The Future of Desalination in Texas

BIENNIAL REPORT ON SEAWATER DESALINATION

Texas Water Development Board

P.O. Box 13231, Capitol Station
Austin, Texas 78711-3231

December 2006

TEXAS WATER DEVELOPMENT BOARD

THE FUTURE OF DESALINATION IN TEXAS
2006 BIENNIAL REPORT ON SEAWATER DESALINATION

December 2006

This page intentionally blank

The Future of Desalination in Texas

Section 16.060 of the Texas Water Code, directs the Texas Water Development Board to "undertake or participate in research, feasibility and facility planning studies, investigations, and surveys as it considers necessary to further the development of cost-effective water supplies from seawater desalination in the state. The Texas Water Development Board shall prepare a biennial progress report on the implementation of seawater desalination activities in the state and shall submit it to the Governor, Lieutenant Governor, and Speaker of the House of Representatives not later than December 1 of each even-numbered year."

Published and distributed
by the
Texas Water Development Board
P.O. Box 13231, Capitol Station
Austin, Texas 78711-3231

December 2006
Special Report
(Printed on recycled paper)

This page intentionally blank

Letter of Transmittal

December 1, 2006

To: The Honorable Rick Perry, Governor of Texas
The Honorable David Dewhurst, Lieutenant Governor of Texas
The Honorable Tom Craddick, Speaker of the Texas House of Representatives

The Texas Water Development Board respectfully submits the second Biennial Report on Seawater Desalination. The report examines progress toward the goal of creating seawater desalination supplies in Texas and discusses the vital role the state must play to achieve this water supply breakthrough.

Texas Water Code §16.060 directs the Texas Water Development Board to take all necessary actions to further the development of cost-effective water supplies from seawater desalination in the state. As detailed in the executive summary, since April 2002, when Governor Rick Perry first announced his vision to develop drought-proof water supplies from seawater desalination, the Texas Water Development Board has engaged in a systematic process to identify, select and study the best sites for developing a large-scale demonstration seawater desalination project. Currently, the greatest opportunity to move forward substantially on this charge is provided by the Brownsville Public Utilities Board proposal to build a large-scale demonstration seawater desalination plant by the year 2010.

However, as is the case with the world's leading seawater desalination programs, financial incentives are necessary to accelerate development of this new supply in Texas. The Brownsville Public Utilities Board will require financial assistance in the form of grants and low or zero-interest loans to initiate designing, permitting, and constructing of the proposed project.

Developing new, abundant and drought-proof water supplies from seawater desalination is a matter of vital importance to the future economic security of Texas. Therefore, in its deliberations regarding the public benefits of investing in grants and low-interest loans to help the Brownsville Public Utilities Board build a large-scale seawater desalination demonstration plant, the Texas Legislature should consider the tremendous contribution that this rapidly improving water supply technology will mean in providing uninterruptible water supply for the future population of Texas.

E.G. Rod Pittman
Chairman

J. Kevin Ward
Executive Administrator

This page intentionally blank

Table of Contents

This page intentionally blank

Executive Summary

The Brownsville Public Utilities Board, in collaboration with the Texas Water Development Board (TWDB), has made sufficient progress in its pilot plant, design, and financial feasibility studies to commit to building a large-scale seawater desalination demonstration plant by 2010. This commitment is contingent upon securing a financial contribution from the State of Texas—an issue that must be addressed by the Texas Legislature.

What is not at issue, however, is that the reality of a large-scale seawater desalination plant operating on the Texas Gulf Coast is within the state's grasp. Operated and maintained by the Brownsville Public Utilities Board, the plant would supply significant quantities of high-quality water to one of the state's fastest growing metropolitan areas that needs the water. This report examines progress toward the goal of seawater desalination and discusses the vital role the state must play to achieve what would be an unprecedented and historic water supply breakthrough for Texas.

"To me, it is not a matter of whether saltwater will one day be used as an abundant source for public use, but when and where," said Governor Perry in 2004, two years after first proposing the construction of a large-scale demonstration desalination plant along the Texas Gulf Coast. "Large desalination projects require large investments that are forward-looking. Why wait until the need is greatest? Leadership is about getting ahead of problems, and that's what we must do when it comes to water."

In 2003, the 78th Texas Legislature directed TWDB to undertake necessary steps to further the development of cost-effective water supplies from seawater desalination in the state. In response to this directive, TWDB funded $1.5 million for three feasibility studies to assess the technical viability of proposed seawater desalination projects for the Lower Rio Grande Valley—Brownsville, City of Corpus Christi, and Freeport areas.

In 2004 TWDB submitted its initial biennial report on seawater desalination to the Texas Legislature. In this report, TWDB recommended continuing the seawater desalination demonstration initiative and identified seawater desalination pilot plant studies as the next step in the development of the proposed Brownsville, Corpus Christi, and Freeport area projects. The 79th Texas Legislature appropriated funds necessary for TWDB to pursue the pilot plant study initiative.

After carefully reviewing proposals submitted on behalf of the Brownsville, Corpus Christi, and Freeport projects, TWDB selected Brownsville for the pilot plant study. This selection was the next logical and effective step toward implementing the large-scale seawater desalination demonstration project the Governor has envisioned and the legislature has supported by enacting House Bill 1370 in 2003 and appropriating general revenue funds in 2005. On April 17, 2006 TWDB awarded $1.3 million to the Brownsville Public Utilities Board to conduct a 12-month seawater desalination pilot plant study.

The Brownsville pilot plant study was selected, in large part, because of the readiness of the Brownsville Public Utilities Board to transition from a pilot plant study to formal design and permitting during the 2008-2009 funding biennium. Brownsville Public Utilities Board would also be ready to construct a full-scale seawater desalination demonstration plant (25 million gallons per day) by 2010. Any significant time lapse between piloting and implementing the full-scale project creates the risk that the piloted technology becomes dated and less valuable as a project to demonstrate the latest technologies.

The Corpus Christi and Freeport proposals also showed potential, but it was deemed premature to invest in pilot plant studies at these sites during the current biennium because they appeared less likely to be implemented in the near future. These sites should, however, remain under consideration as possible candidates for future funding, particularly if the full-scale seawater desalination projects they support are designed to be integrated into broader inter-regional initiatives.

Governor Perry has consistently expressed his desire to have a large-scale seawater desalination demonstration plant built in Texas and to fund the plant's construction with private activity bonds. Private activity bonds have the potential to make a substantial contribution toward constructing a large-scale seawater desalination plant in Texas but only in those instances in which a private entity is providing substantial financial backing for the project. The Brownsville Public Utilities Board is a public entity and as such can issue bonds with associated tax exemptions that are equivalent to those afforded private entities via private activity bonds for financing projects that benefit the public. The Brownsville seawater desalination project is currently conceived as a publicly financed project.

In order to initiate designing, permitting, and constructing the full-scale seawater desalination demonstration project the Brownsville Public Utilities Board will require financial assistance in the form of grants and zero-interest loans. On the basis of current information, the estimated capital cost of the project is $150 million plus annual operation and maintenance costs of $6.6 to $12.5 million. The Brownsville Public Utilities Board would need to cover the operation and maintenance costs and up to $38 million of the capital costs. To fill the funding gap, the Brownsville Public Utilities Board is requesting financial assistance in the form of a $70 million grant and a $45 million low-interest loan.

The initial *Biennial Report on Seawater Desalination* (2004) presented a compelling list of factors supporting the development of large-scale seawater desalination capacity in Texas. These factors persuasively speak to the impressive potential benefits that seawater desalination offers the citizens of Texas. Other factors that support seawater desalination, in addition to those noted in the initial biennial report, have emerged as a result of the Brownsville project. These include:

- the potential to help meet environmental flow needs, and in particular, the environmental flow needs of the Rio Grande;

- the realization that seawater, by virtue of its unlimited supply, is relatively free of the increasingly contentious ownership and allocation issues associated with groundwater and surface water in Texas; and

- the potential for integrating seawater-derived drinking water supplies into a regional water supply distribution and/or allocation system that extends inland and beyond the Texas Coast.

This last consideration—integrating seawater-derived drinking water supplies into a broader regional water supply system—is gaining increasing attention as major inland metropolitan areas struggle to find reliable sources of water to meet their future water supply needs. Officials from the cities of Laredo and Brownsville have discussed a potential partnership to develop a full-scale seawater desalination plant. These discussions are expected to continue during the course of the Brownsville seawater desalination pilot plant study. The 2006 Regional Water Plan for South Central Texas (Region L) recommends the construction of a major, large-scale seawater desalination facility in the San Antonio Bay area and a water transmission pipeline between San Antonio Bay and Bexar County to provide more than 84,000 acre-feet per year of drinking water supplies to the San Antonio metropolitan area by 2060.

Seawater desalination can no longer be considered a water supply option available only to communities along the Texas Gulf Coast. It must also be considered as an increasingly viable water supply option for major metropolitan areas throughout Texas. Billions of dollars will be required to meet the future water supply needs of Texas identified in the 2007 State Water Plan. In light of that, a state investment in the form of a $70 million grant and a $45 million low-interest loan for the Brownville desalination project can be viewed as a reasonable investment in a technology that holds the promise of providing unlimited supplies of drinking water even during periods of extreme drought. State investment in the Brownsville seawater desalination demonstration project may appear to represent one small step in meeting the future water supply needs of the Lower Rio Grande Valley, when in reality it represents one giant leap in meeting the future water supply needs of the entire State of Texas.

This report represents the fulfillment of TWDB's obligation under Section 16.060 of the Texas Water Code to submit a biennial progress report on the implementation of seawater desalination activities in the state to the Governor, Lieutenant Governor and Speaker of the House of Representatives by December 1st of each even-numbered year. The first biennial report was submitted on December 1, 2004. In addition, this report represents the accountability and good stewardship of state resources that Governor Perry and the Texas Legislature can expect from TWDB as the agency pursues its statutory obligation to further the development of cost-effective water supplies from desalination of seawater. TWDB respectfully submits the following key findings and recommendations:

This page intentionally blank

Key Findings and Recommendations

Construction of a large-scale seawater desalination demonstration project

- **Key Finding**

With state assistance, a large-scale seawater desalination demonstration plant operating on the Texas Gulf Coast and supplying significant quantities of high quality water to one of the state's fastest growing metropolitan areas can be built by 2010.

The Brownsville Public Utilities Board, in collaboration with the Texas Water Development Board (TWDB), has made sufficient progress in its pilot plant, design, and financial feasibility studies to commit to building a large-scale seawater desalination demonstration plant by 2010. The construction of the Brownsville seawater desalination plant will require a financial contribution by the state in the form of a $70 million grant and a low-interest loan of $45 million. Implementing the Brownsville seawater desalination demonstration project would represent the progress toward developing cost-effective supplies from seawater desalination that Governor Perry has envisioned and that the Texas Legislature has devoted state resources to achieve.

- **Recommendation**

In its deliberations regarding the public benefits of investing $115 million in grants and low-interest loans to help the Brownsville Public Utilities Board build a large-scale seawater desalination demonstration plant, the Texas Legislature should consider the tremendous contribution that this historic and unprecedented water supply breakthrough could represent in meeting the state's future water supply, economic development, and environmental needs.

Continued advancement of seawater desalination in Texas

- **Key Finding**

The state's leadership, technical and financial assistance has been and will continue to be vital to the development of seawater desalination in Texas.

The Texas Legislature, per Texas Water Code §16.060, directed the TWDB to "*undertake or participate in research, feasibility and facility planning studies, investigations, and surveys as it considers necessary to further the development of cost-effective water supplies from seawater desalination in the state.*" The state's technical and financial assistance provided the means to complete three important large-scale seawater desalination feasibility studies for the Brownsville, Corpus

Christi, and Freeport area projects and to proceed with pilot plant studies for the Brownsville project. Pilot plant studies for the proposed Corpus Christi and Freeport large-scale seawater desalination plants are the next necessary step for the eventual production of drinking water supplies from these projects. In addition, smaller seawater desalination projects, such as the proposed one-million-gallon-per-day seawater desalination facility on South Padre Island, have and should continue to benefit from the technical and financial assistance provided by the state. The Brownsville, Corpus Christi, Freeport, and South Padre Island projects are among the seawater desalination projects recommended in the 2007 State Water Plan to meet the state's future water supply needs.

Recommendation

The Texas Legislature should consider providing the TWDB with an appropriation of $2.5 million for seawater desalination grants to conduct studies necessary to advance development of seawater desalination projects in Texas.

.

Introduction

Since April 2002, when Governor Rick Perry first expressed his vision for developing seawater desalination supplies in Texas, TWDB has engaged in a collaborative, purposeful approach to identify sites with the greatest potential for seawater desalination, worked with potential project developers in formulating and evaluating the feasibility of such projects and, during the current biennium, initiated a pilot plant study in Brownsville as the next effective step towards realizing the vision for this program.

These efforts, and the manner in which they have been implemented, won international recognition for Texas from the subscribers of the *Global Water Intelligence*, a world-recognized desalination industry publication; TWDB was one of five agencies in the world nominated in 2005 for "Best Water Agency of the Year." The nomination noted the following:

> *"The strategic water agency for Texas responded to the governor's initiative to develop seawater and brackish desalination in Texas and then put its plans into action. The confidence and competence with which the TWDB has executed its desalination plans are a credit to the state. TWDB's even-handed approach to the private sector should set an example to other US water agencies planning to tap non-traditional water sources."*[1]

The cumulative effort of TWDB and its partners in the Seawater Desalination Initiative has brought the state to a point where initiating design and construction of a large-scale demonstration seawater desalination facility at Brownsville can be considered in the near-term. These efforts have also sharpened the understanding of the potential challenges to developing seawater desalination supplies on a broader regional basis at sites such as Corpus Christi and Freeport.

This report describes the actions, analyses, and findings of TWDB with respect to developing large-scale demonstration seawater desalination projects in Texas. It examines challenges to implementing these projects and the role of the state in overcoming those challenges, and identifies next steps, including funding requirements. The report is structured into four sections to address the four items specifically described in the Texas Water Code, Section 16.060(b)[2] which directs TWDB to prepare this biennial progress report and to address the following:

> "(1) Results of the board's studies and activities relative to seawater desalination during the preceding biennium;

[1] ***Water Desalination Report, January 2006.***
[2] ***As amended per adoption of House Bill No. 1370, 78th Texas Legislature.***

(2) Identification and evaluation of research, regulatory, technical, and financial impediments to the implementation of seawater desalination projects;

(3) Evaluation of the role the state should play in furthering the development of large-scale seawater desalination projects in the state; and

(4) The anticipated appropriation from general revenues necessary to continue investigating water desalination activities in the state during the next biennium."

SECTION 1-TEXAS WATER CODE 16.060(b)(1) Results of Studies and Activities

This page intentionally blank

Texas Water Code §16.060(b)(1) requires TWDB to report the results of its studies and activities relative to seawater desalination during the preceding biennium.

In 2003, the 78th Texas Legislature, amended Texas Water Code, Section 16.060, directing TWDB to undertake necessary steps to further the development of cost-effective water supplies from seawater desalination in the state. Two years later, the 79th Texas Legislature appropriated $3.3 million to TWDB for desalination activities; $3.1 million of this amount was for developing seawater pilot plant studies and for brackish groundwater desalination demonstration projects, and $200,000 for staff costs to oversee the projects, monitor the development of desalination technology, and provide educational outreach and technology transfer.[3]

Key activities performed during the 2006-2007 biennium included

- advancing the Large-Scale Demonstration Seawater Desalination Initiative, including initiating a pilot plant study for one of the three proposed Large-Scale Demonstration Desalination Projects;

- providing regional facility planning assistance for a proposed seawater desalination facility on South Padre Island;

- providing technical and educational outreach through Internet-based services and staff presentations at water-related seminars; and

- coordinating efforts with state and federal agencies.

Advancing the Large-Scale Demonstration Seawater Desalination Initiative

In the 2004 Biennial Report on Desalination,[4] TWDB recommended that the state continue advancing toward the construction of large-scale demonstration seawater desalination facilities in Texas. The 79th Texas Legislature considered this recommendation and appropriated funds to TWDB for implementing seawater desalination pilot plant studies.

On July 18, 2005, TWDB deliberated on the approach to implement the referenced appropriation and adopted a Desalination Work Plan for 2006-2007 biennium. The work plan focused on advancing the Large-Scale Demonstration Seawater Desalination Initiative by implementing pilot plant studies for the proposed demonstration projects.

---

[3] Seventy-ninth Legislature, Text of Conference Committee Report Senate Bill No. 1, Regular Session (General Appropriations Act), State of Texas, 2005; page VI-56

[4] Texas Water Development Board "The Future of Desalination in Texas, Biennial Report on Seawater Desalination, Volume 1", December 2004.

A pilot plant is a small-scale version of a proposed water treatment facility designed to evaluate the performance of proposed treatment systems under site-specific conditions. For seawater desalination applications it is generally recommended that the pilot testing cover a 12-month period to record seasonal changes in the source water characteristics, such as chemical composition, temperature, turbidity, and to examine the effectiveness and efficiency of alternative water pretreatment and reverse-osmosis membrane combinations.

Formulating, designing, and executing a pilot plant for a seawater desalination project is a unique and highly specialized activity. Because of the complexity and relative novelty of this type of project, TWDB procured an experienced seawater pilot plant engineering consultant to advise it throughout the pilot plant studies phase. The agency began the qualifications-based procurement process on August 16, 2005. In December 2005, that process resulted in contracting with Reiss Environmental Inc (REI), a firm with proven, hands-on experience in seawater desalination piloting, to assist TWDB in managing the pilot plant studies.

With REI's assistance, TWDB worked with the proponents of the three large-scale demonstration seawater desalination projects to develop a common template for submitting applications for financial assistance for seawater pilot plant studies. The application form was designed to document the applicants' efforts and intent in developing the full-scale projects. Therefore, when applications for financial assistance for pilot plant studies were submitted in March 2006, TWDB had an agreed-upon and objective framework for reviewing and allocating funds for the studies in terms of their effectiveness to move the proposed large-scale demonstration seawater desalination projects forward.

Funding Effective Pilot Plant Studies

Pilot plant studies are a critical step in the planning process for large-scale desalination projects. In general, pilot plant studies involve collecting data on source water quality and simulating and assessing key operational parameters. Data resulting from these simulations can be used to select an optimum desalination treatment process and the equipment for a full-scale facility. Additionally, pilot studies provide valuable information on potential environmental impacts, permitting, costs, and project implementation issues and are an excellent opportunity to inform the public about the proposed project.[5]

To elicit the most from the state's investment in pilot plant studies and to move the Seawater Desalination Initiative forward, TWDB focused its efforts on identifying and funding pilot plant studies that appeared most likely to lead to designing and constructing a full-scale project in the relatively near future.

---

[5] Reiss, C. Robert "The importance of pilot studies in the development of large-scale seawater desalination plants." In Report No. #363, The future on Desalination in Texas, Volume II, edited by (Texas Water Development Board, 2004), 127-136.

Also at issue in this matter is the lag time between completing a pilot plant study and designing the full-scale facility. An efficient project development process pilots the most current desalination technology that could then be used in the full-scale facility. Any significant time lapse between piloting and implementing the full-scale project creates the risk that the piloted technology becomes dated and less valuable as a project to demonstrate the latest technologies. Therefore, in considering applications for financial assistance, TWDB favored proposals that were more likely to lead to designing and constructing a full-scale (25 million gallons per day) treatment facility during the 2008-2009 funding biennium.

On March 10, 2006, the leading sponsors for demonstration seawater desalination projects, Brownsville Public Utilities Board, the City of Corpus Christi and the Brazos River Authority filed financial assistance applications with TWDB to conduct pilot plant studies. While the financial assistance requested totaled $5,672,688, the total costs (including in-kind and cash contributions) were over $7 million (see table below) and in excess of the appropriated funds for pilot plant studies.[6]

Table 1 - Summary of Requests for Financial Assistance for Pilot Plant Studies

Applicants	Requested from TWDB-$	In-kind Contribution- $	Cash Contribution-$	Total Cost of Study-$
Brownsville PUB	1,339,688	385,368	500,000	2,225,056
Corpus Christi	3,063,000	125,000	24,900	3,212,900
Brazos River Authority	1,270,000	*330,000	0	1,600,000
Total	5,672,688	840,368	524,900	7,037,956

(*) Applicant described previous efforts by private partner, Poseidon Resources, Inc., valued at $2 million, including source water assessment and intake permit amendments.

The information contained in the applications confirmed the interest of the applicants and the opportunities for developing projects at each of the three proposed sites. However, of the three proposals, the proposal from the Brownsville Public Utilities Board clearly showed the greatest likelihood of being implemented as a full-scale project in the near future. The Corpus Christi and Brazos River Authority proposals also showed potential but appeared less likely to be implemented in the near future; therefore, it is premature to invest in pilot plant studies at these sites during the current biennium. They should, however, remain under consideration as possible candidates for future studies, particularly if the projects could be formulated as broader inter-regional initiatives.

On April 17, 2006, TWDB selected the Brownsville Pilot Plant study as the next logical and effective step towards implementing the Large-Scale Demonstration Seawater Desalination Initiative and awarded $1,340,000 to the Brownsville Public Utilities Board to conduct a 12-month pilot plant study.

[6] ***Texas Water Development Board, Memorandum to Board Members dated April 11, 2006.***

Brownsville Pilot Plant Study

On July 17, 2006, the Brownsville Public Utilities Board and TWDB signed a contract to implement a Seawater Desalination Pilot Plant study. The study involves

- conducting a detailed assessment of the Brownsville Ship Channel site for installing the full-scale facility (see Figure 1);
- preparing and obtaining Texas Commission on Environmental Quality approval for a pilot plant study protocol;
- developing and implementing a process for identifying and selecting the water pre-treatment and treatment equipment;
- installing a 52,000 gallons per day pilot plant at a site located in the Brownsville Ship Channel;
- collecting data on ocean water quality for modeling of concentrate discharges;
- conducting a 12-month testing of sand and membrane filtration as forms of pretreatment; and evaluating two different types of reverse-osmosis membranes for the removal of dissolved solids from seawater; and
- reassessing the cost of constructing a full-scale facility and evaluating available funding options to implement the project.

Although the contract was not executed until July 17, 2006, the Brownsville Public Utilities Board project team started working on the project on April 17, 2006, the date of TWDB approval of the application for financial assistance. Since then, the project team has developed a pilot plant study protocol that has been approved by the Texas Commission on Environmental Quality, selected pretreatment and treatment equipment manufacturers, commissioned the construction of the pilot plant, started work on the permitting process with the U.S. Corps of Engineers and the U.S. Coast Guard, conducted an assessment of alternate (back-up) sites for the seawater desalination plant, and developed a proposal for operating the full-scale plant at a lower energy cost than was projected in the feasibility study.

Water production operations at the pilot plant are scheduled to begin by December 2006 and continue until December 2007.

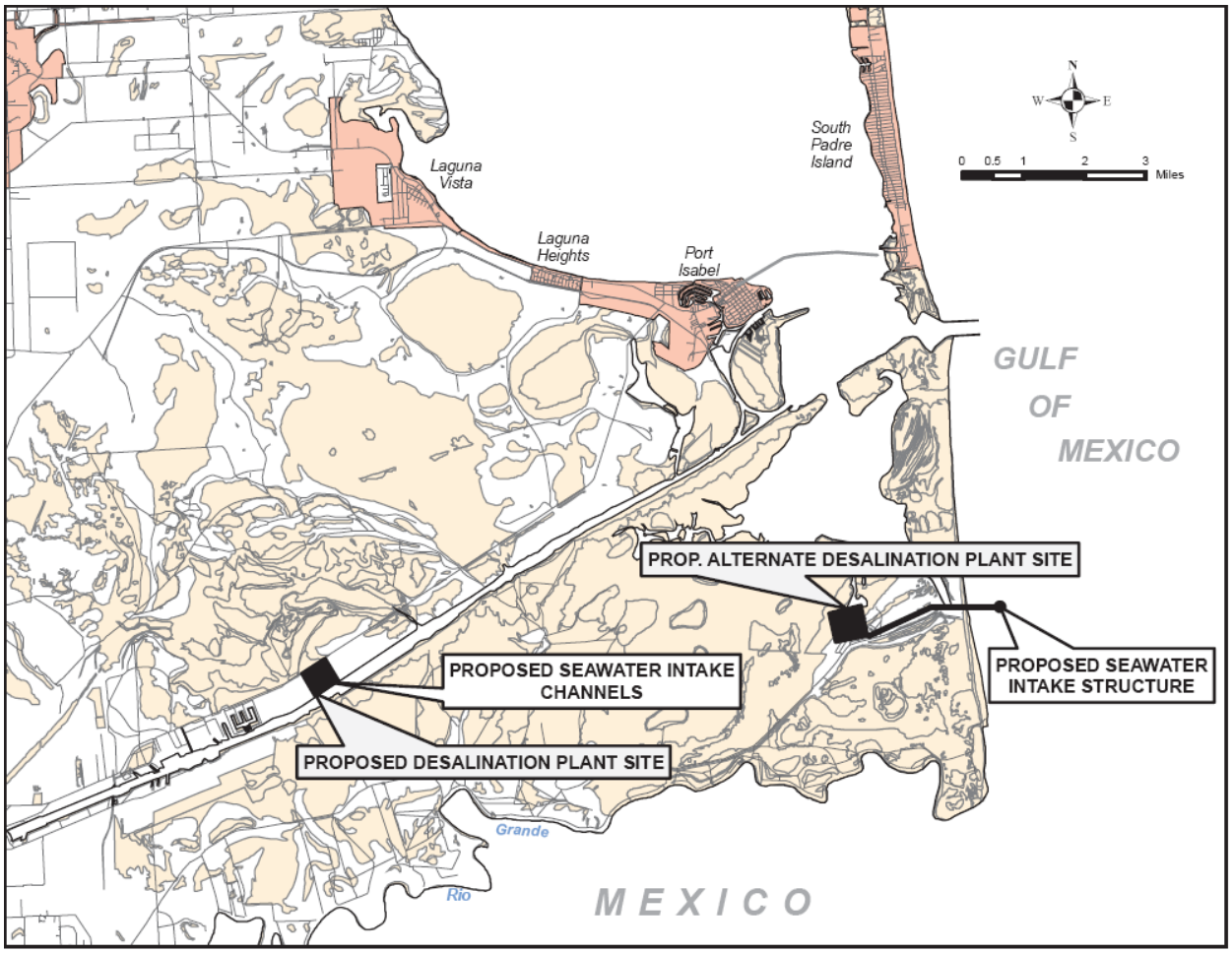


Figure 1 - Location of Proposed and Alternate Brownsville Seawater Project Sites

Project Funding Requirements

The Brownsville Seawater Pilot Plant Study is providing site-specific information for designing, permitting, and costing the large-scale demonstration seawater desalination facility. It also allows the Brownsville Public Utilities Board to explore expanding the scope of the project to include other water providers in the region. The final pilot plant study report—due two months after completion of the pilot plant study—will provide more definitive estimates on the capital, operation, and maintenance costs of the project and assess the financial requirements and funding options to implement it. In the meantime, as part of the current pilot plant study contract with TWDB, the Brownsville Public Utilities Board completed an Interim Report providing revised cost estimates for the full-scale facility and a preliminary assessment of the financial requirements and funding options to implement the proposed project.[7]

[7] ***Brownsville Public Utilities Board per TWDB Contract No. 0604830619. Prepared by NRS, URS and Estrada-Hinojosa. November 2006.***

Capital Cost

The 2004 Brownsville Seawater Desalination Feasibility Study had estimated the cost of the 25 million gallons per day facility at$151 million. After considering price changes, technology improvements, and modification of the project layout, the revised estimate of the capital cost of the project is $150 million. A breakdown of costs by major components is presented in the table below. [8]

Table 2 - Capital Costs (Interim Estimate) for a 25 million gallons per day Seawater Desalination Plant.

Items	Cost
Desalination plant	$88,000,000
Concentrate disposal system	$31,400,000
Finished water transmission system	$12,200,000
Special studies, engineering, National Environmental Policy Act permitting, and construction support services	$18,400,000
Total project cost	**$150,000,000**

Operation and Maintenance Costs

A particular concern with regard to the operation of seawater desalination facilities is the energy costs associated with reverse-osmosis filtration. Energy costs are directly related to the salt content of the water source and, in the case of seawater desalination, they may represent up to 50 percent of a system's operational costs.[9]

Managing power supply and power costs are matters over which the Brownsville Public Utilities Board is ideally positioned to make a difference because of its advantageous dual role as both water and power utility provider. As a power provider, the Brownsville Public Utilities Board is subject to the Electrical Reliability Council of Texas and is required to rate 10 percent of its power load as interruptible. As the operator of the proposed seawater desalination facility, the Brownsville Public Utilities Board would be able to choose operating it on the basis of an interruptible power supply at a considerable level of savings. Specifically, the 2004 Feasibility Study relied upon a power rate of 5.4 cents/kilowatt-hour[10]; under the proposed approach the facility would operate at 20 percent of capacity within a peak power rate of 3.7 cents/ kilowatt-hour and at 100 percent of capacity at an off–peak rate of 2.3 cents/ kilowatt-hour. The potential annual savings from this approach are estimated at $5.8 million per year. The water production yield from the facility would be 12 million gallons per day; however, as water demand increases, the plant would also increase production at a revised power rate.

---

[8] Brownsville Public Utilities Board, Seawater Desalination Feasibility Study, TWDB Contract No. 2004483515.

[9] Pankratz, Tom "Desalination Technology Trends." In Report No. #363, The future on Desalination in Texas, Volume II, Texas Water Development Board, 2004, pgs 99-104.

[10] Ibíd.

The following table presents a revised estimate of the annual operation and maintenance costs for the proposed 25 million gallons per day seawater desalination plant if operated at 100 percent capacity.

Table 3 - Operating and Maintenance Costs (Interim Estimate) for a 25 million gallons per day Seawater Desalination Plant.

Item	Operation and Maintenance Costs	
	Interruptible Power (Yield=25 MGD)	Interruptible Power (Yield=12 MGD)
Power(*)	$ 6,360,000	$ 1,997,710
Chemicals	$ 2,253,465	$ 1,081,663
Labor	$ 1,465,400	$ 1,132,700
Miscellaneous	$ 2,217,000	$ 2,217,000
Plant Site – Lease	$ 179,000	$ 179,000
Total O&M Cost	$ 12,474,865	$ 6,608,073

Estimate of Financial Assistance Needed

To estimate the financial requirements of developing seawater desalination, the Brownsville Public Utilities Board considered its capacity to pay for additional water infrastructure investments, the alternatives to seawater desalination, and the potential for water rights leases to offset the cost of seawater desalination.

Seawater desalination is more expensive than other water management strategies available to the Brownsville Public Utilities Board for meeting future water supply needs. According to the Region M Regional Water Plan, as quoted n the interim report, the cost of seawater desalination is $768 per acre-foot while brackish groundwater desalination is $506 per acre-foot. Brackish groundwater desalination is the next logical step in the utility's investment plan. Therefore, to assess the financial requirements of implementing a full-scale (25 million gallons per day) seawater desalination facility, the Brownsville Public Utilities Board used as a comparative reference the cost of supplementing its current supplies with brackish groundwater desalination.

If the absence of the demonstration seawater desalination project the Brownsville Public Utilities Board would likely move ahead with its plans to develop additional brackish groundwater supplies by expanding the Southmost Regional Water Authority's Brackish Groundwater Desalination Facility (Southmost). If sufficient groundwater is available, then the Southmost expansion could be accomplished gradually, taking full advantage of existing infrastructure and of the modular design qualities of reverse-osmosis desalination technology. Because of the lower salinity of brackish water, this option would also be less expensive to operate.

Another issue to consider in determining the financial requirements of developing seawater desalination is the potential for marketing surplus water rights. Developing

seawater desalination at a volume that exceeds local needs could free up existing water rights; the lease or sale of a portion of those water rights could offset the cost of the seawater desalination project. However, as a replacement for planned brackish groundwater desalination, a 25 million gallons per day facility may only provide for a limited (temporary) surplus of water rights. Based on the current analysis of the Brownsville Public Utilities water supply portfolio, the Interim Report concludes that "it is not recommended that water rights sales should be used for financing, however, a short term lease for 10 years could be used to offset a minor amount of costs."[11]

Once all these factors are considered, the Brownsville Public Utilities Board estimates that, altogether, it would need to invest up to $38 million in capital costs plus the annual operation and maintenance expenses of a 25 million gallons per day seawater desalination facility. This leaves a funding gap of $112 million out of the $150 million of the projected capital cost. The Brownsville Public Utilities Board estimates that it would need financial assistance in the form of grants or zero-interest loans to cover this gap if it is to be able to construct the proposed facility by the year 2010.

Several factors could affect these estimates. Chief among them is the possibility of improving the economics of the project by expanding its scope to a broader service area. Like Brownsville Public Utilities Board, other water providers in the Rio Grande Valley may be prepared to pay a premium for a drought-proof, abundant, high-quality water supply, especially as the competition for brackish groundwater desalination increases and the availability of both brackish and fresh groundwater becomes less certain.

Funding Options

The 2004 Brownsville Feasibility Study included an assessment of financial assistance programs and project capacity scenarios. The Interim Report updated the information and reiterates the conclusion that a combination of financial assistance tools will be required to fund the development of the full-scale project.

Appendix II is a summary of the financial assistance programs that were considered for possible funding of the proposed project and identifies those programs that appear to present the greatest opportunity to assist with the funding of the Large-Scale Demonstration Seawater Desalination Project. These programs include the Drinking Water State Revolving Fund, the State Participation Program, the Water Loan Assistance Fund of the Water Assistance Fund, the Coastal Impact Assistance Program, direct Congressional appropriation (perhaps through a variety of federal funding mechanisms) and the local efforts of either the Brownsville Public Utilities Board or Southmost Regional Water Authority (either/or, but not likely both).

[11] ***Ibíd.***

Brownsville Public Utilities Board Recommendations

In its Interim Report, the Brownsville Public Utilities Board concludes that it "*has identified more cost effective solutions for improving the economics of the proposed seawater desalination project. It has made significant commitments to fund a portion of the capital cost and all of the operational costs of the project. This has significantly reduced the needed subsidy to bridge the utilities capabilities to pay and the cost of developing water, but a gap still remains. There is no "silver bullet" to close this gap. Existing programs can meet some of this need but additional funds will be needed and these will need to be in the form of grants. Further, flexibility in how funds can be appropriated should be provided so that project configuration uncertainties can addressed should the need arise.*

The Brownsville Public Utilities Board recommends that the legislature appropriate and authorize the following:

> *$70 Million in General Revenue funds to the Water Loan Assistance Fund for the purpose of supporting the permitting, design and construction of seawater desalination treatment facility envisioned to be 25 million gallon per day capacity. The Legislature should be asked to support to the maximum extend practicable and consistent with state and federal law the use of the Safe Drinking Water Revolving Fund (estimated to be $45 M over three years) to defray the need for grants. Brownsville PUB will need to cover the remaining $38M in capital costs through system revenues and pay 100% of all operating costs. The Legislature, through this rider, would encourage BPUB and the TWDB to explore all other existing funding sources, including direct federal appropriation, to offset the cost of this project. "*

TWDB concurs that promoting the development of drought-proof water supplies through seawater desalination will require strong financial support from the state. TWDB believes, however, that using the Water Assistance Loan Fund or, potentially, the Water Infrastructure Fund would be a preferred program for funding the remainder amount of the request ($45 million).

Seawater Desalination in the 2006 Regional Water Plans

Other opportunities to advance the development of seawater desalination in Texas were brought up during the recently completed regional water planning cycle. The approved 2006 Regional Water Plans project an increase in water supplies from treating saline water by reverse-osmosis and using other desalination technologies. These include recommendations supporting development of the three projects formulated as part of Governor Rick Perry's Seawater Desalination Initiative (Brownsville, Region M; Corpus Christi, Region H; and, Freeport, Region H) and two more projects needs in Regions L and M.

The 2006 Regional Water Plan for South Central Texas (Region L) recommends the construction of a major, large-scale seawater desalination facility in the San Antonio Bay area and a water transmission pipeline between San Antonio Bay and Bexar County to provide more than 84,000 acre-feet per year of drinking water supplies to the San Antonio metropolitan area by 2060.

The Region M Regional Water Plan recommended a 1-million gallon per day seawater desalination facility on South Padre Island to meet the growing needs of the Laguna Madre Water District. [12] Acting on this recommendation, the Laguna Madre Water District solicited financial assistance from TWDB to update its regional water facility plan and to conduct a seawater desalination pilot plant study. On July 18, 2006, TWDB considered and approved the request for financial assistance and awarded $231,000 to implement its plan.

Laguna Madre Water District is currently considering the use of an innovative form of horizontal beach wells as the intake for the desalination plant, an unprecedented approach in Texas. The information resulting from this innovative study will be useful to other coastal communities that may consider small-scale seawater desalination in the future.

Educational and Technical Outreach Activities

TWDB's Educational and Technical Outreach efforts during the current biennium have included developing a Web site to make available information on all aspects of TWDB's desalination activities in the state. The Web site, located at http://www.twdb.state.tx.us/iwt/iwt.asp, contains downloadable copies of our technical reports, information on previous and all current TWDB-funded desalination studies, and a selection of presentations made by TWDB.

The Web site also has a list of federal, state and other agencies and organizations that have an interest in or are involved with desalination, a list of frequently asked questions, and other useful information, such as desalination meeting announcements. The desalination plant database, which is a comprehensive inventory of desalination plants in Texas, is also available on the Web site.

TWDB is actively involved in the American Membrane Technology Association, the International Desalination Association, and the Affordable Desalination Collaboration Project. This involvement has allowed staff to stay current on the latest issues in desalination technology for the benefit of our stakeholders.

TWDB is on the board of directors of the South Central Membrane Association, an organization dedicated to issues related to membrane filtration for water treatment. The 120-member organization includes water plant operators, water planners, and engineering consultants.

---

[12] Rio Grande Regional Water Plan, approved by the Texas Water Development Board on March 21, 2006.

TWDB has given numerous presentations and participated in the organization of many desalination-related seminars and workshops throughout the state during the biennium, including the following:

- Texas Rural Water Association-Annual Conference, Galveston, 2005
- Texas A&M University-Separations Laboratory, Desalination Workshops, College Station, 2005 and 2006
- Texas A&M University-Kingsville, Innovative Water Technologies Seminar, south Padre Island, 2005
- American Membrane Technology Association-Desalination Workshop, Corpus Christi, 2005
- El Paso Public Utilities Board Desalination Concentrate Workshops, El Paso, 2005 and 2006
- South Central Membrane Technology Association, operator training workshops in San Antonio, Fort Worth, Corpus Christi, 2005 and 2006
- American Water Works Association-Texas Section-Annual Conference, Austin 2006
- American Water Works Association-Annual Conference, San Antonio, 2006
- Texas Water Development Board, Aquifers of the Gulf Coast of Texas Conference, Corpus Christi, 2006
- Environmental Defense Workshop, Austin, 2005

Other Studies

In addition to the seawater feasibility studies, TWDB has provided funding for various desalination research studies during the biennium. These studies are listed and briefly described below:

Inventory of Public Water System Desalination Facilities-Desalination Data Base
The desalination plant database was developed in 2005 by the Bureau of Economic Geology for the Texas Water Development Board under the terms of Contract 2004-483-021. The database contains detailed information on 38 public water supply desalination plants currently operated in Texas. Information for the database was gathered primarily through interviews with plant operators and survey forms. Only public water supply plants with a capacity greater than 0.025 million gallons per day are reported in the database. Plants which were non-operational at the time the survey was conducted are not included. The cumulative design capacity of currently operating facilities is 52 million gallons per day.

A thorough discussion of the methodology employed in collecting the information, the limitations of the study, and the construction and operation of the database can be found in the report entitled " A Desalination Database for Texas," which is accessible electronically through the Web site located at http://www.twdb.state.tx.us/iwt/iwt.asp.

Brackish Groundwater Desalination Demonstration Projects

In 2003, TWDB reported that Texas has an estimated 2.7 billion acre-feet of brackish groundwater.[13] Use of this resource is becoming more common in water-scarce areas of Texas. However, there are some important difficulties associated with implementing brackish groundwater desalination projects that can be particularly challenging for smaller communities. Most important among these are managing desalination concentrate and predicting the long-term performance of brackish groundwater aquifers.

The goal of the Brackish Groundwater Desalination Initiative is to continue facilitating the development of brackish groundwater desalination supplies by creating replicable models of projects that may be effectively transferred to other communities with similar profiles. If successful, these projects can be used by other communities as engineering facility roadmaps to characterize source waters, implement desalination technologies, and manage desalination concentrate.

TWDB, with funding appropriated by the 79th Texas Legislature for this initiative, selected and issued grants for three brackish groundwater demonstration projects:

- **North Cameron Regional Water Supply Corporation.** The intended outcome of this project is a comprehensive engineering facility roadmap documenting the planning, designing, constructing, and operating of a brackish groundwater plant. The 2.3 million gallons per day plant is nearly completed.

- **City of Kenedy and the San Antonio River Authority.** The City of Kenedy is in the process of retrofitting and modernizing an existing reverse-osmosis facility and will conduct a feasibility study to add another brackish groundwater desalination facility to meet the city's projected water needs. This project would allow for a factual comparison of the performance of new technologies versus older reverse-osmosis filtration. This will result in useful information (cost-benefit) for assessing replacement of similar facilities in other areas of the state.

- **City of San Angelo and the Upper Colorado River Authority.** The project consists of implementing an exploratory drilling program to characterize the suitability of the Whitehorse aquifer in Irion County and develop a guidance manual for characterizing brackish groundwater resources for desalination.

Additional information on these projects may be accessed through the "Studies" section of the Texas Water Development Board Innovative Water Technologies web site or at http://www.twdb.state.tx.us/iwt/desal/studies.html.

[13] ***LBG-Guyton,*** **Brackish Groundwater Manual for Texas Regional Water Planning Groups*****, Texas Water Development Board, Austin, Texas, February 2003.***

Coordination with Desalination Research Community

TWDB has continued to remain abreast of research development and participated in key desalination research-related efforts, including:

- providing letters of support to pivotal research activities such as the University of Texas request for funding before the National Science Foundation for membrane related research, and for the Texas A&M proposal for collaborative desalination research with the University of Alicante, Spain, submitted to the United States Department of Agriculture;
- participating in the WaterReuse Foundation Research Advisory Panel for a study entitled "Exploring the Value of Reliability Benefits for Water Reuse and Desalination Projects;" and
- participating as a member of the board of directors of the Affordable Desalination Collaboration Project;

Coordination with Local, State, and Federal Agencies

TWDB has continued to coordinate with state and federal agencies that have a role to play in implementing seawater desalination. Key examples of these efforts are the following:

- Office of the Governor and General Land Office—Through coordination with these two agencies, TWDB assisted the Brownsville Public Utilities Board in applying for financial assistance for the Coastal Impact Assistance Program, a federally funded program administered by state and local entities, to assist in funding for the design and permitting phase of the project;
- United States Environmental Protection Agency, the Railroad Commission of Texas, and Texas Commission on Environmental Quality—TWDB participated in discussion with these three entities regarding desalination concentrate disposal issues. Although the subject focused primarily on brackish groundwater desalination issues, some of the concepts could impact management of seawater desalination concentrate;
- U.S. Bureau of Reclamation—TWDB continued its collaborative efforts with this agency regarding desalination research matters, including linkage of energy generation and water desalination issues, participating in focus groups to discuss the next steps of the Desalination Research Roadmap;
- Texas Commission on Environmental Quality—The Brownsville Public Utilities Board has aggressively pursued early coordination with this agency regarding permitting matters affecting the pilot plant study and, in the future, the full-scale facility. TCEQ has been highly responsive to these efforts and its participation has allowed the pilot plant study to progress at a quick pace;

- City of Corpus Christi and Brazos River Authority—TWDB has continued its dialogue with these entities to ensure that future opportunities to develop seawater desalination at their proposed sites are not overlooked;
- Texas Congressional Delegation—Through the efforts of TWDB's Governmental Relations office, TWDB has continued to provide timely information to members of the delegation to ensure that funding opportunities for Texas Seawater Desalination Initiatives are considered.

SECTION 2-TEXAS WATER CODE 16.060(b)(2) Impediments to Seawater Desalination

This page intentionally blank

Texas Water Code §16.060(b)(2) requires this report to address impediments to implementing seawater desalination projects. TWDB considered research, regulatory, technical, and financial challenges to implementing the current proposals for large-scale seawater desalination projects.

In general, the greatest perceived challenge to developing seawater desalination is its relatively high cost, particularly when compared to water supplies that are already developed. Sound water development policies lean towards developing the lower cost water options first and implementing the more complex and expensive ones later as the need arises. In Texas, the growing need for water is sharpened by the known vulnerability of the state to drought events that can quickly and drastically decimate all water sources—all except seawater.

The greatest benefit of seawater desalination is its dramatic ability to lessen a regional water system's vulnerability to drought. Another unique advantage of water desalination is that once the initial investment is made on intake and outfall structures the treatment components can be incrementally and economically increased in a modular fashion to meet demands and reduce the impact on a utility's cash flow.

As noted in the financial sub-section, below, water desalination is being developed around the world through unprecedented levels of private investment and the use of alternative project development tools such a design-build. In Texas, in order reap the benefits of seawater desalination, the state needs to maintain the momentum that has been gained over the last four years and complete the Brownsville project. This momentum positively impacts research and regulatory developments and paves the way for future projects. The state's initial investment in seawater desalination will facilitate the planning and eventual development of other seawater desalination projects and perhaps create a more attractive private investment environment to ease the financial burden on state programs.

In addition to the financial challenges, the following four sub-sections address the topics of research, technical and regulatory challenges mentioned in Texas Water Code §16.060(b)(2).

Research

Basic and applied research continues to yield substantial improvements in the efficiency and reliability of desalination technologies. This research takes places within academic institutions, equipment manufacturers, and the community of desalination engineering consultants. For example:

- Promising research on membrane technology spearheaded by the University of Texas at Austin and Virginia Polytechnic Institute and State University is

focusing on chlorine resistance properties of membranes to counteract membrane fouling problems;[14]

- Leading membrane manufacturers have begun marketing large diameter membranes that could result in savings of 4 to 7 percent over older membrane designs;[15]
- A public consortium of researchers and equipment manufacturers at the U.S. Navy's Seawater Desalination Test Facility in Port Hueneme, California, has demonstrated the energy-savings benefits of low-pressure reverse-osmosis membranes, high-efficiency pumping, energy-recovery equipment and lower recovery rates in seawater desalination, bringing the energy demands to record low rates of 1.6 kilowatt hour per 1,000 gallons of produced water.[16]

At TWDB, the focus on seawater desalination research has been on resolving practical issues related to implementing desalination projects in Texas. An example of this is the Roadmap for Permitting and Implementing Desalination Projects in Texas.[17] This project produced a model for permitting desalination facilities in Texas, and it is being used as a reference point in the development of the Large-Scale Demonstration Seawater Desalination Project in Brownsville.

Upcoming challenges meriting a research focus include the critical issue of modeling ocean behavior to assimilate large desalination concentrate discharges; assessing desalination site vulnerability to weather events; and demonstrating new technologies. The challenge for the state is to ensure that sufficient funding is available for the continued monitoring and leveraging of promising research activities such as those described above.

Regulatory

The greatest regulatory challenge to seawater desalination in Texas is the fact that it has not been done before. In the process of implementing the pilot plant study phase of the Demonstration Seawater Desalination Initiative, a team composed of staff from the Texas Commission of Environmental Quality, consultants for the Brownsville Public Utilities Board, TWDB, and its pilot plant consultants (Reiss Environmental and Dietrich Consulting Group) have met periodically to address project implementation issues. The coordination has been effective in identifying and addressing regulatory issues. This productive team approach will continue throughout the remaining stages of the pilot plant study.

---

[14] University of Texas application for a grant from the National Science Foundation for research on advanced water purification, August 2006.
[15] WDR and conversation with T. Pankratz
[16] The International Desalination and Water Reuse, Quarterly, Volume 16-2, August/September 2006.
[17] R.W. Beck, Guidance Manual for Permitting Requirements in Texas for Desalination Facilities. November 2004, TWDB Contract # 2003-483-509. Available electronically at http://www.twdb.state.tx.us/iwt/desal/studies/completed.html

It is important for the state to maintain the momentum gained thus far in developing seawater desalination and complete the Large-Scale Demonstration Seawater Desalination Project. An outcome of this effort will be a clear regulatory path to facilitate the permitting process for future large-scale seawater desalination projects.

Technical

Since April 2002, when Governor Perry described the state's goal to develop drought-proof water supplies by desalinating seawater, desalination technology has continued to improve. Water desalination supplies now have an even greater share in water supply portfolios around the world. For example, in Spain, work is underway to increase seawater desalination capacity by 367 million gallons a day by the year 2009;[18] in Australia, a 33 million gallons a day facility is nearly completed and groundbreaking for a new 31.7 million gallons a day took place in September 2006;[19] in Israel, the largest desalination reverse-osmosis facility in the world is now completed and in operation, producing 78 mgd at a cost of approximately $2.00/1,000 gallons; and, closer to home, in California, an agreement has been developed by the City of Carlsbad and Poseidon Resources Inc.—a private investor—to develop a 50 mgd facility by 2009.[20]

These developments illustrate the fact that there are no apparent technical impediments to implementing seawater desalination. However, as is the case with regulatory issues, since the Brownsville project represents the first project of its kind n Texas that in itself is itself a challenge and a great opportunity.

As is the case with regulatory challenges, the best way to address the technical issues of developing a large-scale seawater desalination project is to demonstrate the solutions by implementing the project.

Financial

The Demonstration Seawater Desalination Initiative has been an effective tool for identifying technical and regulatory challenges in developing seawater desalination. As these challenges continue to be identified and addressed, the costs and financial requirements to implement a full-scale project also become better defined and understood.

Since 2002, when Texas began its more active pursuit of seawater desalination, a staggering 4.5 billion gallons per day of additional desalination capacity has been installed in the world. [21] The great majority of this development has been funded through

---

[18] Water Desalination Report, October 2, 2006
[19] Water Desalination Report, September 25, 2006
[20] Poseidon Resources, The Carlsbad Desalination Project, http://www.carlsbaddesal.com/
[21] Gassson, Christopher. Global Water Intelligence. Electronic correspondence to Jorge Arroyo, TWDB. October 18, 2006.

public private partnerships and the use of design-build-own-operate procurement approaches. These funding mechanisms allocate the risk of developing technologically complex projects to experienced developers whose incentive is the opportunity to access a reliable revenue stream to recover their investment at a profit. When the reliability of the revenue stream is in question or insufficient to meet the capital and operational costs of a facility, then the project is not well-suited for private capital participation.

Subsidies help public water providers overcome the incremental cost of developing new sources of water supply. The subsidies are justified on the basis of public interest to ensure the availability of a long-term, reliable water supply system. An example of this approach is the creation of the Stewardship Fund by the Metropolitan Water District of Southern California, a wholesale provider reaching 18 million customers through 26 member agencies.[22] The Metropolitan Water District encourages water supply diversity by offering water producers a $250 subsidy for each acre-foot of desalted water produced over a 30-year period. The program is funded through a self-imposed stewardship fee of $25 per acre-foot of water and is earmarked for development of new water supplies to replace imported water.[23]

Texas, too, has a compelling public interest in developing drought-proof water supply sources and, like California, the relative proximity to the ocean of large demand centers heightens the interest in seawater desalination. Although there is not an umbrella organization in Texas of the reach and scope of the Metropolitan Water District of Southern California, the layout of river basins and the distribution of water demand centers along key rivers in Texas provides an opportunity to extend the reach of large seawater desalination projects to a wide service area, including inland regions, through the infusion of new water supplies at the end of those river basins. Thus, developing seawater desalination projects in Brownsville, Corpus Christi, Freeport, and Galveston could have benefits on upstream communities such as Laredo, San Antonio, Austin, and Dallas. Therefore, in discussing the requirements for financial assistance for seawater desalination, the state should consider the potential of creating large new sources of water supply for much of Texas, not just the coastal communities where the projects are based. In its interim report, the Brownsville Public Utilities Board discusses various options to fund the gap between its available funding and what would be required to implement a full-scale, 25 million gallon per day project. The possibility of expanding the regional reach of the project to communities as far inland as Laredo may impact the final configuration of the project. Over the course of the next 12 to16 months when the pilot plant study will be conducted, the Brownsville Public Utilities Board will arrive at a decision on the final development of the project. Based on an early analysis of the interim report, it seems clear that the Brownsville Public Utilities Board will require a subsidy to support the development of a full-scale project.

---

[22] ***http://www.mwdh2o.com/mwdh2o/pages/about/about01.html***

[23] ***Metropolitan Water District of Southern California, Rates and Charges Effective January 1, 2005, Water Stewardship Rate.***

To move forward effectively in fulfillment of its statutory charge under Texas Water Code 16.060, the Texas Legislature will need to provide grants and low interest loans for funding the next phase of the Brownsville Large-Scale Demonstration Seawater Desalination Project. A broader policy to encourage additional future development of seawater desalination supplies would encourage development of other potential regional projects such as those in Freeport and Corpus Christi.

This page intentionally blank

SECTION 3-TEXAS WATER CODE 16.060(b)(3) Role of the State

This page intentionally blank

Texas Water Code §16.060(b)(3) requires this report to evaluate the role the state should play in furthering the development of large-scale seawater desalination projects in the state.

Section §16.060 of the Texas Water Code defines the role of the Texas Water Development Board in regard to seawater desalination: *"The board shall undertake or participate in research, feasibility and facility planning studies, investigations, and surveys as it considers necessary to further the development of cost-effective water supplies from seawater desalination in the state."*

Texas has a strategic need to develop new, drought-proof water supply sources from seawater desalination. The State's role is to lead in developing that source. . During the current biennium, the state and the Brownsville Public Utilities Board have brought this effort substantially closer to the point where construction of a full-scale plant could be initiated by the end of the 2008-2009 biennium. The state is currently conducting a 12-month-long pilot study to collect important site specific information and evaluate the performance of the proposed system. However, until the goal of this program is fully realized the state's leadership and support will be essential.

The potential benefits of seawater desalination in Texas, however, go beyond completing the Brownsville project. Thanks to the hydrologic interconnectivity of Texas and the location of large water demand centers, not only does seawater desalination have the ability to provide cost-effective, drought-proof water supplies to coastal areas, it also has the potential to benefit large inland demand centers through marketing of water-rights based on common waterways. This creates an even greater need for the state's leadership to act as a facilitator in formulating such projects.

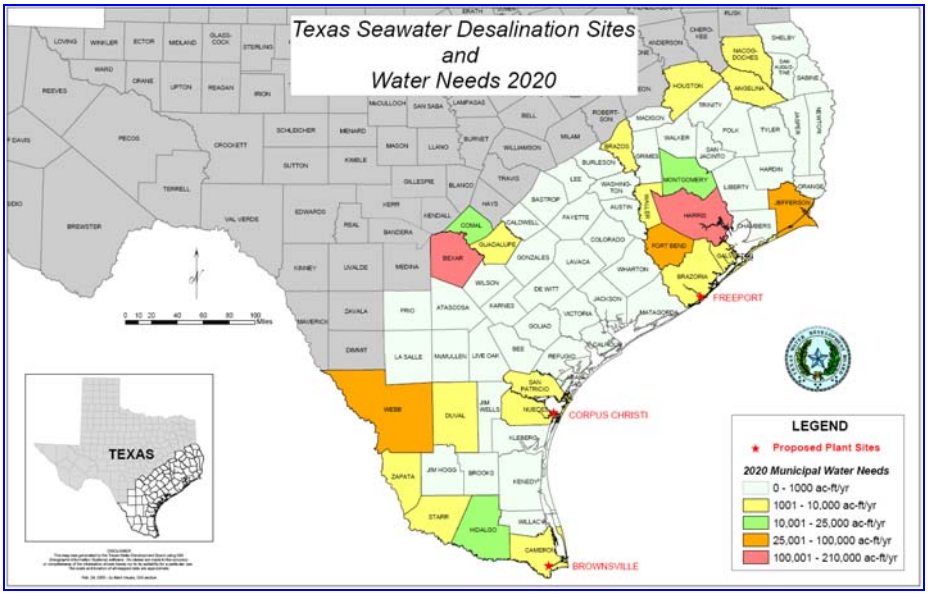


Figure 2 - Seawater Desalination Sites and Potential Service Areas

Over the 2008-2009 biennium, the state's assistance should then focus on

- providing financial assistance to the Brownsville Public Utilities Board to study, design, and construct a Large-Scale Demonstration Seawater Desalination Project;

- providing a funding policy to assist in the development of regional seawater desalination projects that could extend the drought-proof benefits of seawater desalination to inland communities;

- continuing to facilitate feasibility and facility planning work by funding desalination studies for other proposals likely to lead to the development of full-scale facilities;

- continuing to provide funding for technical assistance and educational outreach efforts to promote desalination; and

- Continuing to inform the Texas Congressional Delegation on the status and future of the desalination program to identify appropriate opportunities for federal financial assistance for desalination projects, particularly for the three proposed demonstration seawater desalination projects.

SECTION 4-TEXAS WATER CODE 16.060(b)(4) Anticipated Appropriation

This page intentionally blank

Texas Water Code §16.060(b)(4) requires this report to convey to the legislature the appropriation from general revenues TWDB anticipates will be necessary to continue investigating water desalination activities in the state during the next biennium.

Thanks to the legislative guidance and appropriations resulting from the 78th and 79th Texas legislative sessions, TWDB and the Brownsville Public Utilities Board have made substantial progress in implementing the Large-Scale Demonstration Seawater Desalination Project.

The 80th Texas Legislature must make pivotal funding decisions if Texas is to maintain the momentum gained in this program and if construction of the Large-Scale Demonstration Seawater Desalination Project is to begin in the fall of 2008. See Figure 3 for a project development time line, scheduled legislative sessions, and the state funding biennia cycles.

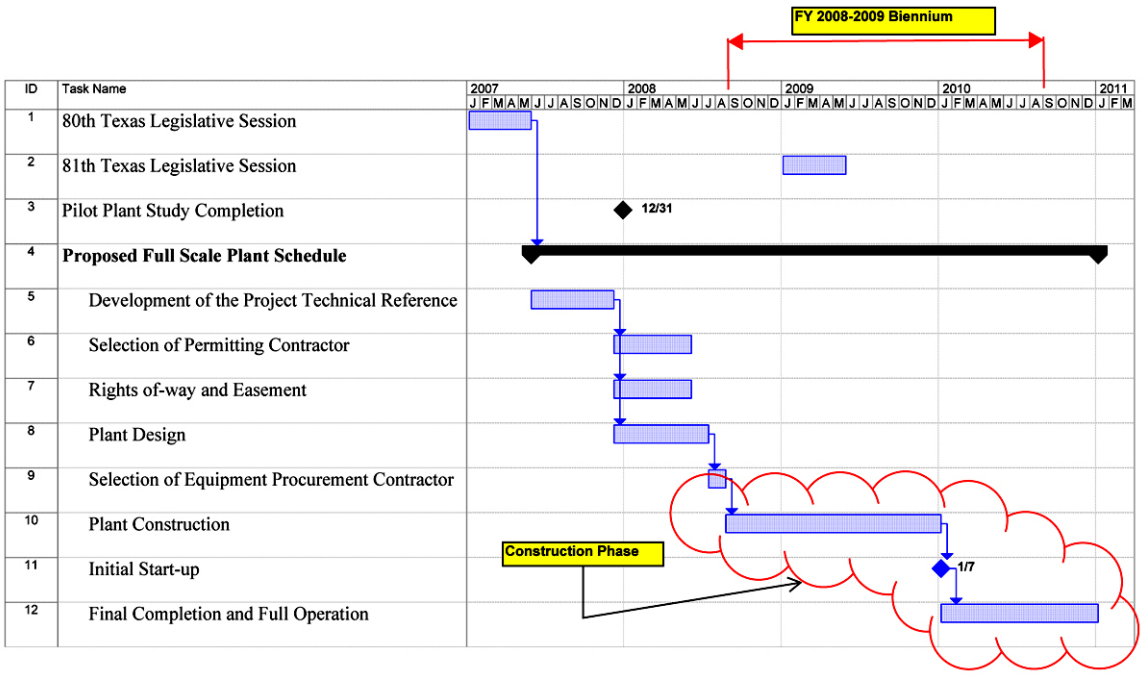


Figure 3 - Time Line for Implementing the Brownsville Large-Scale Seawater Desalination Project

In order to initiate design and construction of the full-scale project, the Brownsville Public Utilities Board will require financial assistance in the form of grants and zero interest loans. On the basis of the current information, the estimated capital cost of the project is $150 million plus annual operation and maintenance costs ranging from of $6.6 to $12.5 million. The Brownsville Public Utilities would need to cover the operation and maintenance costs and up to $38 million of the capital cost. To fill the funding gap, Brownsville is requesting financial assistance in the form of grants—$70 million—and low interest loans—$45 million.

TWDB recommends the legislature consider the following request:

- Issue a rider in an amount of $70 million for grants to the Brownsville Public Utilities Board through the Water Assistance Fund to initiate construction of the project as planned
- Appropriate $45 million to the Water Assistance Fund for zero interest loans to the Brownsville Public Utilities Board or, alternatively, through the Water Infrastructure Fund Program

Additionally, TWDB included restoration of $2.5 million for desalination grants in its Legislative Appropriations Request. Restoration of those funds is critical for giving TWDB the ability to assist in funding seawater desalination studies, such as concentrate discharge modeling, environmental impact assessment, pilot plant studies, and regional facility planning focused on seawater desalination. These studies will reduce planning and development costs for other potential regional seawater desalination projects, such as those in Corpus Christi and Freeport.

Appendix I - Interim Progress Report - Executive Summary by the Brownsville Public Utilities Board[24]

[24] ***Submitted by the Brownsville Public Utilities Board per TWDB Contract No. 0604830619. Prepared by NRS, URS and Estrada-Hinojosa. November 2006.***

This page intentionally blank

Table of Contents

List of Figures

List of Tables

This page intentionally blank

Executive Summary

Project Overview

As Texas looks to diversify its limited water supply and to create more environmentally friendly water sources, seawater desalination must be considered. The Brownsville PUB (BPUB) and the Brownsville Navigation District, in collaboration with the Texas Water Development Board (TWDB) believes that there is a place for seawater desalination in its future. The limited supplies in the Rio Grande, limited and costly alternatives and high growth in its service area are driving this belief.

The BPUB has been a leader in innovating water supply solutions. It is ready—as manifested by its financial and technical support for this seawater desalination effort—to take this important next step in water supply development. However, it cannot do it alone. Taking this next set in water resources development is expensive and beyond the reach of a single municipality.

The state must step forward with financial assistance for this project to be financial feasible. As the state did with reservoir development after the drought of the 1950s, so now it must financially back seawater desalination in the 21st century, in partnership with local users like BPUB.

BPUB must also do its fair share and proposes actions to reflect that commitment. BPUB has already assumed significant costs associated with the pilot study and further commits to funding. The project itself have been redefined since the 2004 plan to better meet the overall cost and energy supply issues of the current day. These actions have reduced the amount of subsidy needed from the state but the funding gap is still significant. The result of these actions was a reduction of subsidy needed from external sources to support the capital costs of the project of from $154 to $70 million. BPUB would need to cover all operational costs and additional capital costs (through loans and capital infusion) associated with the project. This figure equates to roughly half the cost of the total project (the combination of capital and operating costs are the total cost to fund the project).

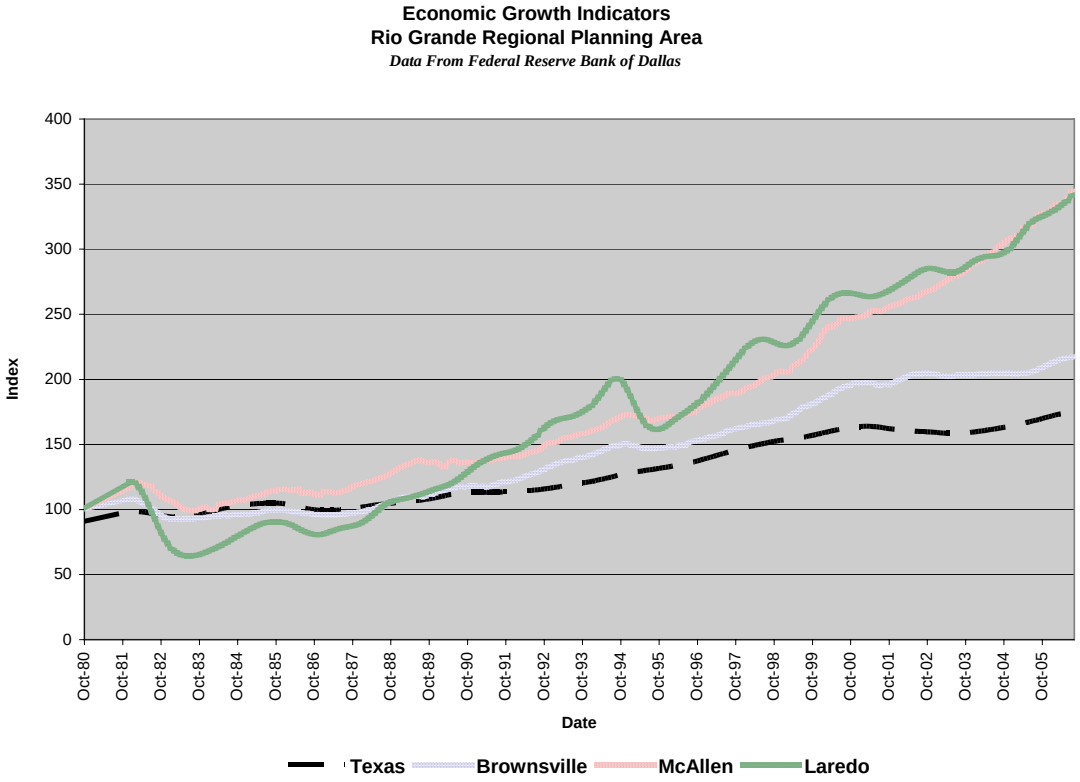
Regional Needs

The South Texas Border continues to be one of the fastest growing areas in the State of Texas and the United States. As the area grows, it becomes more evident, to develop regional approaches to water supply, taking advantage of economies of scale and limited access to available supplies.

The Federal Reserve Bank of Dallas has developed composite indexes that aggregate the movements of key economic indicators for nine metropolitan areas in Texas. Movements in the indexes summarize the movements in locally measured nonagricultural employment, the unemployment rate, inflation-adjusted wages and inflation-adjusted retail sales. The indexes are designed to measure the economy's overall direction.

The South Texas border cities continued to grow as indicated in Figure 1-1. For many years these areas have outpaced other metropolitan areas in the State.

Figure 1-1 South Texas Economic Indicator (Dallas Federal Reserve Bank)



As reported from the Federal Reserve Bank of Dallas:

> ***Brownsville–Harlingen.*** *The business-cycle index shows this metro area outperforming the state and nation since 2000. Brownsville's economy has been boosted by a strong peso and favorable agricultural conditions due to adequate rainfall and good citrus prices.*
>
> ***Laredo.*** *According to its business-cycle index, the Laredo economy has expanded strongly over the past four years. This is consistent with the metro's solid growth in transportation, warehousing and retail sales, which have benefited from increased international trade and the strong peso.*
>
> ***McAllen–Edinburg–Pharr.*** *McAllen's business-cycle index has risen robustly over the past four years. Strength in the metro's economic indicators is closely tied to the stronger peso and a relatively healthy maquiladora sector in the border city of Reynosa.*

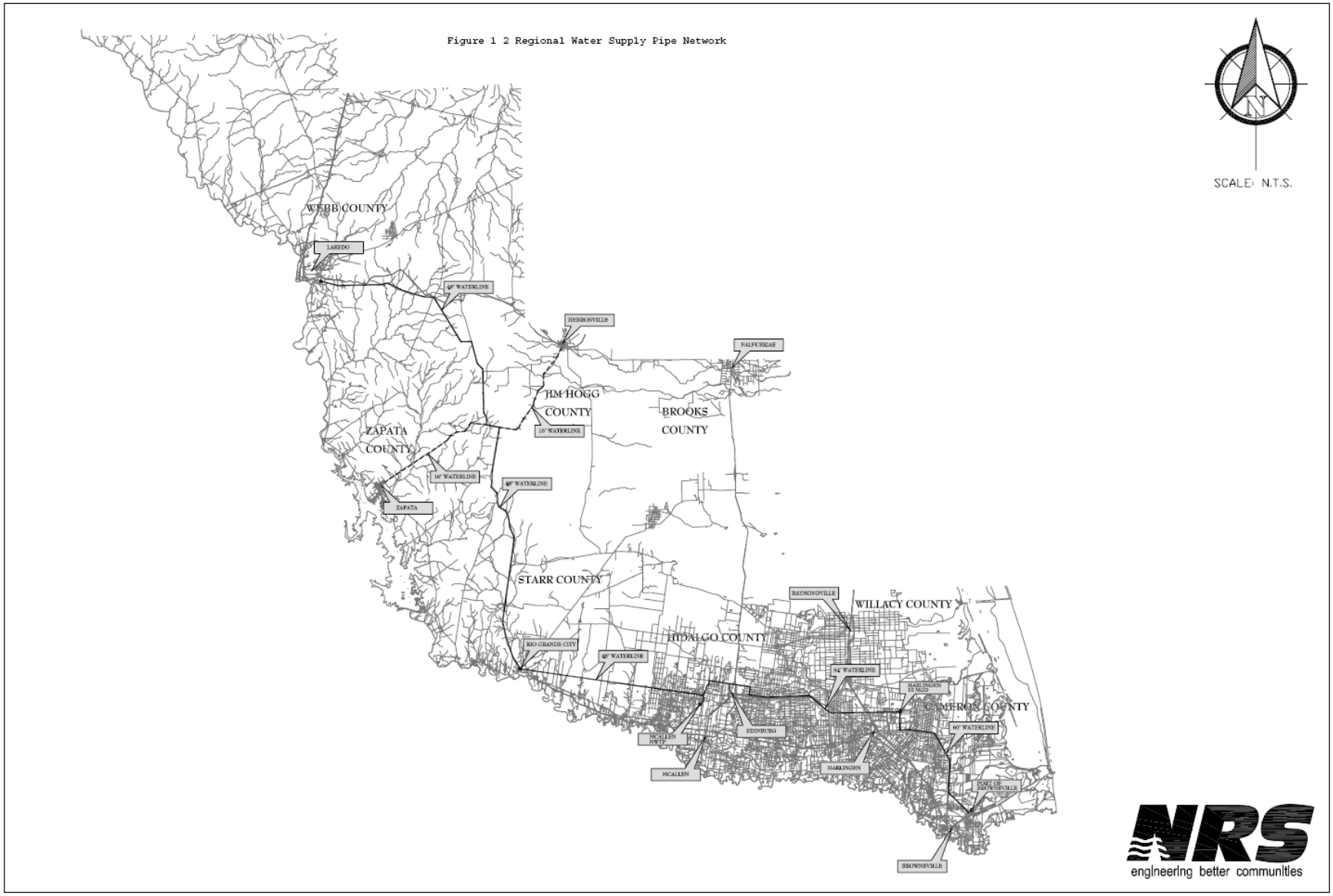
There exists a great potential for these fast growing areas to take advantage of an additional water source to meet the long-term needs of the region. The Rio Grande Valley has the advantage of a closer proximity to a seawater source than that, in and

around Laredo. At current the current time, the City of Laredo is completely dependent upon the Rio Grande. The City realizes that if growth is to continue in Laredo and surrounding areas, an alternative source of water must be developed. Laredo is currently embarking upon a contractual arrangement with a water provider most likely to come from an underground source some 50 miles away. This source is considered to be only an interim supply and that Laredo must plan for a more reliable supply in that of seawater desalination.

While to some, the idea of providing desalinated seawater to Laredo, some 200 miles away, would be a far-fetched idea, but to Laredo, it could be the life blood for an area that may depend on this limitless supply of water in the future. All other sources appear to be limited and that limit could curb the ability for one of the fastest growing cities in the US to continue its prosperity.

Talks between officials from Laredo and Brownsville have been established for the partnering of a full-scale seawater desalination plant. These will continue during the course of the pilot plant project. A potential layout of a major pipeline serving all entities in some capacity, in the eight county south Rio Grande border region is show in Figure 1-2.

Figure 1-2 Regional Water Supply Pipe Network



Major milestones

On March 10, 2006, the Brownsville Public Utilities Board (BPUB) submitted a request for financial assistance to the Texas Water Development Board for implementing a pilot plant study for a large-scale seawater desalination plant. Staff found that the BPUB approach and proposal is clearly the most likely to lead to implementing a full-scale project in the near future. Staff recommended the continued investment in the BPUB proposal to develop a large-scale seawater desalination facility and the TWDB authorization to negotiate a contract for implementing the proposed pilot plant. This was approved by Board action on April 17, 2006. A final work plan and contract was executed between the TWDB and the BPUB on July 17, 2006 for the completion of a Seawater Pilot Plant Study that would serve the BPUB and ultimately the Rio Grande Valley.

Prior to the final execution of the final contract between the BPUB and the TWDB, work was underway to begin the implementation of the pilot plant facility. While the pilot plant has not been completed at this point, major issues have been reviewed and recommended with regard to pilot plant location. Ultimately the Port of Brownsville site has been selected for the pilot plant location. Several major issues have been addressed, including plant location, permitting coordination, pilot equipment selection and site construction activities. The pilot plant is expected to begin operations in November 2006.

Updated Project Costs

In 2004, detailed a Feasibility Study was prepared and submitted to the TWDB. The projected cost for a 25 million gallon a day facility was $151 million. Since that time there has been a large increase in the cost of fuel, electricity and a sharp increase in the cost of steel products and other construction materials. As part of this interim report, the capital and operational costs have been updated to reflect 2006 dollars.

Two sites were considered and costs were projected for each. Site 1 corresponds to the site recommended in the 2004 Feasibility Study; it is located at the Port of Brownsville Channel as shown in Figure 1-3; . The alternative site is located closer to the Gulf of Mexico (Boca Chica) to take advantage of the intake from the Gulf of Mexico. While it appears the Boca Chica site is slightly more costly than the Port site, they could be considered equal in costs at this point.

Even though Site 1 has been selected for the pilot plant operation, the ultimate location could be at the Boca Chica site (Site 2) for reasons such as water quality issues with incoming raw water at this site expected to be of lower quality than that of the ocean intake. Further discussions with the TCEQ concur with this site for the pilot plant to simulate a “worst condition” scenario. If this site proves to be more costly, the pilot and full-scale facility could be located at the alternative site. Water sampling from a potential ocean intake will continue throughout the duration of the study to compare the two conditions and their respective operational costs.

The summary of costs for each of these facilities is show in Table 1-1 below. Further details and discussion of project cost can be found in Section 6 of this report and in Appendix 3.

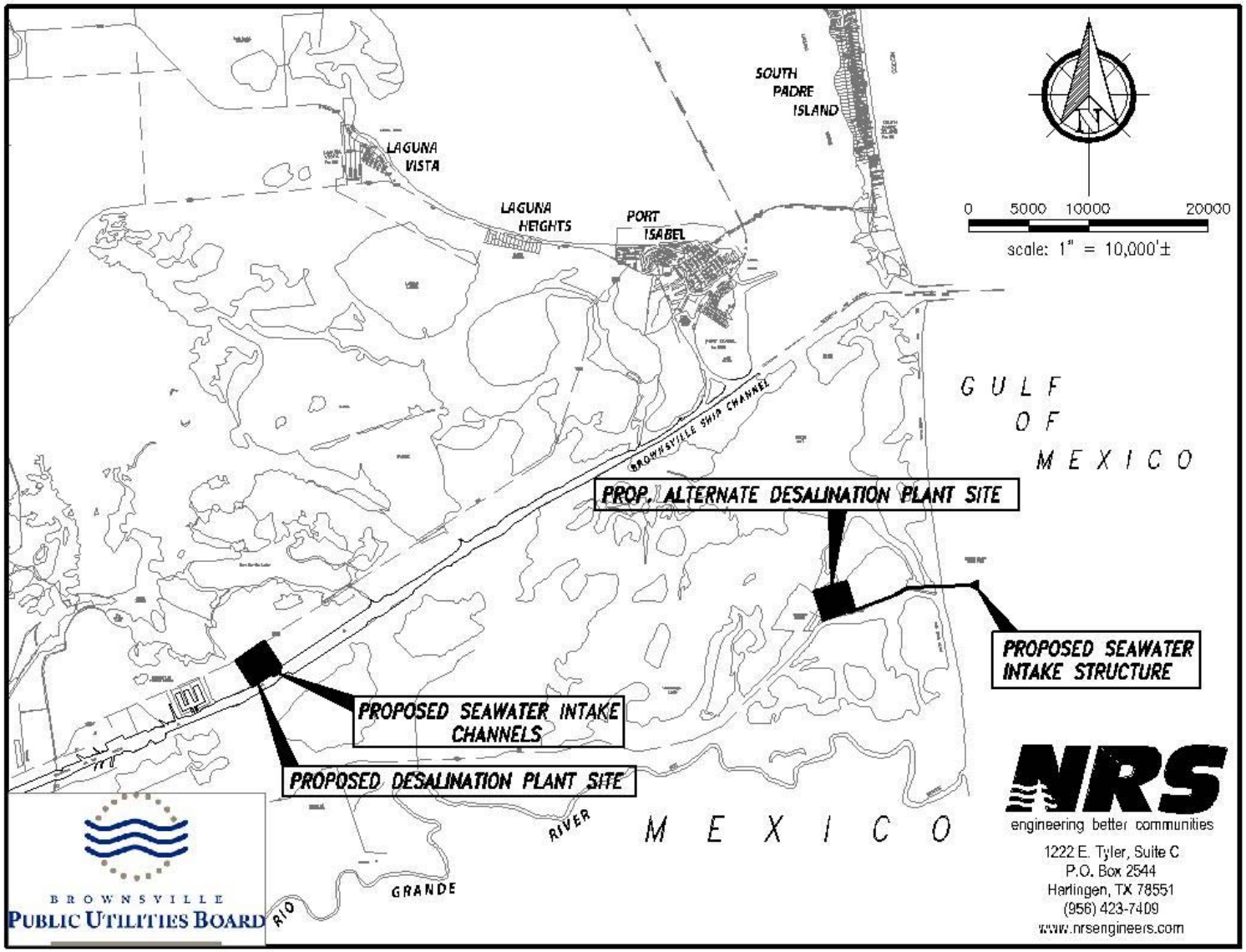
Table 1-1 Capital Cost Projection Summary

Site	**Capital Cost**	**Unique Characterizations:** ▪ Advantage ▪ *(Disadvantage)*
Port of Brownsville	$150,000,000	▪ Direct Intake from Port Channel ▪ Proximity to Brownsville ▪ Proximity to BPUB Power ▪ (Intake Water Quality Issues) ▪ (Distance to Ocean Discharge)
Boca Chica	$163,000,000	▪ Proximity to Ocean Intake ▪ Proximity to Ocean Discharge ▪ Intake Water Quality ▪ (BPUB not Power Provider) ▪ (Site in Environmentally Sensitive Area) ▪ (Service Line Length to Brownsville)

For the purpose of this report, the value of $150 million is used to project the financial need for full-scale plant implementation.

The largest component in the operation of the seawater desalination RO plant (SWRO) is the power cost. Because of rising energy costs, the cost of the project was anticipated to have a sharp increase in the operational cost of the full-scale plant. The cost for energy in the 2004 Feasibility Report was 5.45 cents per kWh. Because of the ability to operate this plant in a mode that takes advantage of cheaper power costs during certain times of the day, a rate of 2.3 to 3.7 cents per kwh can be used to operate the first phase of the full-scale facility. This use of “off-peak” and “interruptible” supply rates will save approximately 30-50% in unit power costs. The plant is planned for a full construction of the 25 mgd capacity but operated during various hours and flow rates for a daily rate of 12 mgd in 2010. By 2015 the daily rate would increase to 18 mgd and the full 25 mgd would be achieved in 2020.

Figure 1-3 Site Locations



This page intentionally blank

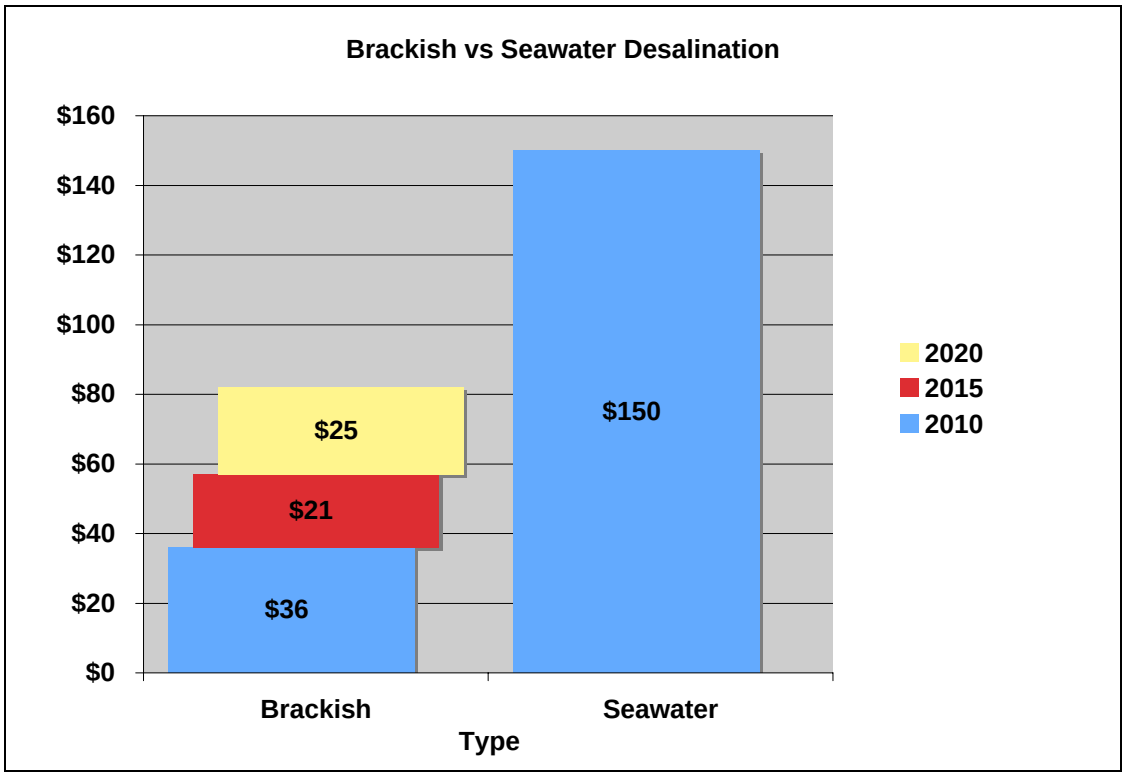
Project Funding

BPUB is aware that the ratepayers would not agree to pay for the full amount of a saltwater desalination project. In comparing the future phasing in costs of brackish desalination and costs of funding saltwater desalination, an up front capital investment million is required. A financial model was developed to show the ability to determine an agreeable funding structure for the needed amount. This model can be found and further described in Appendix 1.

The assumption of this study is for a subsidy to fund the difference between the cost for the BPUB to continue the development of brackish groundwater desalination in and equivalent methodology of the implementation of the seawater strategy. The following figures show the comparison between the capital and operational cost for the two strategies. This difference in cost was inputted into the model to determine the present value of these costs. The plants would be constructed and operated phases.

By comparison, the brackish desalination plant would be constructed and operated in phases each five years beginning with a 12 mgd expansion in 2010, 6 mgd in 2015 and a 7 mgd expansion in 2020 to coincide with the equivalent seawater facility. These comparisons are shown in Figures 1-4 and 1-5.

Figure 1-4 Capital Cost Brackish vs. Seawater



As shown in Figures 1-4 and 1-5, clearly the cost of desalinated brackish groundwater is a less costly alternative for the Brownsville area. Brownsville however sees a great need in additional diversification especially from the traditional Rio Grande and what is a

limited supply in brackish groundwater. It should be noted that Phases 2 and 3 of the brackish expansion, water supply from brackish groundwater has not been confirmed and may be limited by the ability to draw these supplies cost effectively. Projected costs assume that the supply would be available. The following table lists the water sources advantages and disadvantages.

Figure 1-5 Operation Costs Brackish vs. Seawater

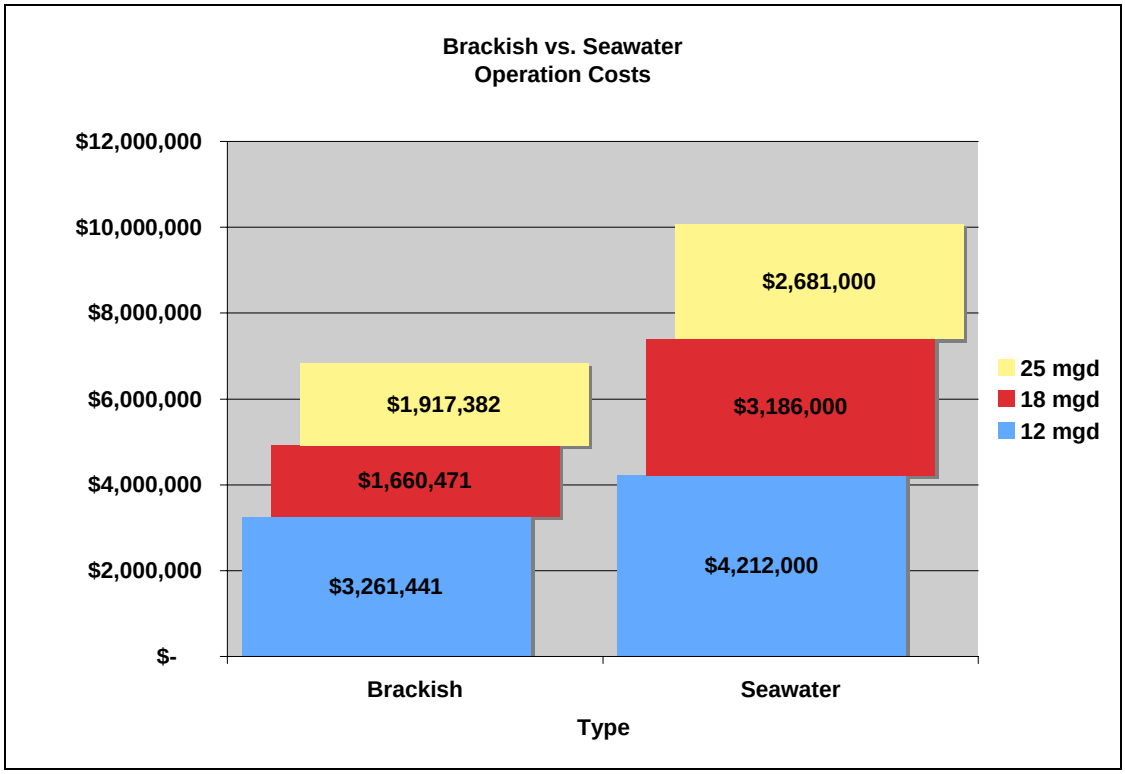


Table 1-2 Source Water Comparison

Source Water	Advantages	Disadvantages
Rio Grande Surface Water	Moderately Economical	Finished Water Quality Water Rights Costs Limited Supply Variations in Water Quality Rising Costs for Treatment
Desalinated Brackish Groundwater	Moderately Economical Alternative Supply Finished Water Quality Regional Benefits	Higher Power Costs Limited Supply Concentrate Discharge Potential Subsidence Issues
Seawater Desalination	Unlimited Water Supply Alternative Supply Finished Water Quality Largest Regional Benefits	Highest Power Costs* Concentrate/Brine Discharge Highest Capital Costs

**Note: Operation of the seawater desalination plant during off-peak and interruptible supply mode brings the cost of power comparable to desalinated brackish groundwater.*

Impediment Issues

The major potential challenges or impediments regarding the ability to develop a full-scale facility could lie in the regulatory issues surrounding a seawater desalination plant and the ability to fund the facility. The location of the plant, near the coast in Brownsville, Texas has several key elements that a full-scale plant in this area must overcome.

Concentrate Discharge

The Texas Commission on Environmental Quality (TCEQ) and the U.S. Army Corps of Engineers (USACE) and related review agencies are of key importance in the issuance of a wastewater discharge permit for the plant. The disposal of this concentrate is projected to be by discharge to the Gulf of Mexico. The degree of mixing, distance off shore, depth, and length is dependent upon the requirements to not adversely affect the aquatic life in the area of discharge. Obstacles could be the objection by environmental groups regarding the potential for higher salinity discharge being inadequately mixed and affecting the marine life in and around the discharge area. These concerns would be addressed in the reports prior to the applications for any permits and approvals. Due to the novelty of a seawater desalination plant, this may be only a challenge and not an impediment issue.

Water Supply Intake

The water diverted from the Brownsville Ship Channel may have additional constituents that make it more difficult to treat but could also be a concern to the TCEQ for drinking water supply. This source of water contains periodic influence from runoff and other events that will show variations in total dissolved solids, bacteria, and other constituents that may require a higher degree of pretreatment and proof of removal. This could prove to be an impediment at the Port location but not a the Boca Chica location.

The plant requires a high volume of water for the treatment process. For a 25 mgd output from the plant, a supply of over 50 mgd would be required. Obstacles could be objections regarding the potential for entrapment of marine life in the pre-screening of water entering the plant. With proper screen sizes, the entrapment issues should only be a challenge and not an impediment.

Financial

The single greatest impediment to the successful completion of the full-scale desalination plant is the ability to successfully fund the demonstration plant. The City of Brownsville and the region have already developed an alternative source of brackish groundwater and are looking to add to the diversification through the treatment of seawater to meet future needs. This source of water comes with a higher capital and operational costs, however. The Brownsville PUB (BPUB) has agreed to sponsor the demonstration project and look toward the implementation, providing the investment equal to the further development of

their existing brackish groundwater facilities. To make the project come to reality, an up front capital investment to subsidize the BPUB's investment could be as high as $70 million. This would have to come in the form of grants, low interest loans and/or other innovative financial schemes further described within this report.

Conclusions and Recommendations

The successful implementation of a full-scale desalination project for Brownsville and the Region will depend upon a group effort of local, regional, state and federal resources. The recommendations for the implementation of a full-scale plant is to initially construct a 25 million gallon per day plant to serve Brownsville and portions of Cameron County. This plant carries a price tag of $150 million of capital costs. The initial operation of this plant would be utilized to operate to its full capacity (25 mgd) during the late evening/early morning hours to take advantage the low cost of off-peak power. The remaining portion of the day would be operated at a lower flow rate (5 mgd) to take advantage of the lower cost of interruptible power supply. The daily flow from the plant would be approximately 12 mgd. This result in a savings from a current estimated rate of $0.52 to between $0.23 and $0.37 per kwh. This is a significant reduction in cost that contributes to 50% to 70% of the operation.

Talks are ongoing with local and regional entities and will continue throughout the pilot plant study to partner in the initial and subsequent phases of this project. Most significant will be the partnering with the City of Laredo in this endeavor to provide that City's long-term solution to their water supply demands. This desalinated seawater could prove to be the future lifeblood of the three fastest growing metropolitan areas in Texas. (Brownsville, McAllen and Laredo)

The BPUB has identified more cost effective solutions to implementing the seawater desalination project and made significant commitments to fund a portion of the capital cost and all of the operational costs of this project. This has significantly reduced the needed subsidy to bridge the utilities capabilities to pay and the cost of developing water, but a gap still remains. There is no "silver bullet" to close this gap. Existing programs can meet some of this need but additional funds will be needed and these will need to be in the form of grants. Further, flexibility in how funds can be appropriated should be provided so that project configuration uncertainties can addressed should the need arise.

There would also be an advantage to the state to spread this funding over more than one biennial funding cycle. An assumed three-year phase-in would allow for completion of the pilot study, acquisition of all appropriate permits, design and construction. No single appropriation bill would have to fund the entire grant portion, and spreading funding would also increase the likelihood of using more SDWRF funding, thereby reducing state costs.

The BPUB recommends that the legislature appropriate and authorize the following:

$70 Million in General Revenue funds to the Water Loan Assistance Fund for the purpose of supporting the permitting, design and construction of seawater desalination

treatment facility envisioned to be 25 million gallon per day capacity. The Legislature should be asked to support to the maximum extent practicable and consistent with state and federal law the use of the SDWRF (estimated to be $45 M over three years) to defray the need for grants. Brownsville PUB will cover the remaining $38M in capital costs through system revenues and pay 100% of all operating costs. The Legislature, through this rider, would encourage BPUB and the TWDB to explore all other existing funding sources, including direct federal appropriation, to offset the cost of this project. Representative Funding and their associated impacts to the BPUB is shown in Table 1-3

Table 1-3 Representative Funding/Cost Impacts

Representative Project Funding Alternatives and Cost Impact to BPUB*		
		Incremental NPV Cost to Brownsville PUB***
100% Loan for all Capital Costs	$112M Loan	$81.9
Grant and Market Loan	$45M market rate loan with State $70 M grant; $35M in capital and all operating costs from BPUB	$19.7
Max. SDWRF Loans**	$45M SDWRF Loan with State $70 M grant; $35 M in capital and all operating costs from BPUB	$0.0
State Participation	$112M	$89.0
State Participation/Market Loan combination	$56 M State Participation; $56 M market loan; $38 M from ratepayers	$85.5

NOTES:
The above analyses assume current TWDB rules and Law and standard market interest rates and loan conditions.
** There are a nearly infinite number of funding scenarios that could be explored. This is a representative cross section.*
*** SDWSRF Program assumed to be maximum $15M/year availability for 0% loan*
****Cost over other potential local water supply options*

This page intentionally blank.

Appendix II- Summary of Existing Financial Assistance Programs

This page intentionally blank.

Funding Source/Type	Uses / Availability	Description	Applicable to Project
State funding			
Clean Water State Revolving Fund Loan Program Loan	Planning, acquisition, and construction; wastewater treatment; storm water and non-point source pollution control projects / An annual priority rating process applies to project.	The **CWSRF** provides financial assistance for wastewater collection and treatment infrastructure. A water quality-based priority rating process provides control over the amount of loans made each year, while not requiring applicants to expend funds and efforts preparing applications for which funds may not be available.	No. Only available for water quality protection.
Drinking Water State Revolving Fund Loan Program Loans and additional subsidies, including "loan forgiveness" in limited cases.	Planning, acquisition, and construction of water-related infrastructure, including water supply and source water protection / An annual priority rating process applies to project.	The DWSRF was created to make low interest loans to water system projects. The interest rate is dependent on the financial status, and population of the community. A disadvantaged community may receive forgiveness, while a larger entity will only receive a low fixed rate.	Yes. Program is based on a competitive allocation process and has a limited availability of funds. Eligibility does not guarantee funding or availability of disadvantaged subsidies.

Funding Source/Type	Uses / Availability	Description	Applicable to Project
Rural Water Assistance Fund Program Loan	Planning, acquisition, and construction of water supply-related infrastructure, including water treatment, water distribution pipelines, reservoir construction, and storage acquisition / Loan dollars not restricted, but no subsidies available without additional appropriations.	The **RWAF** program is designed to assist rural water utilities to obtain low-cost financing for water or water-related projects. The TWDB offers attractive interest rate loans with short- and long-term finance options at near tax exempt rates.	Does not qualify under Rural Water Assistance Fund rules for population.
State Participation in Regional Water and Wastewater Facilities Program / Deferred interest Contract with Repayment Required	Construction of regional water or waste water construction project when the local sponsors are unable to assume debt for the optimally sized facility / Limited Funds	This program is designed to acquire, among other legal purposes, a state interest in the desalination project. The State Participation Program enables the Texas Water Development Board to assume a temporary ownership interest in a regional project when the local sponsors are unable to assume debt for optimally sized facility. The funds are repaid on a deferrable timetable.	Yes, but direct appropriation of state General Revenue Funds is needed for debt service. Rule change needed extending re-payment period and other conditions to make viable for desalination project.

Funding Source/Type	Uses / Availability	Description	Applicable to Project
Water and Wastewater Loan Program / Loan	Planning, acquisition, and construction of water-related infrastructure, including water supply, waste water treatment, storm water and non-point source pollution control, flood control, reservoir construction, storage acquisition, agricultural water conservation, and municipal solid waste facilities / Not Restricted	The goal of this program is to bring adequate water and sewer services to communities that cannot fund a system themselves.	Interest rates not sufficiently attractive for local sponsors (no financial benefit).

Funding Source/Type	Uses / Availability	Description	Applicable to Project
Water Assistance Fund. Water Loan Assistance Program / Loan or grant	Planning, acquisition, and construction of a range of eligible project types, including water supply-related infrastructure, water treatment, water distribution pipelines, reservoir construction, and storage acquisition. Desalination projects specifically named in statute as eligible "as provided by legislative appropriation" (Texas Water Code §15.102(a)) / Restricted by Fund Availability and/or Appropriation. Grant, Loans, and Storage Acquisition Allowed.	Grants for desalination projects statutorily applied in Texas Water Code § 15.102(b)(2)(C). Funds provided by "direct legislative appropriation by the board at its discretion" (Texas Water Code § 15.101(a)).	Yes, but direct appropriation of state General Revenue Funds needed.
Economically Distressed Area Program for Water and Sewer Service / Grant, Loan or combination of both	To bring water and wastewater services to economically distressed areas (Designated by TWDB) / Limited Funds	The Economically Distressed Areas Program was established to provide financial assistance to bring water and wastewater services to economically distressed areas where present water facilities are inadequate to meet the minimal needs of residents.	Service not likely to be eligible for EDAP funding.

Funding Source/Type	Uses / Availability	Description	Applicable to Project
Federal Funding			
The Coastal Impact Assistance Program (CIAP) / Grant	Mitigation of the impact of Outer Continental Shelf activities through funding of onshore infrastructure projects and public service needs / An annual priority rating process applies to project.	The CIAP is intended to assist those coastal states and coastal political subdivisions within those states that have either supported or been impacted in some measure, directly or indirectly, from Outer Continental Shelf (OCS) oil and gas exploration and development activities.	Subject to competition but appears to be legally available for BPUB Desal Project.
Bureau of Reclamation / Grant	Research and development of demonstration projects / $1 million per project	These funds help the desalination plant in two ways. Funds can be used as research dollars and for demonstration projects. Typically, funds are a 25% Bureau match but can be increased to 50% if conditions apply. Any further increase in funds can only be made by congressional appropriation authority.	This is not considered a cost-effective source of funding given small dollar amount and constraints on its use.
Homeland Security/ State Homeland Security Grant Program	Supports the implementation of the State Homeland Security Strategy to address the identified planning, equipment, training, and exercise needs for acts of terrorism / Limited Funds	Multiple Programs are available through DHS, but only this program would appear to apply to BPUB Desal Project.	In theory, yes, but highly unlikely to provide funding given demands for this program more directly related to terror threat

Funding Source/Type	Uses / Availability	Description	Applicable to Project
US Army Corp of Engineers Financing Opportunities / Grant (typically matching grant)	Flood control and environmental restoration if overall project meets multiple goals / NA	The Corp (USACE) does not typically fund water supply projects. However, if the desalination project meets multiple goals in line with USACE's overall mission, funding could be available. This would require a direct congressional authorization to receive implementation funding.	Yes, but only after Congressional action to authorize and appropriate funds.
Direct Congressional Appropriation / Grant	Uses and amount of funds are determined by stipulations included within appropriation / NA	A direct congressional appropriation tied directly to this desalination project. This appropriation could be made through an existing program or could stand alone. The funds could be directly appropriated to BPUB or a federal or state agency, and the specified amount would be given to the City of Brownsville.	Yes, potentially, but would be a stand-alone appropriation in a highly competitive political process.
HR 3834 (and its successor Legislative initiatives) / Subsidy	Provide an energy subsidy to Desalination Projects / Unknown	HR 3834 is currently under consideration in Congress. This bill would provide energy subsidy of 0.62 sp per 100 gallons to desalination projects. This would help offset the high energy cost required to run a desalination plant.	This legislation is not expected to pass this in this session of Congress and would still require an appropriation to implement.
HR 2828 (and its successor Legislative initiatives) / Grants	Investigate and identify opportunities for studying and designing waster resource activities and construct demonstration and permanent facilities / Unknown	HR 2828 is currently under consideration in congress. This bill would provide grants to investigate, plan, design and construct demonstrative water supply projects.	This legislation is not expected to pass this in this session of Congress and would still require an appropriation to implement.

Funding Source/Type	Uses / Availability	Description	Applicable to Project
Bi-national Funding			
Border Environment Cooperation Commission / General Funding	Proven and nonpolluting technology with low operation and maintenance costs / Very Limited	The BECC's financial assistance is minor, related to technical assistance, and not relevant to construction financing but may be considered under special circumstances.	Not currently seen as a viable funding source for this project.
North American Development Bank (Loan and Guarantee Program) / Loan	Water supply projects / Limited by interest rates, and a maximum loan of $4 million.	The **NADB** loan program provides direct financing for infrastructure projects with a demonstrable and reasonable assurance of repayment when private sector financing is not available. Even its best rates are roughly comparable to those that could be received by Brownsville PUB.	Not currently seen as a viable funding source for this project.
North American Development Bank (Border Environment Infrastructure Fund) /Grant	Construction costs that are not covered by other sources, as well as transition assistance / Limited	The **NADB** established the **BEIF** in an effort to make projects affordable, especially for the smallest and poorest communities. The BEIF can be combined with loans and guaranties to facilitate project funding.	Not currently seen as a viable funding source for this project.
International Boundary and Water Commission (IBWC) / Grant	Water supply projects	The project would have to benefit both Mexico and the US for funding to be justified. No ongoing program exists where the desalination plant could apply. Would likely require additional federal appropriation, as well.	Not currently seen as a viable funding source for this project.

Funding Source/Type	Uses / Availability	Description	Applicable to Project
Local			
Brownsville PUB / Loan	The terms and conditions are established by Brownsville PUB after security is approved / Unknown	Each security is issued pursuant to ordinances adopted by the City Commission, which establishes the terms and conditions.	Potentially, yes for part of project cost (operations and some capital financing).
Southmost Regional Water Authority (SRWA) / Loan	The terms and conditions are established by SRWA after security is approved / Unknown	The bonds that are issued by the authority are payable solely from pledged revenues, pledged funds and any and all property pledged as additional security. The indenture requires that the authority deposit an amount equal to more than 1.00 times the average annual principal and interest requirement for all bonds.	Potentially, yes for part of project cost (operations and some capital financing).