

Section 4B

Identification, Evaluation, and Selection of Water Management Strategies

4B.1 Water Management Strategies

Title 31 TAC 357.7(a)(7) requires that the regional water planning group evaluate all water management strategies determined to be potentially feasible. The guidelines list multiple types of strategies and numerous subtypes, including water conservation; drought management measures; reuse of wastewater; expanded use of existing facilities, including systems optimizations, conjunctive use, reallocation of storage to new uses, etc.; interbasin transfers; new supply development; and others. At the beginning of the 2006 planning cycle, the Brazos G RWPG identified approximately 25 water management strategies to be potentially feasible. For the 2011 Plan update, 20 categories of strategies were investigated with some categories containing 11 individual strategies. Many of these were evaluated for the previous 2006 Plan. Several strategies were re-evaluated due to changed conditions such as new hydrologic information or requests for further information. Packages describing amendments to the 2006 Plan are included in Section 4B.21, as originally adopted by the Brazos G RWPG. Costs for these strategies as shown in specific WUG and WWP plans have been updated to September 2008 prices.

Potential water supply strategy categories evaluated during preparation of the 2011 Plan are listed in Table 4B.1-1. Within some of the 15 types of water management strategies listed in Table 4B.1-1 there are a number of sub-options. For instance, in the section on New Reservoirs (Section 4B.12), eleven potential reservoir sites are evaluated.

The remainder of this section describes methods and procedures utilized to evaluate water management strategies considered for inclusion in the 2011 Plan.

4B.1.1 Evaluation of Strategies

The following chapters contain an evaluation of each of the potential water management strategies. Each section is typically divided into five subsections: (1) Description of Option; (2) Available Yield; (3) Environmental Issues; (4) Engineering and Costing; and (5) Implementation Issues. Information in these sections was presented to the Brazos G RWPG

at regularly scheduled public meetings and was used in evaluating strategies to meet water needs in the area.

**Table 4B.1-1.
Water Management Strategies Evaluated
for the 2011 Brazos G Regional Water Plan**

Section No. (Located in Volume II)	Title
4B.2	Water Conservation
4B.3	Wastewater Reuse
4B.4	System Operation of Brazos River Authority Reservoirs
4B.5	Groundwater/Surface Water Conjunctive Use (Lake Granger Augmentation)
4B.6	Desalination
4B.7	Millers Creek Reservoir Augmentation
4B.8	Aquifer Storage and Recovery
4B.9	Brush Control and Range Management
4B.10	Weather Modification
4B.11	Interregional Water Management
4B.12	New Reservoirs
4B.13	Off-Channel Reservoirs
4B.14	Interconnection of Regional and Community Systems
4B.15	Carrizo-Wilcox Aquifer Development
4B.16	Voluntary Redistribution
4B.17	Miscellaneous Strategies
4B.18	Storage Reallocation in Federal Reservoirs
4B.19	Chloride Control
4B.20	BRA Reservoir Connections
4B.21	Amendments to the 2006 Plan Brought Forward to the 2011 Plan

4B.1.2 Plan Development Criteria

It is the goal of the Brazos G RWPG to develop a plan to meet projected water needs within the Brazos G Area. The Brazos G RWPG has adopted a set of Plan Development Criteria that was used to evaluate whether a given strategy should be used to meet a projected shortage

and ultimately be included in the Brazos G Regional Water Plan. The proposed strategies were developed by evaluating the water management strategies using the Plan Development Criteria and then matching strategies to meet projected shortages. This section discusses the evaluation criteria adopted by the planning group during plan development, and criteria to be met in formulation of the plan. The adopted plan elements will meet these criteria:

- **Water Supply** – Water supply must be evaluated with respect to quantity, reliability, and cost. The criteria for quantity are that the plan must be sufficient to meet all projected needs in the planning period. The criteria for reliability is that it meet municipal and industrial needs 100 percent of the time, and 75 percent of agricultural needs 75 percent of the time. The criteria for cost are that the projected cost be reasonable to meet the projected needs.
- **Environmental Issues** – Environmental considerations must be examined with respect to environmental water needs, wildlife habitat, cultural resources, and bays and estuaries. The criteria for environmental water flows and wildlife habitat are that stream conditions must meet permit requirements for diversions that currently have permits. For projects that require permit acquisition the project will provide adequate environmental instream flows for aquatic habitat. Projects should be sited to avoid known cultural resources, if possible. Flows to bays and estuaries should meet expected permit conditions. (It should be noted that the Brazos River does not have a well-defined estuary or bay system, so bay and estuary inflow requirements are expected to be low).
- **Impacts on Other State Water Resources** – The criteria recommend a follow-up study by the Brazos G RWPG if any significant impacts are anticipated on other state water resources.
- **Threats to Agriculture and Natural Resources** – The criteria requires that the planning group identify any potential impact, compare the impact to the proposed benefit of the plan, and make recommendations. With the exception of large projects that will affect large acreages, such as reservoir projects, the water management strategies evaluated will have no significant impact to the State’s Agricultural resources.
- **Equitable Comparison of Feasible Strategies** – This is achieved by the equal application of criteria across different water development plans.
- **Interbasin Transfers** – The planning group may consider interbasin transfers as a supply option. The criteria require that the participating entities recognize and follow Texas Water Code requirements for expected permitting requirements.
- **Impacts from Voluntary Redistribution** – The criteria require that any potential third party social or economic impacts from voluntary redistribution of water rights be identified and described.
- **Other Criteria** – Texas Water Development Board (TWDB) allows the Brazos G RWPG to adopt other criteria. The Brazos G RWPG has not adopted any further criteria.

The following sections discuss the methods and procedures used to develop the information needed to evaluate the strategies and compare them to the criteria.

4B.1.3 Engineering

A procedure was developed to maintain equal and consistent consideration of various design and cost variables across differing water management strategy options. These are planning level estimates only, and do not reflect detailed site-specific design work, nor any extensive optimization and selection of design variables. These procedures standardized the consideration of the following design and costing issues as closely as possible, given the varying scope and magnitude of differing projects. For each option, major cost components were determined at the outset. Estimates of volume of water and rate of delivery needed were developed from the supply-demand comparisons presented in Section 4A, if directly applicable. Volumes necessary to meet shortages were estimated, and both average annual and peak rates of projected delivery were calculated. Average annual rates were adjusted to reflect pump station downtime for maintenance activities. Transmission and treatment facilities were generally sized based on peak rates of delivery. Water source and delivery locations were determined, considering source and destination elevations, surrounding land use, and other geographic considerations. Further details on engineering factors considered are presented in the discussions of the various water management strategies presented in Volume II, Sections 4B.2 through 4B.21.

4B.1.4 Cost Estimates

The cost estimates of this study are expressed in three major categories: (1) construction costs or capital (structural) costs, (2) other (non-structural) project costs, and (3) annual costs. Construction costs are the direct costs incurred in constructing facilities, such as those for materials, labor, and equipment. "Other" project costs include expenses not directly associated with construction activities of the project, such as costs for engineering, legal counsel, land acquisition, contingencies, environmental studies and mitigation, and interest during construction. Capital costs and other project costs comprise the total project cost. Operation and maintenance, energy costs, purchase of wholesale water and debt service payments are examples of annual costs. Major components that may be part of a preliminary cost estimate are listed in Table 4B.1-2. All costs represent second September 2008 prices.

To estimate capital costs, tables of unit costs for each major component in the capital costs were developed through an internal review of bid documents and project cost audits of projects that HDR and Freese & Nichols (subconsultant) have implemented in the past. The cost

tables report all-inclusive costs to construct, including the construction, infrastructure and control equipment, and all other materials, labor, and installation costs. Unit costs were developed for pump stations, intake structures, pipelines, wells, reservoir structures, channel dams and any other structural component called for in a water supply option.

**Table 4B.1-2.
Major Project Cost Categories**

Capital Costs (Structural Costs)	Other Project Costs (Non-Structural Costs)
<ol style="list-style-type: none"> 1. Pump Stations 2. Pipelines 3. Water Treatment Plants <ol style="list-style-type: none"> a. Conventional b. Desalination 4. Water Storage Tanks 5. Off-Channel Reservoirs 6. Well Fields <ol style="list-style-type: none"> a. Injection b. Recovery c. ASR Wells 7. Dams and Reservoirs 8. Relocations 9. Other Items 	<ol style="list-style-type: none"> 1. Engineering (Design, Bidding and Construction Phase Services, Geotechnical, Legal, Financing, and Contingencies) 2. Land and Easements 3. Environmental - Studies and Mitigation 4. Interest During Construction
	Annual Project Costs
	<ol style="list-style-type: none"> 1. Debt Service 2. Operation and Maintenance (excluding pumping energy) 3. Pumping Energy Costs 4. Purchase Water Cost (if applicable)

As previously mentioned, “other” (non-structural) project costs are costs incurred in a project that are not directly associated with construction activities. These include costs for engineering, legal counsel, financing, contingencies, land, easements, surveying and legal fees for land acquisition, environmental and archaeology studies, permitting, mitigation, and interest during construction. These costs are added to the capital costs to obtain the total project cost. A standard percentage applied to the capital costs is used to calculate a combined cost that includes engineering, financial, legal services, and contingencies.

Annual costs are those that the project owner can expect to incur if the project is implemented. These costs include repayment of borrowed funds (debt service), operation and maintenance costs of the project facilities, pumping power costs, and water purchase costs, when applicable.

Debt service is the estimated annual payment that can be expected for repayment of borrowed funds based on the total project cost, an assumed finance rate, and the finance period in years. As specified by the TWDB in Section 4.1.2 of *Exhibit C, General Guidelines for*

Regional Water Plan Development (2007 – 2011), debt service for all projects was calculated assuming an annual interest rate of 6 percent and a repayment period of 40 years for large reservoir projects and 20 years for all other projects.

Operation and maintenance costs for dams, pump stations, pipelines, and well fields (excluding pumping power costs) include labor and materials required to operate the facilities and provide for regular repair and/or replacement of equipment. In accordance with TWDB guidelines, unless specific project data are available, operation and maintenance costs are calculated at 1 percent of the total estimated construction costs for pipelines, at 1.5 percent of the total estimated construction costs for dams and reservoirs, and at 2.5 percent for intake and pump stations. Water treatment plant operation and maintenance costs were based on treatment level and plant capacity. The operation and maintenance costs include labor, materials, replacement of equipment, process energy, building energy, chemicals, and pumping energy.

In accordance with TWDB guidelines, power costs are calculated on an annual basis using the appropriate calculated power load and a power rate of \$0.09 per kilo-Watt-hour (kWh). The amount of energy consumed is based upon the pumping horsepower required.

The raw water purchase cost, if applicable, is included if the water supply option involves purchase of raw or treated water from an entity. This cost varies by source and by supplier.

A cost estimate summary for each individual option is presented with total capital costs, total project costs, and total annual costs. The level of detail is dependent upon the characteristics of each option. Additionally, the cost per unit of water involved in the option is reported as costs per acft and cost per 1,000 gallons of water developed. The individual option cost tables specify the point within the region at which the cost applies (e.g., raw water at the reservoir, treated water delivered to the WUG or WWP, or elsewhere as appropriate).

Numerous recommended water management strategies are included in plans for individual water user groups that are not analyzed to the exact level of detail as the separate water management strategies described in most of Volume II. These generally involve small interconnections between two neighboring systems or purchases of additional supplies from a wholesale water provider or adjacent water user group. These strategies are referred to as miscellaneous strategies and are summarized in section 4B.17.

Note that costs include only those infrastructure elements needed to develop, treat and transmit the water supply to the distribution system of the WUG or WWP. Distribution costs are not included in the cost estimates.

4B.1.5 Methods Used to Investigate Environmental Effects of Proposed Regional Water Management Strategies

The Regional Water Planning Guidelines (31 TAC 357.7) require that each regional water management strategy includes an evaluation of environmental factors, specifically effects on environmental water needs, wildlife habitat, cultural resources, agricultural resources, upstream development on bays, estuaries, and arms of the Gulf of Mexico. These factors were evaluated for each of the proposed water management strategies according to the level of description and engineering design information provided. Details regarding the methodology to investigate environmental water needs, instream flow needs, impact on bays and estuaries, and fish and wildlife habitat are generally included in the analysis of each strategy.

4B.1.6 Agricultural Water Management Strategies

New firm water supplies often cannot be developed for irrigated agriculture, because the cost of development usually far exceeds the value of the water in irrigated production. The assumption is made that the available groundwater resources are already fully exploited. Cloud seeding and brush control for water yield are the only potential new supplies of water for irrigated agriculture, but a firm yield cannot be assigned to these practices. Without any firm supply of water, agricultural producers will have to reduce the irrigation and confined livestock demands through a variety of conservation and other management practices. Conservation practices were evaluated, specifically related to irrigation conservation and the savings of water that can be expected. The evaluation is presented in Volume II, Section 4B.2.2.

4B.1.7 Water Conservation and Drought Preparation

Water conservation recommendations are included in the plans for individual water user groups. Water conservation as a water management strategy for individual municipal water user groups was evaluated as per the description in Volume II, Section 4B.2.1. Costs and savings to be expected from various Best Management Practices (BMPs) are described, and recommended target reductions in per capita water use (gpcd) are presented. For irrigation conservation, specific costs, expected savings and conservation target recommended by the Brazos G RWPG are described in Volume II, Section 4B.2.2. For conservation for other types of use (manufacturing, steam electric, mining, livestock) the Brazos G RWPG has recommended a target goal of seven percent reduction in overall water demands for entities with projected

shortages, and has presented a list of recommended BMPs in Volume II, Section 4B.2.3. Little guidance exists for estimating water savings and costs for BMPs for non-municipal and non-irrigation uses, as water use under each of these categories is facility-specific.

While water conservation is a viable water management strategy that makes more efficient use of available supplies to meet projected water needs, drought management recommendations have not been made by the Brazos G RWPG as a water management strategy for specific WUG needs. The regional water plan is developed to meet projected water demands during a drought of severity equivalent to the drought of record. The purpose of the planning is to ensure that sufficient supplies are available to meet future water demands. Reducing water demands during a drought as a defined water management strategy does not ensure that sufficient supplies will be available to meet the projected water demands; but simply eliminates the demands. While the Brazos G RWPG encourages entities in the Brazos G Area to promote demand management during a drought, it should not be identified as a “new source” of supply. Recommending demand reductions as a water management strategy is antithetical to the concept of planning to meet projected water demands. It does not make more efficient use of existing supplies as does conservation, but instead effectively turns the tap off when the water is needed most. It is planning to not meet future water demands. When considering the costs of demand reduction during drought, the costs for drought management could be considered as the economic costs of not meeting the projected water demands, as summarized in Appendix I.

4B.1.8 Funding and Permitting by State Agencies of Projects Not in the Regional Water Plan

Senate Bill 1 requires water supply projects to be consistent with approved regional water plans to be eligible for TWDB funding and to obtain TCEQ permits. Texas Water Code¹ provides that the TCEQ shall grant an application to appropriate surface water, including amendments to existing permits, only if the proposed action addresses a water supply need in a manner that is consistent with an approved regional water plan. TCEQ may waive this requirement if conditions warrant.

For TWDB funding, the Texas Water Code² states that the TWDB may provide financial assistance to a water supply project only after TWDB determines that the needs to be met by the

¹ Texas Water Code, Section 11.134

² Texas Water Code, Section 16.053(j)

project will be addressed in a manner that is consistent with the appropriate regional water plan. The TWDB may waive this provision if conditions warrant.

The Brazos G RWPG has considered the variety of actions and permit applications that may come before the TCEQ and the TWDB and does not want to unduly constrain projects or applications for small amounts of water that may not be included specifically in the adopted regional water plan. “Small amounts of water” is defined as involving no more than 1,000 acft/yr, regardless of whether the action is for a temporary or long term action. The Brazos G RWPG provides direction to TCEQ and TWDB regarding appropriations, permit amendments, and projects involving small amounts of water that will not have a significant impact on the region’s water supply as follows: such projects are consistent with the regional water plan, even though not specifically recommended in the plan. However, many of the projects associated with these “small amounts of water” have been included where possible in the miscellaneous strategies Section 4B.17.

The Brazos G RWPG also provides direction to the TWDB regarding financial assistance for repair and replacement of existing facilities, or to develop small amounts of water (less than 1,000 acft/yr). Water supply projects not involving the development of or connection to a new water source, or involving development of a new supply less than 1,000 acft/yr, are consistent with the regional water plan, even though not specifically mentioned in the adopted plan.

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