



Volume II

Identification, Evaluation, and Selection of Water Management Strategies



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1 Water Management Strategies

Title 31 TAC 357.7.34 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, interbasin transfers, new supply development, and others. Many of the strategies evaluated are updates from the evaluations performed for the 2016 Plan, with costs and supply typically being the most common items updated. Costs for these strategies as shown in specific Water User Group (WUG) and Wholesale Water Provider (WWP) plans have been updated to reflect September 2018 prices.

1.1 Identification of Potentially Feasible Strategies

TWDB rules require that the process for identifying potentially feasible Water Management Strategies (WMSs) be documented at a public meeting (31 TAC §357.12(b)). This section describes the documented process used by Brazos G to identify potentially feasible WMSs. On February 7, 2018, Brazos G formally considered the process for identifying, evaluating and selecting WMSs as described below.

Process for identifying, evaluating and selecting WMSs:

1. Include strategies identified in previous plans
 - a. Include recommended and alternative strategies from 2016
 - b. Include strategies evaluated, but not recommended in 2016
 - c. Include strategies evaluated in previous Plans that were not moved forward
2. Identify draft needs and develop additional ideas to meet those needs
3. Maintain ongoing communication from local interests through the process

Then, an initial list of potentially feasible strategies is determined, and additional WMSs are included if local interests request them and the planning schedule and budget allow for the addition.

The Scope of Work Committee of Brazos G met on July 17, 2018, and August 17, 2018, to identify potentially feasible WMSs and determine which strategies to recommend evaluating for the 2021 Brazos G Plan.

Seawater desalination was not considered potentially feasible due to distance from the coast.

Brackish groundwater was not considered because it is considered part of the MAG, and would have only been considered if it was cheaper than going to a freshwater portion of an aquifer. The TWDB has recently identified Brackish Groundwater Production Zones, the supplies from which might be considered as separate from the MAG. In the next cycle of regional water planning, these Brackish Groundwater Production Zones might constitute additional sources of supply for water management strategies.

On August 12, 2020, the BGRWPG identified the threshold of significant water needs for consideration of aquifer storage and recovery projects to be 10,000 acft/yr or greater. Table 1-1 presents the 15 WUGs having needs exceeding this threshold, and an assessment of ASR potential for each WUG. Aquifer storage and recovery is recommended as a water management strategy for seven of those, either specifically as a strategy where the WUG is the sponsor, or as a strategy for a WWP that provides the WUG supply. In addition, ASR is recommended as a water management strategy for other WUGs with needs less than the 10,000 acft/yr threshold. ASR is not considered as a potential strategy for county-aggregated WUGs such as Irrigation or Steam-Electric unless a specific project sponsor requests it be recommended. None have made the request.

Table 1-1. Assessment of ASR Potential

Water User Group	2070 Need (acft/yr)	Assessment of ASR Potential
Abilene	(18,910)	ASR not identified as potentially feasible; hydrogeology appears unsuitable
Bryan	(19,650)	ASR recommended as a water management strategy
College Station	(13,360)	ASR recommended as a water management strategy
County-Other, Williamson	(37,814)	ASR recommended for WWP (BRA)
Georgetown	(65,467)	ASR recommended as a water management strategy and recommended for WWP (BRA)
Hutto	(10,703)	ASR recommended for WWP (BRA)
Leander	(19,041)	ASR recommended for WWP (LCRA, Region K)
Round Rock	(16,566)	ASR recommended for WWP (BRA) (LCRA, Region K)
Temple	(17,103)	ASR recommended for WWP (BRA)
Irrigation, Comanche	(15,292)	ASR not identified as potentially feasible
Irrigation, Haskell	(15,835)	ASR not identified as potentially feasible
Irrigation, Knox	(10,706)	ASR not identified as potentially feasible
Mining, Williamson	(10,745)	ASR not identified as potentially feasible
Steam-Electric Power, Milam	(32,254)	ASR not identified as potentially feasible
Steam-Electric Power, Somervell	(35,867)	ASR not identified as potentially feasible

Potentially feasible water management strategies evaluated during preparation of the 2021 Plan are listed in Table 1-2.

Table 1-2. Potentially Feasible Water Management Strategies Evaluated for the 2021 Brazos G Regional Water Plan

Chapter (Volume II)	Water Management Strategy and Description
2	Water Conservation (implement accelerated use of various water conservation techniques to achieve water savings above what is already included in the TWDB water demand projections)
3	Wastewater Reuse (use highly treated wastewater treatment plant effluent to meet non-potable and potable water needs)
4	New Reservoirs (new or updated evaluations of the following proposed new reservoirs) <ul style="list-style-type: none"> • Brazos River Main Stem Off-Channel Reservoirs • Brushy Creek Reservoir • Cedar Ridge Reservoir • Coryell County Off-Channel Reservoir • City of Groesbeck Off-Channel Reservoir • Hamilton County Reservoir • NCTMWA Lake Creek Reservoir • Red River Off-Channel Reservoir near Arthur City • South Bend Reservoir • New Throckmorton Reservoir • Turkey Peak Dam - Lake Palo Pinto Enlargement
5	Groundwater <ul style="list-style-type: none"> • City of Bryan Groundwater Strategies • City of College Station Groundwater Strategies • Williamson County Groundwater Strategies
6	BRA System Operations
7	Conjunctive Use (conjunctively use surface water supplies with available groundwater supplies) <ul style="list-style-type: none"> • Lake Granger Augmentation • Oak Creek Reservoir and Champion Well Field
8	Aquifer Storage and Recovery (Inject or percolate excess surface water into groundwater aquifers, storing for future use) <ul style="list-style-type: none"> • City of Bryan ASR • City of College Station ASR • Lake Georgetown ASR • Lake Granger ASR • Johnson County SUD and Acton MUD ASR • Trinity ASR in McLennan County
9	Regional Water Supply Projects <ul style="list-style-type: none"> • Bosque County Regional Project • Milam County Groundwater and Alcoa Supply for Williamson County • Brushy Creek RUA Water Supply Project • East Williamson County Water Supply Project • Lake Belton to Stillhouse Hollow Pipeline • Lake Whitney Water Supply Project (Cleburne) • Somervell County Water Supply Project • Trinity Basin Supplies to the Middle Brazos • West Central Brazos Water Distribution System • West Texas Water Partnership Supply to Abilene (Region F evaluation)
10	Augmentation of Existing Reservoir Supplies <ul style="list-style-type: none"> • Lake Aquilla Storage Reallocation • Lake Granger Storage Reallocation • Lake Whitney Reallocation • Lake Whitney Over-Drafting Supply with Off-Channel Reservoir • Millers Creek Reservoir Augmentation
11	Control of Naturally Occurring Salinity
12	Brush Control (increase deep percolation and discharge to streams by removing unwanted brush)
13	Miscellaneous Strategies (various pipelines, treatment plants and groundwater wells to meet projected needs of water user groups and wholesale water providers)

1.2 Evaluation and Recommendation of Strategies

The following chapters contain technical evaluations of the potentially feasible water management strategies the Brazos G Regional Water Planning Group (RWPG) and the Texas Water Development Board (TWDB) wished to consider. 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 Brazos G Area.

Technical evaluations of water management strategies are presented at public meetings of the Brazos G RWPG. Most strategies are identified as potentially feasible to serve specific WUGs or WWPs, and are usually evaluated in coordination with potential sponsors. Other strategies are initially identified as potentially feasible to meet needs for multiple WUGs and/or WWPs. In the case where the preferred strategy for a WUG or WWP has not been communicated, the Brazos G RWPG recommends a strategy based on the WUG's existing sources of supply and the location and sources available to the strategy. These recommendations are presented and reviewed at three public subregional meetings prior to adoption of the Initially Prepared Plan to provide the opportunity for WUGs to request modification of the recommendations prior to adoption of the Initially Prepared Plan. The Brazos G RWPG desires for the Brazos G Regional Water Plan to reflect the initiatives of the water providers in the Brazos G Area.

1.3 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 projected needs in the planning period. The criteria for reliability is that it meet municipal, industrial, and agricultural needs 100 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 minimal).

- 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 require 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 management strategies.
- Interbasin Transfers – The planning group may consider interbasin transfers as a supply option. The criteria require that the participating entities recognize and account for 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 – 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.

1.4 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 Volume I, Chapter 4, 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 2 through 13.

1.5 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. All costs for these categories were estimated using the TWDB Unified Costing Model as required by the TWDB.

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 1-3. All costs represent September 2018 prices.

Table 1-3. Summary of Major Components Included in Preliminary Cost Estimates of Potential Water Supply Strategies

<i>Capital Costs (Structural Costs)</i>	<i>Other Project Costs (Non-Structural Costs)</i>
1. Pump Stations	1. Engineering (Design, Bidding and Construction Phase Services, Geotechnical, Legal, Financing, and Contingencies)
2. Pipelines	2. Land and Easements and Surveying
3. Water Treatment Plants	3. Environmental - Studies and Mitigation
4. Water Storage Tanks	4. Interest During Construction
5. Off-Channel Reservoirs	
6. Well Fields	
7. Dams and Reservoirs	<i>Annual Project Costs</i>
8. Relocations	1. Debt Service
9. Other Items	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 Exhibit C, Second Amended General Guidelines for Fifth Cycle of Regional Water Plan Development (April 2018)¹, debt service for all projects was calculated assuming an annual interest rate of 3.5 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 \$0.08 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

¹ Available for download at:
https://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/contract_docs/2ndAmendedExhibitC.pdf?d=123001.1799999047

strategies are referred to as miscellaneous strategies and are summarized in Volume II, Section 13.

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.

1.6 Quantitative Factors Used to Evaluate Environmental and Agricultural Impacts of Potentially Feasible 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.

Potential water management strategies were evaluated for potential impacts to the following environmental and agricultural resources.

- **Environmental water needs** – The water necessary to sustain a sound ecological environment. Surface water strategies could potentially utilize this water source. Reuse supplies could potentially use water that would have otherwise been discharged into a surface water body. Groundwater strategies are assumed to not have an impact on surface water needed for environmental needs.
- **Wildlife habitat** – The area disrupted from implementation of a strategy.
- **Threatened and Endangered Species** – The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess a proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. The threatened, endangered, candidate and species of greatest conservation need located in a county where a potential strategy is located were identified and used to quantitatively assess potential impacts.
- **Wetlands** – The area classified as wetlands that is disrupted from the implementation of a strategy. Pipelines, wells, pump stations, and water treatment plants are anticipated to be located outside of wetland areas. Therefore, only reservoir footprints and surface water intakes are considered to impact wetlands.
- **Cultural resources** – The physical evidence or place of past human activity that may be disrupted from the implementation of a strategy.
- **Bays and estuaries water needs** – The freshwater inflow necessary to sustain a sound ecological environment in the bays, estuaries, and arms of the Gulf of Mexico. Potential strategies included in the Brazos G Plan are located a

substantial distance from the coast and are not anticipated to impact water needs of bays and estuaries.

- **Agricultural resources** – The land required for agricultural production related to farming and ranching. Potential strategies located in rural locations are assumed to impact agricultural resources.

Each impacted resource was quantitatively assessed and scored using the following parameters. The amount of area impacted by the implementation of a strategy is estimated using the following assumptions.

- Reservoir footprint (actual acreage impacted)
- WTP (5 acres)
- Pipeline ROW width of 50 ft
- Groundwater wells (2 acres)
 - Intakes and pump stations (5 acres)
 - Well field connection pipelines and pipelines less than 24 in diameter are assumed to have negligible impacts and are not included in the total area impacted.

Scoring of the criteria ranges from a value of 1 (highest impacts) to 3 (lowest impacts). The quantitative criteria used to evaluate the impacts of potentially feasible strategies and projects is presented in Table 1-4. A matrix summarizing the impacts of the individual water management strategies can be found in Appendix P.

Table 1-4. Quantitative Criteria Applied to Evaluate Impacts to Environmental and Agricultural Resources of Water Management Strategies and Projects

Score	Impact	Environmental Water Needs	Wildlife Habitat Acres Impacted	Wetland Acres Impacted	Number of Species Present ¹	Bays and Estuaries (river miles from coast) ^a	Agricultural Resources (rural acres impacted)
1	High	None	>10,000	>1,000	>100	0 - 100	>10,000
2	Medium	Reuse, Surface Water	1,000 - 10,000	1 - 1,000	50 - 100	100 - 200	1,000 - 10,000
3	Low	Conservation, Groundwater	0 - 1000	0	0 - 50	>200	0 – 1000

1. Number of Threatened, Endangered, or Candidate Species located in County or Counties of strategy.

1.7 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. 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 2.

1.8 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 2. For municipal water user groups, the Brazos G RWPG recommends a goal of a one-percent reduction per year (until the target rate of 140 gpcd is reached) in overall water demands, regardless of whether an entity reports a water supply need or not during the planning period. For Williamson County municipal water users, a target rate of 120 gpcd by Year 2070 is recommended. For conservation for non-municipal use (irrigation, manufacturing, and mining), the Brazos G RWPG has recommended a target reduction in water demand of 3% by 2020, 5% by 2030, and 7% from 2040 to 2070 for entities with a water supply need (shortage) during the planning period. The Brazos G RWPG does not recommend water conservation as a strategy to meet steam-electric needs. The plan presents a list of recommended BMPs in Volume II, Section 2. 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 2. 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 G.

1.9 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 certain types of TWDB funding and to obtain water right permits from the Texas Commission on Environmental Quality (TCEQ). Texas Water Code 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 Code 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 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 temporary or long term. 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 as miscellaneous strategies Section 13.

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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