Unit Price*	*Cost*
Dam & Reservoir				
Mobilization (5%)		LS		$2,300,329
Clearing and Grubbing	10,066	AC	$4,000	$40,264,000
Care of Water During Construction (1%)		LS		$1,380,197
Random Compacted Fill	2,761,000	CY	$2.50	$6,902,500
Core Compacted Fill (Impervious)	653,500	CY	$3.00	$1,960,500
Soil Cement	112,000	CY	$65.00	$7,280,000
Roller Compacted Concrete	175,831	CY	$75.00	$13,187,325
Mass Concrete	3,891	CY	$150.00	$583,650
Rock Riprap	6,253	SY	$115.00	$719,106
Sand Filter Drain	323,300	CY	$35.00	$11,315,500
Outlet Works Tower and Conduit	1	LS	$2,858,000	$2,858,000
Power Drop	1	LS	$250,000	$250,000
Instrumentation	1	LS	$550,000	$550,000
Spillway Low Flow System	1	LS	$400,000	$400,000
Engineering Contingencies (35%)				$31,482,888
Subtotal Dam & Reservoir				**$121,433,995**
Pump & Pipeline				
Pump Station & Intake (510 MGD)	1	LS	$28,688,730	$28,688,730
Pipeline (2-120-inch)	15,629	LF	$870	$13,597,230
Stilling Basin (786 cfs)	1	LS	$2,377,650	$2,377,650
Engineering Contingencies (35%)				$15,632,264
Subtotal Pump & Pipeline				**$60,295,874**
Conflicts				
Oil & Gas Pipeline	7,597	LF	$48	$364,679
Power Transmission Line	7,170	LF	$450	$3,226,541
Roads	45,322	LF		
Major	18,480	LF	$900	$16,632,000
Minor	26,842	LF	$150	$4,026,271
H20 Drill	4	EA	$25,000	$100,000
H20 Well	14	EA	$25,000	$350,000
Oil & Gas Well	23	EA	$25,000	$575,000
Engineering Contingencies (35%)				$8,846,072
Subtotal Conflicts				**$34,120,564**
Land				
Land Acquisition	36,967	AC	$3,100	$114,597,700
Environmental Studies and Mitigation Lands	36,967	AC	$3,100	$114,597,700
Subtotal Land				**$229,195,400**
CONSTRUCTION TOTAL				**$445,045,832**
Interest During Construction (36 months)				$53,405,500
TOTAL COSTS				**$498,451,332**
ANNUAL COSTS				
Debt Service (6% for 40 Years)				$33,127,076
Operations & Maintenance				$2,698,477
Pumping Energy				$3,771,987
Total Annual Costs				**$35,825,553**
Firm Yield (acft/yr)				**71,437**
Unit Costs of Water ($/acft/yr)				**$501**

Units: AC = Acre; CY = Cubic Yard; EA = Each; LB = Pound; LF = Linear Foot; LS = Lump Sum; SF = Square Foot; and SY = Square Yard.

3.4.5.4 Environmental Considerations

Cuero II Reservoir would inundate portions of TCEQ unclassified stream segments 1803A (Elm Creek) and 1803B (Sandies Creek). Neither these segments nor the Guadalupe River near Cuero are listed by Texas Parks and Wildlife Department (TPWD) as Ecologically Significant Stream Segments.

Cuero II Reservoir will inundate 28,154 acres of land at conservation storage capacity. Table 3.4.5-6 and Figure 3.4.5-7 summarize existing landcover for the Cuero II Reservoir site as determined by TPWD using methods described in Appendix C. Existing landcover within this reservoir site is dominated by grassland (47 percent) with sizeable areas of shrubland (21 percent), broad-leaf evergreen forest (18 percent), and upland deciduous forest (12 percent). Only about 2 percent of the site is classified as bottomland hardwood forest.

Table 3.4.5-6.
Acreage and Percent Landcover for Cuero II Reservoir

Landcover Classification	*Acreage*[1]	*Percent*
Grassland	13,134	46.6%
Shrubland	5,903	20.9%
Broad Leaf Evergreen Forest	5,128	18.2%
Upland Deciduous Forest	3,329	11.8%
Bottomland Hardwood Forest	619	2.2%
Seasonally Flooded Shrubland	65	0.2%
Marsh	34	0.1%
Total	28,212	100.0%

[1] Acreage based on approximate GIS coverage rather than calculated elevation-area-capacity relationship.

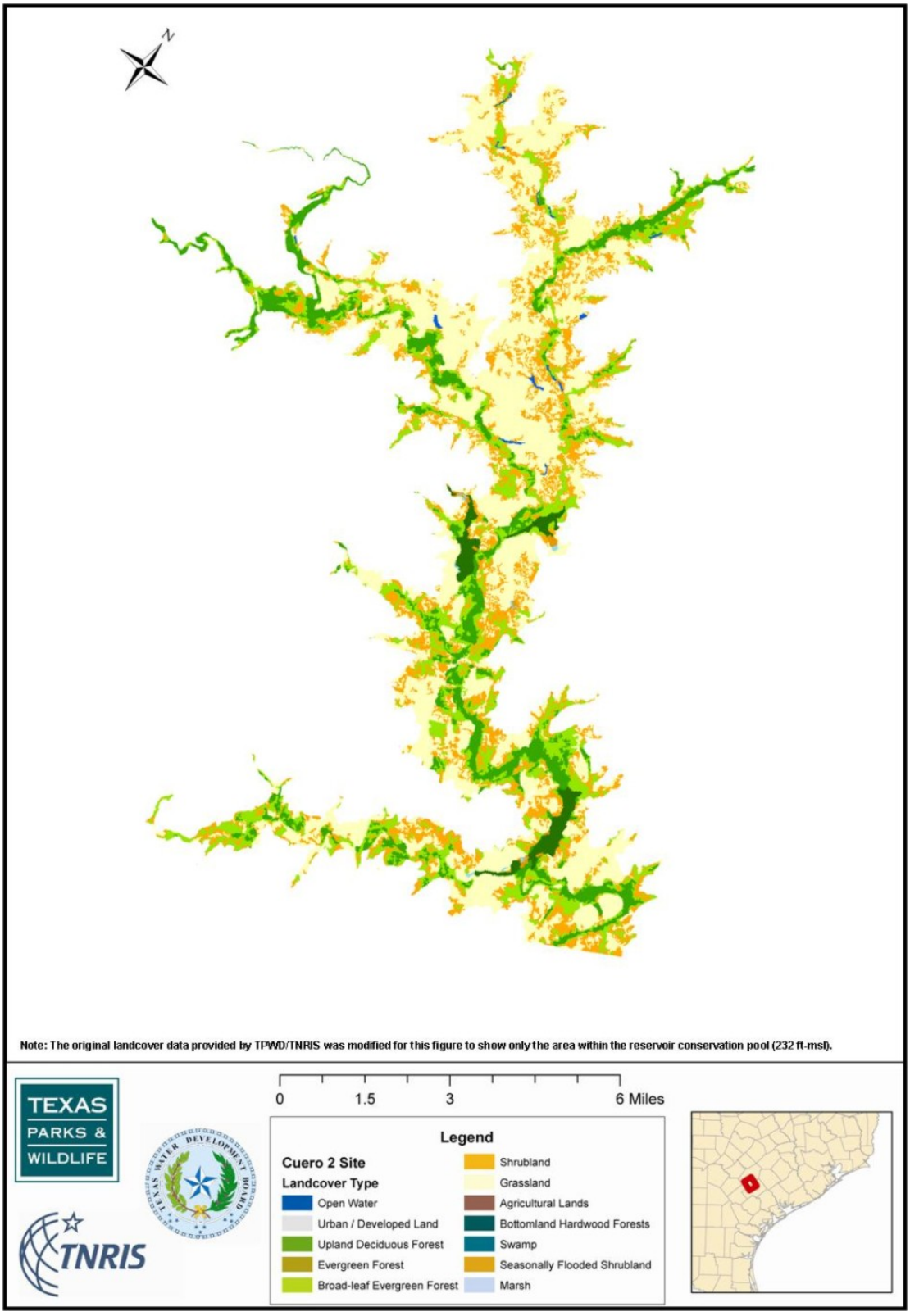

Figure 3.4.5-7. Existing Landcover for Cuero II Reservoir

3.4.6 Fastrill Reservoir (Weches Reservoir)

3.4.6.1 Project Description

The Fastrill Reservoir Project, in Anderson and Cherokee Counties, was first identified and evaluated in the Report on Master Plan for Water Supply Reservoirs prepared for the Upper Neches River Municipal Water Authority in 1961 (Forrest & Cotton, 1961). In this plan, Fastrill Reservoir was identified as one among three potential reservoir projects (including Ponta Reservoir and substantial enlargement of Lake Palestine) for development of new water supplies in the Neches River Basin. The proposed dam location below SH 294, with a conservation storage pool level of 274 ft-msl and flood pool level of approximately 280 ft-msl, is shown in Figure 3.4.6-1.

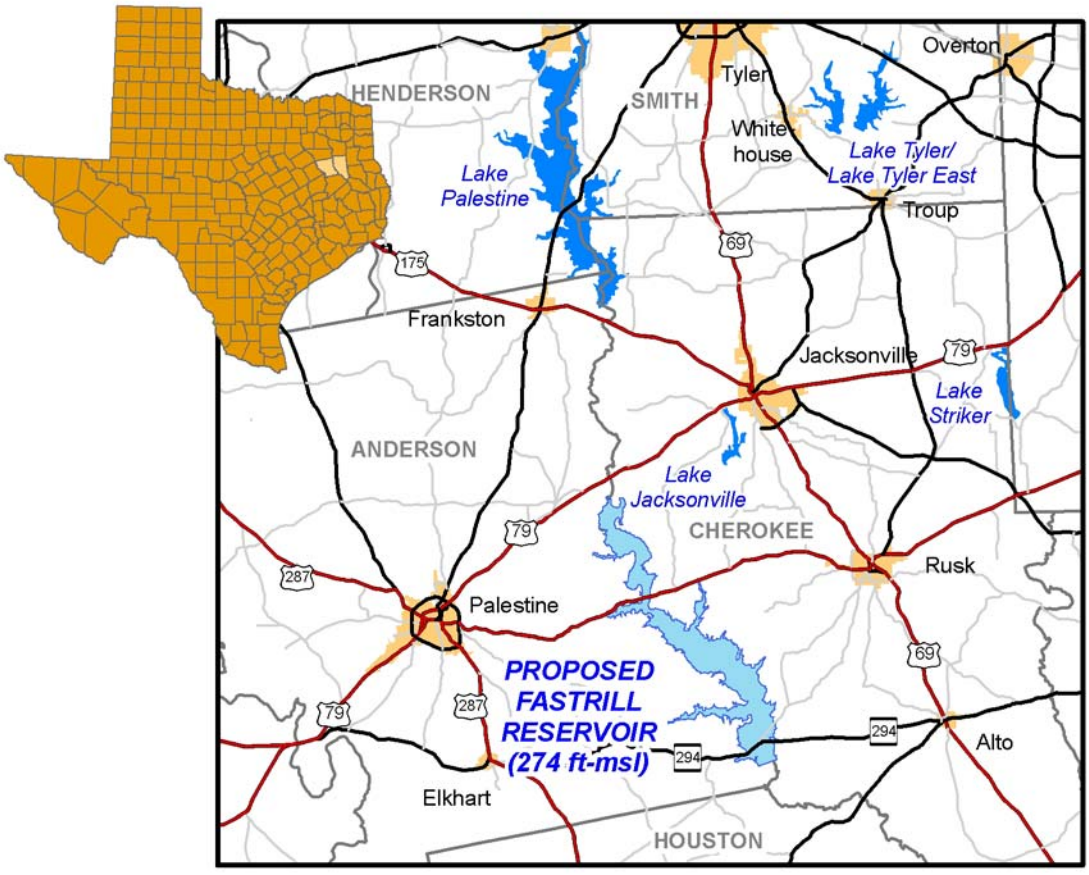

Figure 3.4.6-1. Location Map of Fastrill Reservoir

The Fastrill Reservoir site lies completely within the Weches Reservoir site recommended in the 1968 and 1984 State Water Plans. Although the Weches dam site is about 10 river miles downstream of the Fastrill dam site, available information indicates that the Weches Reservoir, if constructed at the conservation pool elevation once considered (282 ft-msl), would inundate the entire Fastrill Reservoir area. Conservation storage capacity for Weches Reservoir (~1,402,000 acft) was to have been about 2.8 times that of Fastrill Reservoir (~500,000 acft).

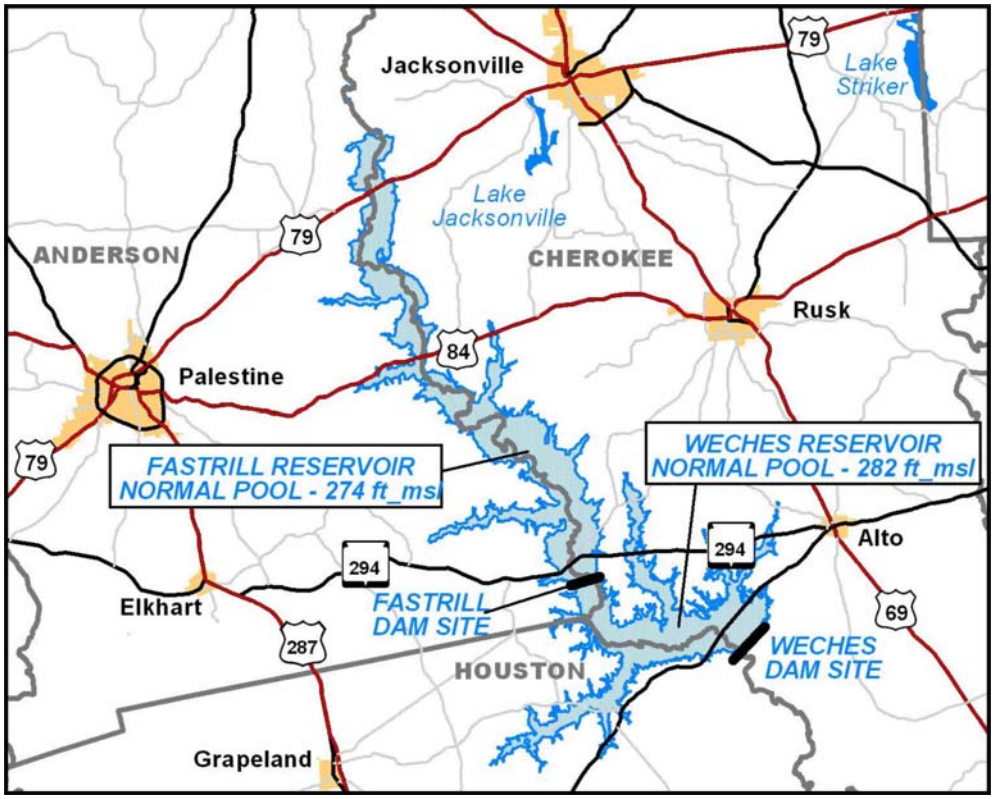

Figure 3.4.6-2. Location Map of Weches Reservoir

With the establishment of regional water planning as part of the process for updating the State Water Plan (pursuant to Senate Bill 1 of the 75th Texas Legislature), Fastrill Reservoir emerged as a potentially feasible project identified in the 2001 East Texas (Region I) Regional Water Plan. In the 2006 Region C Water Plan (approved by the TWDB on April 18, 2006), Fastrill Reservoir is a recommended water management strategy to meet projected needs for Dallas as well as water user groups in Anderson, Cherokee, Henderson, and Smith Counties in Region I. The 2006 Region C Water Plan further recommends Fastrill as a unique site for

reservoir construction citing its location and geologic, hydrologic, topographic, water availability, water quality, and current development characteristics as making it uniquely suited to provide water supply for Region C. The 2006 East Texas Regional Water Plan (approved by the TWDB on May 16, 2006) also recognizes Fastrill Reservoir as an alternative water management strategy to meet projected needs in Region I. The 2007 State Water Plan (TWDB, 2007) includes a recommendation for legislative designation of the Fastrill site as one of unique value for the construction of a reservoir.

Projected municipal, industrial (including manufacturing), and steam-electric needs for additional water supply prior to year 2060 total 136,476 acft/yr for counties within a 50-mile radius of the Fastrill Reservoir site. The nearest major population and water demand centers to the Fastrill Reservoir site are Dallas / Fort Worth (127 miles) and Houston (130 miles).

3.4.6.2 Reservoir Yield Analyses

The elevation-area-capacity relationship for Fastrill Reservoir is presented in Figure 3.4.6-3 and Table 3.4.6-1 and was developed from 10-ft contour, digital hypsography data from the Texas Natural Resources Information System (TNRIS). These data are derived from the 1:24,000-Scale (7.5-minute) quadrangle maps developed by the USGS. The total area inundated at each 10-ft elevation contour is shown in Figure 3.4.6-4. Surface areas and capacities associated with 274 ft-msl are computed by linear interpolation between values for 270 ft-msl and 280 ft-msl and are subject to future refinement based on more detailed topographic information. At the conservation storage pool elevation of 274 ft-msl, Fastrill Reservoir would inundate 24,948 acres and have a capacity of 503,563 acft.

Table 3.4.6-1.
Elevation-Area-Capacity Relationship for Fastrill Reservoir

Elevation (feet)	*Area (acres)*	*Capacity (acft)*
219	0	0
220	29	10
230	539	2,318
240	3,614	20,812
250	10,529	88,518
260	15,524	217,977
270	21,134	400,548
274	24,948	503,563
280	30,668	658,086
290	39,247	1,006,781

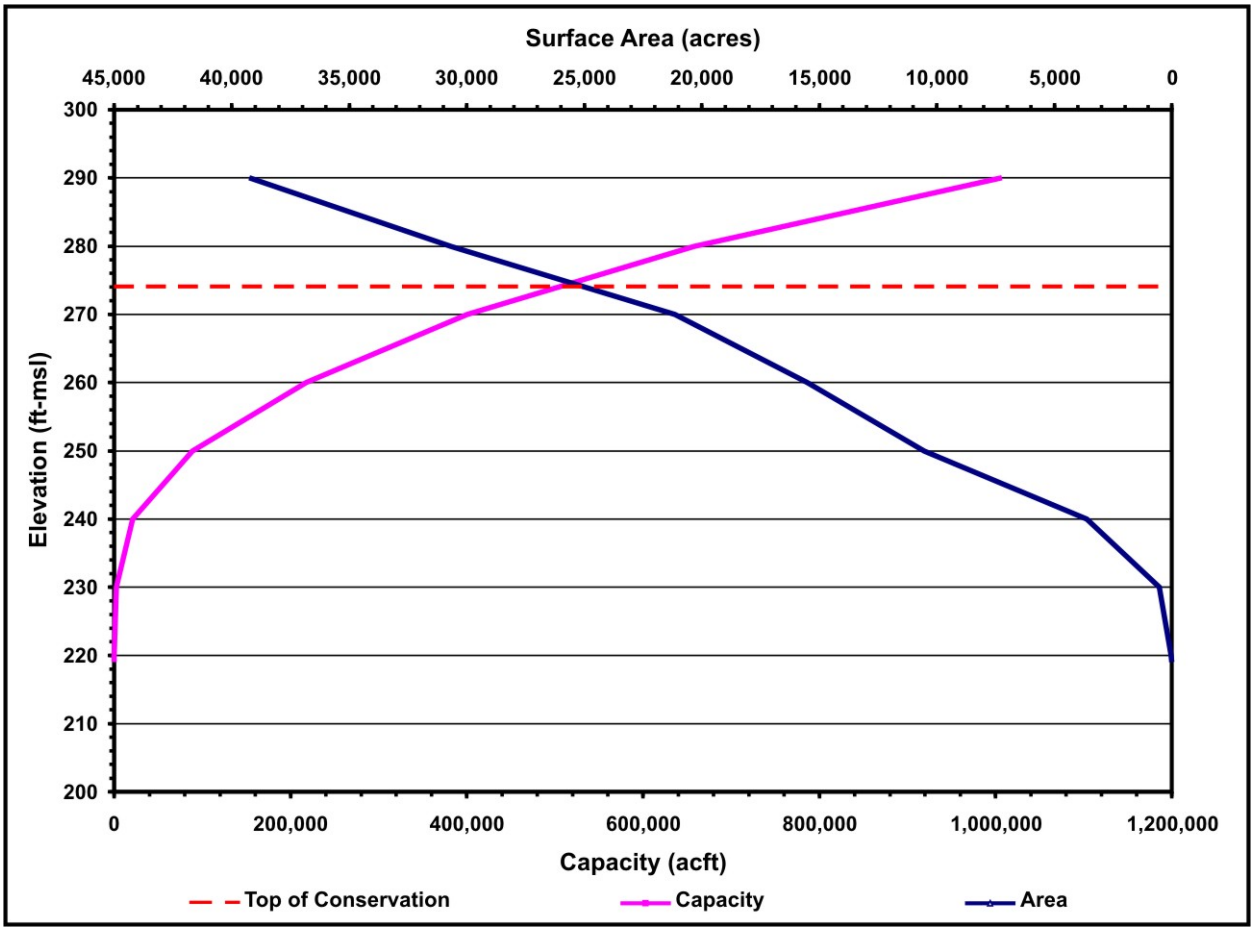

Figure 3.4.6-3. Elevation-Area-Capacity Relationship for Fastrill Reservoir

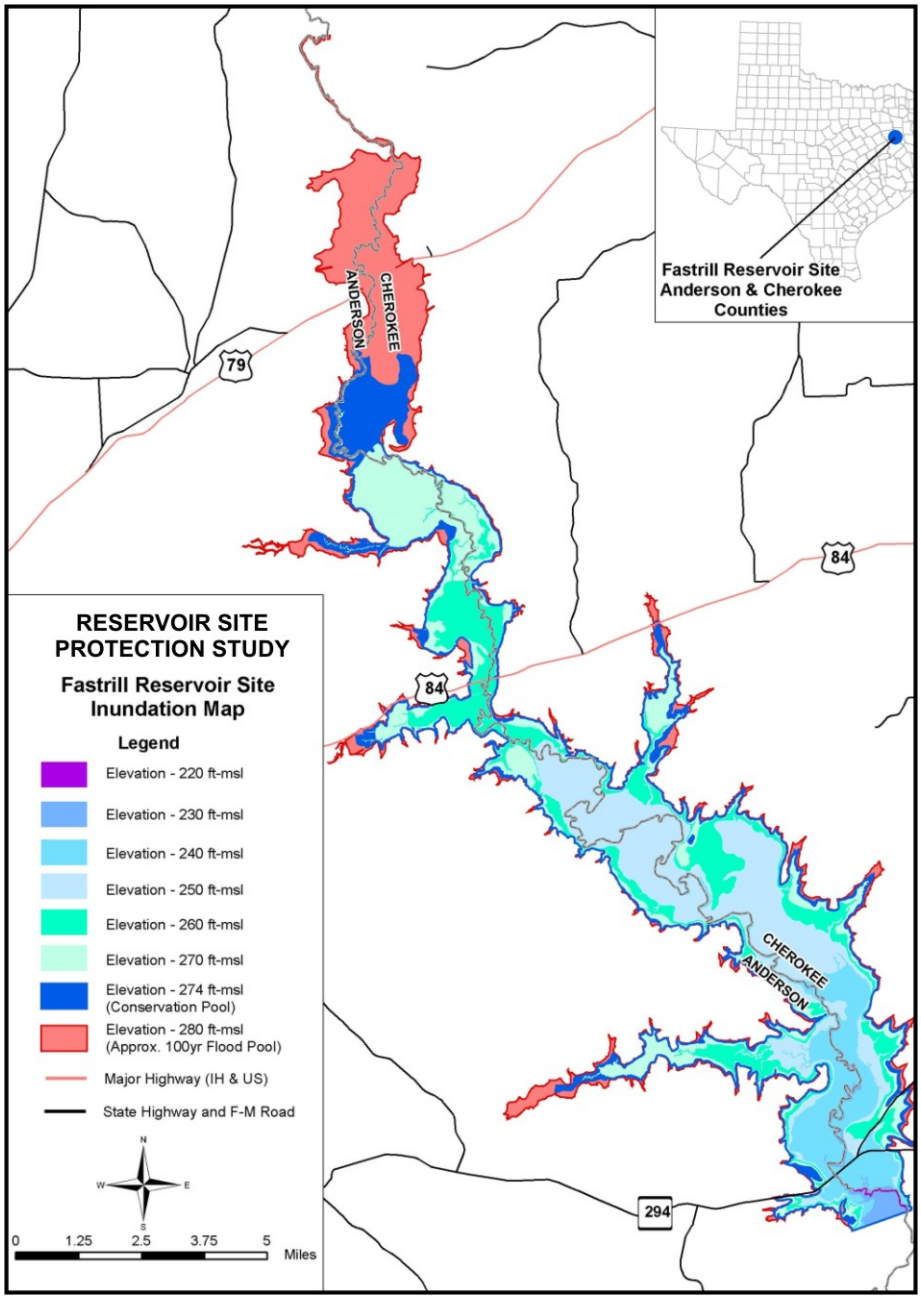

Figure 3.4.6-4. Inundation Map for Fastrill Reservoir

Median and quartile (25th percentile) streamflows have been calculated for the Fastrill Dam site based on monthly naturalized flows from the Neches River Basin Water Availability Model (Neches WAM) (Brown & Root Services, et. al., 2000). These monthly naturalized flows are then disaggregated to daily naturalized flows using historical records of streamflow for the USGS Neches River near Neches gaging station. For each month, daily flows are ranked and

median and quartile flows are then extracted. The natural median and quartile flows for the Fastrill Dam site are presented in Table 3.4.6-2.

Table 3.4.6-2.
Consensus Criteria for Environmental Flow Needs for Fastrill Reservoir

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Median (cfs)	942	1,288	1,347	1,095	1,083	496	161	67	83	139	336	628
Median (acft/mo)	57,920	71,542	82,807	65,132	66,571	29,492	9,930	4,148	4,945	8,551	20,015	38,599
Quartile (cfs)	432	647	636	566	464	205	67	67	67	67	166	313
Quartile (acft/mo)	26,571	35,916	39,124	33,659	28,551	12,218	4,145	4,145	4,011	4,145	9,865	19,267
7Q2 (cfs)	67.4	67.4	67.4	67.4	67.4	67.4	67.4	67.4	67.4	67.4	67.4	67.4
7Q2 (acft/mo)	4,145	3,744	4,145	4,011	4,145	4,011	4,145	4,145	4,011	4,145	4,011	4,145
Note: The 7Q2 value is used when it exceeds the value of the median and/or quartile.												

The Consensus Criteria for Environmental Flow Needs (CCEFN) (TWDB, August 1997), a three-staged criteria that uses percentage of reservoir capacity as a trigger for determining the pass-through requirement, is used for the modeling of Fastrill Reservoir. Pass-through flows are the monthly naturalized median flow when reservoir storage is greater than 80 percent of capacity, the monthly naturalized 25th percentile flow when the reservoir is between 50 and 80 percent of capacity, and the published 7Q2 when reservoir capacity is less than 50 percent of conservation capacity. The CCEFN values used include the median and quartile flows in Table 3.4.6-2 and the 7Q2 value of 67.4 cfs published in the Texas Surface Water Quality Standards. Fastrill Reservoir is located well in excess of 200 river miles from the coast, therefore freshwater inflow needs for bays and estuaries are not explicitly considered herein, but are assumed to be sufficiently addressed by CCEFN.

The firm yield of Fastrill Reservoir is estimated by using the TCEQ Neches WAM data sets and a modified version of the Water Rights Analysis Package (WRAP) (TCEQ, 2004) which specifically incorporates the special condition in Certificate of Adjudication No. 06-4411 regarding subordination of the BA Steinhagen - Sam Rayburn Reservoir System. A Daily Operations Model (DOM) developed by HDR is used to determine the monthly pass-through amounts to meet environmental flow requirements for Fastrill Reservoir subject to CCEFN. The DOM uses monthly inflow and availability quantities from the Neches WAM to determine the flow to be passed for downstream senior water rights. The total monthly inflow is then

distributed to daily values using historical data from nearby streamflow gages. The daily pass-through for senior water rights is determined through an iterative calculation and is taken uniformly throughout the month to the extent that sufficient inflow occurs on a daily basis. Next, the daily pass-through required for downstream senior water rights is compared to the environmental flow pass-through requirement. The greater of the two becomes the daily pass-through amount. An alternative pass-through amount is calculated for each of three potential reservoir storage zones defined by percentage of capacity. Finally, daily pass-through amounts are summed to a time-series of monthly pass-through amounts and added to the Neches WAM data file.

The firm yield of Fastrill Reservoir is calculated using the Neches WAM. The Neches WAM simulates a repeat of the natural streamflows over the 57-year period of 1940 through 1996 accounting for the appropriated water rights of the Neches River Basin with respect to location, priority date, diversion amount, diversion pattern, storage, and special conditions including instream flow requirements.

Four potential conservation storage capacities are modeled for Fastrill Reservoir. These conservation storage capacities are associated with 280 ft-msl, 274 ft-msl, 270 ft-msl, and 265 ft-msl conservation pool elevations. Table 3.4.6-3 includes the conservation storage capacities associated with these four conservation elevations.

For the purposes of this study, Fastrill Reservoir is modeled as an independent reservoir, not relying upon makeup water from Lake Palestine. Fastrill Reservoir is simulated with a junior priority date, independent of Lake Palestine. Firm yield estimates for Fastrill Reservoir for all four conservation pool elevations are shown in Table 3.4.6-3. Current planning initiatives envision a conservation elevation of 274 ft-msl for Fastrill Reservoir, thereby yielding a firm water supply of 134,038 acft/yr. For comparison purposes, the firm yield of Fastrill Reservoir at conservation elevation 274 ft-msl without an environmental flow requirement is 179,441 acft/yr, meaning that about 45,000 acft/yr (25 percent) of the firm yield potential of Fastrill Reservoir is dedicated to environmental flows. Figure 3.4.6-5 shows the relationship between firm yield and conservation capacity for Fastrill Reservoir.

In a recent study for the Upper Neches River Municipal Water Authority (UNRMWA) and the City of Dallas (HDR, September 2006), the firm yield of Fastrill Reservoir under an independent operations scenario was reported as 137,843 acft/yr at conservation elevation 274 ft-msl. The firm yield estimate in the current study is less than that in the September 2006 study in

that the September 2006 study because treated effluent discharges upstream of Lake Palestine and Fastrill Reservoir have been excluded.

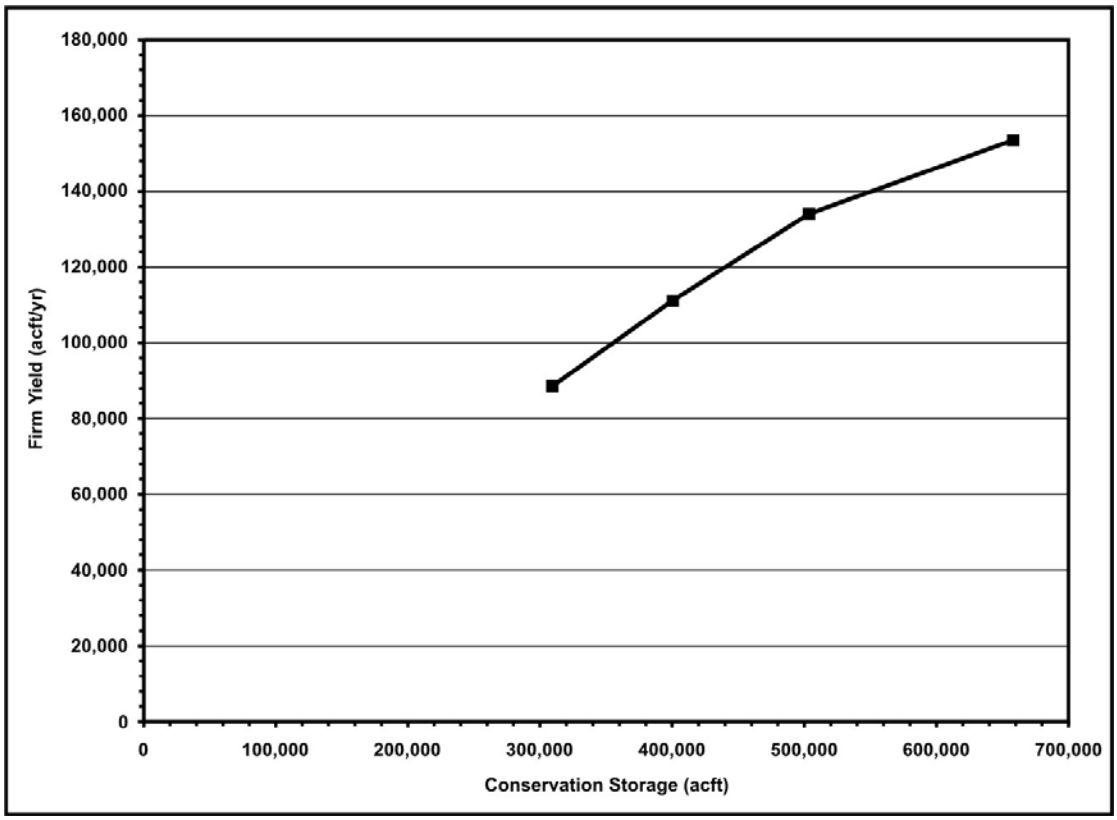

Figure 3.4.6-5. Firm Yield vs. Conservation Storage for Fastrill Reservoir

Table 3.4.6-3.
Firm Yield vs. Conservation Storage for Fastrill Reservoir

Conservation Pool Elevation (ft-msl)	*Conservation Storage (acft)*	*Environmental Bypass Criteria*	*Yield (acft/yr)*
265.0	309,263	CCEFN	88,589
270.0	400,548	CCEFN	111,097
274.0*	503,563	CCEFN	134,038
		None	179,441
280.0	658,086	CCEFN	153,476
*Proposed conservation storage.			

Figure 3.4.6-6 illustrates storage fluctuations through time for Fastrill Reservoir under independent operations subject to firm yield diversions and CCEFN. The reservoir storage frequency curve in Figure 3.4.6-6 indicates that the reservoir would be full about 13 percent of the time and more than half full about 80 percent of the time.

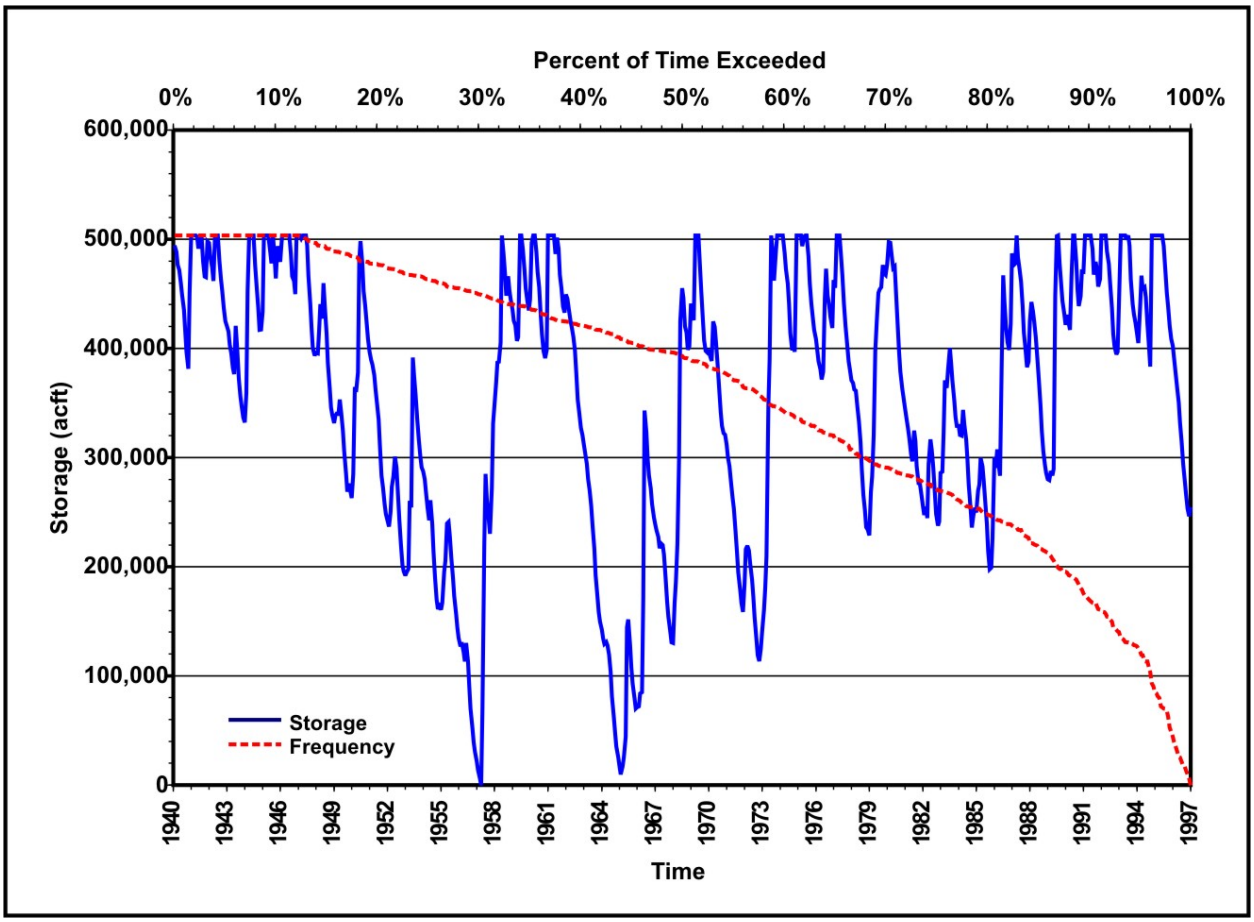

Figure 3.4.6-6. Simulated Storage in Fastrill Reservoir (Conservation Elevation = 274 ft-msl, Diversion = 134,038 acft/yr)

3.4.6.3 Reservoir Project Cost Estimates

The geology at the Fastrill Reservoir dam site is conducive to an earthfill dam similar in nature to the existing Blackburn Crossing Dam, which impounds Lake Palestine. More specifically, a zoned earthfill dam that maximizes the use of locally available materials is proposed to impound Fastrill Reservoir. The length of the dam is estimated at approximately 6,800 feet with a maximum height of 74.4 feet. The service spillway would include a gated intake tower, two 72-inch conduits through the dam, and a conventional St. Anthony Falls outlet

structure. Flood flows would be passed through a 700-foot wide, uncontrolled, concrete ogee emergency spillway.

Figure 3.4.6-7 shows the major conflicts within the conservation pool of Fastrill Reservoir. Potential conflicts include three major roadways (SH 294, US 84, and US 79), minor roadways, two railways (including the Texas State Railroad), power transmission lines, a natural gas pipeline, and oil and gas wells. Resolution of facility conflicts represents approximately 32 percent of the total capital cost.

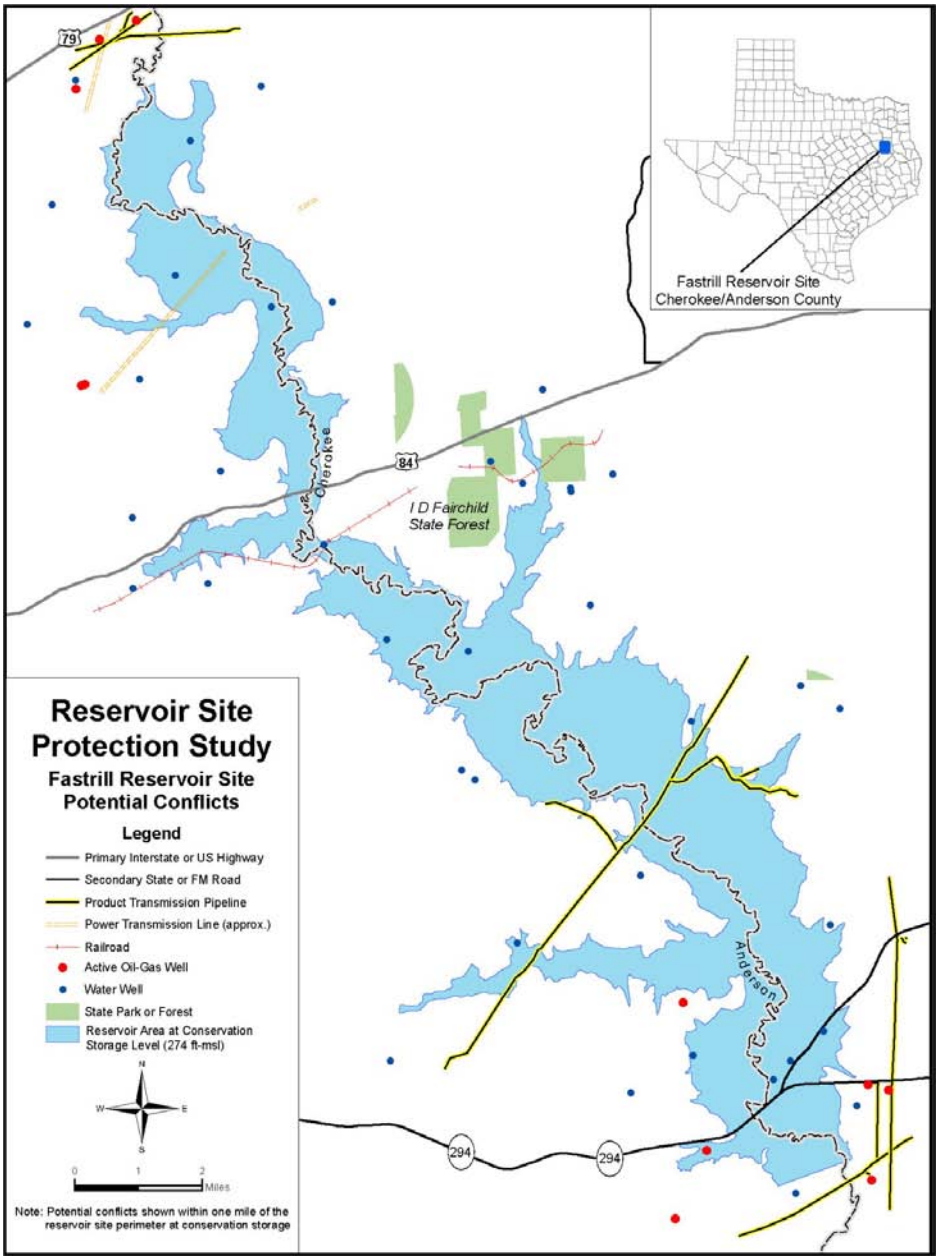

Figure 3.4.6-7. Potential Major Conflicts for Fastrill Reservoir

A summary cost estimate for Fastrill Reservoir at elevation 274 ft-msl is shown in Table 3.4.6-4. Quantities and relocation costs are based upon detailed information from the Fastrill Reservoir Preliminary Yield & Feasibility Study (HDR, September 2006). Dam and reservoir costs total about $56 million, while relocations total another $93.5 million. Land, which includes mitigation lands, totals about $112 million. Annual costs for Fastrill Reservoir are approximately $20.3 million during the 40-year debt service period, giving the project a unit cost of raw water at the reservoir of $152/acft ($0.47 per 1,000 gallons).

Table 3.4.6-4.
Cost Estimate – Fastrill Reservoir @ Elevation 274 ft-msl
(page 1 of 2)

	Quantity	*Unit*	*Unit Price*	*Cost*
Dam & Reservoir				
Mobilization (5%)	1	LS		$1,907,907
Clearing and Grubbing	78	AC	$4,000	$310,771
Care of Water During Construction (3%)	1	LS		$1,144,744
Required Excavation	176,679	CY	$2.50	$441,698
Random Compacted Fill	2,471,688	CY	$2.50	$6,179,219
Core Compacted Fill (Impervious)	1,109,594	CY	$3.00	$3,328,782
Soil Bentonite Slurry Trench	379,500	SF	$15.00	$5,692,493
Soil Cement	156,173	CY	$65.00	$10,151,223
Reinforced Concrete	21,033	CY	$400.00	$8,413,032
Gates Hoist and Operating System	1	EA	$250,000	$250,000
Spillway Bridge	199	LF	$1,300	$258,960
Flex Base Roadway	4,264	SY	$20.00	$85,282
Sand Filter Drain	75,218	CY	$35.00	$2,632,633
Grassing	39	AC	$4,500	$174,808
Instrumentation	1	LS	$550,000	$550,000
Engineering Contingencies (35%)				$14,532,543
Subtotal Dam & Reservoir				**$56,054,095**
Conflicts				
Existing Structures	22	EA	$50,000	$1,100,000
Roadways				
FM 23	1	LS		$2,075,000
SH 294	1	LS		$12,484,000
US 84	1	LS		$8,243,000
US 79	1	LS		$5,490,000
Railways				
Texas State RR	1	LS		$16,294,000
Missouri Pacific RR	1	LS		$13,267,000
Power Transmission	1	LS		$3,562,000

Table 3.4.6-4.
Cost Estimates – Fastrill Reservoir @ Elevation 274 ft-msl
(page 2 of 2)

Natural Gas Lines				
6.63"	5,600	LF		$560,000
16"	6,300	LF		$1,260,000
10.75"	18,100	LF		$3,620,000
Oil & Gas Wells	54	EA	$25,000	$1,350,000
Engineering Contingencies (35%)				$24,256,750
Subtotal Conflicts				**$93,561,750**
Land				
Land Acquisition	30,668	AC	$1,825	$55,969,100
Environmental Studies and Mitigation Lands	30,668	AC	$1,825	$55,969,100
Subtotal Land				**$111,938,200**
CONSTRUCTION TOTAL				**$261,554,045**
Interest During Construction (36 months)				$31,386,485
TOTAL COSTS				**$292,940,530**
ANNUAL COSTS				
Debt Service (6% for 40 Years)				$19,468,828
Operations & Maintenance				$840,811
Total Annual Costs				**$20,309,639**
Firm Yield (acft/yr)				**134,038**
Unit Costs of Water ($/acft/yr)				**$152**

Units: AC = Acre; CY = Cubic Yard; EA = Each; LB = Pound; LF = Linear Foot; LS = Lump Sum; SF = Square Foot; and SY = Square Yard.

3.4.6.4 Environmental Considerations

Fastrill Reservoir would inundate a portion of TCEQ classified stream segment 0604. Texas Parks and Wildlife Department (TPWD, 1999) listed the entire length of the Neches River below Lake Palestine as ecologically significant. Inundation by or operations of Fastrill Reservoir could have effects relevant to three TPWD criteria, as follows:

(1) Biological Function — Texas Natural Rivers System nominee for outstandingly remarkable fish and wildlife values; priority bottomland hardwood habitat displays significant overall habitat value

(2) High Water Quality/Exceptional Aquatic Life/High Aesthetic Value — National Forest Service wilderness-type area, exceptional aesthetic value

(3) Threatened or Endangered Species/Unique Communities — unique, exemplary, and unusually extensive natural community; Paddlefish; Creek chubsucker, Blue sucker; Neches River rose-mallow

Fastrill Reservoir will inundate 24,948 acres of land at conservation storage capacity. Table 3.4.6-5 and Figure 3.4.6-8 summarize existing landcover for the Fastrill Reservoir site as determined by TPWD using methods described in Appendix C. Existing landcover within this reservoir site is dominated by bottomland hardwood forest (32 percent) with sizeable areas of evergreen forest (21.5 percent), and upland deciduous forest (18 percent). Marsh, swamp, and open water total about 12 percent of the reservoir area.

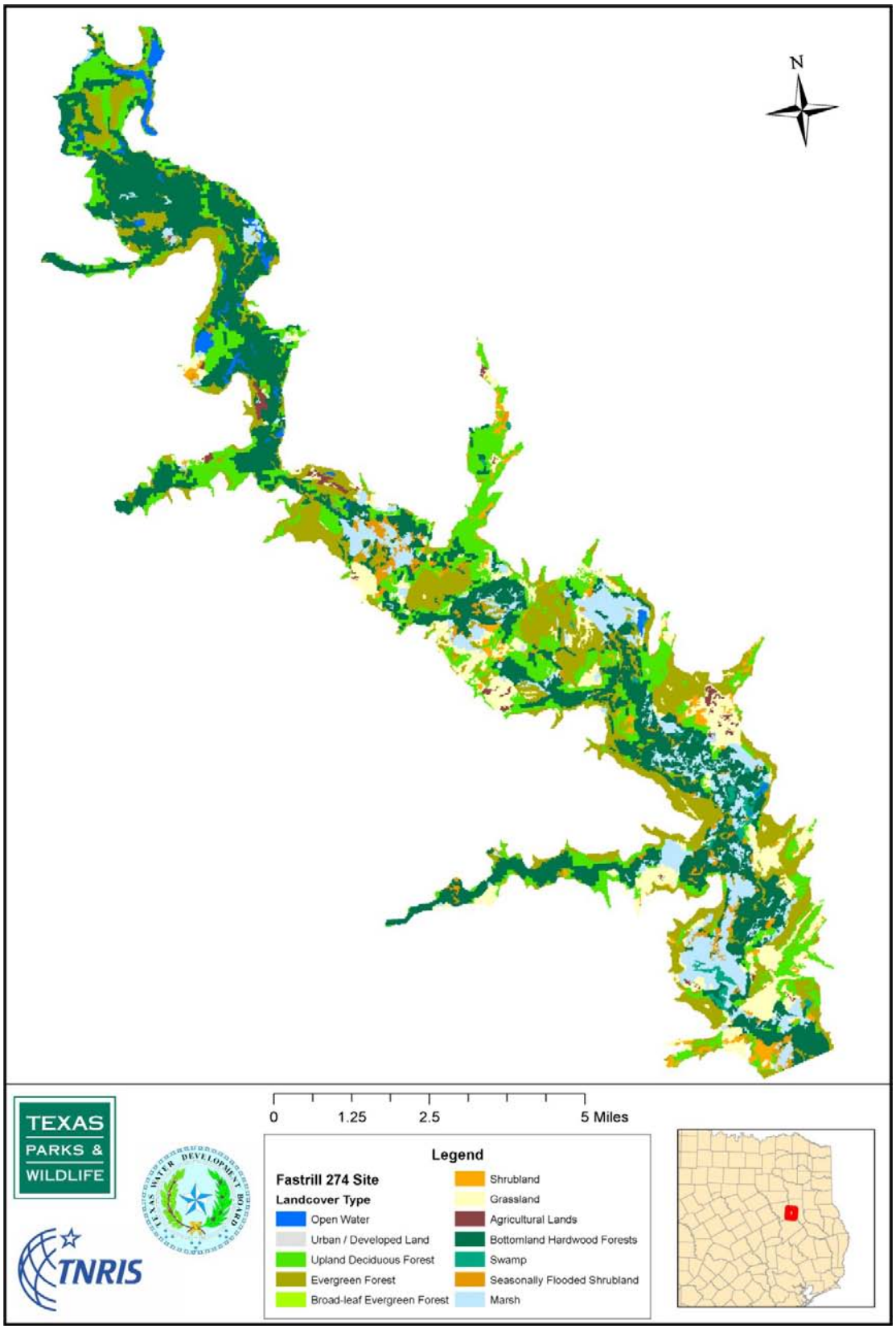

Figure 3.4.6-8. Existing Landcover for Fastrill Reservoir

Table 3.4.6-5.
Acreage and Percent Landcover for Fastrill Reservoir

Landcover Classification	*Acreage*[1]	*Percent*
Bottomland Hardwood Forest	7,781	32.2%
Evergreen Forest	5,202	21.5%
Upland Deciduous Forest	4,432	18.3%
Grassland	2,446	10.1%
Marsh	2,377	9.8%
Shrubland	562	2.3%
Seasonally Flooded Shrubland	554	2.3%
Open Water	410	1.7%
Swamp	224	0.9%
Agricultural Land	213	0.9%
Total	24,201	100%

[1] Acreage based on approximate GIS coverage rather than calculated elevation-area-capacity relationship.

The U.S. Fish & Wildlife Service (USFWS) has formally created the Neches River National Wildlife Refuge (NRNWR) with the purposes of protecting habitat for migratory birds, bottomland hardwood forests, and wetlands and providing for compatible wildlife-dependent recreation opportunities (US Fish & Wildlife Service, March 2005). The NRNWR includes a segment of the Neches River and its floodplain as well as surrounding upland areas that are coincident with the proposed location of Fastrill Reservoir. This refuge site was one among 14 Priority 1 sites identified by the USFWS in their Texas Bottomland Hardwood Preservation Program report (USFWS, May 1985). Priority 1 areas are considered to be excellent quality bottomlands and high value to key waterfowl species including mallards and wood ducks. The Fastrill Reservoir site is also located immediately upstream of a Priority 1 site bottomland preservation site identified as Middle Neches River (N-4).

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3.4.7 Lower Bois d'Arc Creek Reservoir

3.4.7.1 Description

Lower Bois d'Arc Creek Reservoir is a proposed reservoir on Bois d'Arc Creek, a tributary of the Red River. Figure 3.4.7-1 shows the location of the project, which is in Fannin County in North-Central Texas. A reservoir at this site (then called the Bonham Reservoir) was included in the Red River Compact (Red River Compact Commission, 1979). The project has been studied previously for the Red River Authority and the North Texas Municipal Water District (Freese and Nichols, 1984 and 1996) and was recommended as a water supply for the North Texas Municipal Water District in the 2001 and 2006 Region C Water Plans (Freese and Nichols et al., 2001 and 2006a) and the 2002 and 2007 Texas State Water Plan (Texas Water Development Board, 2002 and 2006).

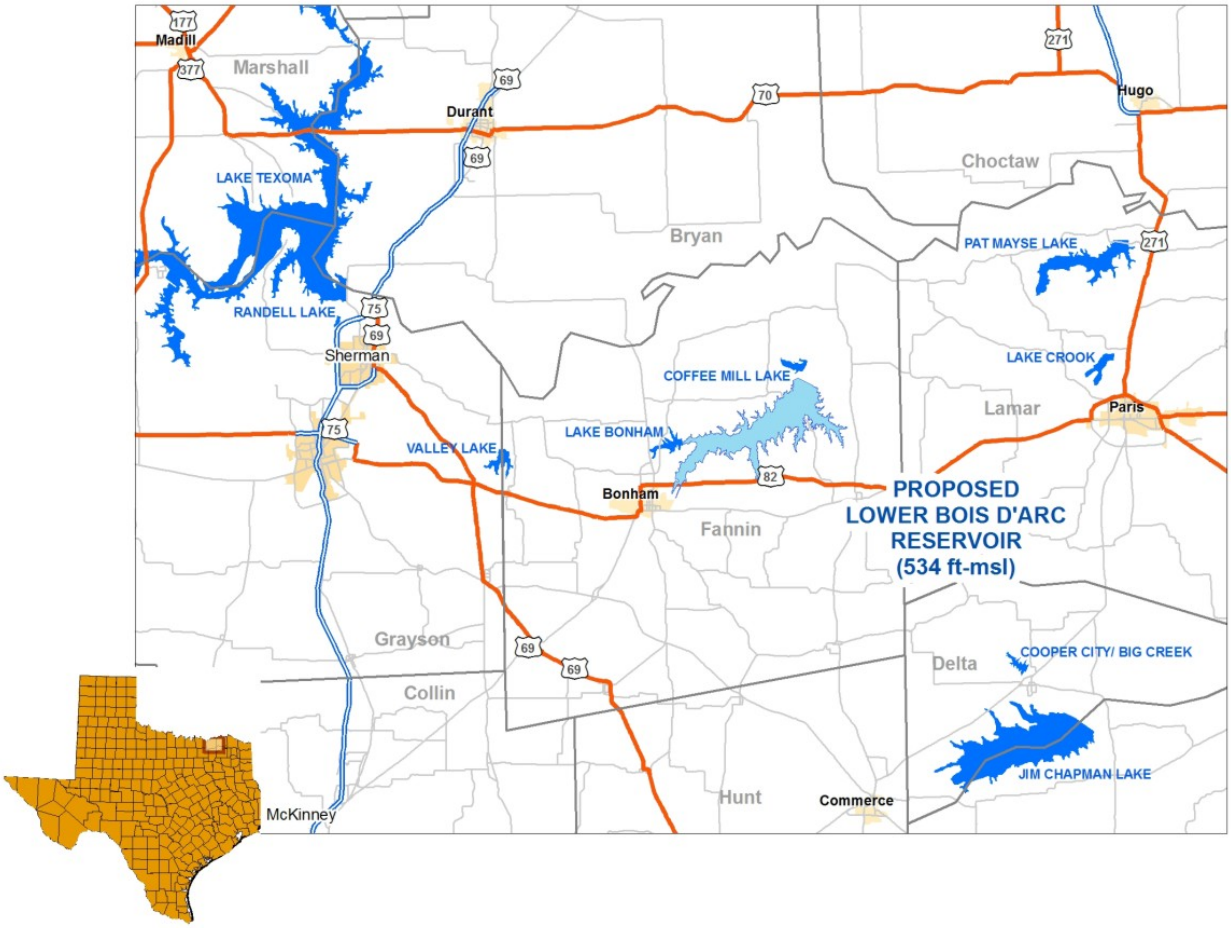

Figure 3.4.7-1. Location Map of Lower Bois d'Arc Creek Reservoir

Lower Bois d'Arc Creek Reservoir is recommended as a unique reservoir site in both the 2001 and 2006 Region C Water Plans. The reservoir is planned to provide water to the North Texas Municipal Water District, which serves water to customers over an eight-county area in north central Texas. The projected needs of the District for additional supply are 113,000 acft/yr in 2010, increasing to over 545,000 acft/yr by 2060 (Freese and Nichols et al, 2006a). The projected needs for additional water supply within 50 miles of the proposed reservoir site by 2060 are 728,028 acft/yr. The nearest major demand center is the Dallas-Fort Worth area, which is located approximately 60 miles southwest of the reservoir site.

3.4.7.2 Reservoir Yield Analysis

The reservoir area capacity data was developed from USGS topographic data and aerial photography that was flown in March 2004. The aerial photography provided 2-foot contour data at the reservoir site up to elevation 540 ft-msl. Table 3.4.7-1 shows the area-capacity-elevation (ACE) data for Lower Bois d'Arc Creek Reservoir. Figures 3.4.7-2 and 3.4.7-3 show the ACE curves and inundation at 10-foot contours.

The firm yields for Lower Bois d'Arc Creek Reservoir were performed using a modified version of the February 8, 2006 Red River WAM (Espey et al. 2002 and TCEQ 2006) Yields were calculated at elevations 530, 534, 536, and 538 ft-msl. The conservation elevation for the proposed reservoir is 534 ft-msl. The yield at this elevation is 126,280 acft/yr.

The hydrology at the Lower Bois d'Arc Creek dam site was calculated outside the WAM and input directly to the model. This adjustment was made because the original WAM underestimates the flows in the Bois d'Arc Creek watershed. From December 1962 to September 1985, the USGS operated the Bois d'Arc Creek near Randolph gage, which measured flows from about 22 percent of the proposed reservoir watershed. There were no known diversions or return flows above this gage, so the flows are representative of natural conditions. A recent study of the proposed reservoir compared these historical flows to naturalized flows in adjacent watersheds (Freese and Nichols, 2006b). This study concluded that naturalized flows in the Sulphur River Basin were probably a better estimator of flows in the Bois d'Arc Creek watershed than incremental flows in the main stem of the Red River, which is the default method used in the TCEQ Red River WAM. The study recommended adding a new primary control

Table 3.4.7-1.
Elevation-Area-Capacity Relationship for Lower Bois d'Arc Creek Reservoir

Elevation (feet)	*Area (acre)*	*Capacity (acft)*
464.0	5	4
470.0	19	76
480.0	378	1,197
490.0	2,001	15,109
500.0	4,288	50,684
510.0	6,987	99,108
520.0	10,601	180,995
530.0	14,724	302,570
534.0	16,526	367,609
540.0	19,616	467,767
550.0	23,967	678,337
560.0	29,670	954,617

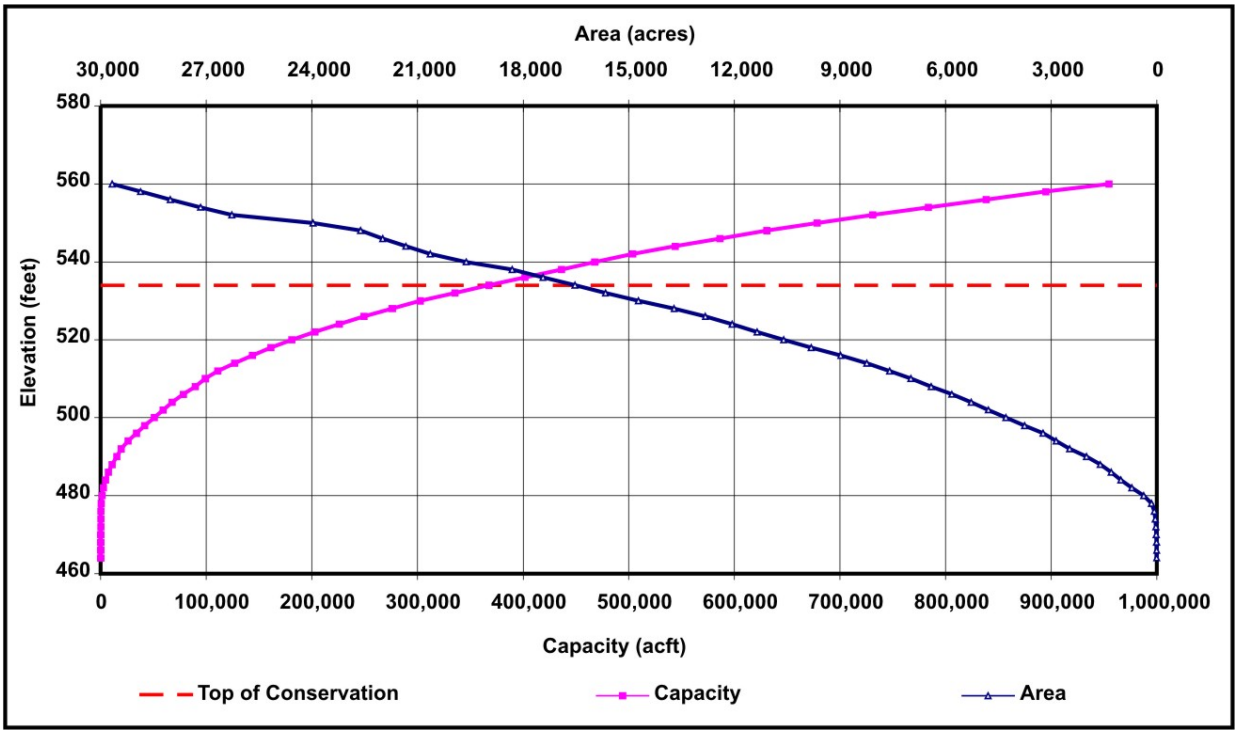

Figure 3.4.7-2. Elevation-Area-Capacity Relationship for Lower Bois d'Arc Creek Reservoir

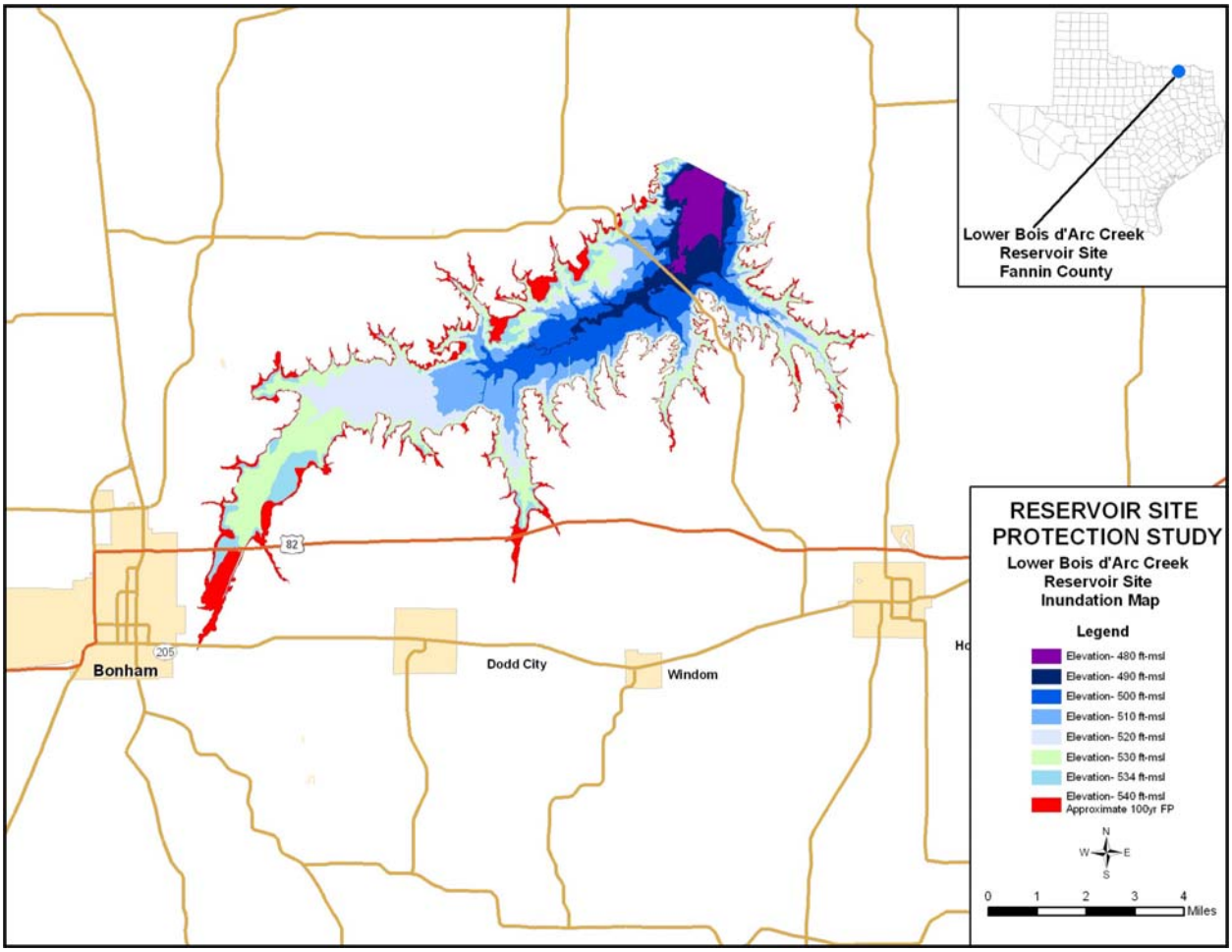

Figure 3.4.7-3. Inundation Map for Lower Bois d'Arc Creek Reservoir

point at the proposed reservoir site using flows based on data from the Randolph gage on Bois d'Arc Creek and naturalized flows in the Sulphur Basin. This method was adopted for the current yield evaluations. More information can be found in the *Report Supporting an Application for a Texas Water Right for Lower Bois d'Arc Creek Reservoir* (Freese and Nichols, 2006b).

For the hydrologic analyses, a new control point was added to the Red River WAM between secondary control points X10200 and X10260. This control point has a drainage area of 327 square miles. A standard firm yield was calculated assuming that water was passed to downstream senior water rights as determined in the WAM Run 3.

The yield studies used the Consensus Criteria for Environmental Flow Needs (CCEFN) bypass criteria developed in the 2006 study of the reservoir. The CCEFN criteria may be found

in Table 3.4.7-2. At the recommended conservation elevation, the bypass criteria reduce the yield of the reservoir by 880 acft/yr.

Table 3.4.7-2.
Consensus Criteria for Environmental Flow Needs for Lower Bois d'Arc Creek Reservoir

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Median	acft/mo	1,568	2,515	2,348	1,873	1,779	706	105	12	30	103	467	1,201
	cfs	25.5	44.9	38.2	31.5	28.9	11.9	1.7	0.2	0.5	1.7	7.8	19.5
25th	acft/mo	447	884	827	664	520	100	4	0	0	0	47	144
	cfs	7.3	15.8	13.4	11.2	8.5	1.7	0.1	0.0	0.0	0.0	0.8	2.3
7Q2	acft/mo	0	0	0	0	0	0	0	0	0	0	0	0

Table 3.4.7-3 and Figure 3.4.7-4 show the results of the yield studies. Note that in Figure 3.4.7-4 the yield of the reservoir per acre-foot of increased conservation storage is higher at a conservation elevation of 538 feet. However, the proposed reservoir is immediately downstream of Lake Bonham and the City of Bonham. Increasing the elevation of the reservoir would impact the existing dam for Lake Bonham and increase the potential for flooding in the City of Bonham. The storage trace for the recommended conservation pool elevation and the storage frequency curve are shown in Figure 3.4.7-5. This figure shows that at the proposed conservation elevation of 534 feet, the reservoir would be full about 13 percent of the time and below 50 percent full (183,805 acft) less than 20 percent of the months.

Table 3.4.7-3.
Firm Yield vs. Conservation Storage for Lower Bois d'Arc Creek Reservoir

Conservation Pool Elevation (ft-msl)	*Conservation Storage (acft)*	*Environmental Bypass Criteria*	*Yield (acft/yr)*	*Critical Period*
530.0	302,570	CCEFN	117,190	7/75 - 8/80
534.0*	367,609	CCEFN	126,280	7/75 - 2/81
		None	127,160	7/75 - 2/81
536.0	401,647	CCEFN	130,820	7/75 - 2/81
538.0	436,333	CCEFN	139,570	7/51 - 2/57
*Proposed conservation storage.				

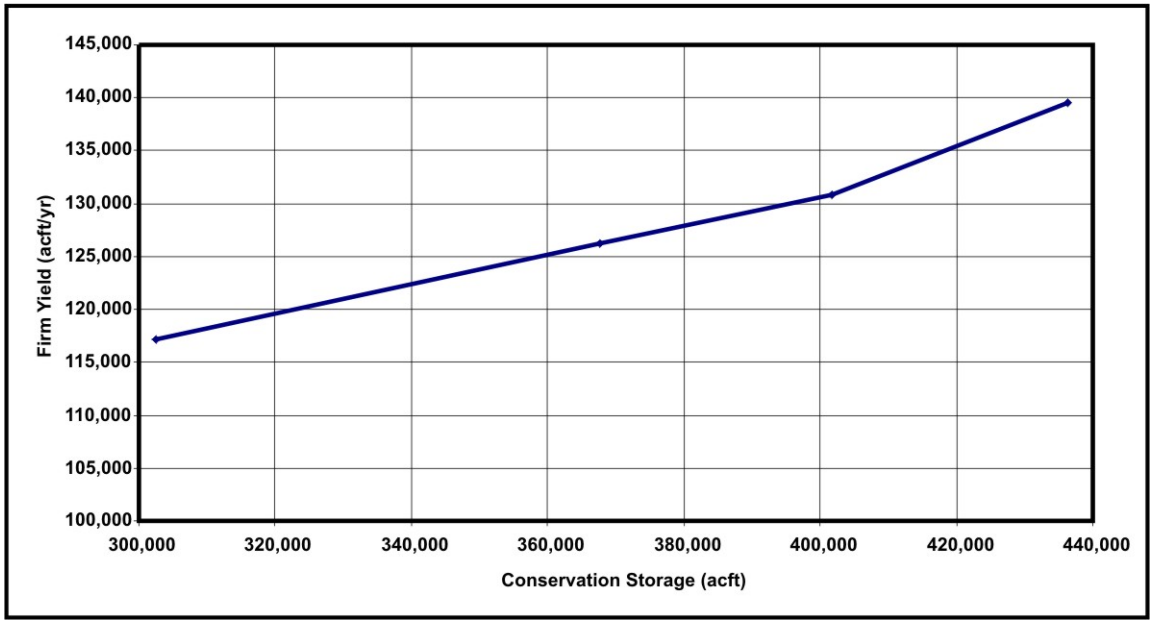

Figure 3.4.7-4. Firm Yield vs. Conservation Storage for Lower Bois d'Arc Creek Reservoir

3.4.7.3 Reservoir Costs

Costs for the Lower Bois d'Arc Creek Reservoir Dam assume a zoned earthen embankment and uncontrolled spillway. The length of the dam is estimated at 10,400 feet with a maximum height of 90 feet. The service spillway would include an approach channel; a 150-foot uncontrolled concrete weir, chute, hydraulic jump stilling basin, and outlet channel.

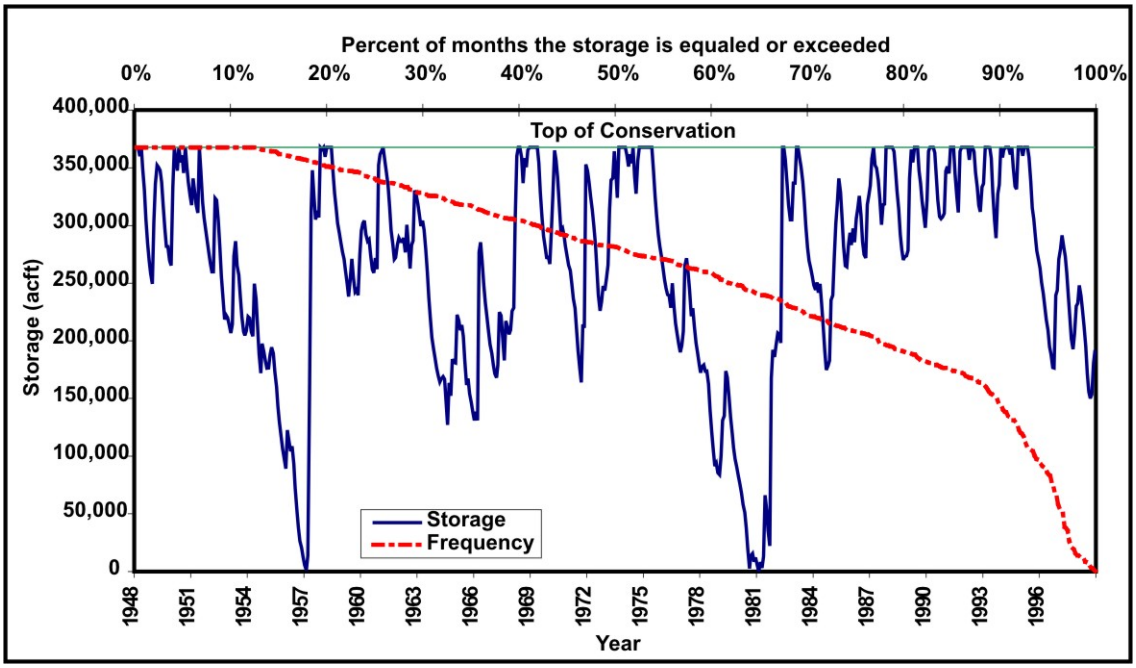

Figure 3.4.7-5. Simulated Storage in Lower Bois d'Arc Creek Reservoir (Conservation Elevation = 534 ft-msl, Diversion = 126,280 acft/yr)

Conflicts identified at the site include a cemetery, electrical lines, several roads (including U.S. Highway 82 and F.M. 1396), a 10-inch gas line and several other structures. A list of the potential conflicts is provided in Table 3.4.7-4. In addition to these conflicts, the cost estimate includes protection of the downstream slope of the Lake Bonham Dam, which will abut the upper reaches of the Lower Bois d'Arc Creek Reservoir. Costs for these conflict resolutions were developed from data provided by TNRIS and from the study report in support of the water right permit application for Lower Bois d'Arc Creek Reservoir (Freese and Nichols, 2006b). The conflict costs represent less than 10 percent of the total construction cost of the reservoir project. Figure 3.4.7-6 shows the conflicts as mapped by TNRIS.

Table 3.4.7-4.
List of Potential Conflicts for Lower Bois d'Arc Creek Reservoir

Gas Pipeline	Power Transmission Lines
Roads	Cemetery

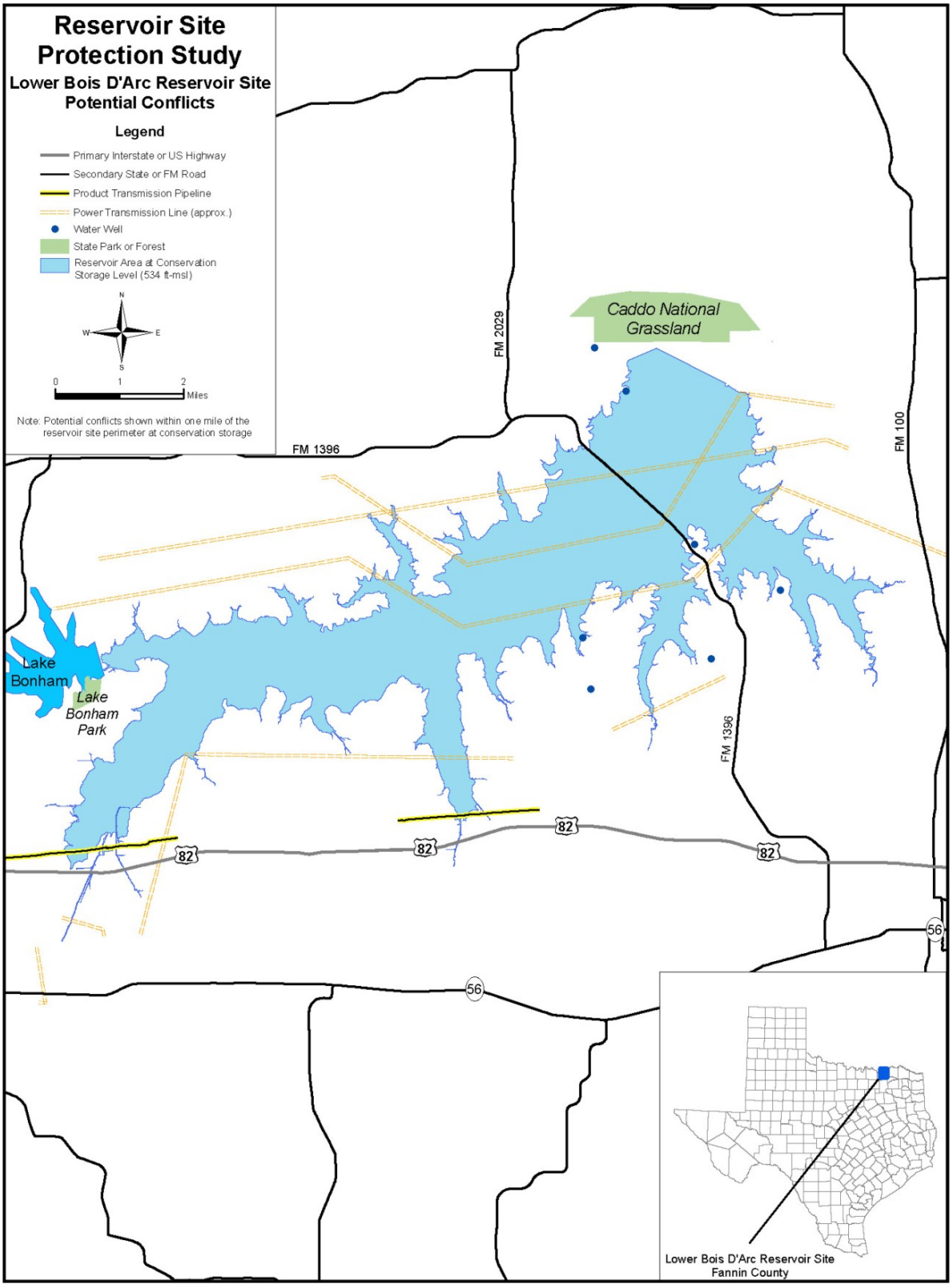

Figure 3.4.7-6. Potential Major Conflicts for Lower Bois d'Arc Creek Reservoir

Table 3.4.7-5 shows the estimated capital costs for the Lower Bois d'Arc Creek Reservoir Project, including construction costs, engineering, permitting and mitigation. Unit costs for the dam and reservoir are based on the unit cost assumptions used in this study. Local costs could vary. Utilizing these unit costs, the total estimated cost of the project is $248 million (2005 prices). Assuming a yield of 126,200 acft/yr, raw water from the project will cost approximately $140 per acre-foot ($0.43 per 1,000 gallons) during the debt service period.

3.4.7.4 Environmental Considerations

Lower Bois d'Arc Creek Reservoir is located on an ecologically significant stream as identified by the Texas Parks and Wildlife Department. The designation is based on biological function, hydrologic function, and the presence of a riparian conservation area. The Region C Water Planning Group did not identify this stream segment as ecologically unique in the 2006 water plan. Portions of the creek that would be impacted by the reservoir were altered (straightened and widened) approximately 80 years ago to reduce localized flooding. The site is located immediately upstream of the Caddo National Grasslands, but would have minimal impacts to these lands. The U.S. Fish and Wildlife Service has identified Priority 4 bottomland hardwoods considered "moderate quality bottomlands with minor waterfowl benefits" (USFWS, 1985) in the vicinity of the project.

Lower Bois d'Arc Creek Reservoir will inundate 16,526 acres of land at conservation storage capacity. Table 3.4.7-6 and Figure 3.4.7-7 summarize existing landcover for the Lower Bois d'Arc Creek Reservoir site as determined by TPWD using methods described in Appendix C. Existing landcover within this reservoir site is dominated by upland deciduous forest (42 percent) with sizeable areas of grassland (28 percent) and agricultural land (17 percent). Bottomland hardwood forest comprises only about 2.2 percent of the reservoir area while marsh, swamp, and open water total about 3.5 percent of the reservoir area.

Table 3.4.7-5.
Cost Estimate — Lower Bois d'Arc Creek Reservoir @ Elevation 534 ft-msl

	Quantity	*Unit*	*Unit Price*	*Cost*
Dam & Reservoir				
Mobilization (5%)	1	LS	$2,976,100	$2,976,000
Clearing and Grubbing	85	AC	$4,000	$340,000
Care of Water During Construction (1%)	1	LS	$589,300	$589,000
Required Excavation	2,339,400	CY	$2.50	$5,849,000
Borrow Excavation	2,030,000	CY	$2.00	$4,060,000
Random Compacted Fill	3,261,000	CY	$2.50	$8,153,000
Core Compacted Fill	711,200	CY	$3.00	$2,134,000
Soil Bentonite Slurry Trench	497,700	SF	$15.00	$7,466,000
Soil Cement	114,900	CY	$65.00	$7,469,000
Flex Base Roadway	29,200	SY	$20.00	$584,000
Sand Filter Drain	293,000	CY	$35.00	$10,255,000
Grassing	41	AC	$4,500	$185,000
Intake Tower for Low-Flow Outlet	527	CY	$750	$395,000
Conduit for Low-Flow Outlet	660	CY	$500	$330,000
Impact Basin for Low-Flow Outlet	160	CY	$500.00	$80,000
Gates and Miscellaneous for Low-Flow Outlet	1	LS	$200,000	$200,000
Electrical System and Instrumentation for Low-Flow Outlet	1	LS	$195,000	$195,000
Spillway Structure and Reinforced Concrete	19,700	CY	$375	$7,388,000
Roller Compacted Concrete	49,900	CY	$60	$2,994,000
Bridge	3,000	SF	$150	$450,000
Barrier and Warning System	1	LS	$50,000	$50,000
Embankment Instrumentation	1	LS	$250,000	$250,000
Timber Guard Posts and Guard Rail	1	LS	$55,000	$55,000
Misc. Internal Drainage	1	LS	$50,000	$50,000
Engineering and Contingencies				$21,874,000
Subtotal for Dam & Reservoir				**$84,371,000**
Conflicts				
Utilities				
10-in Gas Pipeline	3,720	LF	$27	$100,000
138 KV Line	1	LS	N/A	$1,500,000
345 KV line	1	LS	N/A	$3,735,000
Other structures	1	LS	N/A	$3,000,000
Cemeteries	27	EA	$6,000	$162,000
Major Roads (raised)	5,000	LF	$900	$4,500,000
Other roads	7,200	LF	$150	$1,080,000
Lake Bonham (protection)	1	LS	$175,000	$175,000
Engineering and Contingencies at 35%				$4,988,000
Land Acquisition - Conservation Pool plus 10%	22,000	AC	$2,675.00	$58,850,000
Environmental Studies and Mitigation Lands	22,000	AC	$2,675.00	$58,850,000
CONSTRUCTION TOTAL				**$221,311,000**
Interest During Construction (36 months)				**$26,927,000**
TOTAL COST				**$248,238,000**
ANNUAL COSTS				
Debt Service (6% for 40 years)				$16,498,000
Operation & Maintenance				$1,125,000
Total Annual Costs				**$17,623,000**
UNIT COSTS				
Per Acre-Foot				$140
Per 1,000 Gallons				$0.43

Units: AC = Acre; CY = Cubic Yard; EA = Each; LB = Pound; LF = Linear Foot; LS = Lump Sum; SF = Square Foot; and SY = Square Yard.

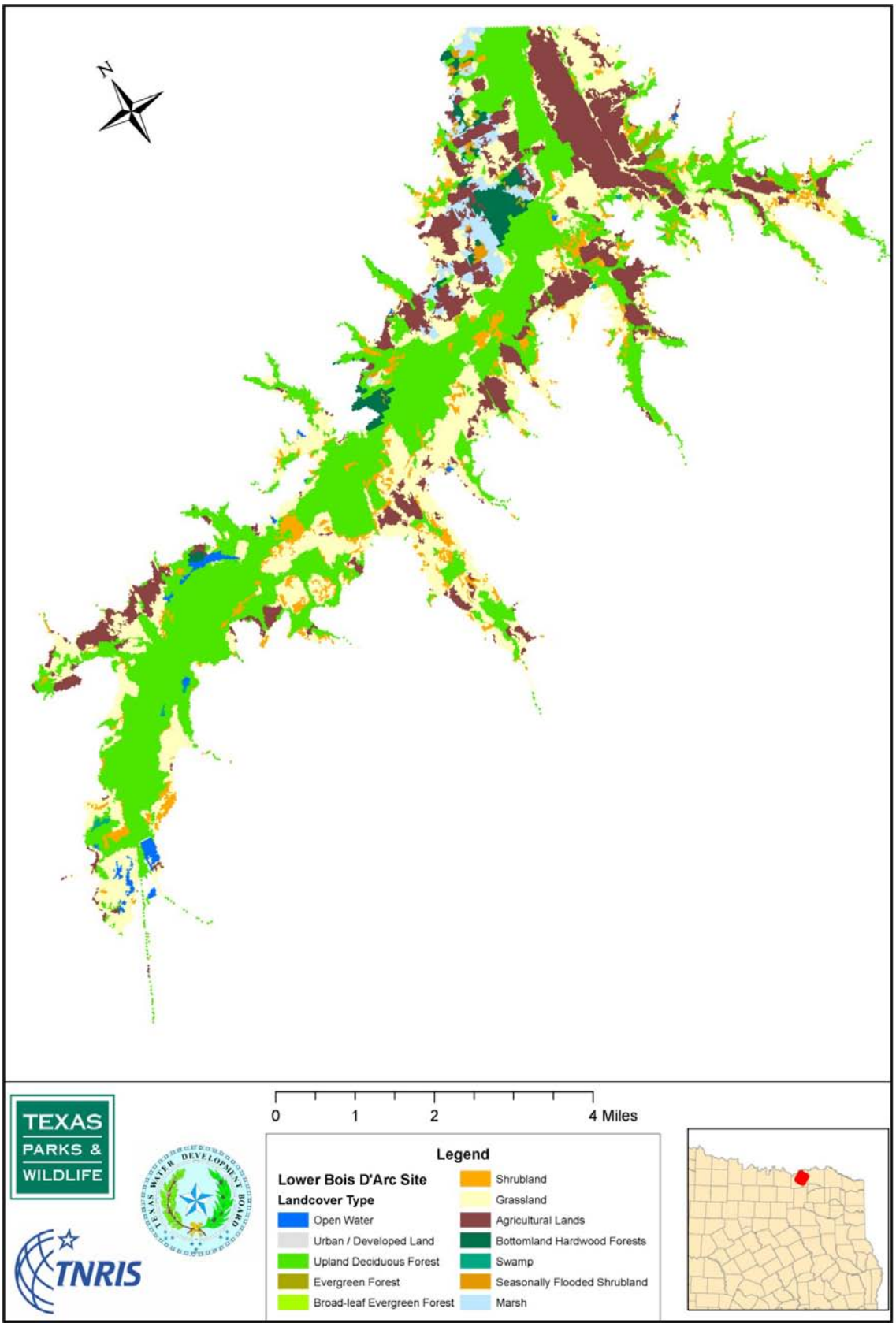

Figure 3.4.7-7. Existing Landcover for Lower Bois d'Arc Creek Reservoir

Table 3.4.7-6.
Acreage and Percent Landcover for Lower Bois d'Arc Creek Reservoir

Landcover Classification	*Acreage*[1]	*Percent*
Bottomland Hardwood Forest	373	2.2%
Marsh	407	2.5%
Seasonally Flooded Shrubland	73	0.4%
Swamp	29	0.2%
Evergreen Forest	61	0.4%
Upland Deciduous Forest	6,936	41.9%
Grassland	4,671	28.2%
Shrubland	1,038	6.3%
Agricultural Land	2,826	17.1%
Open Water	135	0.8%
Total	16,549	100.0%

[1] *Acreage based on approximate GIS coverage rather than calculated elevation-area-capacity relationship.*