CITY OF SUGAR LAND

# INTEGRATED WATER RESOURCE PLAN

## EXECUTIVE SUMMARY

March 2019


CDM Smith®

*In association with*
*KIT Professionals, Inc.*


SW

# TABLE OF CONTENTS



# KEY TO OPTIONS EVALUATED

- Advanced Metering Information
- Aquifer Storage and Recovery
- Water Loss Control
- Expanded Water Supply Contracts
- Conservation
- Desalination – Seawater
- Commercial/Industrial Conservation and On-site Reuse
- Off Channel Reservoir
- Direct / Indirect Potable Reuse
- Surface Water Treatment Plant Expansion
- Expanded Reclaimed Water System
- Desalination - Brackish Groundwater
- Collection System Wastewater Scalping
- Access to Brazos River Water
- Groundwater Credit Banking


# ACKNOWLEDGMENTS


## Citizen Task Force

Trisha Frederick, P.E. – *Chairperson*
James Goldman – *Vice Chairperson*
Ruth Barrett
Elizabeth Bryson
Ann De Stefano
Chuck Hewell, P.E.
Michaela Lim
Bruce Lowrie
Poonam Mathur
Showri Nandagiri, P.E.
Baseer Pirzada
Leo Weinberg, P.E.
Enayat Zareian
Megan Ortiz – *Alternate*

## City Council Task Force

Himesh Gandhi
Steve R. Porter
Harish Jajoo*

## City Staff

Allen Bogard – *City Manager*
Chris Steubing, P.E. – *Assistant City Manager*
Michael Goodrum* – *Assistant City Manager*
Robert Valenzuela, P.E., CFM – *Director of Public Works*
Brian Butscher, P.E. – *Assistant Director of Public Works*
Katie Clayton, P.E. – *Water Resources Manager*
Colleen Spencer – *Conservation Manager*
Jessie Li, Ph.D., P.E. – *City Engineer*

## Mayor and City Council Adopting the IWRP:

Joe R. Zimmerman
*Mayor*

Himesh Gandhi
*At Large Position 1*

Jennifer J. Lane
*At Large Position 2*

Steve R. Porter
*District 1*

Bridget R. Yeung
*District 2*

Amy L. Mitchell
*District 3*

Carol K. McCutcheon
*District 4*

## Consultant Team

Tina Petersen, Ph.D., P.E.* – *CDM Smith*
Amber Batson, P.E. – *CDM Smith*
Jenny Bywater, P.E. – *CDM Smith*
Will Garde, P.E. – *CDM Smith*
Jessica Fritsche – *CDM Smith*
Dan Rodrigo – *CDM Smith*
Susan Morea – *CDM Smith*
Bill Mullican, P.G. – *CDM Smith*
Sunil Kommineni, Ph.D., P.E., BCEE – *KIT Professionals*
Justin Bartlett, Ph.D, P.E. – *KIT Professionals*
Roopa Metla, P.E. – *KIT Professionals*

*Former member

**A Letter from Our Public Works Director…**

The City of Sugar Land strives to enhance the quality of life for our community through a commitment to excellence in the delivery of public utilities the Sugar Land Way. Proactive planning for our future is key to the City of Sugar Land's continued success.

Historically, we have relied on water from deep within underground aquifers to serve our drinking water needs. Over time, pumping of groundwater across the region has resulted in a phenomenon called subsidence. Subsidence is the settling or shrinking of the land surface, and in some areas across the region, the natural ground has settled as much as 10 feet. Subsidence can impact our infrastructure and increases the potential for localized flooding. The State of Texas has adopted regulations that limit the amount of groundwater an entity can pump within our region. The City has already reduced its use of groundwater to comply with the current regulations; however, a further reduction is currently mandated by 2025.

***The City of Sugar Land Public Works Water Utilities Division takes pride in maintaining a tradition of producing superior quality water, maintaining water and wastewater infrastructure and providing responsive and efficient customer-oriented service in a cost-effective and innovative manner.***

To address and mitigate the risk associated with these regulations, the City created a thirteen-member Citizen Task Force, with varying backgrounds, to discuss the complex water issues facing the city. In addition, a special City Council Subcommittee was created to provide the strategic direction and help guide staff and the Citizen Task Force through this process. Over the last two plus years, the City has been working on the development of an Integrated Water Resource Plan (IWRP). The IWRP allows the City to evaluate a wide mix of water supply options, combined with potential new policies and management strategies to meet these regulatory requirements and our long-term supply needs. This innovative approach allows the City to maximize the current infrastructure, meet the goals of the community, and develop new infrastructure to address the challenges in the future.

In the following document you will find the results of thousands of hours of collaboration with our citizens, council members, staff members, and our consultant team to find the best solutions for our community. We have outlined a plan that will meet the goals and objectives of our community, including: (1) providing reliable water supply, (2) optimizing water resources, (3) promoting system efficiency, (4) developing cost-effective solutions, (5) protecting the environment, (6) maintaining quality of life, and (7) promoting equity.

We look forward to implementing these new strategies and projects over the coming years so that all of our citizens can continue to be proud of our city. If you have any questions on this process or your water supply, please call us at 281-275-2900 or 311 at any time. We are here to serve you.

Sincerely
Robert Valenzuela, PE, CFM
Director of Public Works
City of Sugar Land

**RESOLUTION NO. 19-06**

**A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF SUGAR LAND, TEXAS, ADOPTING THE INTEGRATED WATER RESOURCE PLAN TO EVALUATE AVAILABLE WATER SUPPLIES AND WATER SUPPLY INFRASTRUCTURE TO MEET FUTURE WATER DEMANDS AND THE REGULATORY REQUIREMENTS OF THE FORT BEND SUBSIDENCE DISTRICT; AND SETTING FORTH OTHER PROVISIONS RELATED THERETO.**

WHEREAS, the City Council created a City Council Task Force to assist in developing an Integrated Water Resource Plan (Plan) to address water supply and water supply infrastructure needs to meet future water demands and the regulatory requirements of the Fort Bend Subsidence District; and

WHEREAS, by Resolution No. 16-46, adopted on December 20, 2016, the City Council authorized a project to develop the Plan and established an Integrated Water Resource Citizen Task Force (Citizen Task Force) to evaluate the Plan objectives, participate in community dialogue and education regarding water resource issues, and provide feedback on the final framework of the Plan; and

WHEREAS, on March 21, 2017, the City Council appointed thirteen members and one alternate member from the community to serve on the Citizen Task Force; and

WHEREAS, the members of the City Council Task Force and Citizen Task Force typically met once per month after the date of their appointment to fulfill the objectives established by the City Council; and

WHEREAS, the Plan incorporates recommendations of the City Council Task Force and community input gathered from a Citizen Task Force and at stakeholder meetings; NOW, THEREFORE;

**BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF SUGAR LAND, TEXAS:**

**Section 1.** That the facts and recitations set forth in this Ordinance are declared to be true and correct.

**Section 2.** That the City of Sugar Land Integrated Water Resource Plan attached as Exhibit "A" (Integrated Water Resource Plan) includes the following key recommendations:

(a) Development of a Water Utility Rate Study;
(b) Implementation of Advanced Metering Infrastructure
(c) Expanded reclaimed water system infrastructure at and from the North

Wastewater Treatment Plant;
(d) Expanded reclaimed water system infrastructure at and from the South Wastewater Treatment Plant;
(e) Expansion of the Surface Water Treatment Plant and transmission system;
(f) Access to the Brazos River Water through the Gulf Coast Water Authority's infrastructure;
(g) Development of a Water Supply Credit Banking Policy; and
(h) Focused efforts on controlling water loss.

**Section 3**. That the City Council adopts the Integrated Water Resource Plan.

APPROVED on March 19, 2019.

Joe R. Zimmerman, Mayor

ATTEST:

Thomas Harris, III, Interim City Secretary

APPROVED AS TO FORM:

Exhibit A: City of Sugar Land Integrated Water Resource Plan

# 1 INTRODUCTION

The City of Sugar Land (City) is a vibrant community located in Fort Bend County about twenty miles southwest of Houston. The area was initially sugar plantations in the mid-1800s, was incorporated in 1959, and has become an award-winning suburban community with a population nearing 120,000 residents and a strong, sustainable local economy.

The City recently annexed two adjacent communities, New Territory and Greatwood, in December 2017. This annexation increased the City's population by more than 30 percent and expanded the City's utility service area to include these two communities.

Historically, water supply needs for the City have been met by groundwater from the Gulf Coast aquifer system, similar to other municipalities across Fort Bend, Harris, and Galveston counties. Groundwater withdrawals from the Gulf Coast aquifer system throughout the region, combined with the underlying geologic structure in the southeast Texas coast, have resulted in a phenomenon called subsidence. Subsidence is the settling of the land surface due to groundwater production and consolidation of clays in the subsurface, a geologic process that is for the most part not reversible. This can result in increased potential for localized flooding and damage to infrastructure including buildings, highways, and pipelines. To date, as much as ten feet of land subsidence has occurred in portions of these counties. Because of this, the Fort Bend Subsidence District (FBSD) was established by the Texas Legislature in 1989 to regulate groundwater withdrawals to prevent further land subsidence in Fort Bend County. Beginning in 2014, the City had to meet FBSD regulations requiring 30 percent of its water demand to come from alternative (non-groundwater) sources. In 2025, this water supply requirement will increase to 60 percent alternative sources.


In 2008, the City completed a groundwater reduction plan (GRP) to meet FBSD regulations. The GRP includes the City and eighteen other partner entities. These partner entities include nearby communities and private well owners—such as property owner associations, levee districts, or businesses. The City acts as the manager of the GRP and handles reporting to FBSD on behalf of all participants to demonstrate the group's compliance with the regulations.

If the City and its GRP participants do not meet the minimum 30-percent use of alternative water supplies, the City will be penalized. The 2018 penalty rate was $6.50 per 1,000 gallons of excess groundwater withdrawals. This penalty is higher than the rate that the City charges its customers. If the City chooses to be non-compliant and pay the fee, water rates throughout the City would need to increase significantly. Conversely, FBSD incentivizes the use of alternative water by awarding credits to the GRP if, within that given year, the GRP "over converts" by using alternative water sources for more than 30 percent of the water supply. Credits are also issued for education programs aimed to reduce water consumption. Since the City implemented the surface water treatment plant and other reclaimed water projects prior to the conversion deadline, the City has been able to accumulate over 8 billion gallons worth of credits as of the end of 2018. These credits can be used in the future in the event that there is a drought and additional groundwater is needed to meet the City's drinking water needs for drinking, businesses and irrigation.

In 2015, the City began to develop a comprehensive plan to meet the 2025 deadline for 60-percent alternative water supply. The traditional method for water supply planning has focused on the cost to develop additional water supplies and the available yield of the newly developed water supply. The City developed a list of over three dozen specific questions that needed to be answered prior to making a long-term investment in additional water resources, such as:

- Do we have enough water? Do we have excess water?
- How reliable are our surface water contracts?
- How important is reliability to our community?
- How willing is our community to accept risk?
- What is the future of wastewater reuse?
- How should we prioritize our supply options?
- Are we using the right water for the right use?
- Are we maximizing system efficiency?
- Are we being fair and equitable to all customers?
- What are the drivers for future supply decisions?

The City recognized the need to develop an alternative approach to the traditional planning process. This approach needed to allow for capital projects but also needed to include potential policy and procedure recommendations. Staff also felt it was critical to involve the City Council as well as members of the public when formulating the proposed path forward for our community. The City selected the Integrated Water Resources Plan (IWRP) process as the best tool for completing this program. The IWRP allows the City to evaluate policies, management strategies and capital improvement projects while building consensus and support from City staff, citizens, and council members impacted by the final IWRP recommendations. In 2017, the City retained CDM Smith, Inc. to assist with the development of the IWRP.

The IWRP encompasses an approximately 55-square-mile area, including the City limits, the recently annexed areas of New Territory and Greatwood, and the City's extra-territorial jurisdiction (ETJ) area. The IWRP planning area was subdivided based upon pre-established planning areas from previous City planning efforts, which are shown in **Figure 1** (next page). ETJ planning areas include Tara Plantation, Royal Lake Estates, portions of Riverstone, and the largely undeveloped area known as Brazos South.

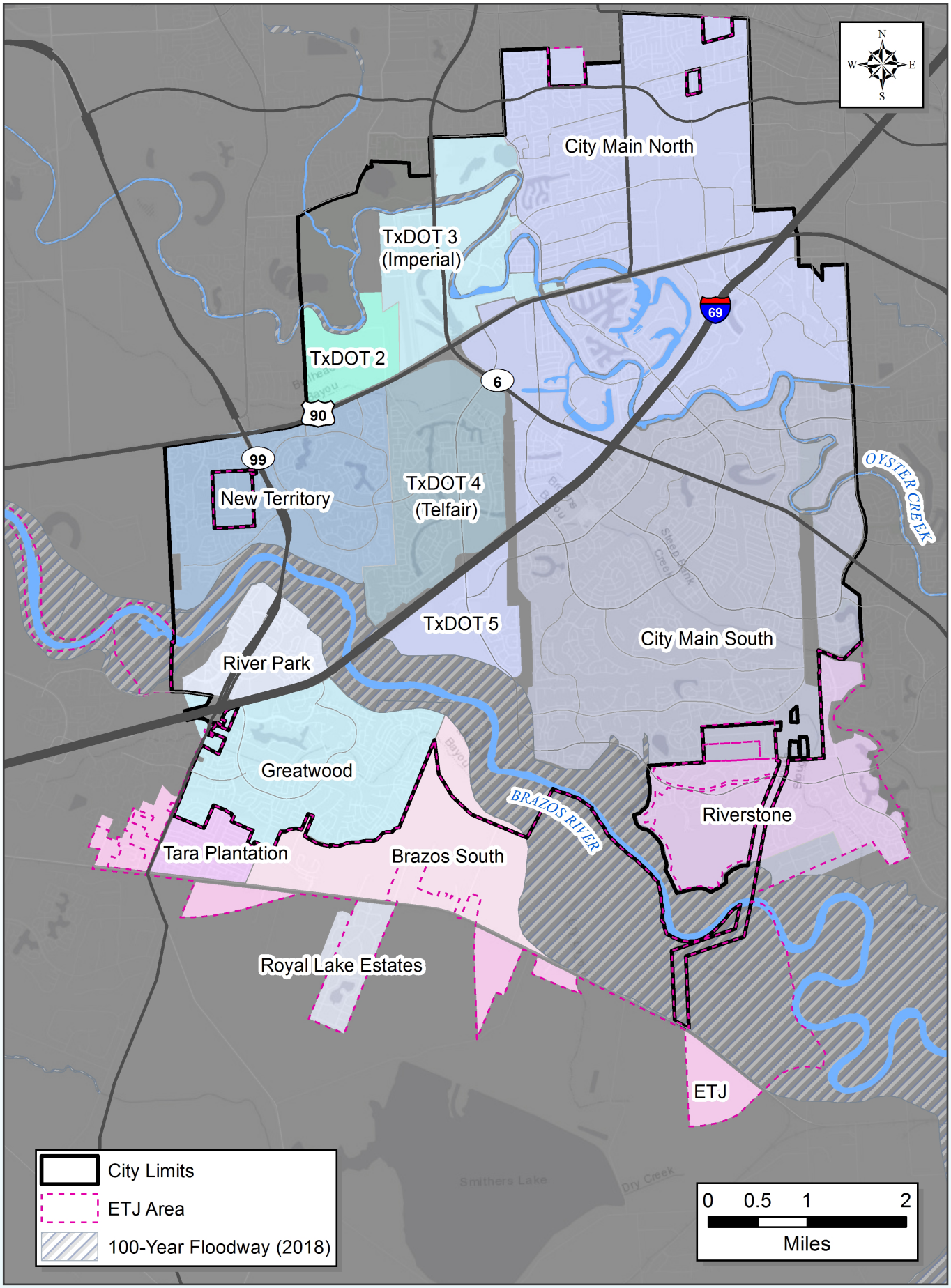



*Figure 1: IWRP Planning Areas*

The IWRP process, as seen in **Figure 2**, includes:

- Gather an understanding of the City's regulatory environment, including the targets required for the next conversion deadline for FBSD
- Develop overall goals for the community (i.e. objectives)
- Determine how to quantitatively evaluate whether each objective is being met via performance measures
- Assess the existing supply options combined with the future demand needs to establish the gap that must be filled
- Identify potential capital projects, management strategies, or policies to meet those gaps, also known as options

**OBJECTIVES**
*Represent major goals of plan, defined in broad, understandable terms (e.g. ensure water reliability)*

**PERFORMANCE MEASURES**
*Indicate how well an objective is being achieved (e.g. frequency and magnitude of water shortages or total lifecycle cost)*

**OPTIONS**
*Represent individual water supply projects or demand-side management measures*

**PORTFOLIOS**
*Represent combinations of options designed to best meet the stated objectives and will be evaluated in terms of metrics.*

- Develop initial themes for groups of projects (also known as portfolios) to evaluate against the performance measures
- Utilize a Decision Support Model (DSM) to demonstrate performance of the initial portfolios over a long-range period
- Input the results from the DSM and other performance metrics into a decision software scoring tool to rank the portfolios against each other
- Create new hybrid portfolios based upon results of the initial pass of the modeling analysis to see if the score can be improved with a different combination of projects
- Complete a sensitivity analysis to see if the ranking of portfolios would change given different test scenarios (such as extreme drought, significant fluctuation in costs, etc.)
- Select the recommended portfolio for implementation by the City

Through this process the City was able to identify a preferred IWRP strategy composed of management strategies, operational policies, and capital projects.


*Figure 2: The Planning Process*

Both the citizens and the City Council members played a vital role in the IWRP Process. Two task forces were created to support this effort—a Council Task Force and a Citizen Task Force. The Council Task Force was composed of Council Member Himesh Gandhi representing At-Large Position One and Council Member Steve R. Porter representing District One. The Council Task Force was responsible for providing input on the IWRP objectives, providing feedback on Citizen Task Force governance, and providing feedback on the questions to be answered by the IWRP. The thirteen-member Citizen Task Force was appointed by the City Council and represented a diverse range of interests and backgrounds to guide the development of the plan. The Citizen Task Force was responsible for developing objective weights, providing feedback on options, and providing feedback on the final IWRP framework. Each task force met separately, typically on a monthly basis over a period of approximately 24 months.

## Development of IWRP Planning Objectives

An early part of the IWRP process involves the establishment of planning objectives or goals for the program. These objectives should be distinct, measurable, non-redundant, understandable, and concise. The City, with input from both the Council Task Force and Citizen Task Force, considered those numerous questions that needed to answered as well as their ideals for the community to develop seven objectives for the plan: provide reliable water supply, develop cost-effective solutions, promote system efficiency, optimize water resources, maintain quality of life, protect the environment, and promote equity.


Understanding how the community feels about the relative importance of each objective when compared to each other is crucial to the success of the IWRP. Through a series of workshops, the Citizen Task Force members were asked to evaluate which objectives were most important to them. Citizens were asked questions such as, "Is it more important for the City to provide reliable water supply or cost effective solutions?" Based upon the outcome of the workshops, relative weighting scores were applied to each objective. For example, if two similar combinations of projects were identified, one focused on low cost and one focused reliability, the reliability score would carry more weight than the cost score in the comparison of the two because the citizens felt it was more important for the community. Both the objective definitions and the relative weighting scores are presented in **Figure 3**.

***Optimize Water Resources (18%)***

*Maximize City water supplies to meet current and future demands, including using the "right" type of water for the "right" use of water (e.g., non-potable water for irrigation demands).*

***Maintain Quality of Life (7%)***

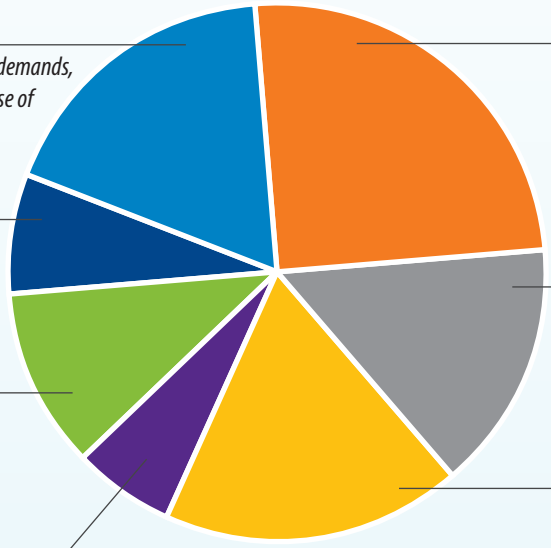
*Acknowledge the value water resources have on the economic, cultural, and recreational health of the City and its residents.*

***Protect Environment (11%)***

*Protect the natural environment of the community, including impacts to receiving waters (e.g., discharges to creeks and rivers) and land subsidence.*

***Promote Equity (6%)***

*Promote fairness and equity among all water users, both potable and non-potable.*



***Provide Reliable Water Supply (25%)***

*Maintain reliable water supplies for the City with an acceptable amount of risk, accounting for droughts, subsidence, facility failures, and regulatory uncertainties.*

***Develop Cost-Effective Solutions (15%)***

*Manage the financial impacts associated with meeting customer expectations for service and water quality.*

***Promote System Efficiency (18%)***

*Maximize efficiency and effectiveness for water use and value of water resources, including water loss, and operational management (e.g., improved water age and distribution system water quality).*

*Figure 3: IWRP Objectives*

Once the IWRP objectives were set, the City established how each objective would be scored/ranked in a series of performance measures. The performance measures could include a quantitative metric (such as how much would it cost to operate this new water supply system) to a qualitative score (such as how difficult would it be to permit the new water supply on a scale of 1-5). **Figure 4** presents the performance measures that were utilized in this IWRP.

**OPTIMIZE WATER RESOURCES**
- *Percent of non-potable demands met with non-potable supply*
- *Percent utilization of surface water contracts*

**PROVIDE RELIABLE WATER SUPPLY**
- *New non-groundwater yield incorporated*
- *Percent of alternative water usage during modeled extreme summer drought*
- *Yield from options with high implementation challenges*

**DEVELOP COST-EFFECTIVE SOLUTIONS**
- *Levelized cost of delivered water ($/1,000 gallons)*
- *Total capital cost (present value $)*

**PROMOTE SYSTEM EFFICIENCY**
- *Average percentage of demand savings from demand management options*
- *Qualitative score for operational complexity*

**PROMOTE EQUITY**
- *Qualitative equity impact score*
- *Percent of demands with access only to groundwater*

**PROTECT ENVIRONMENT**
- *Additional energy cost of options ($/year)*
- *Qualitative subsidence score*
- *Qualitative environmental scores*

**MAINTAIN QUALITY OF LIFE**
- *Qualitative score for benefiting economy*
- *Unmet annual amenity lake raw water demand during modeled 5-yr drought*

*Figure 4: Performance Measures*

# 2 EXISTING SYSTEM AND DEMANDS

The City and its ETJ area are served by several distinct water systems: potable water systems, wastewater treatment systems, a reclaimed water system, and a non-potable water system (**Figure 5**). During the IWRP process, these systems were characterized so they could be incorporated into the Decision Support Model further described in subsequent sections.

## Potable Water Systems

Historically, the majority of the City's drinking water supply has been from groundwater. There are twelve City groundwater plants ranging in size from approximately 3 to 12 million gallons per day (MGD) of production capacity and three smaller (up to 1 MGD) non-City groundwater plants that serve the ETJ area. In response to FBSD's original 30 percent alternative water supply conversion deadline, the City constructed a 9-MGD surface water treatment plant (SWTP) that went into operation in 2013 that has since been re-rated to approximately 11 MGD of production capacity. The SWTP is currently capable of delivering treated surface water to three of the City groundwater plants via a surface water transmission system where it is blended with groundwater before entering the distribution system. The City has over 600 miles of transmission and water distribution lines ranging from 1 inch to 36 inches.

The City has three sources of water available to supply the SWTP with surface water. The City holds a contract with the Gulf Coast Water Authority (GCWA), a wholesale water provider, who delivers raw water from the Brazos River to Oyster Creek. The contract with GCWA provides 10 MGD (11,201 AFY) of raw water, and an agreement to purchase an additional 10 MGD for future needs. The City also has a contract with the Brazos River Authority (BRA) for 6,388 acre-feet per year (AFY) of raw water but does not have any infrastructure to divert the water to the SWTP at this time. Finally, the City holds a water right on Oyster Creek which allows the City to withdraw 18,000 AFY. The Water Supply Reliability Study analyzed the Oyster Creek water right and found that during drought conditions, the firm reliability is only 3,660 AFY (3.2 MGD).

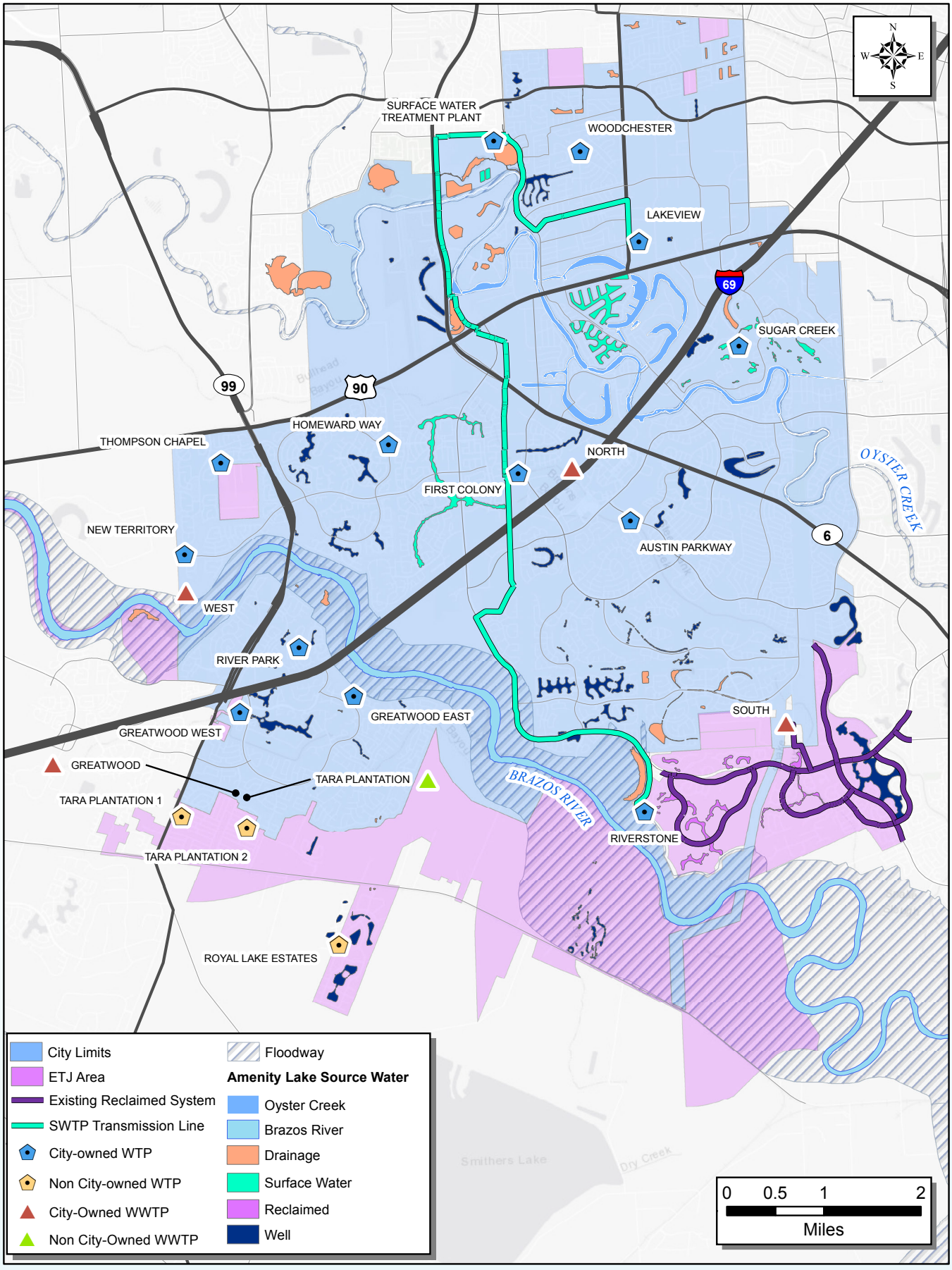



*Figure 5: Existing City and ETJ Water Systems*

## Wastewater Systems

The City operates four wastewater treatment plants (WWTPs) within the City limits ranging in size from approximately 1 to 6 MGD: North WWTP, South WWTP, West WWTP, and Greatwood WWTP. The Tara Plantation WWTP facility is a smaller facility (<1 MGD). It treats flows coming from the ETJ area and is not operated by the City. In addition to the WWTPs, wastewater infrastructure includes over 500 miles of gravity mains ranging from 4 to 60 inches in diameter and 40 miles of force mains up to 24 inches in diameter. The collection system also includes approximately 140 lift stations within the City limits.

## Reclaimed and Non-potable Water Systems

Within the City's planning area, non-potable water needs such as irrigation and the filling of amenity lakes can be supplied by either potable water or non-potable water. Non-potable water sources include reclaimed water, untreated surface water, or untreated groundwater. Many communities within the City have amenity lakes, and maintenance of amenity lake levels is a major use of non-potable water. Several GRP participants have agreements that allow them to use untreated groundwater from their private wells to irrigate landscapes and fill amenity lakes. Others have agreements to use untreated surface water to fill and maintain amenity lakes. **Figure 5** shows the amenity lakes located throughout the planning area and what source of water they currently utilize.

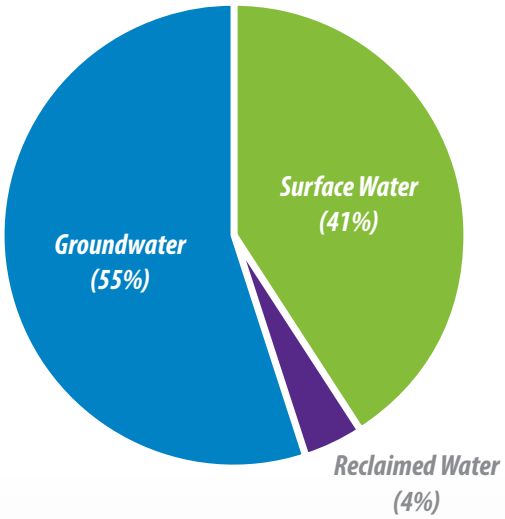



*Figure 6: Total Current Supply Mix*

For reclaimed water, the South WWTP has existing infrastructure capable of producing and delivering Type I reclaimed water. The West WWTP does not produce reclaimed water, but the City has an agreement to supply some of its effluent to Fort Bend County Levee Improvement District 7, which operates its own treatment facilities to produce Type I reclaimed water. Type I reclaimed water is used for refilling amenity lakes, irrigation, and other non-potable uses by customers that receive it.

**Figure 6** shows the current mix of water supplies in the City.

## Demands

With the existing water infrastructure characterized, an analysis was performed to determine the community's water needs (demands) by planning area for the present (2018), mid-range (2025), and long-term (2040) planning horizons. In the analysis, the total potable water demand was divided between nonrevenue water (NRW), indoor usage, and outdoor usage for both average weather and for dry weather conditions. NRW is water that is produced but lost before reaching the customer. This can be from physical water loss via leaks or breaks or apparent losses due to metering inaccuracies. **Figure 7** presents the demands that are currently being met by potable water under average weather conditions. During dry weather, outdoor usage is assumed to increase while indoor usage is held constant, as indoor usage is assumed to be independent from the weather.

Non-potable demands represent the demand currently being met by non-potable sources such as reclaimed water, untreated surface water, or untreated groundwater. These demands typically are related to irrigation or amenity lake filling by GRP participants and other water customers (e.g. home-owner associations). Non-potable water demands are a small component of the overall water demand at around 2 MGD as an annual average under average weather conditions ; however, there can be a significant difference seasonally for these demands. Lake filling and irrigation rates are much higher in the summer than winter. Non-potable water demands are assumed to increase by 65 percent under dry weather conditions as they are highly dependent on climate conditions. This is based upon historical water usage during previous drought conditions in the City.

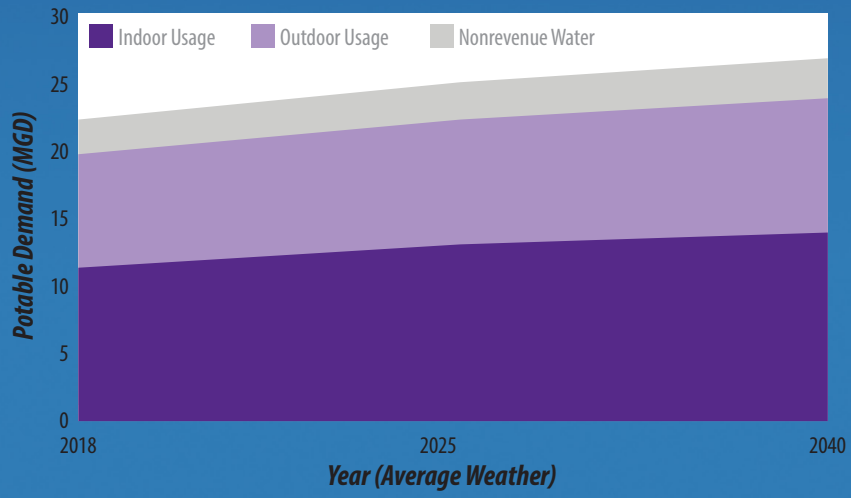



*Figure 7: Projected Demand for Current Potable Water Classified by Usage Type (Average Weather Conditions)*


# 3 NEEDS ASSESSMENT

An important aspect of the IWRP is the needs assessment—the ability to analyze in an integrated, interconnected manner (1) if there is a gap between the current supplies and the future demand, and (2) if the City can meet the next FBSD conversion requirement to have 60 percent of the water supply from alternative (non-groundwater) sources. A decision support model (DSM) was developed to simulate current and future demands, supplies, and major system constraints.

The needs assessment in the DSM was calculated under two weather conditions--dry and average. During dry weather conditions, there is reduced availability of surface water supplies and increased outdoor demands as residents utilize more water for irrigation in drier weather.

Ultimately, the needs assessment showed that there is currently enough water supply infrastructure to meet future demand; however, there is not enough alternative (non-groundwater) supply to meet the future regulatory conversion requirements to avoid penalties. If the City does not rely on previously banked credits, under both average and dry conditions, the City would be out of compliance with the FBSD 60-percent conversion requirement in 2025. This can be seen in **Figure 8**. The City currently

has some over-conversion and educational credits banked that could be redeemed to allow continued delivery of excess groundwater for a period of time while avoiding the financial penalties from FBSD. Under average weather conditions, these credits may last for up to nine years. Under dry conditions, they would be depleted within four years. If another drought of record happens similar to 2011, they could be depleted even more quickly. Regardless of the amount of credits currently banked, without any future alternative supplies in the City, there are not enough credits to allow the City to avoid the steep disincentive fees from FBSD for excess groundwater withdrawals. By 2040, it is estimated that the total fee payments could be anywhere from $70-230 million, depending upon weather conditions and assuming the fee remains at the 2018 value of $6.50 per 1,000 gallons. To avoid paying disincentive fees, the City ultimately needs a minimum of 5.3 MGD of new alternative water supply under average weather conditions and up to 9.5 MGD for dry weather conditions.

## Needs Assessment Results

*Existing infrastructure can meet demands but not regulatory requirements.*

| | AVERAGE WEATHER | DRY WEATHER |
|---|---|---|
| Minimum additional alternate water supply needed to meet FBSD conversion requirements at buildout | 5.3 MGD | 9.5 MGD |
| Estimated time after next conversion deadline until financial disincentive fees are incurred with use of banked credits | 9 years | 4 years |
| Total cumulative disincentive fees through 2040 without additional alternative water supplies, with use of credits | $70 million | $230 million |

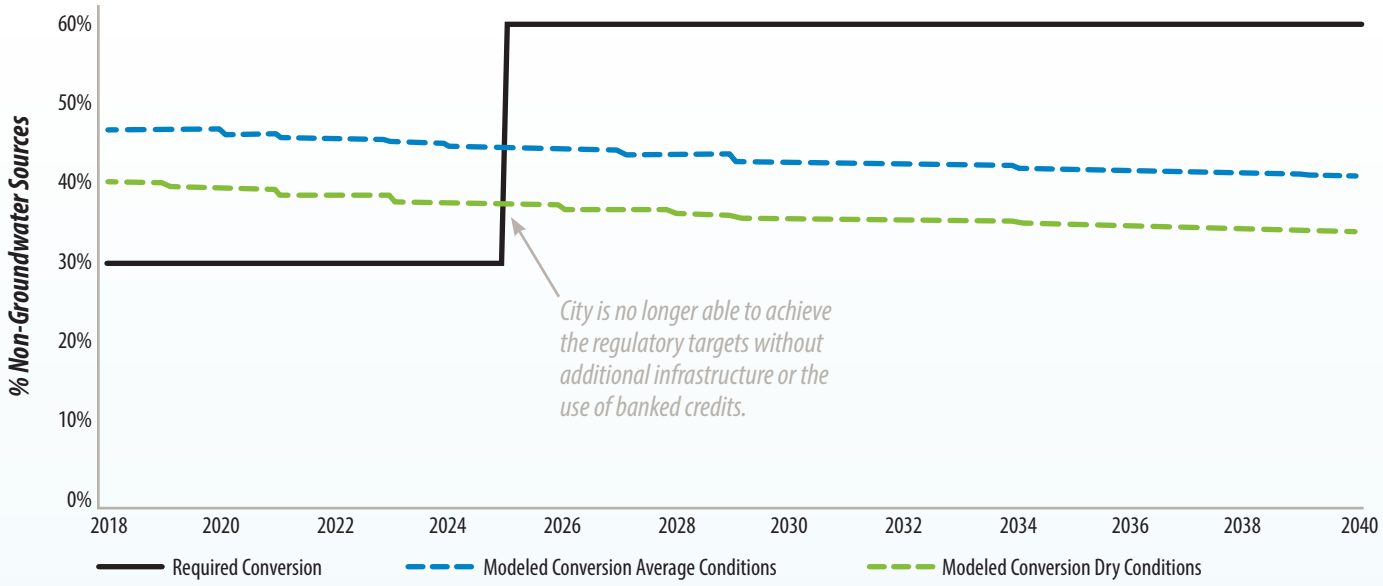



*Figure 8: Compliance with FBSD Conversion Requirements under Average and Dry Conditions*

# 4 OPTIONS

In support of the IWRP, future water supply options were developed to help the City meet their long-term water supply needs. Fifteen future water supply options were defined through a collaborative process with City staff and the consultant team. These included three demand management options, four reclaimed water options, four infrastructure and storage options, three alternative water supplies, and groundwater credit banking.

A summary for each option is provided below. More detail on the development of each option can be found in the IWRP report.

## Demand Management

***Advanced Metering Infrastructure (AMI)*** is an integrated system of customer water meters, communication networks, and data management systems that provides real time water use information to the City and its residents. AMI has multiple potential benefits including: more informed customers who adjust usage behaviors based upon the data and a more informed utility to make data-driven decisions. Implementation of AMI would reduce water losses in the City's water distribution system with improved customer meter accuracy, reduced unauthorized consumption, reduced data transfer/archive errors, reduced data billing errors, and reduced customer-side leaks by identifying uncharacteristic water use.

***Water Loss Control*** can be achieved in two forms, real and apparent. Real water loss is typically a result of leaks in the distribution system or unmetered water use, whereas apparent losses are typically due to meter and billing inaccuracies. The City currently has a robust water loss control program with routine audits in accordance with standards set by the American Water Works Association/International Water Association. Deficiencies from each audit are addressed in a timely manner as budgets allow. For this option, the City would continue to perform audits and address deficiencies. Additionally, the City would expand the program to include more water loss control measures such as a strategic leak detection pilot program, a district metering area feasibility study, a large meter assessment and testing program, a demand profile for 2-inch and larger meters, and a real loss component analysis.

***Conservation*** is the reduction of customer water use throughout the City via elements like educational programs, incentives, or new requirements with potential penalties for failure to comply. For this analysis, two types of conservation were evaluated: basic and advanced. The basic program is incentive-focused; whereas, the advanced program considers ordinances for reducing outdoor water use. These two programs were developed based on review of conservation practices implemented by cities similar to Sugar Land. The basic program is composed of the following initiatives: continuing distribution of WaterWise kits to local schools; continuing free residential and nonresidential irrigation system evaluations; improving conservation awareness through education and outreach; and offering rebates for rain barrels, irrigation "smart" controllers, and water efficient household fixtures. The advanced program is composed of the following initiatives: twice-weekly irrigation ordinance and landscape transformation ordinance with incentives for conversion of existing landscapes to more drought-tolerant materials.

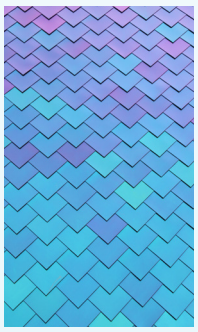
## Reclaimed Water

***Expanded Reclaimed Water System*** Reclaimed water is highly treated wastewater that can be distributed to customers for non-potable uses such as irrigation, amenity lake filling, cooling towers, and industrial water use. In 2018, the City completed a Reclaimed Water Supply Study that identified possible customers and considered potential reuse projects to meet those needs. The top recommended options from that master planning effort were incorporated into this IWRP for consideration. This option would expand the City's reclaimed water system to incorporate additional customers and increase reclaimed water use. It has two sub-options: expansion of the existing 2-MGD reclaimed water treatment facilities at the City's South WWTP and construction of reclaimed water facilities at the City's North WWTP. The locations and capacities of additional facilities are contingent upon customer interest, potential reclaimed water usage, and proximity to the City's WWTPs. It is envisioned that reclaimed water would be delivered directly to ponds, lakes, or storage tanks at customer receiving stations.

***Direct Potable Reuse (DPR) / Indirect Potable Reuse (IPR)*** While all water is eventually reused, both DPR and IPR include the proactive decision to transform wastewater into drinking water via advanced treatment systems. These two options are gaining a lot of momentum across the country where dependable water supplies are dwindling. The Texas Commission on Environmental Quality (TCEQ) has strict requirements for implementation of DPR/IPR projects based on protection of public health, natural resources, and lessons learned from previous projects. DPR would send highly treated WWTP effluent directly to the SWTP where it would be blended with other water sources for treatment and distribution. The proportion of blended water for DPR supply at the SWTP would be kept within 10 to 20-percent of the total water supply. IPR would introduce highly treated WWTP effluent into an environmental buffer such as groundwater or a surface reservoir. The treated effluent would be extracted from the environmental buffer and sent for further treatment at the SWTP. Due to space constraints and the implementation challenges for IPR at this location, DPR was the representative option considered for potable reuse within the IWRP.

***Collection System Wastewater Scalping***, also known as decentralized or satellite wastewater treatment, is a process in which a locally-placed treatment plant withdraws wastewater directly from the collection system to produce reclaimed water for targeted local use. Any residuals from the scalping plant are returned to the trunk sewer for treatment at the centralized WWTP downstream. These facilities are typically located close to the end-users of reclaimed water. For the IWRP, two lift stations within the North WWTP service area were identified as ideal potential candidates and evaluated.






***Commercial/Industrial Conservation and On-site Reuse*** includes a targeted effort with commercial and industrial facilities to reduce water consumption and/or develop a localized on-site reuse system for non-potable demands. By treating wastewater on-site, these facilities reduce flows to the City's collection system and WWTPs. Additionally, the use of reclaimed water reduces demands on the City's potable water system. Implementation of conservation measures at commercial/industrial facilities can further reduce their demands on the potable water system and also reduce costs for those commercial/industrial customers. In the IWRP, capacity of on-site reuse facilities is based on anticipated non-potable water demand.

## Infrastructure and Storage

***Surface Water Treatment Plant Expansion*** The existing SWTP is rated for approximately 11 MGD, but was designed for an ultimate build-out of 22 MGD. In the IWRP, two different scenarios were considered--a partial expansion of 5.5 MGD to meet the minimum needs for compliance with FBSD under average weather conditions or a full expansion by 11 MGD for build-out of the plant. Either expansion would enable the City to increase the use of existing surface water rights/contracts, allow the City to use expanded contracts if in place, and would increase surface water utilization to comply with the FBSD requirements. This option requires expansion of the surface water transmission system to additional groundwater plants. By expanding the surface water transmission system, there is more demand that can be served by the treated surface water. In the IWRP model, Woodchester, Austin Parkway, and Homewood Way were considered; however, if this option is ultimately selected, a routing study will be necessary to confirm the final locations.

***Access to Brazos River Water*** The City may wish to access the Brazos River water that it currently has under contract with BRA or any additional water purchased from them. Two sub-options were evaluated to access this water: construction of a new City-owned/operated pump station or contracting with GCWA to use their existing infrastructure to convey the BRA water to Oyster Creek. Additionally, if a the City wishes to construct the off-channel reservoir (OCR) option, a pump station would be required to convey flow to the OCR. For the purpose of the IWRP, it was assumed that if a new pump station was constructed, it would be sized to 12 MGD to provide the City greater flexibility of operations.

***Aquifer Storage and Recovery (ASR)*** is a strategy in which treated surface water, untreated or treated groundwater, or reclaimed water is stored underground in an aquifer during periods when water supply is plentiful and recovered for use during periods when water supply is needed. Storing water underground can improve drought preparedness and loses less water to evaporation when compared to traditional open reservoirs. For the IWRP, it was assumed that the ASR project would be implemented near the SWTP transmission lines to take surplus treated surface water from the transmission system and use it to recharge an aquifer below the City. The water would then be available to withdraw during peak seasonal demands or times of drought.

***Off-Channel Reservoir (OCR)*** includes the construction of a reservoir disconnected from the Brazos River to store raw surface water for later use as water supply at the SWTP. An OCR would allow the City to maximize existing contracts for Brazos River water and/or water rights on Oyster Creek by providing storage. Depending on the location, the OCR could also be designed to capture rainwater and stormwater runoff, provided that the necessary water right permit is obtained. The raw surface water from the OCR would be sent to the SWTP via Oyster Creek. The reservoir would be sized to reliably supply surface water during the high demand periods and extended drought periods. For this analysis, it was assumed that the OCR would store enough surface water to fully supply the existing 11-MGD SWTP for 60 days.

## Alternative Water Supplies

***Seawater Desalination*** is the treatment of high-salinity seawater to make drinking water via energy intensive membrane filtration processes. This option could be achieved two ways: (1) the City could construct their own treatment plant close to the ocean and pump the water approximately 55 miles through new pipelines, or (2) the City could contract with a third-party water provider to purchase treated seawater that is piped from Angleton to the City. The first option was deemed more feasible and was evaluated in the IWRP.

***Brackish Groundwater Desalination*** Brackish groundwater has a salinity between that of freshwater and seawater, with brackish water in the range of 1,000 to 8,000 milligrams per liter as compared to seawater which typically has a salinity of around 35,000 milligrams per liter. There are several aquifers that can supply brackish water including the Jasper and lower Evangeline formations, which are approximately 2,000 to 3,000 feet below the surface. Salinity from brackish groundwater can be removed using reverse osmosis treatment. This option assumes that a brackish groundwater treatment facility with several wells would be constructed at the City's SWTP site. It should, however, be noted that FBSD does not currently consider this brackish water as an alternative water supply but may in the future consider it as such.

***Expanded Water Supply Contracts*** As previously mentioned, the City has contracts in place with GCWA and BRA for surface water supply to be delivered to Oyster Creek then treated at the SWTP. This option considers pursuing other contracts such as: additional Brazos River water from BRA that is expected to be available during the spring of 2019, water rights on Rabbs Bayou and Middle Bayou, and/or the purchase of wastewater effluent from upstream WWTPs that is discharged to the Brazos River and conveyed through bed and banks permits. For the IWRP, purchase of additional water from BRA is considered the most feasible opportunity; however, similar to the current contract, neither BRA nor the City has infrastructure in place to convey this water from the Brazos River to Oyster Creek. If this option is considered, it must be considered in conjunction with the option for access to Brazos River Water, which is either the construction of the City's own pump station on the Brazos River or a new contract with GCWA to convey the BRA water through their existing infrastructure to Oyster Creek.

## Groundwater Credit Banking

***Groundwater Credit Banking*** The FBSD allows the City to earn credits that can be accumulated over time if they over-convert above the target alternative water volume. Over-conversion of surface water offers a one-to-one credit; whereas, reclaimed water is a credit of 1.5 gallons for every gallon of over-conversion. As part of their GRP compliance strategy, the City constructed the SWTP in 2014. When running at full capacity, this plant exceeds the current 30-percent conversion target, which provides the City an opportunity to gain over-conversion credits. The City has been accumulating these credits, as well as credits earned through supporting the WaterWise educational program, into a "credit bank." This can be used to offset the groundwater disincentive fees if the City pumps more groundwater than their GRP allows in a given year. Groundwater credit banking does not directly yield new water. However, it does enable the City to legally access groundwater supplies that would otherwise be prohibited based on FBSD regulations.


Each of the options with their estimated costs and 2040 yield are shown in **Table 1**. All costs are expressed in 2018 dollars and are broken down into total capital cost, operation and maintenance (O&M) cost, and total annual cost with debt service. Capital costs are the expenditures directly associated with designing, permitting, and constructing the option. O&M costs are the expenditures required to maintain and operate the option, such as electrical or labor costs. Total annual costs take into account the option's O&M costs, debt service, lost revenue, and credits for avoided treatment.

| Options | Option Type | 2040 Yield (MGD) | Total Capital Cost ($) | Operation & Maintenance Cost ($/year) | Total Annual Costs ($/year) |
|---|---|---|---|---|---|
| Advanced Metering Infrastructure | Demand Management | 0.94 | $12,504,000 | $75,000 | $2,321,000 |
| Water Loss Control | Demand Management | 0.24 | $360,000 | $132,000 | $98,000 |
| Conservation – Basic (Rebates) | Demand Management | 0.86 | $0 | $489,000 | $2,013,000 |
| Conservation – Advanced (Ordinances) | Demand Management | 2.19 | $0 | $1,091,000 | $2,865,000 |
| Expanded Reclaimed Water System (North System) | Reclaimed Water | 1.10 | $17,707,000 | $370,000 | $1,944,000 |
| Expanded Reclaimed Water System (South System) | Reclaimed Water | 0.40 | $9,817,000 | $203,000 | $1,201,000 |
| Direct Potable Reuse | Reclaimed Water | 4.00 | $80,634,000 | $2,845,000 | $9,315,000 |
| Collection System Wastewater Scalping (West Airport) | Reclaimed Water | 0.17 | $9,676,000 | $299,000 | $1,031,000 |
| Collection System Wastewater Scalping (Harmon LS) | Reclaimed Water | 0.17 | $8,048,000 | $271,000 | $872,000 |
| Commercial/Industrial On-site Reuse | Reclaimed Water | 0.04 | $3,675,000 | $123,000 | $407,000 |
| Surface Water Treatment Plant Expansion (5.5 MGD) | Infrastructure and Storage | 5.50 | $50,019,000 | $2,594,000 | $5,985,000 |
| Surface Water Treatment Plant Expansion (11 MGD) | Infrastructure and Storage | 11.00 | $66,325,000 | $5,188,000 | $9,265,000 |
| Access to Brazos River Water (Pump Station to Oyster Creek) | Infrastructure and Storage | 5.70 | $22,713,000 | $834,000 | $2,657,000 |
| Access to Brazos River Water (Pump Station to Reservoir) | Infrastructure and Storage | 5.70 | $19,891,000 | $778,000 | $2,374,000 |
| Aquifer Storage and Recovery (Airport)* | Infrastructure and Storage | 6.60 | $7,123,000 | $559,000 | $1,131,000 |
| Aquifer Storage and Recovery (Retrofit)* | Infrastructure and Storage | 6.60 | $2,373,000 | $559,000 | $749,000 |
| Aquifer Storage and Recovery (SWTP) | Infrastructure and Storage | 6.60 | $6,260,000 | $559,000 | $1,061,000 |
| Off-channel Reservoir | Infrastructure and Storage | 6.00 | $51,804,000 | $644,000 | $4,801,000 |
| Seawater Desalination (New Pipeline) | New Water Supply | 5.00 | $139,595,000 | $5,206,000 | $15,842,000 |
| Seawater Desalination (BWA Northern Line)* | New Water Supply | 5.00 | $108,549,000 | $5,607,000 | $13,752,000 |
| Brackish Groundwater Desalination (2 MGD) | New Supply Sources | 2.00 | $26,364,000 | $1,320,000 | $3,209,000 |
| Brackish Groundwater Desalination (4 MGD) | New Supply Sources | 4.00 | $43,409,000 | $2,182,000 | $5,213,000 |
| Expanded Water Supply Contracts (Purchase from BRA) | New Supply Sources | 3.57 | $0 | $296,000 | $296,000 |
| Groundwater Credit Banking | Groundwater Credit Banking | N/A | -- | -- | -- |

*Table 1: Water Supply Option Summary*

**Indicates Options Not Modeled in DSM*


# 5 PORTFOLIO EVALUATIONS

A portfolio is a combination of future water supply options which can meet the increased FBSD regulatory requirements. There are thousands of potential ways in which the fifteen future water supply options and the numerous sub-options could be combined in portfolios, so a systematic process was utilized in forming and evaluating selected groups of portfolios. Based on the needs assessment, at least 6 MGD was set as the lower boundary for new yield to be included in a portfolio. Portfolios were initially grouped around themes in order to evaluate performance meeting the community objectives. The six initial portfolio themes were:

- **Low cost:** Selection of options with the lowest unit cost
- **Non-potable supply:** Options focused on meeting non-potable demand with non-potable supply while conserving the current potable supply
- **Surface water focused (5.5-MGD expansion):** Options focused on utilizing the current surface water contracts through a smaller SWTP expansion
- **Surface water focused (11-MGD expansion):** Options focused on utilizing the current surface water contracts through a larger SWTP expansion
- **Maximum reliability:** Options which utilize hydrologically independent supplies and thus perform well under drought conditions
- **Local control:** Selection of options where the water source in under the control of the City


Following analysis of the initial themed portfolios, a new set of portfolios were developed with the goal of improving performance. Called hybrid portfolios, these portfolios were not constrained by themes but instead could contain any mix of project options. City staff submitted nine initial hybrid portfolios for evaluation, and the two highest scoring ones were carried forward for further analysis. In the next round of analysis, options were added and removed from the best scoring portfolios to evaluate if the score could be further improved. A comparison of many of the portfolios evaluated is presented in **Figure 9**. Each of these portfolios would allow the City to successfully meet the regulatory targets; however, they all perform differently in how well they achieve the stated IWRP objectives. Each of the colored bars represents how the portfolio scored for a given objective. The longer a segment, the better the portfolio did at achieving that objective. The portfolios with the longest overall length are the ones that best met the City's overall

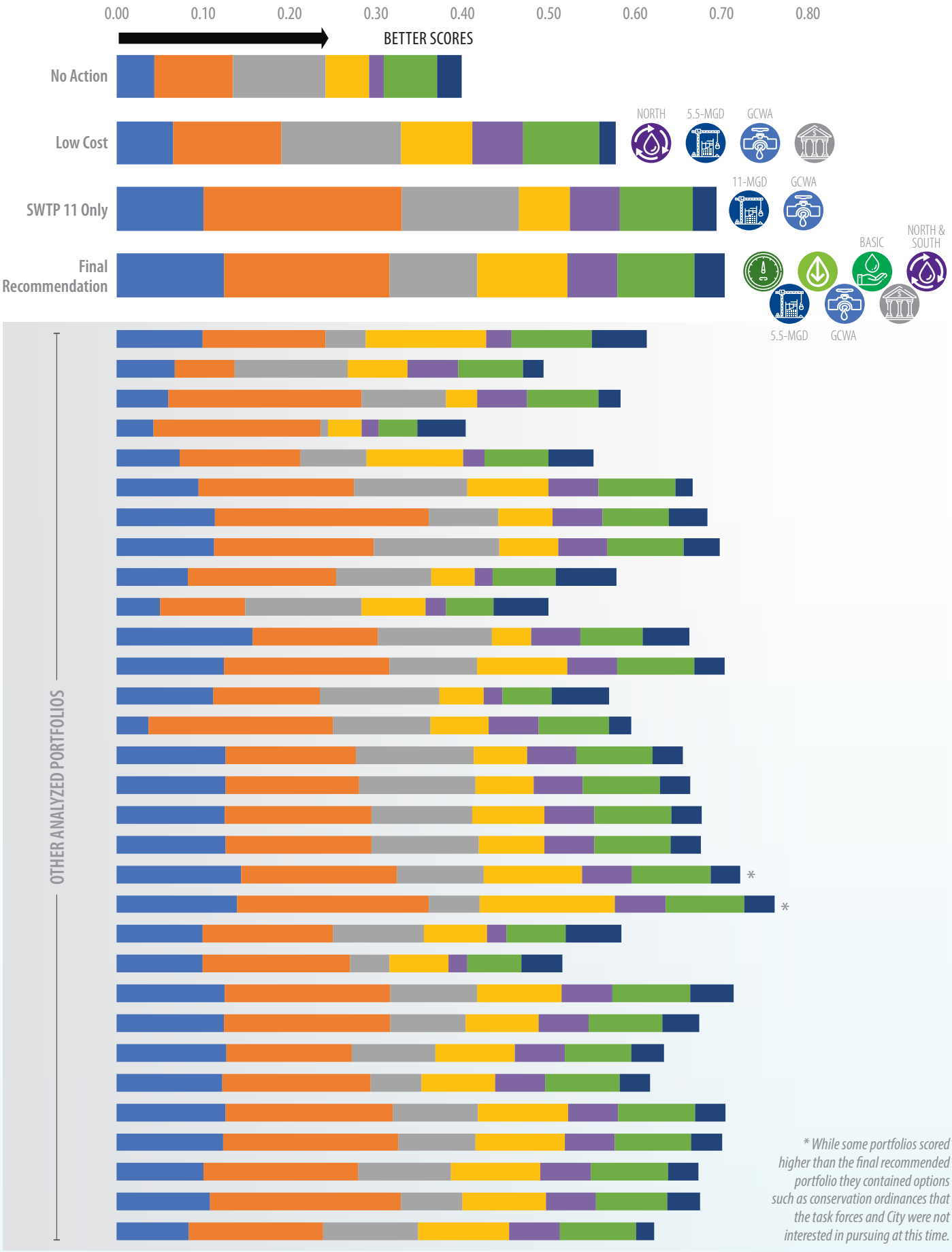



*Figure 9: Sampling of Portfolios Analyzed through IWRP Process*

goals. Of particular note are the following four portfolios: (1) No Action. If the City stays with the current set of water supply options, that portfolio ranks very low compared to others considered. (2) Low Cost. If the City chose to implement the lowest cost portfolio, it could meet the demands but would not meet the objectives of the community as well as other portfolios. (3) SWTP 11 Only. This is the current plan for the City in the existing Capital Improvement Plan (CIP). While this portfolio does meet the overall objectives well, it does not have the risk diversified set of options that the City ultimately desires. (4) Final Recommendation. This best meets the values of the community as determined through this IWRP process and through close coordination with both the Citizen and Council Task Forces.

The portfolio analysis determined groups of options that generally improved scores and aided the City in meeting their multiple IWRP objectives. It also revealed options that generally brought down scoring. The following were the major findings:

- Including any of the demand management options improves the total score through improved reliability and system efficiency. While including all demand management would have produced the highest score, implementation of mandatory conservation ordinances was deemed by the task forces as not being the best fit for the City at this time.
- Expanding the surface water treatment plant provides the most cost effective and efficient method of bringing online more non-groundwater yield.
- While both brackish and seawater desalination scored well for drought reliability, the significant costs and implementation challenges lead to an overall decrease in the portfolio scoring when included. Potential challenges include permitting, blending issues with current water supplies, brine disposal, and uncertainty of whether brackish groundwater will be considered by FBSD as an alternative non-groundwater supply.
- Direct potable reuse decreases the portfolio scores when included mainly due to cost considerations and implementation challenges.
- Inclusion of on-site reuse and wastewater scalping had a neutral effect on the scoring. They were not included in the final recommended portfolio due to their small yields but opportunities could be considered if they arise.
- Expanding the reclaimed water systems at both the North WWTP and South WWTP increase the overall scoring with benefits for optimizing water resources and providing a more reliable water supply.
- Building a pump station to access BRA contract water has a higher cost, increased operational complexity, and more environmental impacts compared to negotiating a contract with GCWA to use existing infrastructure to pump the water to Oyster Creek.
- While both storage options (ASR and OCR) allow better optimization of the current surface water contracts and provide increased drought reliability, this is balanced by implementation challenges, operational complexity, and potential environmental impacts. An ASR Feasibility Study is currently underway for the area and may change implementation requirements to make it less challenging. If this happens, the City may wish to re-evaluate the feasibility of ASR.

**Observations from the Multiple Passes and the Sensitivity Analysis:**

***Options that Improve Scores:***

***Neutral Scoring / Potential for Future Analysis:***

***Options that Decrease Scores:***

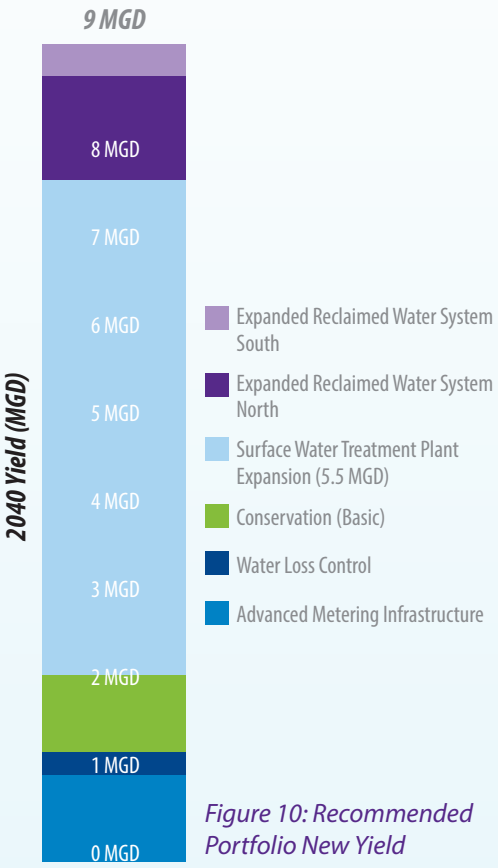


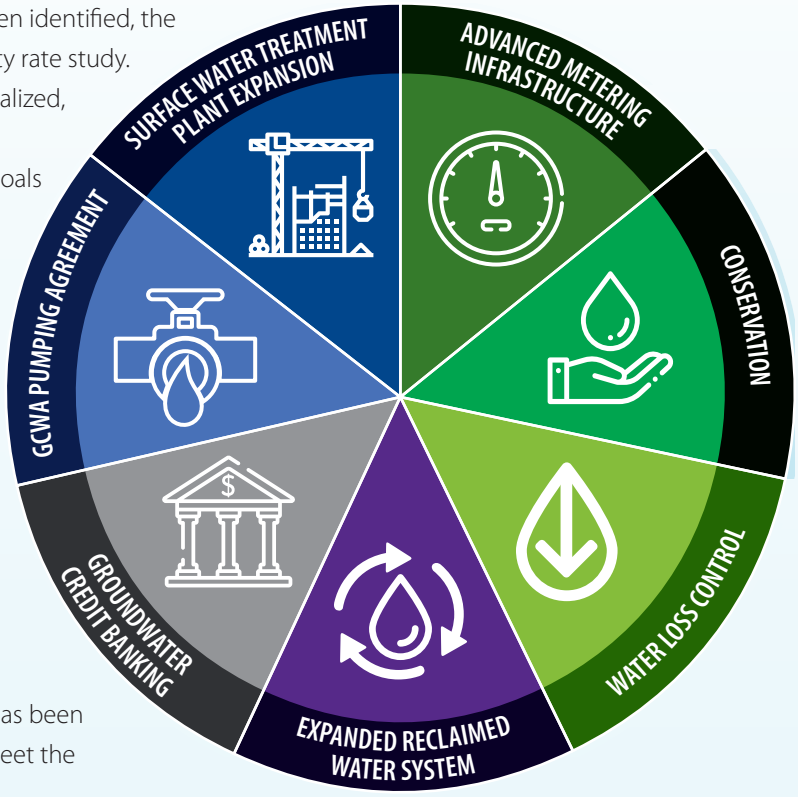

*Figure 10: Recommended Portfolio New Yield*

The final recommended portfolio includes a risk diversified mix of the best scoring options including a 5.5-MGD expansion of the SWTP, expanding the reclaimed water system from both the North and South WWTPs, implementing AMI, enhancing the current water loss control program, negotiating a contract with GCWA to pump the City's BRA contracted water, a series of basic conservation initiatives and rebate programs, and credit banking. **Figure 10** shows the new non-groundwater yield of the options included within the recommended portfolio.


# RECOMMENDATIONS

Through this IWRP process, the City has been able to develop a comprehensive and holistic path forward for continued compliance with FBSD regulations while meeting the community's objectives to: (1) provide reliable water supply, (2) optimize water resources, (3) promote system efficiency, (4) develop cost-effective solutions, (5) protect the environment, (6) maintain quality of life, and (7) promote equity. A set of diversified policy recommendations, management tools, and capital improvement projects have been identified to best meet these objectives. Costs have been established for implementation of each of these recommended options; however, it is noted that this was completed on a planning level based on current cost of service and contractual and regulatory requirements.

Now that the recommended portfolio of projects have been identified, the next step of this process must be the completion of a utility rate study. This study should identify how these projects can be capitalized, provide an understanding of associated rate impacts, and establish final phasing so that the City may achieve their goals and objectives in a timely manner before the next FBSD regulatory deadline. During this rate study, the City may need to refine the anticipated phased project costs and timing to meet their community financial objectives. The rate study should consider groundwater pumpage, GRP fees, potential disincentive fees for delayed projects, and raw water rates. Additionally, the rate study should provide recommendations for the expanded reclaimed water system including potential connection fees and usage rates to allow the City to recover costs associated with implementing, operating and maintaining the expanded reclaimed water system.




Additional details on each of the recommended options has been provided as well as proposed phasing of the projects to meet the community's objectives.

## Implementing the Preferred Strategy

### AMI

Implementation of AMI requires multiple pieces of infrastructure including new meters, meter communication networks, AMI software, data management systems and an analytics portal. The AMI network should be integrated into the City's utility billing system in order to take full advantage of the benefits rendered by AMI.

It is recommended that AMI be implemented across the entire City service area to maximize benefit to the community and capitalize on the data analysis capabilities for more efficient utility operations. There are two infrastructure components to the AMI project: the replacement of old meters and the installation of a meter communication network. The City can phase the program to maximize data collection capabilities and defray large capital expenditures for full meter replacement across the City. This could be accomplished via (1) prioritizing meters to be replaced in a phased approach across the City, (2) completing the initial phase of meter replacement as budget allows, focused on older or problematic meters, then (3) retrofitting any remaining existing meters with meter interface units to allow for immediate data collection until those meters are scheduled to be replaced in the future.

### Water Loss Control

Before beginning the IWRP process, the City already had an aggressive water loss control strategy including audits every three years and implementing recommendations from those audits. The IWRP water loss control option builds upon the City's current efforts, providing a cost-effective strategy for reducing water demand and improving efficiency of available water resources. The IWRP recommends several water loss control measures in addition to the continued program. The first step is to develop metered areas of 1,000 to 3,000 customers to improve water loss tracking between the City's water treatment plants and the City's customers. Secondly, the IWRP recommends developing a large-user meter assessment program and demand profile for these meters. Finally, it is recommended that the City conduct a strategic leak detection program. These steps will synergize with the AMI program.

### Basic Conservation

The recommended basic conservation program builds on measures the City is already doing, such as WaterWise education kits and irrigation audits, while developing a new rebate program that would reimburse customers for implementing certain conservation practices such as purchasing and installing low flow water fixtures or high efficiency (low water usage) appliances. The basic conservation program pairs well with AMI implementation, as it allows customers the opportunity to track their water use in real time and see how conservation practices can help lower their monthly bills.


The benefits of conservation are highly dependent on customer participation. Early outreach and customer education will be necessary to entice citizens to participate in the rebate program to realize demand savings within the City.

### Expanded Reclaimed System - North and South

The Reclaimed Water Supply Study identified several large potential reclaimed water customers in the US-59/I-69 highway corridor. Servicing these customers would require expansion of the City's reclaimed water system with additional treatment and distribution from the North WWTP. The conceptual layout includes reclaimed water trunk lines extending from the North WWTP along US-59/I-69 and branching out to customers. The exact locations and capacities of facilities are contingent upon customer interest and potential reclaimed water usage. As the City invests in an expanded reclaimed water system, development of reclaimed water policies and guidelines will be necessary. The South WWTP has an existing 2-MGD reclaimed water system which supplies reclaimed water to the Riverstone area. It is recommended that the capacity of the system be expanded to serve additional customers. This option is prioritized lower than expansion of the north system due to fewer opportunities for additional reclaimed water demand. Policies on requesting service, requiring service for large users within a certain distance of the reclaimed water distribution system, reclaimed customer contract provisions, cross-connection control requirements, and requirements for reclaimed water usage in new development areas should be established.

## SWTP Expansion by 5.5 MGD

The recommended 5.5-MGD expansion would increase the plant capacity to 16.5 MGD and, if required, still allow for a final expansion to the full 22-MGD capacity at a later date. The expansion of the SWTP by 5.5 MGD provides the majority of the yield required to achieve the 60-percent non-groundwater supply goal, and therefore, the City should strive to make this expanded facility operational by 2025 to meet FBSD's increased regulatory requirements.

To utilize the expanded water production at the SWTP, an expansion of the surface water transmission system is also required. The initial plan includes an extension of the transmission system to Austin Parkway, Woodchester and Homeward Way groundwater plants for blending prior delivery into the distribution system; however, this will be subject to confirmation in a future routing study.

## Access to Brazos River Water

In order to expand the SWTP and have sufficient water during times of drought, the City needs additional surface water to be available in Oyster Creek. The recommended method to obtain this surface water is to negotiate a long-term pumping agreement with GCWA to deliver the City's BRA contract water from the Brazos River to Oyster Creek through the existing GCWA infrastructure. An agreement must be reached prior to the 5.5-MGD SWTP expansion in order to achieve full benefits of the expansion.

## Groundwater Credit Banking

The IWRP showed that over-conversion credits can provide a significant value to the City. It is recommended that the City develop a policy on accrual of credits to a defined amount to hold or "bank" for risk mitigation purposes. While the policy is being developed, it is recommended that the City continue to operate the SWTP and reclaimed water system with a focus on gaining over-conversion credits, as well as WaterWise education credits, prior to the regulatory targets increasing in 2025. After regulatory targets increase, it is recommended that the City consider prioritizing use of non-groundwater sources when they are available, even if this causes over-conversion up to the targeted credit bank amount per the City's policy. Credits can be redeemed in the future to meet alternative water requirements in years when alternative water use may fall short of the regulatory targets. The City may also wish to establish provisions for the potential sale of excess credits in the new credit policy.

Implementation of the recommended IWRP Strategy has been divided into three planning horizons; near-term (less than five years), medium-term (five to ten years), and long-term (ten years and beyond). Proposed phasing has been presented on the following pages in **Figure 11** and **12**.

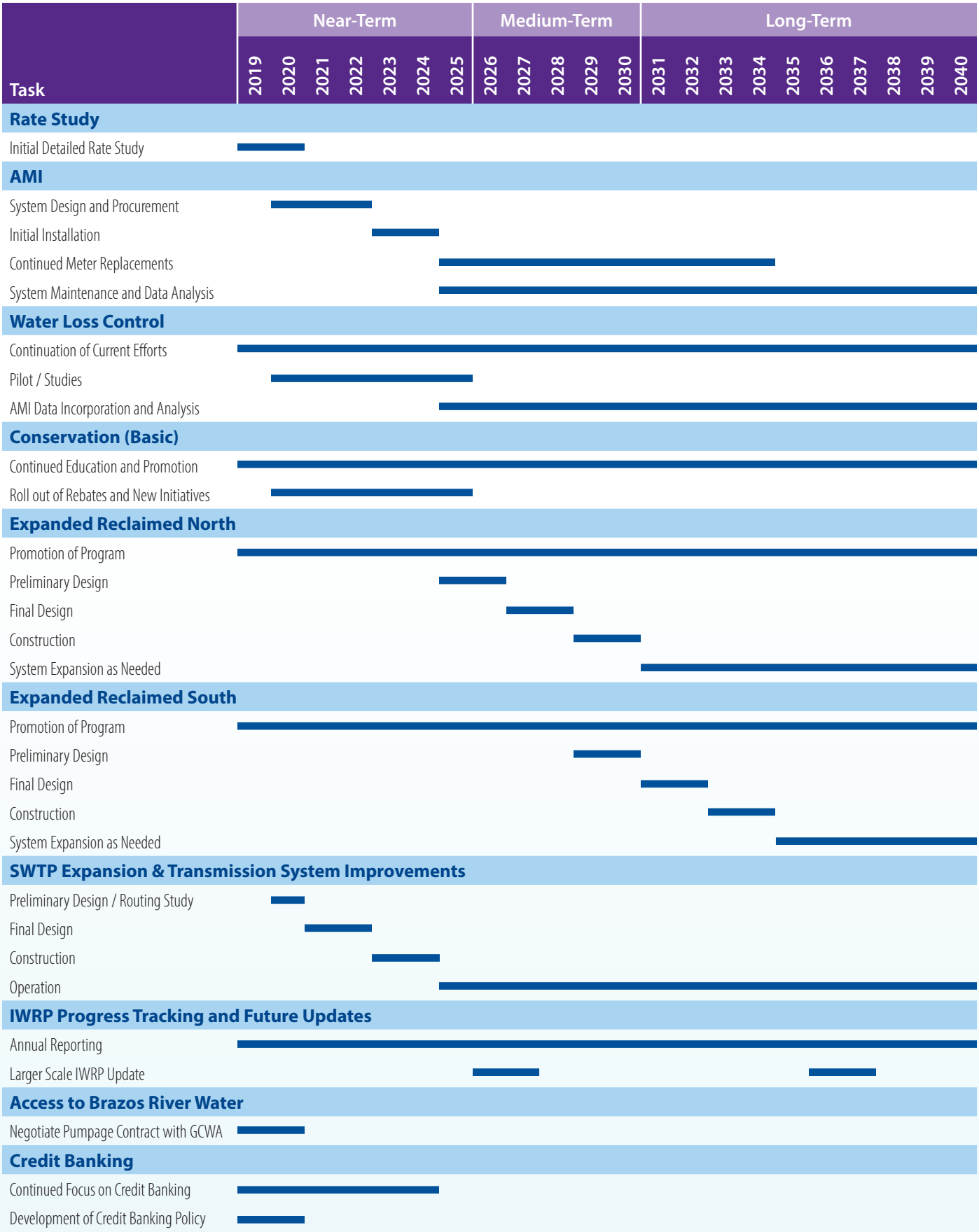



*Figure 11: Proposed Implementation Schedule*

| Planning Horizon | Task | Start Year | Completion Year | Applicable Option |
|---|---|---|---|---|
| Near Term | Conduct a detailed rate study for City utility customers, GRP participants, and potential reclaimed water customers. | 2019 | 2020 | All |
| | Update current Capital Improvement Plan and Water and Wastewater Master Plan to include recommended IWRP strategies. | 2019 | 2020 | All |
| | Continue current water loss control program and address deficiencies identified via the existing program. | 2019 | Continual | Water Loss Control |
| | Continue current conservation education and audit programs. | 2019 | Continual | Conservation |
| | Negotiate pumpage of BRA contract water from Brazos River with GCWA. | 2019 | 2020 | SWTP Expansion/Access Brazos River Water |
| | Evaluate current and potential contracted water supplies (i.e. expiration of GCWA option water and new water available from BRA) | 2019 | 2020 | All |
| | Develop groundwater credit policy including establishing a defined amount to hold for risk mitigation purposes | 2019 | 2020 | Credit Banking |
| | Develop reclaimed water policy for new service, connection fees, usage rates, contract provisions, service areas, etc. | 2019 | 2020 | Expanded Reclaimed North and South |
| | Complete routing study to confirm feasibility of recommended expansion of the surface water transmission system to additional groundwater plants. | 2020 | 2020 | SWTP Expansion |
| | Develop and roll-out new conservation initatives including enhanced education and outreach as well as rebate program for rain barrels, smart irrigation controllers, water efficient household fixtures, and high efficiency washing appliances. | 2020 | 2025 | Conservation |
| | Initiate pilots/studies for additional water loss control measures such as developing a large meter user assessment program and piloting a strategic leak detection program. | 2020 | 2025 | Water Loss Control |
| | Complete preliminary design, final design, and construction of the SWTP expansion and associated transmission system improvements. | 2020 | 2025 | SWTP Expansion |
| | Procure and install AMI system including system design, installation of necessary new meters, and installation of meter interface units. | 2023 | 2025 | AMI |
| | Outreach to potential reclaimed water users for both the North and South systems to garner interest in program and establish project start dates. | 2020 | 2030 | Expanded Reclaimed North and South |
| Medium Term | Continue AMI meter replacement and gather AMI data for informed utility operations and maintenance. | 2026 | Continual | AMI |
| | Incorporate AMI data into the City's water loss control strategy. | 2026 | Continual | AMI/Water Loss Control |
| | Complete preliminary design, final design, and construction of the Reclaimed North System expansion. | 2026 | 2030 | Expanded Reclaimed North |
| | Initiate a formal IWRP update based upon latest regulatory plan update and what conversion has been achieved as of the 2025 deadline. | 2026 | 2027 | IWRP Progress Tracking |
| Long Term | Complete preliminary design, final design, and construction of the Reclaimed South System expansion. | 2031 | 2034 | Expanded Reclaimed South |
| | Complete a formal IWRP update | 2036 | 2037 | IWRP Progress Tracking |

*Figure 12: Prioritization of Recommended Actions from IWRP Process*

## Adaptive Management

While recommendations for the timing of various infrastructure is provided, it is recognized that the implementation strategy should be adaptive and flexible to future changes. Potential uncertainties relevant to the plan should be monitored, such as changes to the assumptions utilized in the analysis, regulatory drivers, changes in water demands, development/growth, and other factors. If any of these are encountered, the IWRP allows for an incremental and flexible approach to overcoming these disrupters, such as having projects be fast tracked or paused. Additionally, credits can be redeemed to meet the regulatory requirements if projects are delayed or the availability of alternative water supply sources is temporarily reduced. If conditions change dramatically, the City also has the other analyzed water supply options at their disposal. A list of some current uncertainties and potential adaptation strategies has been presented in **Figure 13**.

**UNCERTAINTIES**

- Increased or decreased predicted rate of development
- Adding or losing GRP participants
- Reduced or accelerated reclaimed water demand from anticipated users
- Interest in reclaimed water from potential neighboring communities or industries
- Increased or reduced rate of assumed conservation participation
- Adjustments to regulatory requirements
- Occurrence of prolonged drought
- Changes to pricing assumptions

**STRATEGIES**

- Fast track or pause expanded reclaimed water supply projects
- Use banked credits
- Expand the SWTP to full 22-MGD capacity
- Implement conservation ordinances
- Reconsider on-site reuse as opportunities arise
- Reconsider ASR and brackish groundwater desalination based on additional FBSD guidance
- Utilize DSM for analysis of other potential options

*Figure 13: Adaptive Management Techniques*

## Moving Forward

To proactively plan for future FBSD regulations and continue to provide exceptional water resource management, the City initiated the development of the IWRP. Shown on **Figure 14** is the year 2040 modeled water use comparing the current infrastructure and contracts to the recommended set of options as determined through this IWRP process. As seen in the figure, change is needed to meet future regulatory requirements. Otherwise, the City may face significant multi-million dollar disincentive fees for using too much groundwater. However, because of the City's goal to maintain a financially and environmentally responsible community, this situation must be avoided. A robust strategy of diversified options will be used moving forward, enabling the City to honor its commitment to excellence in the delivery of public service.

The City staff, the Citizen and City Council Task Forces, and the consultant team rigorously worked for more than two years to develop a cohesive vision for the Sugar Land community. From start to finish, the IWRP characterized the City's entire water infrastructure, formulated and weighted guiding objectives, conceptualized fifteen water supply options with several sub options, created a DSM with thousands of pieces of programming logic, quantified the City's future water supply needs, developed and evaluated over thirty-five unique portfolios, and laid a solid foundation for the City and its citizens to advance into the future with confidence.

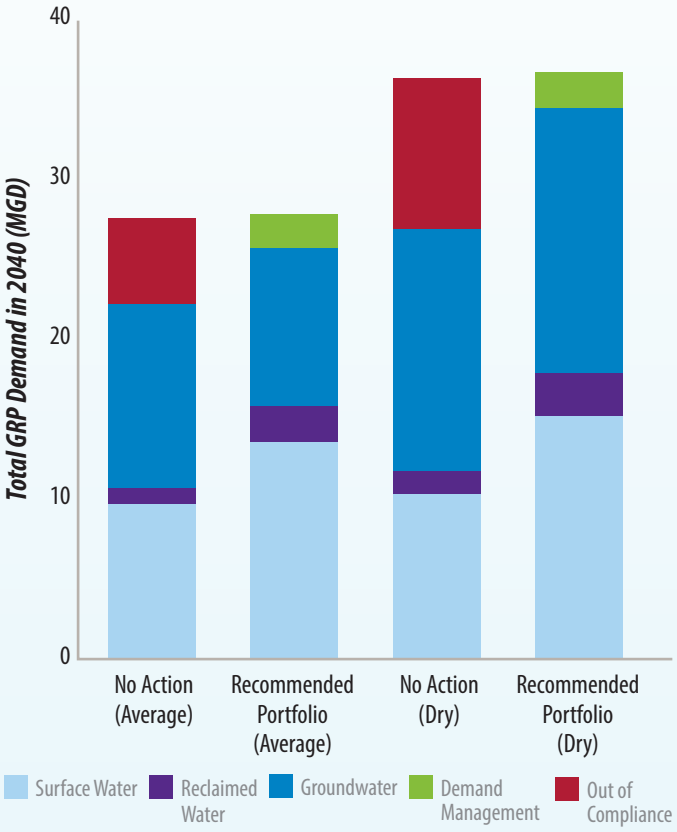



*Figure 14: No Action versus Recommended Strategy*