

5A.7 Enhancement of Reservoir Yields

The set of alternatives considered as enhancements of reservoir yields is similar to the type involving the expanded use of existing supplies, described in Section 5A.4, in that steps are taken to increase the yield or available supplies in existing reservoirs. This category, however, includes those that involve a significant change in the resource configuration and a corresponding capital expenditure. These would include such changes as increasing the storage in a reservoir by raising the conservation pool level or building a new embankment downstream from the current one. They would also include the development of a diversion project that would temporarily store and then divert water from an adjacent creek or river into the reservoir. Five potential alternatives were delineated within the region, each corresponding to an identified supply deficit. These were:

- Increasing the storage in Lake Leon by raising the pool level;
- Diverting flows from California Creek into Lake Stamford;
- Diverting flows from Sweetwater Creek into Lake Sweetwater;
- Diverting flows from Battle Creek to Lake Cisco;
- Increasing the available storage in Lake Fort Phantom Hill by building a new embankment downstream of the current dam; and
- Supplementing the yield of Lake Fort Phantom Hill with available groundwater in Jones County.

A brief review of past work and available information demonstrated that the latter two alternatives would not be practical. The first four were reviewed further and are described in the following sections. Their locations are shown in Figure 5A.7-1.

5A.7.1 Increased Storage in Lake Leon

5A.7.1.1 Description of Option

Lake Leon is owned by Eastland County Water Supply District and currently stores 27,300 acft of water. This alternative would increase this storage by seven feet, or 13,000 acft, for a total storage of 40,300 acft. The shortages in Eastland County that would be addressed by this alternative include an agricultural shortfall of about 8,000 acft/yr and a current municipal shortage for the City of Cisco of about 316 acft/yr that decreases to 185 acft/yr by the year 2030.

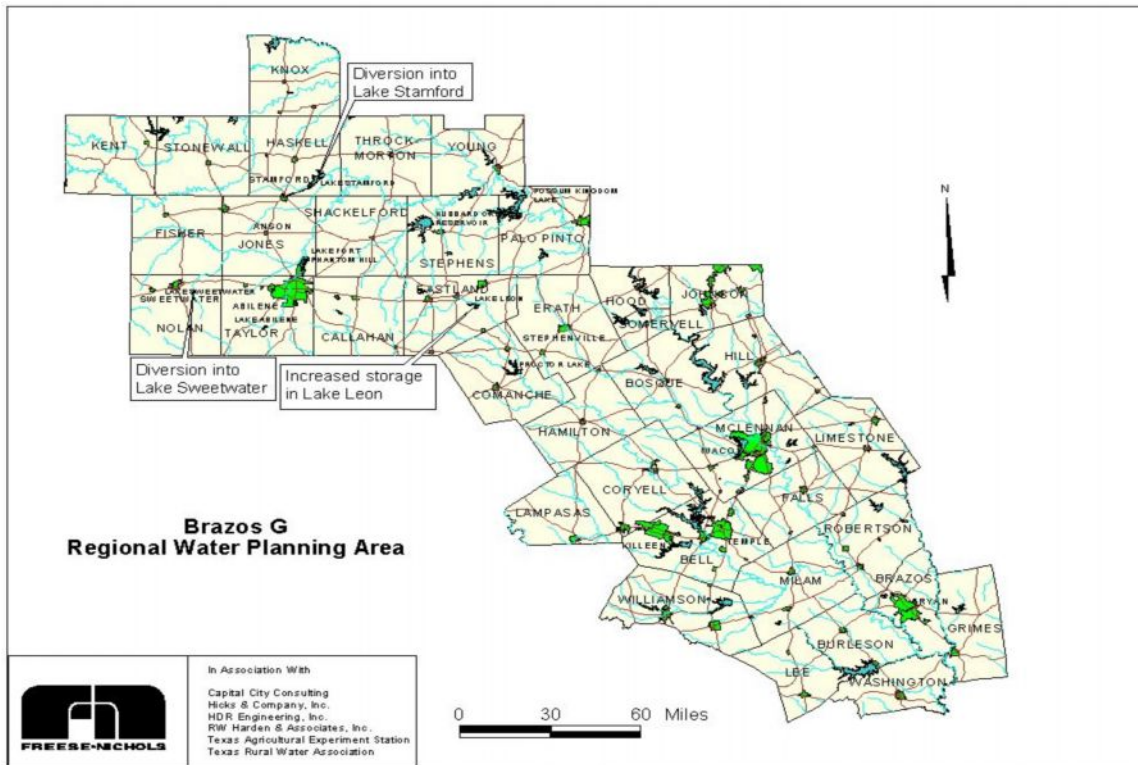


Figure 5A.7-1. Enhancement of Reservoir Yields - Alternatives Reviewed

5A.7.1.2 Available Yield

The updated yield for Lake Leon is 9,100 acft/yr, considerably more than the 4,500 acft/yr listed in the 1990 and 1997 Water Plans and used in the first drafts of this report. This is also more than the permitted withdrawal rate of 6,301 acft/yr. Increasing the pool by seven feet will increase the yield to 12,200 acft/yr, an increase of 3,100 acft/yr in the yield of the reservoir. It is an increase of 7,700 acft/yr over the previously referenced yield, which would eliminate the overall shortage for Eastland County.

5A.7.1.3 Engineering and Costing

This alternative would be effected by plugging the current drop inlet spillway and constructing a new uncontrolled spillway in the central portion of the emergency spillway. A fuse plug would be needed in the emergency spillway so that it does not operate too frequently and the dam would likely need to be raised. The total construction cost was estimated to be

\$2.2 million, for a cost of raw water of about \$715 per acft. No costs have been included for land acquisition or mitigation of structures around the lake that would be impacted.

The distribution infrastructure that would be needed to use the additional surface water for irrigation use would involve a network of small pipelines and pump stations throughout the area, with construction costs probably ranging from \$10 million to \$20 million. For the 3,100-acft/yr incremental benefit, this would equate to a unit cost of about \$325 to \$650 per acft for the raw water supply, in addition to the cost to raise the dam.

5A.7.1.4 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 5A.7-1, and the option meets each criterion.

**Table 5A.7-1.
Comparison of Lake Leon Increased Storage Option to Plan Development Criteria**

<i>Impact Category</i>	<i>Comment(s)</i>
A. Water Supply: 1. Quantity 2. Reliability 3. Cost	1. Sufficient to meet needs 2. High reliability 3. Moderate
B. Environmental factors 1. Environmental Water Needs 2. Habitat 3. Cultural Resources 4. Bays and Estuaries	1. Moderate impact 2. Possible impact 3. Possible impact 4. Negligible impact
C. Impact on Other State Water Resources	• No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	• Potential impact on bottomland farms and habitat in reservoir area
E. Equitable Comparison of Strategies Deemed Feasible	• Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	• Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	• None

The yield calculations did not determine the impact of the additional withdrawals on downstream reservoirs, especially Lake Proctor, or downstream water rights holders. If the option is pursued any further, these will need to be identified and compensated for. This will likely reduce the available downstream supply. In addition, the dam is currently estimated to

only pass 65 percent of the Probable Maximum Flood, and if any improvements are made, the dam will need to be upgraded to meet state dam safety criteria, which is 100 percent of the Probable Maximum Flood. This will likely increase the cost of the alternative. In addition, any structures around the lake that would be impacted by the pool raise would need to be raised or mitigated, adding to the cost of the alternative.

Construction of the network of distribution pipes and key pump stations and main trunk lines would present a challenge as several different farming entities would have to likely switch from groundwater supply to surface water supply and coordination of their needs within a viable funding mechanism will present some challenges.

5A.7.2 Diversion from California Creek into Lake Stamford

5A.7.2.1 Description of Option

The City of Stamford and West Texas Utilities, owners of Lake Stamford, are currently pursuing the construction of a diversion facility on California Creek. The facility would consist of a channel dam on Paint Creek just downstream from the junction of California Creek and Paint Creek. The dam would store flows from California Creek, pushing water back up Paint Creek towards Stamford Dam. A 200 cfs pump station is planned to divert the stored water up into lake Stamford if the reservoir is not full.

5A.7.2.2 Available Yield

The current firm yield of Lake Stamford is 2,930. However, due to limitations on the ability of West Texas Utility's power plant to operate, the actual yield of Lake Stamford would be 1,712 acft/yr, if the lake is not allowed to go below West Texas Utility's minimum operating level. The proposed diversion project will increase the firm yield by 3,750 acft/yr to 6,680 acft/yr. If the lake is maintained above West Texas Utility's minimum level, the increase is to 5,543 acft/yr. By contractual arrangement, this increase in yield is split evenly between the City of Stamford and West Texas Utilities.

5A.7.2.3 Engineering and Costing

The total cost of the proposed project is estimated to be \$6.3 million, with annual costs of financing, operations, and maintenance of \$640,000. This equates to about \$171 per acft for raw water of the incremental increase in firm yield.

5A.7.2.4 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 5A.7-2, and the option meets each criterion.

**Table 5A.7-2.
Comparison of California Creek Diversion Storage Option to Plan Development Criteria**

Impact Category	Comment(s)
A. Water Supply: 1. Quantity 2. Reliability 3. Cost	1. Sufficient to meet needs 2. High reliability 3. Low to moderate
B. Environmental factors 1. Environmental Water Needs 2. Habitat 3. Cultural Resources 4. Bays and Estuaries	1. Low impact 2. Low impact 3. Low impact 4. Negligible impact
C. Impact on Other State Water Resources	• No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	• Negligible or low impact
E. Equitable Comparison of Strategies Deemed Feasible	• Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	• Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	• None

The City of Stamford is currently pursuing state and federal permitting for the project. It has been determined that the diversion will reduce the yield of Possum Kingdom Reservoir by 1,820 acft/yr, for which the Brazos River Authority will be compensated.

5A.7.3 Diversion from Sweetwater Creek into Lake Sweetwater

5A.7.3.1 Description of Option

This alternative was reviewed based on the findings of a 1983 report, *Water Supply Alternatives*, by Camp, Dresser, & McKee. The proposed configuration would consist of the construction of a small earthen dam on Sweetwater Creek, a 7 MGD pump station, and 8,700 feet of 24-inch pipeline. Flood flows on Sweetwater Creek would be diverted in Lake

Sweetwater. Sweetwater is projected to have a slight deficit towards the end of the planning period. There is also a manufacturing and mining use deficit for Nolan County.

5A.7.3.2 Available Yield

The current firm yield of Lake Sweetwater is 1,400 acft/yr. The diversion is estimated to increase the yield by about 790 acft/yr.

5A.7.3.3 Engineering and Costing

The construction cost and annual costs were estimated by updating the 1983 costs. This would be an estimated construction cost of about \$3.0 million and a unit cost of raw water of about \$406 per acft.

5A.7.3.4 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 5A.7-3, and the option meets each criterion.

**Table 5A.7-3.
Comparison of Sweetwater Creek Diversion Option to Plan Development Criteria**

<i>Impact Category</i>	<i>Comment(s)</i>
A. Water Supply: 1. Quantity 2. Reliability 3. Cost	1. Small quantity, but possibly important in a dry area 2. High reliability 3. Moderate
B. Environmental factors 1. Environmental Water Needs 2. Habitat 3. Cultural Resources 4. Bays and Estuaries	1. Moderate impact 2. Possible moderate impact 3. Negligible impact 4. Negligible impact
C. Impact on Other State Water Resources	• No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	• None to low impact
E. Equitable Comparison of Strategies Deemed Feasible	• Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	• Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	• None

Implementation of the diversion alternative would involve standard state and federal permitting issues, including water rights and environmental permits. The water rights issues would also have to address downstream water rights and flow level issues.

5A.7.4 Diversion from Battle Creek into Lake Cisco

5A.7.4.1 Description of Option

Lake Cisco is owned by the City of Cisco and is permitted to hold 45,000 acft of water. However, due to its limited drainage area, there is insufficient runoff to utilize this storage. The yield of the lake is currently estimated to be 500 acft/yr. There is currently a small diversion on Battle Creek, which is located about 5 miles west of the lake. The City has existing water rights for up to 110 acft of storage on Battle Creek, and a withdrawal rate up to 11.15 cfs (5,000 gpm). The proposed project is to enlarge the current storage and pumping capacity to the full permitted sizes and to utilize the existing pipeline. The shortages in Eastland County that would be addressed by this alternative include the municipal use deficit for the City of Cisco, which is currently about 316 acft/yr that drops to 185 acft/yr by the year 2030.

5A.7.4.2 Available Yield

The current yield for Lake Cisco is 500 acft/yr and is projected to drop to 370 acft by 2050. If the current diversion structures are enlarged to full permitted size, the water available should add 500 acft/yr to the yield of Lake Cisco.

5A.7.4.3 Engineering and Costing

This alternative would consist of the construction of a 110 acft lake and a 7.2 MGD pump station on Battle Creek. The total construction cost was estimated to be \$4.7 million, with a unit cost of water of about \$960 per acft, or \$2.95 per 1,000 gallons.

5A.7.4.4 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 5A.7-4, and the option meets each criterion.

Table 5A.7-4.
Comparison of Battle Creek Diversion Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply: 1. Quantity 2. Reliability 3. Cost	1. Relatively small quantity, but possibly important in dry areas 2. High reliability 3. Moderate
B. Environmental factors 1. Environmental Water Needs 2. Habitat 3. Cultural Resources 4. Bays and Estuaries	1. Low impact 2. Low impact 3. Low impact 4. Negligible impact
C. Impact on Other State Water Resources	• No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	• None
E. Equitable Comparison of Strategies Deemed Feasible	• Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	• Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	• None

5A.7.4.5 Environmental Issues

The six options in this category would entail more capital intensive structural improvements and hence greater physical alterations to environmental resources. These physical alterations would include raising dam heights, modifying spillways, and constructing new impoundments, intake structures, pump stations, and pipelines. These developments are likely, in turn, to result in (1) possible modifications in the height and variability of reservoir pool elevations; and (2) seasonally reduced flows in downstream waterways; and (3) physical disturbance to terrestrial environments. The evaluation summarized in Table 5A.7-5 was based on a wide range of natural resource data on threatened and endangered species, and on riparian (stream bank) and littoral (lake side) habitats.

The six enhancement options shown in Table 5A.7-5 are likely to result in more substantial environmental effects due to the greater extent of structural modifications to the water supply infrastructure. *Increased Storage in Lake Leon* will involve raising the dam to effect a 5 to 7-foot increase in conservation pool elevation. This in turn will result in additional inundation of littoral habitat, with possible low impacts on migratory waterfowl, including two federally listed species: the Interior least tern and the Whooping crane. Bank inundation could also affect

other wildlife species as well as possible cultural resources sites. The *Diversion from California Creek into Lake Stamford* option involves construction of a detention structure on California Creek in Haskell County with intake structure, pump station(s), and pipeline to Lake Stamford. Low flows on California Creek would be passed through, with flood flows impounded for pumping to the reservoir. If this option involves alteration of releases from Lake Stamford, low impacts could be anticipated to aquatic and riparian habitats in Paint Creek as well. The option to supplement Lake Fort Phantom Hill with groundwater is similar to an option described under Section 5A.4, *Expanded Use of Existing Sources*, except that a well field and pipeline(s) would also be constructed. Substantial increases in groundwater withdrawals could have localized effects on water levels in the Seymour aquifer. Pipeline construction would add possible low effects to terrestrial habitat in Jones County to the impacts described in Section 5A.4. The option for new impoundment below Lake Fort Phantom Hill would involve construction of a channel dam on Elm Creek about one mile below the reservoir dam, with possible moderate impacts to instream and riparian habitats. Like the Lake Fort Phantom Hill option described in Section 5A.4, there could be possible moderate effects to habitats further downstream. Similar instream and riparian effects could result from the *Diversion from Sweetwater Creek into Lake Sweetwater*, which also requires construction of a detention structure in Sweetwater Creek and pipelines and pump station(s) in Nolan County. Terrestrial impacts from pipeline construction could possibly affect habitat of the Black-capped vireo, a federally listed species.

The Diversion from Battle Creek to Lake Cisco option involves enlargement of the current diversion structure and pumping capacity to transfer more water to Lake Cisco. Since there are no plans to enlarge the existing pipeline, possible low impacts are anticipated to wildlife habitat, cultural resources, and instream flows, while impacts to endangered species and bays and estuaries will be negligible.

This preliminary identification of environmental issues is based on an evaluation of the general characteristics of the water management options. Site-specific investigations of the potentially affected environments would be necessary to provide detailed evaluations of possible habitat and cultural resources impacts of modified pool elevations. A quantitative estimate of the magnitude and seasonal distribution of the reduced downstream flows implied in the *Enhanced Reservoir Yields* options would be needed to further assess the environmental water needs/instream flow and fish and wildlife effects of these options.