5 WATER MANAGEMENT STRATEGIES

Chapter 5 identifies and discusses the water management strategies to meet identified water needs as outlined in Chapter 4. These needs are met through a variety of strategies that have been developed through coordination with the water users in Region F.

Chapter 5 Outline

Chapter 5A: Identification of Water Management Strategies

Chapter 5B: Water Conservation

Chapter 5C: Regional Water Management Strategies

Chapter 5D: Major Water Provider Strategies

Chapter 5E: Water Management Strategies by County

Associated Appendices

Appendix B: Water Management Strategy Evaluation Technical Memorandums

Appendix C: Water Management Strategy Cost Estimates

Appendix D: Strategy Evaluation Matrix and Quantified Environmental Impact Matrix

This chapter is divided into five main parts. Chapter 5A discusses the types of potentially feasible water management strategies, the process used to develop the strategies, and the factors considered in evaluating the strategies. Chapter 5B discusses the water conservation strategies that were considered and recommended for users in Region F. This includes the identification and evaluation for municipal, irrigation, and mining conservation measures. Chapter 5C discusses regional strategies, including subordination, brush control, and weather modification. Chapter 5D presents the recommended water management strategies for the six major water providers in Region F. Chapter 5E addresses the recommended strategies for each water user group with identified shortages and summarizes the water management plans by county.

Over the planning period there may be additional water users that will need to upgrade or modify their water supply systems or develop new supplies but are not specifically identified in this plan. For aggregated water users, such as County-Other, the identification of needs can be challenging due to the nature of the data evaluation. It is the intent of this plan to include all water systems that may demonstrate a need for water supply. This includes established water providers and new water supply corporations formed by individual users that may need to band together to provide a reliable water supply. In addition, Region F considers water supply projects that do not impact other water users but are needed to meet demands or to meet regulatory requirements for consistency with the regional plan even though not specifically recommended in the plan.

This plan gives a potential approach that water suppliers can take to address their needs. Actual implementation of water management strategies is the responsibility of the water suppliers, and the details of strategies will evolve as they are implemented. The Region F Water Planning Group (RWPG) will not be implementing the strategies and does not want this plan to be an obstacle in the development of needed water supplies.

5A IDENTIFICATION AND EVALUATION OF WATER MANAGEMENT STRATEGIES

This section provides a review of the types of water management strategies (WMS) considered for Region F and the approach for identifying the potentially feasible water management strategies for water users with shortages. Once a list of potential feasible strategies has been identified, the most feasible strategies are recommended for implementation. The Region F Plan does not recommend any mutually exclusive strategies. Alternative strategies can also be identified in case the recommended strategies become unfeasible. These strategies are discussed in more detail in later subchapters. This subchapter identifies the potentially feasible strategies for water users that were found to have a projected need in Chapter 4.

5A.1 Identification of Potentially Feasible Strategies

In accordance with TWDB rules, the Region F RWPG has adopted a standard procedure for identifying potentially feasible strategies. This procedure classifies strategies using the TWDB's standard categories developed for regional water planning, which are shown in the box at left.

Water Management Strategy Categories

- Water Conservation
- Drought Management Measures
- Wastewater Reuse
- Management and/or Expanded Use of Existing Supplies
  - System Operation
  - Conjunctive Use of Groundwater and Surface Water
  - Reallocation of Reservoir Storage
  - Voluntary Redistribution of Water Resources
  - Voluntary Subordination of Existing Water Rights
  - Yield Enhancement
  - Water Quality Improvement
- New Supply Development
  - Surface Water Resources
  - Groundwater Resources
  - Brush Control
  - Desalination
  - Water Right Cancellation
  - Rainwater Harvesting
  - Aquifer Storage and Recovery (ASR)
  - Precipitation Enhancement
- Interbasin Transfers
- Emergency Transfers of Water

One of the purposes of this chapter is to provide a big picture discussion on the various strategy types that were identified to potentially reduce or meet the identified needs, the applicability of these strategies for users in Region F, and provide documentation of the strategy types that are not appropriate for Region F.

5A.1.1 Strategies Deemed Infeasible in Region F

While each of these strategy types were considered by the RWPG, not all were determined as viable options for addressing shortages in the region. Region F did not consider drought management as a feasible strategy to meet long-term growth in demands or currently identified needs. This strategy is considered a temporary strategy to conserve available water supplies during times of drought or emergencies and acts as means to minimize the adverse impacts of water supply shortages during drought. Drought management will be employed in the region through the implementation of local drought contingency plans. Region F is supportive of the development and use of these plans during periods of drought or emergency water needs.

The RWPG also did not consider water right cancellation to be a feasible strategy. Instead, Region F recommends that a water right holder

consider selling water under their existing water right to the willing buyer or sell the water right outright. Emergency transfers of water are considered in Chapter 7. Similar to drought management, this strategy is an emergency response to drought or loss of water supplies and is not appropriate for long-term growth in demands.

Region F frequently experiences periods of low rainfall that can extend for a long period of time. Most of the area has been in drought-of-record conditions since the mid-1990s. As such, rainwater harvesting was not considered by the RWPG to be a feasible strategy due to the inherent lack of reliability.

The opportunities for reallocation of reservoir storage is very limited in Region F. There are only two federal reservoir projects, O.C. Fisher and Hords Creek, with a dedicated flood pool that could potentially be reallocated. Due to the limited surface water supply in Region F, reallocation would not result in additional reliable supply. As such, this strategy type is not considered in Region F.

5A.1.2 Potentially Feasible Strategies in Region F

The strategy types (and associated subcategories) that were determined as potentially feasible strategies for entities within Region F are water conservation, wastewater reuse, expanded use of existing supplies (system operation, conjunctive use, voluntary redistribution, subordination, and water quality improvements), new supply development (new surface water, new groundwater, brush control, desalination, and ASR), and precipitation enhancement.

The sections below include a brief discussion of each of these strategy types and the specific application to the users in Region F.

Water Conservation

Water conservation is defined as methods and practices that reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling and reuse of water so that a water supply is made available for future or alternative uses. Water conservation is typically viewed as long-term changes in water use that are incorporated into daily activities.

Water conservation is a valued water management strategy in Region F because it helps extend the limited water resources in the region. It is recommended for all individual municipal and irrigation water users, whether the user has a defined shortage or not. For rural municipal water users, conservation is recommended for County-Other users with an identified water need.

Conservation is also recommended for all mining users. Water conservation measures for manufacturing users are typically process-centered and difficult to develop at the aggregated county level. Region F does not have the level of detail necessary to develop meaningful conservation measures for manufacturing. Therefore, conservation was not considered feasible for manufacturing water users. However, conservation is encouraged for all users and is supported by Region F.

Wastewater Reuse

Wastewater reuse utilizes treated wastewater effluent as either a direct replacement for an existing water supply (direct reuse) or utilizes treated wastewater that has been returned or converted to a water supply resource (indirect reuse). Wastewater reuse is currently utilized by industry and mining users that purchase wastewater effluent from larger municipalities. It is also used for limited irrigation use. CRMWD has a direct potable reuse project that reuses wastewater from the City of Big Spring for municipal use by CRMWD customers. The largest producers of wastewater effluent are the larger cities, including San Angelo, Odessa and Midland. Currently, Odessa and Midland sell most of their treated wastewater for oil

field production Others are considering direct and indirect potable reuse for municipal use. There may be potential to expand wastewater reuse in Region F. Entities considering new or additional wastewater reuse include the City of San Angelo, and several smaller cities.

In addition to the traditional application of wastewater reuse, the mining industry produces millions of gallons of "produced water" a day. This water is impaired with chemicals injected during drilling and hydrocarbons (oil and gas). Much of the produced water is either injected in deep geologic formations or recycled for mining use. There is an interest in Region F to treat the produced water for other beneficial uses. This strategy will be considered for Region F.

Expanded Use of Existing Supplies

Expanded use of existing supplies includes seven subcategories ranging from selling developed water that is not currently used to enhancing existing supplies through operations, storage, treatment or other means. In Region F, five of the seven subcategories were determined potentially feasible. These include:

- subordination of senior water rights
- system operation
- conjunctive use of groundwater and surface water
- water quality improvements
- voluntary transfer (sales or contracts for developed water), and
- the recapturing of storage for surface water use through dredging. (Specifically, this strategy was considered for the City of Junction.)

Subordination of Downstream Water Rights

Texas surface water is governed by a priority system, where water rights are issued based on first in time is first in right. In the Colorado River Basin, there are several very large rights that are located in the lower part of the basin that have older (senior) priority dates. These more senior rights can make priority calls on water right holders in Region F. Under a strict priority analysis, the reliable surface water supply in Region F is very low. For many reservoirs, there is no reliable supply. This strategy assumes that senior right holders in the lower Colorado River Basin subordinate their seniority to upper basin water right holders, therefore this strategy is called subordination. Subordination has occurred for several decades in the basin and this strategy is still a reasonable approach to estimate the reliable supply in Region F rather than developing additional new supplies. Subordination typically involves an agreement between water right holders. Due to the sensitive nature of individual agreements, costs are not assigned to this strategy. This strategy is assessed for all reservoirs in the Colorado Basin in Region F and the run-of- river water rights for the City of Junction.

System Operation

System operation involves optimizing the management of two or more water supplies to maximize the supplies from each source and can result in increased water supplies overall. CRMWD and San Angelo both own and operate multiple surface water systems that could potentially benefit from system operation. In previous planning, system operation analyses of these systems found minimal increases in water supplies from system operation. While this strategy is currently employed by CRMWD and San Angelo and supported by Region F, this strategy type was considered and dismissed for purposes of creating additional supply in Region F.

Conjunctive Use of Groundwater and Surface Water

Conjunctive use is the operation of multiple sources of water to optimize the water resources for additional supply. In Region F, CRMWD, San Angelo, and Brady own and operate both surface water and groundwater sources. All three entities intend to conjunctively use the surface water when available to meet demands and use additional groundwater to supplement surface water

supplies during drought when surface water resources are depleted. This will help reduce evaporative losses associated with the surface water reservoirs, while still meeting demands with groundwater when surface water is unavailable, or the quality has deteriorated. For Brady, additional treatment of its groundwater will be needed to use this source when surface water is unavailable. The City of Brady has received funding to implement this treatment project which is currently underway.

Water Quality Improvements

Water quality improvements allow for the use of impaired water for municipal or other uses. Generally, this strategy is considered for users with sufficient water quantity but impaired water quality. In Region F, there are considerable amounts of brackish surface water and groundwater. Water quality improvement for these sources are typically accomplished through desalination or blending. This is discussed under the strategy type "Desalination". This strategy type would apply to treatment of other water quality parameters, such as nitrates and radionuclides.

The Hickory aquifer has elevated levels of radionuclides that exceed the drinking water standard. Users of this source include Brady, Eden, Mason, Millersville-Doole WSC, and San Angelo. Additionally, the Lipan aquifer, which serves Concho Rural Water Corporation and rural users in Tom Green County, contains some elevated levels of nitrates.

Voluntary Redistribution

Voluntary redistribution is the transfer of existing water supplies from one user to another through mutually agreeable sales, leases, contracts, options, subordination, or other similar types of agreements. Typically, the entity providing the water has determined that it does not need the water for the duration of the transfer. The transfer of water could be for a set period of years or a permanent transfer. Redistribution of water makes use of existing resources and provides a more immediate source of water. In Region F, there is little to no developed water that is available for redistribution without the development of additional strategies. This strategy is used to represent sales and contracts between a water provider and its customers. It can include current contractual obligations and potential future customers.

5A.1.3 New Supply Development

New supply development utilizes water that is not currently being used or generates new supplies through aquifer storage and recovery of water that otherwise would not have been available. This strategy type typically includes substantial infrastructure improvements to develop the new source, transport the water and, if needed, treat the water for its ultimate end use. The subcategories for this strategy type include new surface water development, new groundwater development, brush control, and aquifer storage and recovery.

Surface Water Development

The opportunity for new surface water development is limited in Region F. The Water Availability Model for the Colorado River Basin shows little to no available water for new appropriations. There are existing water rights that are currently not being used but could potentially be further developed. However, there are no identified sponsors for surface water development. New surface water development is not considered in Region F.

Groundwater Development

After the subordination strategy is implemented, groundwater accounts for approximately 75 percent of the total water use in Region F in 2020. In parts of the region, there are considerable amounts of groundwater for future development but most of these sources are located far from the identified needs. In other areas, the groundwater is limited or of poor quality. Even with these limitations, groundwater is a viable and cost-effective

supply source for some users. Because surface water supplies are so limited in Region F, the vast majority of municipal water users with a need after subordination during the planning period are expected to expand current groundwater use, develop new groundwater supplies, or purchase water from a provider that develops groundwater. Table 5A-1 shows the amount of groundwater that is available for new groundwater development by aquifer in 2020. Counties that have reached or are near capacity in utilizing the fresh groundwater resources allocated by the MAGs in at least one aquifer are Andrews, Brown, Crockett, Irion, Loving, Martin, Mitchell, Scurry, Tom Green, and Ward counties. In areas where groundwater is not regulated, groundwater development may occur even if the MAG is exceeded. Groundwater production may also exceed the MAGs due to unmetered mining uses such as oil and gas exploration and production and other exempt uses.

Table 5-1
Available Groundwater Supplies for Strategies

Aquifer	Unallocated Supplies[a] (acre-feet/year)
Capitan Reef Complex Aquifer	25,753
Cross Timbers Aquifer	689
Dockum Aquifer	21,481
Edwards-Trinity-Plateau and Pecos Valley Aquifers	250,908
Edwards-Trinity-Plateau Aquifer	242
Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifers	129,548
Ellenburger-San Saba Aquifer	3,793
Hickory Aquifer	18,576
Igneous Aquifer	145
Lipan Aquifer	744
Marble Falls Aquifer	215
Ogallala and Edwards-Trinity-High Plains Aquifers	30,064
Ogallala Aquifer	32,961
Other Aquifer	18,798
Pecos Valley Aquifer	0
Rustler Aquifer	6,444
Seymour Aquifer	10
Trinity Aquifer	0

a. This is the amount of groundwater that is available for strategies. These amounts may not necessarily be available in a particular county and/or river basin.

Brush Control

In 1985, the Texas Legislature authorized the Texas State Soil and Water Conservation Board (TSSWCB) to conduct a program for the "selective control, removal, or reduction of … brush species that consume water to a degree that is detrimental to water conservation." In 1999 the TSSWCB began the Brush Control Program. In 2011, the 82nd Legislature replaced the Brush Control Program with the Water Supply Enhancement Program (WSEP). The WSEP's purpose is to increase available surface and groundwater supplies through the selective control of brush species that are detrimental to water conservation[1]. As part of their competitive grant, cost sharing program, WSEP considers

- priority watersheds across the state
- the need for conservation within the territory of a proposed projection based on the State Water Plan
- and if the Regional Water Planning Group has identified brush control as a strategy in the State Water Plan.

Three primary species of brush in Region F are eligible for funding from the WSEP. They include juniper, mesquite, and salt cedar.

Feasibility studies have been conducted for seven watersheds in Region F. These studies indicate there is potential for water loss reduction from brush, but these losses have been difficult to quantify during periods of drought. However, brush control can still be effective as part of a conjunctive use strategy by increasing inflows into surface water sources during times of normal rainfall. Surface water can be heavily relied on when available, allowing groundwater to be conserved for future times of drought. There are several active brush control programs in Region F, including the City of San Angelo's program for brush removal from Twin Buttes and O.C. Fisher Reservoirs and CRMWD's program for salt cedar removal at Lake Spence. Other water providers have partnered with the TSSWCB on brush removal projects in the past. However, brush management must be an ongoing strategy to continue to realize water savings. This strategy is a potentially feasible strategy for operators and users of the CRMWD system, San Angelo system, Concho River, and Lake Brownwood.

Desalination

Desalination is the removal of excess salts from either surface water or groundwater for beneficial use. In Region F, most of the fresh groundwater supplies have been developed and are currently being used. The region has an abundant source of brackish water that potentially could be desalinated and used for municipal use. This process tends to require considerable energy and has historically been more costly than conventional treatment. It also produces a waste stream that can vary from about 10 percent to nearly 50 percent of the raw water, depending upon the level of and type of dissolved constituents. Since this strategy is fairly expensive, it is not an economically viable option for agricultural use. This strategy is considered for the municipal development of brackish water, including CRMWD's diverted surface water system and brackish groundwater.

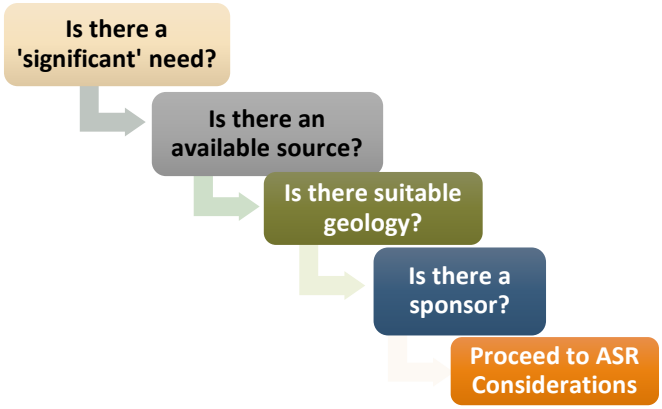
Aquifer Storage and Recovery (ASR)

Aquifer storage and recovery (ASR) involves storing water in aquifers and retrieving this water when needed. The water to be stored can be introduced through enhanced recharge or more commonly injected through a well into the aquifer. If an injection well is used, Texas law requires that the water not degrade the quality of the receiving aquifer. Source water for ASR can include excess surface water, treated wastewater, or groundwater from another aquifer.

To determine the feasibility and applicability of ASR, there are several technical considerations. Specifically,

- ASR requires suitable geological conditions for implementation. Since geologic conditions vary by location, studies must be performed to determine what specific locations would be suitable for ASR.
- Raw surface water and wastewater reuse most likely will require pretreatment prior to injection.
- Operation of an ASR system could significantly impact the amount of water that is retrievable.

Figure 5-1
ASR Screening Process



Recent legislation passed by the 86th Texas Legislature and signed by the Governor on June 10, 2019 requires the regional water plans to consider ASR and provide a specific assessment of this strategy if the region has significant needs. The definition of significant need is deferred to each region. Region F defined the threshold for significant needs to be 5,000 acre-feet per year. There are three entities that meet the significant need threshold: City of Midland, City of San Angelo, and steam electric power generation in Mitchell County.

The steam electric power need is associated with a proposed combined cycle facility for FGE. This facility is no longer being considered at this time, eliminating the projected need for steam electric power. For the other two entities, ASR has been considered but were dismissed for various reason. About 20 years ago, the City of Midland operated an ASR system at a nearby well field. Water from the City's Paul Davis well field was pumped to Midland and stored in the McMillan well field for peaking operations. Operations were ceased after a couple years due to geochemical concerns (perchlorate) and control over the injected water[2] . Midland is not interested in pursuing ASR. The City of San Angelo also considered ASR as part of its Water Supply Engineering Feasibility Study[3] . ASR was ruled out as a potentially feasible strategy due to the lack of suitable geology.

If a sponsor identified ASR as a potentially feasible water management strategy, it was evaluated as part of the Region F Plan. For this plan, ASR is evaluated for the Town of Pecos City.

5A.1.4 Precipitation Enhancement

Precipitation enhancement introduces seeding agents to stimulate clouds to generate more rainfall. This process is also commonly known as cloud seeding or weather modification. In Region F, there are two ongoing weather modification programs: the West Texas Weather Modification Association (WTWMA) project and the Trans Pecos Weather Modification Association (TPWMA) program. Between these two programs, there are active precipitation enhancement activities occurring in 11 counties in Region F. From 2004 to 2016, the WTWMA has helped increase precipitation across its target area by roughly 16%, which translates to a 2.25" increase in precipitation and an additional 1.27 million acre-feet of water per year[4]. This strategy was considered for irrigated agriculture in those counties.

5A.1.5 Summary of Potentially Feasible Strategies

Potentially feasible water management strategies were identified for water users, wholesale water providers, and major water providers in Region F. These strategies include a wide assortment of strategy types, which were carefully reviewed for entities with identified needs.

Strategies were only considered potentially feasible if the strategy:

- Is appropriate for regional planning
- Utilizes proven technology and is technically feasible
- Has an identifiable sponsor
- Could meet the intended purpose for the end user considering water quality, economic feasibility, geographic constraints, and other factors, as appropriate
- Meets existing regulations

While some strategies were determined not to be potentially feasible at this time, the Region F RWPG supports the research and development of new and innovative technologies for water supply. With continued research, new technologies will become more reliable and economical for future users and may be applicable for water suppliers in Region F.

The process for identifying potentially feasible water management strategies was presented at the March 15, 2018 RFWPG meeting in Big Spring. There were no public comments and the RFWPG approved the methodology. A list of the potentially feasible water management strategies considered for Region F is included in Attachment 5A. The process for strategy development and evaluation is presented in the following sections.

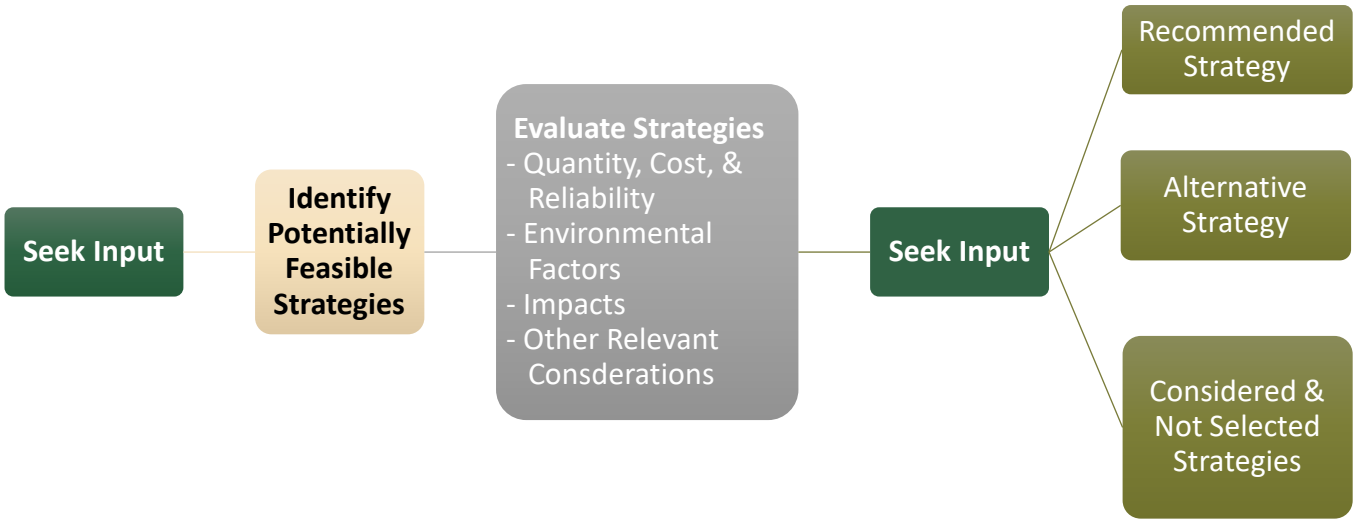
5A.2 Strategy Development

Water management strategies were developed for water user groups to meet projected needs while accounting for their current supply sources, previous supply studies, and available supply within the region. Much of the water supply in Region F is from groundwater, and several of the identified needs could be met by development of new groundwater supplies. Where site-specific data or local aquifer information were available, this information was used. When specific well fields could not be identified, assumptions regarding well capacity, depth of well, lift distance, and associated costs were developed based on county and aquifer estimates. It is important to remember that it is difficult to determine one estimate that is appropriate across an entire county for each aquifer and water user group. The goal was to find average values that were representative for regional planning purposes. In most cases, new surface water supplies are not feasible because of the lack of unappropriated water in the upper Colorado Basin.

Water transmission lines were assumed to take the shortest route, following existing highways or roads where possible. Profiles were developed using GIS mapping software and Google Earth. Pipes were sized to deliver peak-day flows within reasonable pressure and velocity ranges. Water losses of 25 percent were included for strategies requiring reverse osmosis (RO) treatment (potable reuse or desalination). Water losses associated with transmission were assumed to be negligible for regional planning purposes.

Municipal and manufacturing strategies were developed to provide water of sufficient

Figure 5-2
Strategy Development and Evaluation Process



quantity and quality that is acceptable for its end use. Water quality issues affect water use options and treatment requirements. For the evaluations of the strategies, it was assumed that the final water product would meet existing state water quality requirements for the specified use. For example, a strategy that provided water for municipal supply would meet existing drinking water standards, while water used for mining may have a lower quality.

In addition to the development of specific strategies to meet needs, there are other water management strategies that are general and could potentially increase water for multiple user groups. These include weather modification and brush control. A brief discussion of each of these general strategies and its applicability to Region F is included in Chapter 5C.

5A.3 Strategy Evaluation Criteria

The consideration and selection of water management strategies for water user groups with needs followed TWDB guidelines and were conducted in open meetings with the Region F RWPG. The potentially feasible strategies were evaluated in accordance with state guidance.

Strategy Evaluation Criteria

- Quantity, reliability and cost
- Environmental factors, including effects on environmental water shortages, wildlife habitat and cultural resources
- Impacts on water resources and other water management strategies
- Impacts on agriculture and natural resources
- Other relevant factors

Other relevant factors include regulatory requirements, political and local issues, amount of time required to implement the strategy, recreational impacts of the strategy, and other socio-economic benefits or impacts.

The definition of quantity is the amount of water the strategy would provide to the respective user group in acre-feet per year. This amount is considered with respect to the user's short-term and long-term shortages. Reliability is an assessment of the availability of the specified water quantity to the user over time. If the quantity of water is available to the user all the time, then the strategy has a high reliability. If the quantity of water is contingent on other factors, reliability will be lower. The assessment of cost for each strategy is expressed in dollars per acre-foot per year for water delivered and treated for the end user requirements. Calculations of these costs follow the Texas Water Development Board's guidelines for cost considerations and identify total capital cost and annual costs by decade. Project capital costs are based on September 2018 price levels and include construction costs, engineering, land acquisition, mitigation, right-of-way, contingencies and other project costs associated with the respective strategy. Annual costs include power costs associated with transmission, water treatment costs, water purchase (if applicable), operation and maintenance, and other project-specific costs. Debt service for capital improvements was calculated over 20 years at a 3.5 percent interest rate.

Potential impacts to sensitive environmental factors were considered for each strategy. Sensitive environmental factors may include wetlands, threatened and endangered species, unique wildlife habitats, and cultural resources. In most cases, a detailed evaluation could not be completed because previous studies have not been conducted or the specific location of the new source (such as a groundwater well field) was not identified. Therefore, a more

detailed environmental assessment will be required before a strategy is implemented.

The impact on water resources considers the effects of the strategy on water quantity, quality, and use of the water resource. A water management strategy may have a positive or negative effect on a water resource. This review also evaluated whether the strategy would impact the water quantity and quality of other water management strategies identified.

A water management strategy could potentially impact agricultural production or local natural resources. Impacts to agriculture may include reduction in agricultural acreage, reduced water supply for irrigation, or impacts to water quality as it affects crop production. Various strategies may actually improve water quality, while others may have a negative impact. The impacts to natural resources may consider inundation of parklands, impacts to exploitable natural resources (such as mining), recreational use of a natural resource, and other strategy-specific factors.

Strategy evaluations are included in Appendix C and associated infrastructure cost estimates may be found in Appendix D. Appendix E includes a Strategy Evaluation Matrix and Quantified Environmental/Agricultural Impact Matrix.

LIST OF REFERENCES

[1] Texas State Soil and Water Conservation Board: Water Supply Enhancement Program. Available online at http://www.tsswcb.texas.gov/en/brushcontrol.
[2] Texas Water Development Board. Report 090483094, An Assessment of Aquifer Storage and Recovery in Texas, February 2011.
[3] City of San Angelo. Water Supply Engineering Feasibility Study, October, 2018.
[4] West Texas Weather Modification Association: Analysis and Research. Available online at http://wtwma.com/analysis_and_research.htm.