Utilizing Non-Potable Water Projects To Meet Groundwater Conservation Goals in the City of Sugar Land

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Abstract

Water sources stretched thin by burgeoning populations and the increasing costs of unfunded regulatory mandates have prompted the need for creative new approaches to ensuring adequate and affordable water supply for the customers of many Texas municipalities and other water suppliers. With the growth of groundwater conservation districts and dwindling surface water supplies, effluent reuse and related non-potable water projects have become increasingly feasible alternatives. This case study is an evaluation of the City of Sugar Land's planned use of non-potable water projects and multiple solutions as strategies for reducing the costs of a groundwater withdrawal reduction mandate.

To potentially reduce the costs of the surface water conversion process, the City evaluated the feasibility of supplementing the benchmark treatment plant option with a range of other alternatives, including non-potable water supply projects (for both untreated surface water and reclaimed effluent). The City found that due to a number of large volume private wells, municipal customers using treated water for non-potable uses, the geographic advantage of a surface water supply source in close proximity to many users, and the potential to serve non-potable uses in new development, that non-potable supply projects could produce an appreciable savings. Not only would these projects reduce groundwater withdrawals, and thus reduction volumes, but they would also earn early/over conversion credits from the Subsidence District.

Instead of a more traditional, City-owned model for its conceptual non-potable water system, Sugar Land is pursuing a series of partnership opportunities with other public and private entities. The resulting non-potable component of the City's Groundwater Reduction Plan will include a mix of city-owned infrastructure, public-private partnership non-potable projects, and wholesale non-potable water customers. This project is an evaluation of the potential for public-private partnerships on non-potable water projects and multiple solution approaches as tools for meeting regulatory requirements in a more cost-effective manner than traditional single-source alternatives.

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I) Introduction

As is evidenced by the preponderance of water-related legislation filed by the current Legislature, Texas is in the midst of a change in both the philosophy and practical implementation of managing the State's water resources. Traditional legal frameworks and permitting processes are slowly giving way to a more regional, comprehensive approach driven in no small part by the increasing pressures of relatively unfettered population growth. Concepts like regional groundwater management and the ecological importance of environmental flows in water bodies, once somewhat alien to a framework of prior appropriation and rule of capture, have now become mainstream focal points of discussion. In this evolving environment, traditional, relatively monolithic models of water supply development are similarly changing to reflect a greater range of interests, planning strategies, and alternative supply options. A growing contender is the sometimes-contentious field of non-potable water supply projects, including a vast increase in interest among water suppliers for the potential of effluent reuse. Technologies and projects once unfeasible compared to the low costs of utilizing groundwater resources, now hold the potential to serve as cost-reducing alternatives or supplements, in the face of increasing regulation of groundwater resources, and increasing demand for surface water sources. As supplies tighten and the comparative economics of cost begin to promote these alternative projects, increasing attention is being paid to the potential impact of their widespread use. This effect is especially pronounced in those areas currently meeting or planning to meet restrictions on groundwater withdrawal that was traditionally unrestricted. As these suppliers face regionally based restrictions, traditional planning models begin to give way to an emphasis on equally regional solutions to mandated requirements. In the interest of minimizing the costs of meeting unfunded regulatory mandates, non-potable water projects present an opportunity to work with partners on mutually beneficial solutions to common problems. As follows, the City of Sugar Land is a case study in the potential for non-potable water projects as a cost-effective supplement to traditional water supplies. More importantly, the model for pursuing these projects via public-private partnerships emphasizes the efficacy of fiscally responsible, comprehensive regional solutions. The implementation of these projects, which already stand to save the City several hundred thousand dollars a year in avoided costs, can have an appreciable affect as part of a comprehensive solution.

II) Fort Bend County Growth

Fort Bend County is located directly southwest of Harris County and the City of Houston. The county has seen rapid growth in the past decade, as the pace of development there has significantly outpaced the growth of the Houston region as a whole. Like many similar areas in the Houston metropolitan area, Fort Bend County has seen a relatively rapid transformation from an area primarily agrarian in character to one increasingly characterized by spreading urban and suburban development. The County experienced over a 30% percent growth rate between the 2000 census and 2005 estimates[1], with a large portion of the growth centered on the northern and northeastern regions of the County. County population projections show this growth is not likely to slow soon, with expectations it may reach as high as 950,000 by the year 2030, as development continues in existing urban centers and spreads south

[1] US Census figures, http://quickfacts.census.gov/qfd/states/48/48157.html

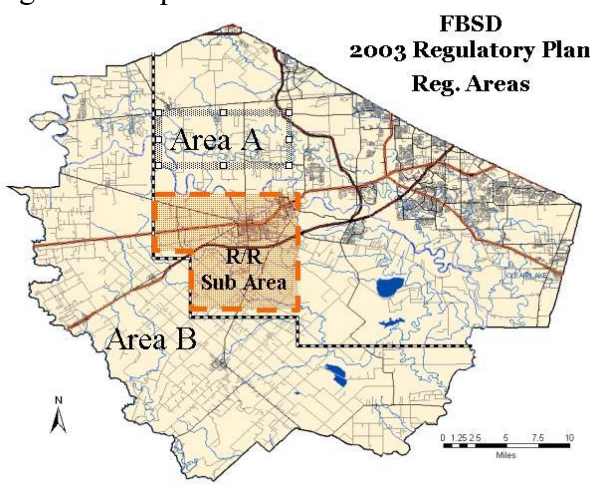
and west into formerly agricultural areas[2]. Current projections from the County project that Fort Bend's population may increase to 460,000 and 675,000 in 2010 and 2020, respectively. In that same general time frame, the City of Sugar Land, located in the northeastern corner of Fort Bend County, abutting the extraterritorial jurisdiction (ETJ) of Houston to its north, saw its population increase from 24,529 in 1990 to its current estimated level of 76,228[3]. By 2030, at the further end of the planning horizon, the projections show City populations reaching 146,700. In addition, the population in the City's ETJ (composed of several communities and undeveloped area considered likely to be annexed in the future) is projected to reach an additional 18,500 in the same time period.[4] Previous projections by several regional entities have under-predicted the growth of the past several years. Barring unaccounted for natural or artificial limitations on growth, the population and water demand could continue to outstrip projections in the near future.

The quick pace and scope of change in this area brings with it a host of challenges for meeting the demands of the burgeoning population. Groundwater has traditionally been the default source in meeting the water demand of the County, and particularly its larger municipalities. While utilizing the groundwater supplies of the Gulf region remains part of a viable strategy for meeting future demands, the cumulative effects of increased groundwater withdrawals in the form of regional ground subsidence has necessitated a more managed approach. Fort bend County has experienced a growing problem with differential ground subsidence linked to increased groundwater withdrawals. In response to the potential impacts of unrestrained subsidence, the Fort Bend County Subsidence District was created.

III) Regulatory Mandate

Based on projected growth and modeling of sustainable groundwater availability, the Fort Bend County Subsidence District began the process of formulating a regulatory solution for curbing subsidence. The regulatory incarnation of this process was the issuing of their Regulatory Plan in 2003. The Regulatory Plan covers three regulatory areas within Fort Bend County. Area A is composed of the northern/eastern, developing portion of the county, while Area B is composed of the primarily agricultural portion of southern Fort Bend County. Within Area A is a sub area centered on the municipalities of Richmond and Rosenberg. Area A, containing the larger urban centers and suburban development, also contains the areas in which subsidence was most prominent.

Figure 1: Map of Fort Bend Subsidence District Regulatory Areas



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[2] http://www.co.fort-bend.tx.us/upload/images/population.pdf
[3] http://www.sugarlandtx.gov/sugarland/press_room/quick_facts/population_history.asp
[4] 2007 population projections, City of Sugar Land

The areas of most dramatic subsidence in the County are found in its northeastern corner, closest to the City of Houston. This also coincides with the historical development of Houston as it has spread to the southwest. Given the discrepancy between the subsidence issues Areas A and B, the focus of the groundwater withdrawal reduction efforts has been the former. The sub area of A was created to recognize the unique challenges of the Richmond/Rosenberg area. Area A's regulatory mandate has three primary components. The first element of the surface water conversion process for entities in Area A is to file a Groundwater Reduction Plan (GRP) by January 1, 2008 indicating how a water provider or group of providers plan to meet their reduction deadlines. The second and third elements are two reduction milestone deadlines. Under the requirements, water suppliers with permitted groundwater wells in Area A must reduce their groundwater withdrawals to 70% by 2013, and 40% in 2025. The sub area of Area A has additional time to meet the first reduction deadline. The Subsidence District permits groundwater wells within its area of jurisdiction. The reduction requirements apply to all groundwater permittees whose wells producing over 10,000,000 gallons a year, whether by single well or an aggregate of wells from a given system. Failure to meet the reduction deadlines results in a disincentive fee, currently set at $3.25 per 1000 gallons, on 60% of the water produced. Well systems producing less than 10,000,000 gallons a year do not have to file a GRP, but may be required to convert at a later date. Given the traditional reliance on groundwater sources as the sole solution for meeting supply demands for many of the municipalities in the regulated areas, the reduction deadlines represent a significant challenge, requiring water suppliers to seek creative options.

IV) The City of Sugar Land's GRP

The greater City of Sugar Land area is comprised of four primary groups of water users. The first is the City's utility system, the second is the Municipal Utility Districts serving the City’s ETJ, the third is the variety of private well owners located throughout the City and its ETJ including three private utility systems, and the fourth is potential wholesale raw water customer located on or near Oyster Creek. Oyster Creek flows through the City, and a variety of communities are located close enough to the water source to utilize it for irrigation and other uses. The potential wholesale non-potable customers, however, are not likely to be GRP participants, given a lack of permitted wells to convert. The City has considered the potential to serve other interests outside its limits and ETJ, but has not yet explored these options, preferring to concentrate first on its citizens and ETJ residents. However, there are several entities that have expressed possible interest, leaving the potential for a future fifth category of participants open.

Sugar Land was fortunate to have the advantage of geography on its side, in terms of proximity to potential surface water sources. Oyster Creek flows through the northern half of the City, and had two inexpensive water providers pushing water through it or collecting flow from it. And, as will be discussed later, there were a large number of water users with non-potable uses in close proximity to these sources. The compact nature of the City's population and the proximity of its water sources also lends itself well to the potential to over-convert dense areas to avoid transmission line costs to more remote users. The City’s GRP planning has put an emphasis on over-converting density as a way to save on transmission costs.

As the City was working through its seminal GRP planning efforts, City Council approved a policy stance indicating that the City would plan on behalf of itself and its ETJ, even if the ETJ communities eventually decided not to participate with the City in its GRP. While the City and its ETJ utility systems account for the lion's share of the water demand, preliminary estimates from City staff showed the potential of 1 to 2 MGD conversion demand from private wells. In line with its stance on planning for the ETJ, the City is planning on behalf of the private wells in both the City and the ETJ. The private wells in the City and ETJ are held by a mix of interests ranging from industrial processes to HOAs. The primary use of the wells is for non-potable water supply, filling amenity lakes and irrigation. The City's projected demand for the total of all potential participants. The sum of the projected average day water demand for the City and its ETJ is approximately 29.4 MGD in 2013, 33.4 MGD in 2025, and 34.5 MGD at ultimate build out. This means the volumes of groundwater needing to be converted, before the addition of the private well volumes, by the aforementioned years are approximately 8.8 MGD, 20 MGD and 20.7 MGD, respectively. The City currently has an option contract for 20 MGD of surface water with the Gulf Coast Water Authority, and a similar contract with the Fort Bend Water Control and Improvement District No. 1 for 15.3 MGD of Oyster Creek water flow impounded between a series of dams within the City limits. This leaves the City with 35.3 MGD of surface water on paper, which represents a potential surplus.

The City serves a dual role in the GRP, as both participant, and administrator. Sugar Land's GRP is based on equal per capita costs paid by all participants. So both a City resident, an ETJ MUD resident, and a private well owner would all pay a fee per 1000 gallons produced. The City established and maintains a separate enterprise fund into which only the revenues of the GRP fees are paid, and only the costs of conversion are disbursed. In this way, the ability to determine the actual costs of conversion, and neatly allocate both cost and benefit, is not entangled with the City's Utility enterprise fund. While the fund is separated from the utility fund and all participants pay an equal amount into it, it is still a City maintained fund, and as such, the City serves as the administrator of the GRP, retaining decision-making ability on projects to pursue and what wells to convert. In this way, the City is both participant, as its residents pay into the fund, and administrator, as its staff implements the GRP. Unlike some nearby GRP groups, the City, via the surface water fund, will build, maintain and own all GRP-funded infrastructure put in place to meet the conversion. While some Water Authorities approach non-potable projects among their participants on a reimbursement or credit basis, the Sugar Land GRP is built on the premise that instead of crediting projects that may not be the most efficient of all potential projects in the GRP area, the City as the GRP administrator will pick which projects to proceed with, and these projects will then be funded from the collective contributions of the Surface Water fund, rather than by individual participants. However, while everyone will be paying the costs of the projects, along with the cost of the shared surface water treatment plant, the benefits will also be shared equally. If a neighborhood HOA whose wells fill its lakes is converted via pump station providing raw surface water, the costs of the pump station are shared by everyone in the GRP, and so too are the benefits.

Sugar Land took part in a series of studies with a variety of potential partners to determine their conversion options. The options given the most serious consideration were a regional plant serving a large number of nearby municipalities, a smaller three-entity plant with two neighboring water providers, a City owned surface water treatment plant and a combination of a smaller City plant and treated surface water purchased from the City of Houston. After consideration of all these options, Sugar Land undertook a study with Lockwood, Andrews and Newnam, Inc. to compare the relative feasibility of each approach. While some of the larger regional plants had a better benefit in terms of economies of scale, the prohibitive cost of transmission, and the allocation of costs between the partners made these solutions far less viable. Given this analysis, the City selected building its own surface water treatment plant as its benchmark option. The proposed Sugar Land Surface Water Treatment Plant offered the City a low cost, quality option, with better control of the process. This policy decision by City Council included the caveat that staff would use this option as a benchmark, continuing to seek out alternatives and supplemental programs as long as they served to bring the cost of the benchmark option down. This policy decision set the tone of future project considerations by establishing the firm benchmark. Essentially, staff would go on to compare all projects costs, in cost per thousand gallons, to the cost of producing a thousand gallons of treated surface water. With this option as the standing route for the GRP development, the City then began to approach the potential

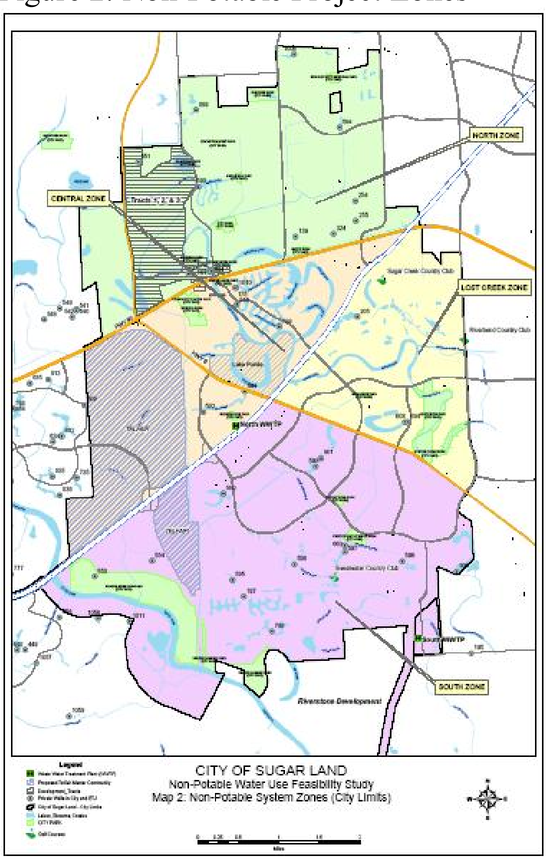
GRP participants with preliminary cost estimates and membership structures.

V) Feasibility of the Non-Potable Option

With a benchmark option and direction from Council, staff pursued the potential to supplement the proposed treatment plant with any option that might reduce the volume of treated surface water needing to be produced. As with any area, the City and its ETJ contained a variety of water uses and users. In order to evaluate the potential for non-potable supply projects, staff concentrated on a given user's need, rather than a potential source. In this way a non-potable user could be served a variety of different sources that met their need, based on whichever option was most feasible, including the option to over-convert a more feasible area instead. The first step taken was to study the feasibility of non-potable water projects in general. The City retained the services of URS Corporation to study a two-part question. The first aspect of the study was to compare our potential non-potable supply with potential non-potable users and project this comparison spatially to create a preliminary system layout. The second aspect of the study was to look at the projected costs of the project in comparison to the City's benchmark option, to determine if non-potable projects were a financially beneficial alternative to some portion of our required treated surface water volumes.

URS projected a potential non-potable demand from private wells, developing areas, and non-potable uses currently being served with treated water 4.3 MGD in 2013, and 4.7 in 2025. The projected supply from our City non-potable sources was 13.6 MGD in 2013, and 15.6 MGD in 2025. The water balance showed a surplus of available supply, even if the total of the demand was served. The next step in this comparison was to look at which of the potential projects could feasibly be served with non-potable water. To account for different sources and supply options throughout the City, URS broke the City into four zones, based on likely groups of projects and major barriers like highways.

Figure 2. Non-Potable Project Zones



The Central, North, and Lost Creek zones were based on using raw surface water from Oyster Creek to serve non-potable needs from central pump stations. The South zone, which is not in as close proximity to Oyster Creek, was to be served with treated effluent from the City's South Wastewater Treatment Plant. The City's North Wastewater Treatment plant was not considered for supplying projects due to its age and the potential it would be decommissioned within the planning horizon. In each of the four areas the potential non-potable users were evaluated, and those found to be most feasible were put in preliminary groupings to be served by central pump stations. The results of the cost comparison between the four areas showed that the Central and North zones were most feasible, with the Southern and Lost Creek zones far less feasible. It should be noted that the costs for the zones were based on serving all the projects found to be feasible in an area, with the proposed central pump station model. As well, the South zone was been broken out to reflect its source. The Fort Bend Subsidence District, in recognition of the promise of treated effluent to meet regulatory demands, has built into its regulatory plan a credit for the use of treated effluent that is given at a ratio of 1.5 credits per gallon of treated effluent used. The 1.5:1 ratio means that even though the cost of treated effluent is less feasible than serving raw surface water or serving treated surface water in its actual cost, the gained credit multiplier, when applied to its costs, makes it relatively more competitive. These comparative costs are shown below[5]:

Figure 2. Cost Benchmarking for Non-Potable Project Zones

Zone	Average Day Demand (MGD)	Unit Cost for Producing Non-Potable Water ($/1000 gallons)		
		Const. and Eng.	O&M, Energy, and Raw Water Purchase	Total (Raw Cost)
North	1.74	$0.49(1)	$0.51(2)	$1.00
Central	0.59	$0.85(1)	$0.51(2)	$1.35
Lost Creek	0.53	$2.02(1)	$0.51(2)	$2.56

(2) At 5% interest and 30-year payback period. Project life is assumed to be 30 years. See Appendix B.
(3) O&M and Energy Cost = $0.40/1000 gallons: Source – City of Dallas Recycled Water Implementation Plan (Mikesa et. al.) Raw Water Purchase Cost =$0.11/1000 gallons: Source: City of Sugar Land

Zone	Average Day Demand (MGD)	Unit Cost for Producing Non-Potable Water ($/1000 gallons)			Credit-Weighted Demand (MGD)	Credit-Weighted Unit Cost ($/1000 gallons)
		Const. and Eng.	O&M, Energy, and Raw Water Purchase	Total (Raw Cost)		
South	1.45	$2.12(1)	$0.40(2)	$2.52	2.18	$1.81

(2) At 5% interest and 30-year payback period. Project life is assumed to be 30 years. See Appendix B.
(3) O&M and Energy Cost = $0.40/1000 gallons: Source – City of Dallas Recycled Water Implementation Plan (Mikesa et. al.) South Zone will utilize reclaimed water from South WWTP and hence will not incur raw water purchase costs

The primary purpose of the study was to determine if non-potable projects were a feasible alternative/supplement to treated water volumes, and in this sense, the answer was very clear. Even with a conceptual system layout that served more users with more relatively expensive line length than the City would probably implement, the costs of non-potable projects proved to be very competitive with treated surface water overall, and more feasible in certain areas. Further adding to the promise of the non-potable alternatives was the conservative nature of the cost estimates. While URS was conducting the study, there was uncertainty over the level of treatment needed for raw surface water when used for non-potable uses that may involve human contact. Unlike treated effluent, there is no specific standard for the application of raw surface water. To err on the side of caution, staff and URS included in the costs for the projects treatment to Type I effluent standards, the requirements for using

[5] The City of Sugar Land Non-Potable Water Use Feasibility Study, URS Corporation, 8/06.

treated effluent in similar situations. In subsequent study and conference, it is apparent that this is a higher quality than would be necessary for most uses identified. The most promising projects, as expected, were those along the Oyster Creek corridor, or in close proximity thereof. Because of the credit multiplier, treated effluent from the South Plant turned out to be more of a potential option that previously thought. As the City's first concern was whether these projects were worth pursuing further, the results of the study served to both answer that question favorably and also provide a general road map for further analysis of the more promising projects.

VI) Wholesale and Other Public/Private Partnership Opportunities

Along with the projects identified in the URS Non-potable feasibility study, City staff was already pursuing a series of wholesale raw water and other non-potable supply projects with several developing areas in its city limits and ETJ. These projects were not included in the final URS analysis, due to their size and preexisting agreements. However, it is these projects that have shown the most promise not only as feasible alternatives to treating equivalent volumes of surface water, but also in implementing a model of public-private partnerships. In general, these projects, as will be described, were either new or preexisting pump stations on Oyster Creek. However, the developments they served did not have existing wells or served uses for which there were no wells to convert. The following are the primary projects completed or being pursued by the City:

A) Telfair

The Telfair property is a developing series of tracts, previously Texas Department of Criminal Justice agricultural areas, directly adjacent to the west of the City. It was annexed prior to development, and as such did not have preexisting water supply wells it intended to use on a permanent basis for its potable or non-potable uses. In discussions with City staff, both parties realized the potential benefit of working out a non-potable water supply arrangement. The Telfair development included a series of large (How large) lakes designed for amenity, drainage and wetlands mitigation, the latter being satisfied by wetlands vegetation plantings on an underwater shelf along the perimeter of the lakes. The Telfair non-potable project was based on the concept of the City building a pump station on Oyster Creek, which has an extension very near the eastern edge of the Telfair property. The pump station would feed raw surface water, obtained under the City's water contract with WCID #1, to the edge of the Telfair property. The Telfair property would then transport the water via pipe to the most convenient part of their lake system. Subsequently, the developers would build a series of small pump stations on the lake system which would feed into a series of non-potable irrigation delivery infrastructure, allowing the entire development's common areas to be irrigated with non-potable water. Telfair would pay to put in the infrastructure from the edge of its property through the irrigation system, and the City would pay for the pump station and line to Telfair's property edge. A contract for water supply was signed between the two parties, and construction of the pump station is underway. Under the contract, Telfair is obligated to use a minimum of 109,000,000 gallons a year up to a maximum of 365,000,000 gallons a year (1 MGD), and to avoid waste. To ensure that the quality of the water is acceptable for non-potable uses involving potential human contact, Telfair is required to test its quality at regular intervals, and take necessary steps if certain quality benchmarks are not met. In return, the City offered free water for five years, after which an ordinance non-potable rate would go into effect. Fort Bend County Levee Improvement District 17 (LID 17), a political district set up as a funding mechanism for the construction and maintenance of levees to ward off flooding from the nearby Brazos River, is the entity representing the property in the contract with the City. LID 17 will see an initial savings from five years of free water, and the ability to utilize the lake system as a transport mechanism. In the long term, Telfair would benefit from the lower costs of untreated raw surface water, as compared to using treated potable water to fill the lakes and irrigate. More importantly, Telfair will be able to keep its lakes full and sustain its wetland plantings along the perimeter. Because of Telfair's size, proximity to Oyster

Creek, and relatively large demand, the City was able to serve a large volume of raw water with minimal investment in infrastructure. In addition, even though the City must pay the WCID #1 for the water it supplies to Telfair in the first five years, the project generates early conversion credits from the Subsidence District toward the City's GRP. When combined with the cost avoidance of not having to treat an equivalent amount of surface water in the future, the pump station pays for itself in only a few years, depending on how quickly Telfair ramps up to their full demand. After that, the project helps lower the costs of the surface water conversion as long as it is in place, by substituting cheap raw water for more expensive treated surface water. In this way, the citizens of Telfair, who as city residents pay into the GRP, benefit from reduced costs, LID 17 saves water costs and gains free supply for a limited time, and the GRP in general gets a large return on the small pump station investment. The Telfair project is the City's best example thus far of successful implementation of a public-private partnership focusing on non-potable water supply. This success is in large part due to creative, non-traditional approaches on behalf of both entities involved, such as Telfair's use of wetland plantings on shelves around its lake perimeter meets regulatory requirements in a unique way that adds value to the community and environment at the same time. The end result is a solution that is not only more financially viable to both parties than traditional approaches, but brings with it a host of less economically tangible benefits.

B) Lake Pointe

Like Telfair, Lake Pointe is a developing area within the City limits. However, unlike Telfair, Lake Pointe is located directly on Oyster Creek, and had already put in a pump station to serve their irrigation needs with raw surface water. Although the City did not partner with the Lake Pointe developers on the infrastructure, it did seek out the opportunity to serve the community with a wholesale raw surface water agreement. In the same type of deal signed with Telfair, the City offered Lake Pointe free water for a number of years. In return, the City was to receive all the credits it generated from early/over-conversion, as well as the benefit of reducing the amount of potable surface water it would otherwise need to treat by offsetting an equivalent volume with the untreated water supplied to Lake Pointe. The Lake Pointe volume is less than the Telfair volume, but requires no infrastructure investment on behalf of the City/GRP, and benefits both parties, as well as the other participants in the GRP.

C) FCCA

The First Colony Community Association serves the neighborhoods of the southern portion of Sugar Land. Like the Lake Pointe property, FCCA also owns and maintains a pump station on Oyster Creek. The City is currently pursuing a similar contract with FCCA as was developed in the Telfair and Lake Pointe deals, under which the City acts as wholesale water supplier.

D) North Plant Reuse

While somewhat different than the aforementioned projects, City staff are conducting a study with URS to determine the feasibility of using effluent from the City's North Wastewater Treatment Plant to supplement an FCCA owned lake directly to its north. While the original non-potable study did not include the North WWTP because of its age and the uncertainty that it would remain as a viable source through the planning horizon, staff did want to investigate the short term potential of generating early/over-conversion credits by using its treated effluent. The FCCA currently supplies the lake from groundwater wells, and then pumps water from the lake into an irrigation system for nearby areas. If the project study shows it to be financially feasible, the GRP may pursue the opportunity to pay for the necessary treatment and supply infrastructure to supply treated effluent to the lake system and its irrigation systems, eliminating the need for its water wells. The GRP implementation may also consider expanding this project to serve common areas of nearby highways currently irrigated with potable water, further reducing costs.

While they differ in size and scope, the aforementioned projects all have some distinct advantages in common:
1) They help all the parties (the GRP, the private user, and the area residents) involved reduce costs.
2) They rely on large compact volumes and small transmission line sizes to get a maximum benefit for the investment in infrastructure.
3) They rely on financial incentive to produce a mutually beneficial result, with the GRP providing water at or below its own inexpensive rate. This represents little extra cost to the City, but is of great value to the user, given their alternatives.
4) Conversely, the GRP and area residents receive the benefit of reduced groundwater volumes and earned early/over-conversion credits, letting each party give the other something of value while not incurring a cost of equal value.

As these projects were the "low hanging fruit", given their large volumes and relatively small investment costs, the City compared them to our benchmark option, and proceeded based on their respective benefit. The comparison was based on whether, and to what degree, these projects cost less than our anticipated cost of producing and serving an equivalent volume of treated potable surface water. The City is continuing to follow this same line of analysis in evaluating other potential public/private partnership opportunities. However, the model for incentivizing these projects is noteworthy. In respect to the City projects identified above, the benefit already projected for just Telfair and FCCA represents a cost avoidance of several hundred thousand dollars based on a reduction in treatment, transmission, and operations costs compared to an equivalent volume of treated surface water. At the same time, these and similar projects generate additional value through the early/over-conversion the credits generated with the Subsidence District.

VII) The Benchmarking Approach

As demonstrated above, the advantageous geography and opportunistic pursuit of the most financially feasible projects stand to produce a significant benefit to Sugar land's GRP. The success of the approach so far relies heavily on the model by which City staff evaluated and prioritized the projects. While some smaller entities may be able to meet their reduction requirements solely through reuse projects, most larger water suppliers under similar regulatory mandates will add non-potable projects as a supplement to more traditional options. In these scenarios, benchmarking a fully loaded potable surface water cost against potential non-potable supplements provides an easy method by which a supplier can determine if and when projects are feasible for their program. Not unlike the standard comparisons made in any utility project, the benchmarking serves both to determine the overall feasibility of the project (i.e., is it cheaper than the benchmark option?) as well as its relative feasibility to other potential projects. When the City compared some of the public-private partnership projects to others identified in the URS study, it was easy to informally rank them based solely on the expected benefit of the project. Also considered in comparing potential projects were issues of total capital cost in terms of cash flow, and payback period of the project investment. To properly compare the full cost and benefits of the project, the value of credits and the impact of the reuse credit multiplier were considered in conjunction with the expected cost avoidance versus the benchmark option. As shown by the Telfair example, the projects that received the highest priority had a combination of large benefit to cost ratio, low absolute capital investment, and a simple implementation. The largest asset to the benchmarking process is the top down ability of Sugar Land's GRP administrator to make the sole decision of what project to pursue. This approach has been the core of the City's GRP planning.

VIII) The Non-Potable Planning Model

As detailed, the City is currently pursuing a variety of solutions to its groundwater reduction requirements. While the majority of the surface water produced will be potable water for potable uses, the addition of non-potable projects, and especially partnerships with other public and private entities, promises to make an appreciable reduction in the costs of the overall conversion process. Time will tell what the final balance of sources and costs will be, but non-potable projects will reduce the cost of the GRP appreciably compared to the benchmark option. The planning model for selecting and funding projects the City has been effective so far in prioritizing and evaluating the feasibility of the multitude of potential projects and uses. While these elements apply to the GRP planning process as a whole, they came into best use when the City applied them to potential non-potable projects. The primary components of the planning model are:

Opportunistic Planning - The approach that benefited the City most in the non-potable aspect of the GRP was being decidedly opportunistic. This element revolves around constant review of future opportunities, and active involvement in pursuing partnerships even if they fall outside conventional planning timelines and strategies. It also involves looking beyond the benchmark solution to continually test for a better supplement or strategy. Sugar Land's pursuit of the Telfair and Lake Pointe projects occurred before a full policy approach to non-potable projects had been finalized. However, given the time-sensitive nature of the projects, and the excellent return they represented, the City went ahead with the projects. This approach is best applied to developing areas, where non-potable projects can reduce initial costs rather than serving as a retrofit. The benefit of being opportunistic is that it shifts the water supplier from solely a demand-responsive role to one in which future demand can be shaped to best advantage.

Benchmarking - As discussed, benchmarking serves to provide a tool for both comparative and absolute costs of proposed alternatives. This approach fits best when a water supplier is not facing absolute shortages, and wants to compare options. Finding a good benchmark option, and then continually testing supplements helps ensure the final solution emphasizes fiscal efficiency and has considered a group of options.

Top Down Planning - The core element of the City's GRP was to create a quality solution in the most financially feasible way possible. Sugar Land has found so far that sharing the costs and benefits equally among all participants, at the same time that the City as the GRP administrator retains the sole authority to decide what projects are funded, allows for a more efficient use of the pooled resources, and a more equitable benefit to the participants. Not every private well, for example, is feasible to convert to alternative sources. If the GRP reimbursed those wells that happened to have the advantage of geography, and not others, there would be an equity issue among the participants. By pooling the costs, and then selecting the most cost efficient projects without bias, the concern for equity is negated because being converted or not converted carry no advantage or disadvantage. Everyone pays the same into the GRP, essentially "buying compliance", and everyone benefits when that compliance is obtained in the cheapest manner possible.

Value Generating Incentives - One of the more rewarding elements of the City's GRP has been its opportunities to enter into contractual supply agreements that function as public-private water partnerships. The Telfair and Lake Pointe projects are representative examples of this concept. By offering incentives that are a low cost to the offering party, but of higher value to the receiving party, and receiving the same in turn, both parties save costs by working together. The use of free water as an incentive to generate credits benefits both parties. In the Telfair project, the City and the property make an initial investment in infrastructure. However, that infrastructure allows for greater savings by transferring an asset from one party to the other that creates value because of the transaction through the generation of credits and avoidance of increased groundwater demand. The underlying template for the relationship applies well to developing areas, but also could work well in any scenario in which a project represents an ability to generate a value beyond direct cost reductions, as is the case with generated credits.

Use-Based Planning - one of the elements of flexibility in the City's GRP was planning based around water users needs, rather than their traditional source. Focusing on need allowed staff to identify potential projects in which need and source did not align. Some of the projects identified in the URS study included irrigation of common areas with potable water that could be converted to non-potable water. The need for the use was non-potable, so the analysis of the misalignment of the need and the source points to a potential project. This approach also helps with issues of equity. Instead of focusing on rates and costs based on source, the GRP focuses on the use. A non-potable use is treated the same whether it's served with treated effluent, raw surface water, or other source. In this way the most feasible option for any user becomes the determining factor, rather than the source. This relates closely to the ability to plan from the top down, and select projects by comparative feasibility rather than a specific source for a specific use.

Over-Converting Density - In both the GRP in general, and in non-potable partnership projects in particular, the focus of Sugar Land's planning model has been on over-converting dense areas. The savings on transmission costs provide a great benefit and dense projects offer a localized economy of scale. While this is a fairly standard approach, the City has benefited from tying it directly to its prioritization process. The Telfair project represented a dense, low transmission, high volume opportunity, and thus it was a high priority project. The City is following this approach with their planning for treated surface water as well. The key to the efficacy of this approach is also tied to equity. Because the GRP participants pay equally into the costs of conversion, who is or is not converted holds no benefit/disadvantage. The costs and benefits are shared, allowing the City again to focus solely on the most fiscally efficient way to convert the population. In this case, it is more efficient to convert one large urban center on behalf of outlying areas, or one large non-potable project on behalf of smaller, more remote projects. In the case of non-potable projects, over-conversion adds to the feasibility of the investment by maximizing return per capital. This approach works well for Sugar Land, because it is a combination of dense urban center and more remote users. However, in Fort Bend County, as with many other areas facing groundwater reduction requirements, this is a common pattern of development, and thus is applicable in many situations.

Flexibility - While many of the other elements involve some aspect of flexibility, it is a philosophical decision as well. Sugar land has some distinct geographical and supply options advantages, but there is still a fundamental policy decision that must be made regarding the approach to this planning process. By emphasizing flexibility, the City is able to benchmark different options against each other instead of throwing all its support behind one or the other, pursue multiple solutions, and pursue opportunities outside of a traditional framework. Flexibility as an approach has a great deal to do with comfort in changing course if necessary.

Multiple Solutions - By evaluating and implementing more than one solution to the regulatory mandate, a water supplier is able to balance the options against each other in terms of quality and cost, and maintain a greater degree in flexibility. More than one source also provides a relative degree of security as compared to a single option, in the event of a significant incident in the system. This approach also helps meet multiple objectives, by assuring a balance of costs with adequate supply and other considerations. For instance, a highly beneficial non-potable project can help offset the costs of a less feasible project that offers a greater supply value. This approach is most relevant to those suppliers who have multiple objectives, and multiple options, or who want to balance security with costs, like one might diversify stocks in a portfolio.

IX) Conclusions

While this is essentially a case study of one municipality's progress in using non-potable projects to meet regulatory requirements, lessons, if not a planning model, for entities in similar situations may be drawn from the results of the City's approach. As detailed in the discussion of the planning model Sugar Land employed, the most significant benefits for the City stem from the reliance on opportunistically identifying and creating projects, focusing on fiscal efficiency through a benchmarking process, and maintaining flexibility of decision making by eliminating inequity between participants. The latter is represented most clearly by the non-potable partnership opportunities the City pursued. By focusing first and foremost on what lowers the costs for everyone, while offering incentives that don't rely solely on regulatory mandate, the City is able to serve a user's need in an attractive way while simultaneously gaining a reciprocal benefit. The real test of the City's approach will be in hindsight after the implementation of its GRP. However, even in the planning process, the inclusion of non-potable projects has allowed Sugar Land to retain a flexibility in its groundwater reduction solutions, reduces its costs, provides economic incentive for further development of more efficient alternative water projects, and meet its regulatory requirements. It is apparent that in an atmosphere of diminishing resources and increasing regulation, water suppliers will have to be more creative and make wiser use of their assets and relationships with other entities to meet growing demand. The City's approach mirrors the regulatory and resource supply conditions it is under. However, with a flexible approach a supplier can use this changing paradigm of water resource management to create value from efficiency and wise use that is lost in more traditional models. The implementation of public-private partnerships is a valuable tool in generating value and flexibility to offset regulatory costs.